Original Article

Effects of Dual task training on balance and activities of Daily Livings (ADLs) in patients with Parkinsonism

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ABSTRACT

Objective : To study the efficacy of dual task training with variable priority instructional set and fixed priority instructional set in improving balance and Activities of Daily Living(ADLS) in Patients with Parkinson's Disease. Methodology : 30 Parkinson's disease patients were divided in to two groups with 15 subjects in each group took part in this study. Both of the groups were having proportion of 8 males and 7 females with Hoehn & Yahr scale stage 1-3 in group A and group B. Age group taken was between 50- 80 years with mean age of 66.27 in group A and mean age of 66.67 in group B. Comparison of Disease duration(in yrs.) showed mean and standard deviation of 3.8 and2.18 for group A and mean and standard deviation of 4 and 2.24 for group B and the p value was 0.80 which shows there was no significant difference between two groups. Subjects were assessed by using two physical performance measures before giving the treatment protocol i.e. readings on Berg balance scale(BBS) and UPDRS scale part II (ADL'S) section were taken. In the training session, subjects have undergone balance training of forty five minutes session, five times a week for a period of three weeks. Group A (=15 subjects) was trained under dual task balance training under a fixed priority instructional set , during each session, attention was focused on both postural and cognitive task at all the time and activities are divided in to stance and gait activities. In stance activities subjects were instructed to do semi tandem stand, eyes open, arm alteration with cognitive task as spell words forward from l-x and in other activity subject has to draw letter with the foot and cognitive task was name any word start with letter l-x . In gait activity subjects were asked to perform tandem / semi tandem walking while counting backward from 200-90, obstacle crossing while counting backward from 200-90, semi tandem / Tandem walking with auditory tone discrimination & obstacle crossing with auditory tone discrimination (low volume vs. high),whereas in other group B subjects were given same training as group A but with half training session focusing attention on postural task performance and half training session with attention on cognitive task performance i.e. with variable priority instructional set. Results : After 3 weeks of training programme there was significant difference in pre and post assessment and training scores in balance and Activities of daily living skills recovery. Improvement was seen in both of the groups but more improvement was noted in group B with variable priority instructional set as compared to group A with fixed priority instructional set. Conclusion : Exercise programmes can be carried out safely in Parkinson's disease patients. The balance and functional independence of Ambulatory Parkinson's Disease patients can be improved by specific type of balance training. As doing concurrent tasks posse's great difficulty with Parkinson's disease patients in day today environment therefore a balance training program which focuses on dual task with increasing difficulty and shifting priorities between two tasks is efficacious in improving balance and functional recovery in Parkinson's Disease patients.

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1. Introduction

Parkinson's disease is a progressive neurological condition that occurs due to the loss of Dopamine producing brain and degeneration of both motor and non motor basal ganglia circuitry. (J.M. Pavon etal)

Typical manifestations include resting tremors, bradykinesia, rigidity and gait impairment.

Parkinson's disease is associated with disability, morbidity, institutionalization, high health care utilization, costs and even mortality.

In Parkinson's disease (PD) primary pathologic changes involve loss of nigrostriatal dopaminergic neurons (A.T. Karagulle Kendi etal.)

It occurs frequently in older adults with a prevalence of around 780 per 100,000 people (Meg E. Morris et al.)

It is common among older people, affecting more than 1 in every 100 people over the age of 75 years and 1 in every 1000 people over the age of 65 years. approximately 10 people per 1 million in the population are diagnosed in their 30s and 40s, thus early onset PD is uncommon, On a worldwide basis it is thought that around 10 million older people have PD with a large proportion of the population aging it can be predicted that by the year 2020 more than 40 million people in the world will have this progressive neurological condition (Meg E Morris)

There is greater incidence of PD in men than in women Postural instability (PI) is a common feature of Parkinson's disease (PD), becoming a clinical concern in the middle stage of the progressive illness.

Axial symptoms, such as balance impairments, are one of the main predictors of quality of life for individuals with PD and have been shown to increase fall risk. Up to 68% of individuals with PD will fall in a 1-year period, which can lead to injury and large personal and societal costs.

During many activities of daily living, people need to perform more than one task at a time; The capacity to do a second task (Dual Task performance) is highly advantageous during walking because it allows for communication between people, transportation of objects from one location to another and monitoring the environment so that threat to balance can be avoided.

Dual task performance is also known as concurrent performance and involves the execution of primary task which is the major focus of attention and a secondary task performed at the same time

Gait disturbances increases in people with Parkinson disease during the performance of a second motor task. The magnitude of gait deterioration is thought to be proportional to the complexity of the motor task being performed.

Study on training of balance under single and dual task conditions in older adults with balance impairments by Patima Silsupodol have concluded that older adults may be able to improve their balance under dual task conditions only following specific type of balance training.

As in Parkinson's disease patients both balance impairments , postural instability ,basal ganglia degeneration and age related changes are resisting factors in performing dual task therefore Dual task training for improving balance and activities of daily living (functional improvement) in Parkinson disease patients under different instructional sets forms the basis of the study.

2. Material and Method

Previous studies have shown that, with advancing age, performing an attention demanding task while walking interferes with gait performance and there is increasing evidence that a strong relationship exists between dual task related gait changes and risk of falling among older adults. Walking requires more attention among older adults as compared to young adults. Thus, for older individuals , walking while performing an attention demanding task represents a divided attention task and dual task related gait changes results from interference between gait and attention splitting task.

O'shea etal. in 2002 did a study to identify whether the type of secondary task (motor/cognitive) determines the severity of dual task interference in people with Parkinson's disease and concluded that although the performance of simultaneous motor / cognitive tasks compromised gait in people with Parkinson's disease , the type of secondary task was not a major determinant of severity of dual task interference.

Kramer etal. in 2005 did a study to find out whether dual task performance of 2 discrimination tasks with similar motor requirements can be moderated by training.The results indicated that ,even when the 2 tasks required similar motor responses, both older and younger adults could learn to perform the task faster and more accurately. Moreover, the improvement in performance generalized to new task combinations involving new stimuli. Therefore it appears that training can substantially improve dual task processing skills in older adults.

Chen etal. in 1996 did a study to find out how divided attention during stepping over obstacle would affect older & younger adults and found that both young and old adults had a significantly increase risk of obstacle contact while negotiating obstacles when their attention was divided. But divided attention degraded obstacle avoidance abilities of the old significantly more than it did in the young.Diminished abilities to respond to physical hazards presenting the environment when attention is directed elsewhere may partially account for high rates of falls among elderly.

To study the efficacy of Dual task training with Fixed priority instructional set and Variable priority instructional set in improving Balance and Activities of daily livings in Parkinson's disease patients.

2.1. Methodology

Design: This study is a quasi experimental design, which intends to find the effects of balance training on balance and Motor recovery within the sample. The subjects performed under two training instructional sets and results were observed for differential efficacy of the two balance training techniques.

2.1.1.Sample

A sample of 30 Parkinson's disease patients of fifty and above years of age divided in to two groups (A & B) of fifteen each by convenient sampling method took part in this study. The subjects were collected through Trishla orthopedics & Rehabilitation center (Allahabad), O.P.D. of Saaii College of medical science and technology, Kanpur, Vardaan hospital, and Health link physiotherapy clinic (Faridabad) and Parihar's Spastic care and Advanced Physiotherapy Centre, Kanpur.

All subjects signed consent form and were ready to take part in the study. The subjects were given the instructions regarding the procedure and the subjects who fulfilled the inclusion criteria and were ready to attend the exercise program regularly were selected.

2.1.2. Inclusion Criteria

- Severity level on Hoehn and Yahr scale of stage I-III
- Both Gender Male & Female with Age of 55- 80 yrs
- Able to understand verbal instructions and completed 8-10years of formal education(Mini mental status examination; minimum score ≥24)
- Able to walk 9m (30 ft.) of distance without any assistive device.
- Patient with stable Medication Disease duration of 4-5year

2.1.3.Exclusion criteria

- Neurological problems other than Parkinson's disease which can affect balance e.g. Stroke , cerebellar disorder, Balance disorders (dizziness, vertigo), Mylopathy / Myopathy
- Orthopedic problem affecting balance e.g. history of lower limb fractures, dislocations and deformities, artificial limb implantations, Pain in lower extremities.
- Significant hearing & vision impairments affecting balance
- Uncontrolled Hypertension
- Any speech deficits interfering training protocol
- Unstable seizure disorders
- History of more than 1 fall in previous 6 months
- Smoking / Alcohol intake

2.1.4.Instrumentation

- Two chairs of 46 cm of seating height with and without armrest
- A inch Tape / Ruler
- Obstacle (shoe box of 10c.m. high x 19c.m. wide x 33 c.m. long)
- Bed / couch of suitable height
- Footstool or step of 15cm height
- Tape recorder/ Radio /Mobile phone
- A Floor Marker

2.2. Procedure

The subjects were introduced to the study, followed by signing of the consent form. General assessment regarding the sociodemographic data (name, gender, age, Height), Health related information (past medical history, duration since Parkinsonism, use of assistive device) and fall history was gathered in a Participant Checklist form. Fall history was considered to be number of falls in the past 6 months. Cognitive status was assessed using Mini mental status examination (MMSE). The subject was assigned a number to maintain the confidentiality of the subject and were divided in to two groups. Two physical performance measures were used to asses balance performance and Functional status by using Berg Balance Scale (BBS) and UPDRS part II for Activities of Daily Livings (ADL's). Prior to testing, each subject were assured of safety to minimize the risk of falls. Each new task was explained and demonstrated and subject asked if he or she felt safe performing that task and subjects were reassured that they could attempt to contemplate as much of task as possible with safety, if the patient still did not feel safe attempting the task, the examiner entered the lowest possible score for the task and continued to the next item. Three readings on both of the scales i.e. berg balance scale and UPDRS Part II were taken and then mean value was calculated; intermittent rest periods were given between tasks at intervals that are standard across all subjects.

In the training session, subjects have undergone balance training of forty five minutes session, five times a week for a period of three weeks. Group I (=15 subjects) was trained under dual task balance training under a fixed priority instructional set , during each session, attention was focused on both postural and cognitive task at all the time and activities are divided in to stance and gait activities. In stance activities subjects were instructed to do semi tandem stand, eyes open, arm alteration with cognitive task as spell words forward from l-x and in other activity subject has to draw letter with affected foot and cognitive task was name any word start with letter l-x . In gait activity subjects were asked to perform tandem / semi tandem walking while counting backward from 200-90, obstacle crossing while counting backward from 200-90, semi tandem / Tandem walking with auditory tone discrimination & obstacle crossing with auditory tone discrimination (low volume vs. high),whereas in other group II subjects were given same training as group one but with half training session focusing attention on postural task performance and half training session with attention on cognitive task performance i.e. with variable priority instructional set.

Outcome measures: Readings on Berg Balance Scale and UPDRS scale Part II(ADL section) were taken before giving the Balance training and then readministered after three weeks of training to see the effectiveness of treatment protocol and scores were tabulated as data.

2.3.Data Analysis:

After confirming the normality of age, gender, height, weight, Disease duration, Education level, these variables were summarized by mean and standard deviation for the two groups showing no difference during Baseline assessment.

3. Result

Result: Table: 5.1 Demographic data for group A&group B

VARIABLE	MEAN± SD					t	p
	GROUP A		GROUP B				
AGE (yrs.)	66.27	8.21	66.67	8.97		-0.127	0.899
HT	163.33	9.55	163.47	8.41		-0.041	0.9679
WT	62.47	6.4	62.73	6.4		-0.114	0.9100
DISEASE	3.8	2.18	4	2.2		-0.248	0.8058
EDUCATION	7.47	1.55	7.33	41.4		0.247	0.8065

Table 5.2 : WITHIN GROUP ANALYSIS BBS

VARIABLE	MEAN± SD				t	p
	PRE		POST			
GROUP A	43.07	1.87	47.07	2.3	-6.110	0.000
GROUP B	44.2	1.7	50.47	41.3	-23.500	0.000

Figure: 5.2

PRE VS POST FOR BBS FOR GROUP I & II
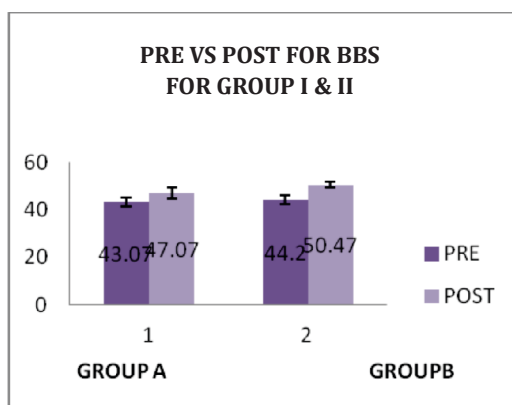
Table: 5.3 : BETWEEN GROUP ANALYSIS BBS

VARIABLE	MEAN± SD				t	p
	GROUP A		GROUP B			
PRE	43.07	1.87	44.2	1.7	-1.738	0.0933
POST	47.07	2.34	50.47	1.3	-4.911	0.000

Figure: 5.3

BETWEEN GROUP FOR BBS...
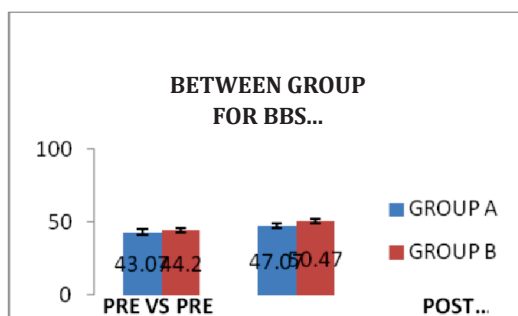
Table 5.4: WITHIN GROUP ANALYSIS UPDRS

VARIABLE	MEAN± SD				t	p
	PRE		POST			
GROUP I	30.47	2.2	27.2	2.37	27.64	0.000
GROUP II	29.87	2.26	24.47	2.17	28.38	0.000

Figure: 5.2

PRE VS POST FOR UPDRS FOR GROUP A&B
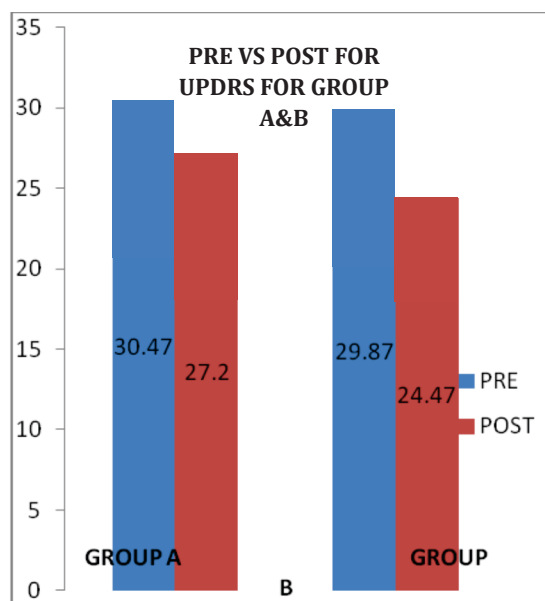
Table 5.5 : BETWEEN GROUP ANALYSIS UPDRS

VARIABLE	MEAN± SD				t	p
	PRE		POST			
GROUP A	30.47	2.2	27.2	2.37	27.64	0.000
GROUP B	29.87	2.26	24.47	2.17	28.38	0.000

Figure: 5.5

BETWEEN GROUP FOR UPDRS
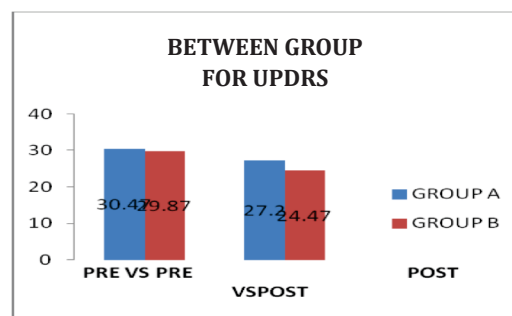
4. Discussion

Results of the mean scores on Berg Balance scale(BBS) and UPDRS part II (ADL section) showed significant improvement in both of groups after three weeks of training session i.e. improvement under both types of instructional sets i.e. fixed priority and variable priority On comparison between Group A and

Group B the mean scores of Berg Balance scale and UPDRS scale score of Group B with variable priority instructional set training showed more improvement than Group A with fixed priority instructional set training.

Significant improvement in balance of both of the groups after training session are in line with the result from the previous studies which shows that older adults may be able to improve their balance under dual task conditions only following specific type of balance training.

There is some evidence in the literature that rhythmic sound patterns can increase the excitability of spinal motor neurons via the reticulospinal pathway reducing the time required for the muscle to respond to a given motor command. It has been shown, for instance, that auditory signals reduced reaction time in a voluntary motor task (Paltsev and Elner, 1967).Also auditory facilitation of the H-reflex has been shown (Rossignol and jones, 1976) and movement related gastronomies activity occurred during the period when the H-reflex was maximal, suggesting that desending motor commands became entrained to the auditory pacing signal so as to make the best use of a potential audiospinal facilitation effect.

It has been shown that Individuals with Parkinson's disease improved the temporal motor parameters studied during walking when receiving external auditory cues. And suggest that auditory paced stimulation is likely to be a novel and inexpensive tool for improving important gait parameters and for gait rehabilitation. Therefore auditory tone discrimination makes an important component of our study protocol.

Behram etal.showed that attentional strategies, where the person responds to different instructional sets such as instructions to walk with long steps or swinging the arms, are effective in the short-term in enhancing stride length and walking speed

The result of the present study have shown that balance component of individual with Parkinson's disease is improving more under variable priority instructional set as compared to fixed priority instructional set. These results are supported by Kramer etal. , who have suggested that balance of elderly improves under variable priority instructional set because of increase accuracy of task and decrease reaction time with variable priority instructional set as compared to fixed priority instructional set and it has been shown that training with variable priority instructional set results in more substantial learning and transfer effect.

Inability to shift priorities in fixed priority instructional set may be explained by the assumption based on Capacity sharing model, according to which dual task interference will occur only if the available resource capacity is exceeded, resulting in decline in performance of one or both of the tasks.

Relevance to clinical practice

As single task training limits the ability of the person to coordinate two task simultaneously which are usually required in daily living activities, training of various activities under dual task context is essential for the learning and performance of multitask coordination.

This research study may serve as the basis for the development and implementation of new gait training programme for individuals with parkinsonism which may help them in efficient allocation of attentional resources between concurrent tasks which is necessary for functional independence involving ADL's in dual task environment and thereby will prevent falls in Parkinson's Disease patients which is a major issue.

This method of dual task balance training can be used in a simple rehabilitation set up and is economical.

Future Research

1.) Balance impaired persons like frail elderly people, community dwelling elderly people and other neurological impaired population such as cerebral palsy, patients with other different forms of stroke may take benefit of similar type of dual task training with different priority instructional sets to improve their balance and gait velocity under dual task context.

2.) Another research on a large number of subjects is required, as sample size in the present study was small to generalize it.

3.) Dose dependent nature and follow up to see the sustained effects of this training should be resolved.

4.) This balance training protocol can be effectively used to find out its effects on risk of falls.

5.) To make training more specific various strengthening and propioceptive enhancement protocol can be combined with this type of training.

Tasks may be practiced in varying environmental context i.e. shifting learning from structuredenvironment to more open real life environment.

5. Conclusion

Exercise programmes can be carried out safely in Parkinson's disease patients. The balance and functional independence of Ambulatory Parkinson's disease patients can be improved by specific type of balance training. As doing concurrent tasks posses great difficulty with patients with Parkinson's disease in day today environment therefore a Balance training program which focuses on dual task with increasing difficulty and shifting priorities between two tasks is efficacious in improving balance and functional recovery in patients with Parkinsonism.

6. References

[1]   Pavon M J,Whitson EH, OkunMS. Parkinson's disease in women: A call for improved clinical studies and for comparative effectiveness research, Maturitas. 2010April; 65(4):352-358.

[2]   Kendi Karagulle TA,Lehericy S, Luciana M, Vgurbil K, Tuite P. Altered diffusion in the frontal lobe in Parkinson's disease ,AJNRAm J Neuroradiol 2008;29:501-05./www.ajnr.org.

[3]   Morris Meg E, Iansek Robert, Kirkwood Beth. A randomized controlled trial of movement stratergies compared with exercise for people with Parkinson's disease,Movement disorders. 2009;Vol.24: 64-71.

[4]   Morris Meg E. Movement Disorders in people with Parkinson Disease : A model for Physical Therapy,Physical Therapy,June 2000; 80: 6.

[5]   SmaniaNicola, Corato Elisabetta, Tinazzi Michele, Stanzani Clementina, Fiaschi Antonio, Girardi Paolo&Gandolfi Marialuisa, Effect of Balance Training on Postural Instability in Patients with Idiopathic Parkinson's Disease,Neurorehabilitation and Neural Repair.2011; 24(9):826-834.

[6]   Leddy Abigail L, Crowner Beth E.,Earhart Gammon M.,Functional gait Assessment and Balance Evaluation system test:Reliability,Validity,Sensitivity and Specificity for identifying individuals with Parkinson Disease who fall.Physical Therapy. 2011; 91:Number 1.

[7]   O'shea Simone,Morris Meg E,Iansek Robert,Dual task interference during gait in people with Parkinson Disease : effects of motor versus cognitive secondary tasks,Physical Therapy. 2002; 82: 9.

[8]   Patima Silsupodol,RC Siu,Anne Shumway cook,Training of balance under single and dual task conditions in older adults with balance impairments,Physical Therapy. 2006; i86(2):269-281.

[9]   Scigliano Giulio,Musicco Massimo, soliveri Paola, Piccolo Immacolata,Roncheti Gabriele, Girotti floriano, Reduced Risk factors for vascular disorders in Parkinson Disease Patients, A case – control study. Stroke. 2006;37:1184-1188.

[10] Brusse Kevin J, Zimdars Sandy, ZalewskinKathryn R, Steffen Teresa M,Testing Functional performance in people with Parkinson Disease,Physical Therapy,February 2005,Volume 85,Number 2.

[11] Lewis Simon JG, Dove Anja, Robbins Trevor W, Barker Roger A.,and Owen Adrian M.,Cognitive impairments in early Parkinson's Disease Are Accompanied by reductions in activity in Frontostriate Neural activity,The Journal of Neuroscience.2003;23(15):6351-6356.

[12] Marras Connie,Rochon Paula,Lang Anthony E.,Predicting Motor Decline and disability in Parkinson Disease,ARCH NEUROL. 2002:Vol 59.

[13] Morris Meg E.,Martin Clarissa L.,Margaret L.,Schenkman,Striding out with Parkinson Disease:Evidence-Based Physical Therapy for gait disorders,Physical Therapy.2010; 90: 280-288.