Effect of Highly Challenging Balance Training on Balance in Subjects with Chronic Parkinson's Disease

Surendra Kumar Rajbanshi [1], Chandrika PC[2], Diker Dev Joshi [3]

[1]Physiotherapist, Nobel Medical College and Teaching Hospital, Biratnagar, Nepal, [2]Associate Professor, [3]Assitant Professor, Padmashree Institute of Physiotherapy, Bangalore, India

Abstract

Background: Highly challenging balance training has been suggested to induce neuroplasticity in individuals with chronic Parkinson's disease (PD So, the present study aims to find the effect of highly challenging balance training on balance in subjects with chronic Parkinson's disease.

Objective: To determine the effect of highly challenging balance training on balance in subjects with chronic Parkinson's disease.

Method: 30 subjects between the age group of 45-60 years diagnosed with PD were included in the study and conveniently allocated to the single group after fulfilling inclusion and exclusion criteria. Baseline data like age, gender, Hoehn &Yahr stage was noted. Subjects underwent Highly Challenging Balance Training 45minutes per session 4 days/ week for 4 weeks. The pre and post test of balance was done by using Berg balance scales(BBS).

Results: The highly challenging balance training on balance showed significant improvement in balance in post-test and also showed significantly improved balance. ($p<0.05$) in subjects with chronic Parkinson's disease.

Conclusion: The result of the present study shows that highly challenging balance training significantly improved balance and showed promising transfer effects to everyday living. Long-term follow-up assessments can be done to further explore these effects. The results also show that regular training is required for the subjects to maintain progress.

Keywords: *Highly challenging balance Training, Parkinson's disease, Balance, Berg Balance Scale*

Introduction

Parkinson's disease (PD) is degenerative neuropathology characterized by the motor slowdown, rigidity, and tremors, with decreased muscular strength and balance, a negative trend of risk of falls and injuries, fear of falling, a decline in physical activity and decreased quality of life.[1,2]

Movement impairments, especially loss of the ability to maintain standing balance, adversely affect function and quality of life in patients with Parkinson's disease.[3] With the progression of the disease, patients lose postural stability and have gait dysfunction, difficulty managing activities of daily living, and frequent falls.[4] Although some motor dysfunction, such as tremor, may be alleviated with drug therapy, characteristics such as postural instability are less

Corrosponding Author:
Surendra Kumar Rajbanshi,
Physiotherapist, Nobel Medical College and Teaching Hospital, Biratnagar, Nepal
Email Id:surendra.raj06.sr@gmail.com

responsive to medication and require alternative approaches.[5]

In addition to these abnormalities, gait impairments and walking limitations are common among people with PD. While gait abnormalities are not pronounced in the early stages of PD, their prevalence and severity increase with disease progression.[6] The consequences of gait impairments in PD are significant and include increased disability, increased fall risk, and reduced quality of life.[7]

Exercise is an integral part of the management of Parkinson's disease because physical activity has been shown to retard the deterioration of motor functions and to prolong functional independence..[8] Balance therapies utilizing static and dynamic stance are common and appear to be effective in improving many gaits and balance measures. .[1]

Methodology

Method and Materials

Data was collected from 4 places of Bangalore:Padmashree Physiotherapy Clinic, ESI Hospital,Parkinson's society, Parkinson's and Ageing research foundation. 30 subjects with chronic Parkinson's disease diagnosed by the neurologist were taken for the study and demographic variables such as age, gender, height, weight, BMI were documented. Inclusion Criteria were male and female subjects within age group 45 - 60 years, Subjects diagnosed by the neurologist as chronic Parkinson's disease, in stage 3 or 4 of modified Hoehn and Yahr scales, the ability to ambulate without physical assistance for at least 5 minutes and >3 weeks of stable anti-Parkinson's medication.Subjects with any visual difficulties, neuromuscular and orthopedic disorders, MMSE score less than 24, history of previous surgical management of Parkinson's disease and uncooperative subjects were excluded.

Procedure

Permission for the study was obtained from the respective Institutions and the subjects to carry out the study. 30 Subjects who fulfilled the inclusion and exclusion criteria were selected for the study and informed consent was taken from them. Demographic variables such as age and gender were documented. Once the consent was received, the test procedure was explained to the subjects Prior to the treatment, the balance was assessed using the Berg Balance Scale. Participants received the training(Table 1) for 45 minutes per day ,4 days a week for 4 weeks. The exercise training and pattern of exercises was progressed from simple to complex, according to the challenging level of each exercise using a ten-point Likert (10 being the greatest level of challenge and 1being no challenge) scale. Exercises were tailored to each individual and were progressed to increase the next level when the perceived challenge to balance was <7. After 4 weeks, Post-assessessment was done for Berg Balance Scale. (Table 3)

Intervention

Anticipatory adjustment	Postural adjustments	Sensory orientation	Stability gait	Biomechanical constraints	Stability limits verticality:
Step ups (forward and lateral),	Stance on foam	Squats on foam	Gait at varying speeds with auditory cueing	Calf raises	Functional reach forward
Sit to stand	Perturbations on a stable and unstable surface	Standing on incline	Gait with dual-task conditions	Calf stretch	Functional reach Lateral

Cont... **Table 1: Highly Challenging Balance training.**

Lunges	Ball toes		Gait with head turns, starts, stops and quick turns	Standing hip abduction	Reaching overhead
Single limb stance with reaching.	Standing hip abduction and flexion.		Walking backward	Push-ups or planks	

Fig: Few exercises of highly challenging balance training (Clockwise: Sit to Stand, Stepup, Lunges)

Results

The data was collected for baseline characteristics(Table 2) and values of outcome measures for all the subjects with chronic Parkinson's disease was analyzed through using the statistical software SPSS version 20.0. The level of significance was kept as 0.05 levels.The frequency distribution was used to describe the baseline characteristics such as age and gender of the subjects with chronic Parkinson's disease.The range, mean and SD was used to describe the age and outcome measures of balance (Table 3). The paired t-test was used to test the significant difference between pre and post outcome measurement. The unpaired t-test was used to test the significance of age, BMI, weight, and height of the subjects with chronic Parkinson's disease. The MS Excel and MS Word software were used to generate the tables.

***Cont...*Table-2: Baseline characteristics of participants**

Characteristics of participants	Values
Gender(Male/Female)	26/4
Age(In Years)	55.93±4.59
BMI	26.29±2.45
Hoen and Yahr Scale(Stage 3/Stage 4)	26/4

Table-3: Range, mean and SD of outcome measures of subjects with chronic Parkinson's disease.

S.N	Outcome measures	Pre test		Post test		Paired t-test	p-value
		Range	Mean ±SD	Range	Mean ±SD		
1	BBS	23-36	32.10±2.01	46-51	48.70±1.29	z=4.790*	p<0.001

*denotes –Significant. (p<0.05).

Discussion

In the present study, there was an improvement in balance by highly challenging Balance Training; this may be possible because it contributed to increasing in muscle strength, greater resistance to fatigue or greater tolerance to muscle discomfort during training.[9]

Weakness in muscle group could give the patients the perception that their "muscle give way" while in standing position and lead to a lack of confidence in performing standing or walking activities. Lower extremity muscle strength was independently associated with reduced bone mass in an individual with PD. Muscle weakness may restrict individuals' activities leading to loss of bone mass and an increase in the risk of falls.[9]

Highly challenging balance training derived from a theoretical framework targeting the essential postural control subsystems may also contribute to more robust improvements in balance control and a subsequent reduction in falls. Despite an incomplete understanding of postural control mechanisms underlying postural instability and falling in PD,[10] multiple physiological systems are known to contribute to postural control. Horak and colleagues have identified six different balance control system (biomechanical constraints, stability limits, anticipatory postural adjustments, postural response, sensory orientation and stability in gait) underlying the complex skill of balancing that may be important to systematically target in balance training aimed at improvement of balance in PD.[11]

In the present study, the highly challenging balance training on balance interventions corresponding to the six interacting systems contributing to balance control using a ten-part Likert scales to determine when to progress subjects. At each session, subjects rated the level of difficulty of each exercise based on the level of challenge to balance. The exercises of anticipatory adjustment single limb stance with reaching, postural adjustment of perturbations on unstable surface, sensory orientation of standing on inclined surface, stability gait of gait with dual-task conditions and

biomechanical constraints of push-ups or planks was difficult at the beginning for all the subjects but after the repeated training the subjects were able to perform.

The results of the study according to the Hoehn and Yahr stages of PD stage 3 were able to easily progress the level of difficulty of each exercise based on the level of challenging to balance where they required 3 to 4 session of highly challenging balance training. Most of the subjects who were in stage 4 of PD faced problems in progressing the level of challenging to balance exercise, but slowly after the training, they were able to complete the exercise with balance control.

In the present study it shows that while comparing between male and female according to the age group between 45-60 years, the subjects were able to easily progress the levels of the challenging exercise, while the subjects of age group above 60years found difficult in performing highly challenging balance training. As the results of the present study, the male has significantly improved balance than female.

A study was done by David Sparrow, et.al. stated that highly challenging balance programs appeared to have the most robust outcomes regarding improvements in balance-related activity performance. Prior studies also suggest that balance training that included a strengthening component of balance control (anticipatory postural adjustment, postural responses, sensory orientation and stability in gait) was more effective in improving balance compared to balance training.[12]

The results of the present study are in agreement with the study done by Mark A. Hirsch et.al who mentioned in their study that muscle strength and balance can be improved in persons with Parkinson's diseases by high-intensity resistance training and balance training which showed 3 main effects on balance: (1) training increased the latency to fall (2) training reduced the percentage of trials resulting in falls and (3) participation in the combined group improved the ability to maintain equilibrium, (i.e., sway less) during destabilizing conditions.[9]

Another study was done by Nicola Smania, et al. mentioned in their study that motor strategy, frequently impaired in PD, consists of maintaining balance by activation of the leg, trunk, and neck muscles while the position of the feet (base of support) is constant. Other important balance strategies, also frequently impaired in PD are "protective" responses, which are featured by changes in the base of support (i.e., one or both feet leave their original position in an attempt to maintain balance) their study was a significant reduction in falls during daily life in the experimental group.[13]

Another study done by Asmara Yitayeh and Amare Teshome stated that multifactorial physiotherapy interventions like muscle strengthening, range of movement, balance training, and walking training exercises were found to have a positive effect on treating balance dysfunction and PI among idiopathic patients with PD. Physiotherapy interventions targeted at preventing falls and Exercises of self-destabilization of the Center of body mass during walking and locomotor dexterity have an impact on reinforcing the need to focus attention on maintaining balance when performing mobility tasks in a standing position.[14]

In a study by David Conradsson, et.al mentioned in their study that improved balance and gait performance in the training group, dual tasking exercises were gradually integrated into the program by adding concurrent cognitive (e.g., counting, remembering items) and/or motor tasks (e.g., carrying and/or manipulating objects) to the balance exercises. Moreover, 4 balance components specific to PD impairments were emphasized: (a) sensory integration (walking tasks on varying surfaces with or without visual constraints) (b) anticipatory postural adjustments (voluntary arm/leg/trunk movements, postural transitions, and multidirectional stepping, emphasizing movement velocity and amplitude); (c) motor agility (inter limb coordination under varying gait conditions and quick shifts of movement characteristic during predictable and unpredictable conditions); and (d) stability limits (controlled

leaning tasks performed while standing with varying bases of support, stimulating weight shifts in multiple directions).[15]

Shannon C. Lefaivre et.al conducted a study to know whether sensory attention focused exercise facilitation the utilization of proprioception to improve balance control in PD and they suggested that in order to overcome the inherent dependence on vision, restriction vision during exercise might require the individual to consciously process proprioception information.[16]

Another study conducted by Hasan Daneshmandi et.al, says that Muscular weakness, reduction of ankle irritability and loss of muscle synergy mechanisms all have a role in the falling. Therefore, implementation of the physical readiness program is a proper strategy to avoid falling because it leads to the increase of muscular power, flexibility and motion control.

It is therefore evidenced that Highly Challenging Balance Training has a significant effect on balance in Parkinson's subjects.

Conclusion

Result of the present study showed statistically significant improvement of the effect of highly challenging balance training on balance in subjects with chronic Parkinson's disease from pre to post measurements of berg balance scale scores Thus, the study accepts alternative hypothesis and concludes that "There is a positive effect of highly challenging balance training on balance in subjects with chronic Parkinson's disease".

Ethical Clearance- Taken from Institutional Ethical Committee of Padmashree institute of Physiotherapy

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Conflict of Interest - Nil

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