

The Effects of Hip Strengthening Program along with Trunk Control Exercises on Trunk Stability, Balance and Gait of Patient with Parkinson's Disease - A Case Report Study

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Abstract: *Parkinson's disease (PD) is a chronic, progressive disease of the nervous system with slow rate of progression and insidious onset. It characterized with cardinal signs such as rigidity, trunk instability, movement and gait disturbances, cognitive & perceptual disturbances, and autonomic dysfunction etc. Aims: The aim of the study is to see the effects of Hip Strengthening Program (HSP) along with Trunk Control Exercises (TCE) in order to improve trunk stability, balance and gait in Parkinson's disease patient. Methodology: A 71-year-old male patient with history of Parkinson disease visited OPD with a complaints of balance, gait instability and history of falls. On evaluation patient comes under stage 3 of Hoehn and Yahr staging of functional disability with balance and gait disturbances. Intervention of hip strengthening and trunk control exercises were given for 6 weeks along with conservative treatment and outcome measures were Trunk control test (TCT), Berg balance scale (BBS), cadence, stride length, step length and step width. Results: when compare to pre, on post assessment there is a significant improvement in all outcome measures at the end of 4 weeks of intervention. Conclusion: On treatment with hip strengthening program along with trunk control exercise, have shown significant improvement on trunk stability, balance and spatialtemporal (ST) parameters of gait.*

Keywords: Parkinson's disease (PD), Hip strengthening program (HSP), Trunk control exercises (TCE), Trunk control test (TCT), Berg balance scale (BBS), spatialtemporal (ST).

1. Introduction

Parkinson's disease (PD) is a neurodegenerative pathology classified as a movement disorder that affects 2–3% of the population over 65 years.¹ It is a disease characterized by dopaminergic and nondopaminergic deficiency² causing a variety of nonmotor symptoms such as sensory symptoms (pain and tingling), hyposmia, sleep alterations, depression and anxiety, abnormal executive and working memory-related functions, and motor symptoms such as bradykinesia, rigidity, tremor, and disturbance of postural control.^{3,1} Of these cardinal motor features, gait disturbance is one of the most disabling characteristics⁴ of the disease since it not only reduces the patient's mobility, but also leads to increased fall frequency⁵; with aggravating gait disturbances the overall quality of life diminishes. It is estimated that more than 70% of patients fall during the course of the disease and such events often result in fractures, often leading to another morbidity.⁶ The management of Parkinson's disease has traditionally centered on drug treatment, but even with optimal medical management, patients still experience a deterioration of body function, daily activities, participation⁷, and decline in mobility. This can lead to increased dependence on others, inactivity, and social isolation, resulting in reduced quality of life.⁸ There has been increasing support for the inclusion of rehabilitation therapies as an adjuvant to pharmacological and neurosurgical treatment, and a call for the move towards multidisciplinary management.⁹ The physiotherapist is a member within this multidisciplinary team, with the purpose of maximizing functional ability and minimizing secondary complications through movement rehabilitation within a context of education and support for the whole person.¹⁰

Physiotherapy for Parkinson's disease focuses on transfers, posture, upper limb function, balance (and falls), gait, and physical capacity and (in) activity.¹¹ It also uses cueing strategies, cognitive movement strategies, and exercise to maintain or increase independence, safety, and quality of life.¹² As we know PD is characterized by the loss of dopaminergic neurons in the substantia nigra, leading to a reduced amount of dopamine in the brain. Hence, this will cause reduced capability of movement control, manifesting as slowness and abnormalities in gait.¹³ Difficulties in gait and turning due to changes in postural control are also problematic, and during the mid and later stages of PD there is a risk of frequent fall. These individuals who had experience of falls, have a fear of falling and change their activities of daily living in an attempt to avoid fall-related activities.¹⁴ Falls and injuries related to falls often lead to fear, reduced mobility and strength which makes the patients dependent. These factors leads to show its influence of mortality, morbidity and quality of life of the patients with PD.¹⁵ Biomechanical research involving healthy younger adults has shown that the trunk segment plays an important role in modulating gait-related oscillations and maintaining head stability; an important goal of the human postural control system.¹⁶ However, the increased axial rigidity that is evident in people with PD significantly impairs the trunk's capacity to attenuate these movement-related forces, which inadvertently reduces head stability and impairs the clarity of the visual and vestibular information used in balance control.¹⁷ There are multiple physiotherapy modalities, namely conventional physiotherapy, resistance training, treadmill training, strategy training, dance, martial arts, aerobic exercises, hydrotherapy, balance and gait training, dual tasking, exergaming, and Nordic walking etc.¹⁸ But

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there is no study retrieved on improving trunk impairment along hip therefore the aim is to see the effects of Hip Strengthening Program along with Trunk Control Exercises in order to improve trunk stability, balance and spatiotemporal parameters of gait in Parkinson's disease patient.

2. Methodology

A) Case description

A 68-year-old man with a 2-year history of Parkinson disease visited OPD with a complaints of falls once or twice in a month, has moderate difficulty in walking but able to walk independent with less support and complains of weakness over limbs, stiffness over the spine and with moderate issues over balance. On evaluation he has moderate. A) Rigidity: in all extremities; the right side is worse than the left and axial area . B) Strength: grossly 3 to 4/5 on manual muscle testing throughout, including grip strength. C) Sensation: is within normal limits throughout. D) Sitting balance: is good during static and fair on dynamic activities. The patient sits with a posterior pelvic tilt, rounded shoulders, and flexed neck. On rising to a standing position, he does move forward in the chair, which positions his feet under his knees. He does not lean forward as he stands and momentarily loses his balance backward on rising from a chair. Static standing fair and dynamic balance on standing is altered. E) Gait pattern: typical of a patient with Parkinson disease with shortened steps and flat foot contact bilaterally. He complains of festination and freezing, but neither is observed during the evaluation. He is taking carbidopa-levodopa. At that time, he found that he could stand up once he fell. On fall efficacy scale of score of 28/100, with above history and assessment it conclude to say patient with Parkinson's with early stage 3 on Hoehn and Yahr disability.

B) Intervention

Intervention of hip strengthening and trunk control exercises were given for 5 days in a week, for 6 weeks duration along with conservative treatment. The exercise-based intervention comprised the following three parts: (1) Warm-up including stretching and ROM exercises; (2) an exercise routine including Hip strengthening program & Trunk control exercises and (3) a cool down phase including supported cycling.¹⁸

- Hip strengthening program: 1RM was calculated, frequency=4-5 days per week for 6 weeks, Intensity = 40% to 50% of 1 RM Repetition, Time=1-2 set 8-10 repetitions & progression to 3 sets, Type=weight cuff 1 to 5kg i.e. 1 to 2 kg used in 1st to 3rd week and progression to 4 to 5kg on 3rd to 6th week. The exercise were the following: Glute bridge, side leg raise, hip extension, squats, abduction exercises, knee lift, Banded walk, hip circles, lunge, kettlebell swing, lying lateral leg lift, weight cuff of.¹⁹
- Trunk control exercises: Exercise sets / dose: Initial started with 7 to 9 repetitions of 2 sets progression to 9 to 13 repetitions of 3 sets. The exercises for 1st to 3rd week are Modified Bridging Exercises, Pushups with Trunk Stabilization, Wall Slides and Exercise Ball Training, for 4th to 6th week Transitional Stabilization Activities: Tai-chai techniques, Bird dog exercise Bobath techniques.²⁰

Conventional treatment: Stretching exercises for the trunk and balance training includes static and balance training and supported gait training. Rate of perceived exertion (RPE) with scale of 0 to 10 was used to determine the intensity of the exercises given.²¹ The intensity of the trunk stretching program was calibrated to an RPE of 2 to 4 during weeks 1 through 6. For the resistance program, the intensity was increased every week, with an RPE of 2 to 3 for weeks 1 through 3, an RPE of 3 to 4 for weeks 3 through 4, an RPE of 4 to 5 for weeks 4 through 5, and an RPE of 5 to 6 for weeks 5 through 6. A three-dimensional movements along flexibility training program was included on improving flexibility of the trunk muscles on specific to group & isolated muscles and also core muscles that connect the upper and lower limbs.²²

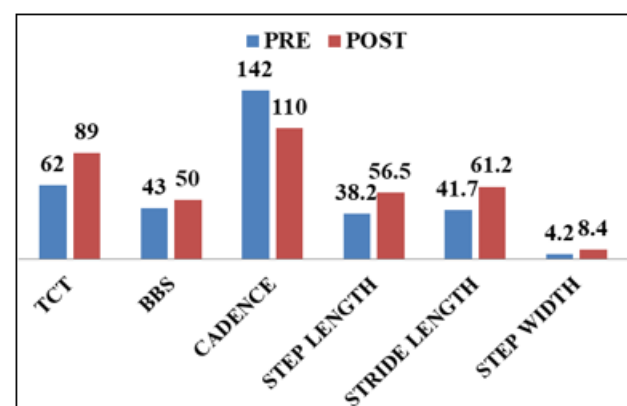
C) Outcome measures

Trunk Control Test, Berg Balance Scale, Spatiotemporal parameters of gait: Cadence, Step length, Stride length and Step width.

3. Data analysis & Results

Table 1: Pre and Post values of Trunk control test (TCT), Berg balance scale (BBS), cadence, step length, stride length and step width.

Outcome Measures	PRE	At 3 rd week	At 6 th week
Trunk Control Test	62/100	73/100	89/100
BERG Balance Scale	43/56	47/56	50/56
Spatiotempor-Al Parameters of GAIT:			
• Cadence	142spm	133spm	110spm
• Step length	38.2cm	45.2cm	56.5cm
• Stride length	41.7cm	50.1cm	61.2cm
• Step width	4.2cm	5.9cm	8.4cm



Graph 1: PRE and POST of Trunk control test (TCT), Berg balance scale (BBS), cadence, step length, stride length and step width

Interpretation: When compare to PRE, there is improvement in all outcome measures at the end 6 weeks of intervention i.e. Trunk control test (TCT) from 62/100 to 89/100; Berg Balance scale (BBS) from 43/56 to 50/56; Spatio-temporal (ST) Parameters: Cadence 142spm to 110spm, step length 38.2cm to 56.5cm, stride length 41.2cm to 61.2cm, step width 4.2cm to 8.4cm.

4. Discussion

This following case report is the first study to identify the effects of trunk control exercise and hip strengthening program along with conventional treatment for 6 weeks of intervention to improve clinical symptoms i.e. axial rigidity and muscle weakness. The outcome measures included were trunk control test, Berg balance scale and spatio-temporal parameters. The end results of the study shown improvement on all outcome measures when compare to pre and post. In Parkinson's as it is a neuro degenerative disorder and its cardinal signs over motor system shows rigidity and muscle weakness which indirectly hamper the functional activity of the patient leading to disability.¹ The present case study is of Parkinson's patient with Hoehn and Yahr early stage 3 disability of which is limiting his functional activity and having fall history due to axial rigidity, lower limb weakness and dynamic balance problems. The trunk plays an important role in combatting the threats of PD on postural control. Loss static balance performance and poor gait can be related with muscles of trunk in patients with PD. Studies says that patients with poor trunk mobility and axial rigidity will impairs the trunk's capacity to attenuate these movement-related forces, which inadvertently reduces head stability and impairs the clarity of the visual and vestibular information used in balance can lead to postural instability, altered balance, abnormal gait performance and risk of falls among individuals with PD, treatment targeting on trunk segments along with hip region could increase the functional capacity and both the static and dynamic balance of patients, it will increase their confidence and decrease their fear of falling.^{23,24} Studies says interventions like stretching, mobility training, strengthening, active muscle re-education may reduce muscle and tendon stiffness and neural adaptations, causing an modulation of I-alpha spinal inhibitory interneurons by reduction of spinal reflex excitability of alpha motor neurons and also improve the stretch tolerance.^{25,26} Thus, our treatment focused on improving mobility and strength of trunk and hip in order to improve global motor function and our results also confirms on improving trunk control, balance and gait which can potentially prevent injuries related to falls. In older adults or those with functional limitations, stretching, mobility exercise and strength training has proved to be effective in reducing falls and fracture events. Compared with other types of exercise, strengthening is more effective intervention, on slowing the loss of muscle strength and bone mass and decreasing the levels of energy-absorbing soft tissue. It also favour's positive changes in body composition, increasing fat-free mass and decreased fat mass with better physical performance and quality of life.²⁷ Hence intervention with trunk control exercises and hip strengthening program along conventional treatment will help the patients of Parkinson's on axial rigidity and muscular weakness which indirectly helps on improving the mobility of spine and extremity weakness, limit the loss of dynamic balance and reduce the risk of fall.

5. Conclusion

On treatment with Trunk control exercise, will help in reducing the muscle and tendon stiffness and neural adaptations, causing an improved stretch tolerance and

reduction in the spinal reflex excitability of alpha motor neurons through the modulation of I-alpha spinal inhibitory interneurons and improve rigidity of the spinal & enhance mobility and on with hip strengthening program is effectively in slowing the loss of muscle mass, bone mass decreasing the energy-absorbing soft tissue which directly favors the positive effects on body composition. Hence we conclude both the intervention are effective on improving global motor function, gait, balance, reduce risk of falls and thereby improve quality of life in patients with Parkinson's disease.

6. Limitations

This is a single case study, evaluating on large population can helping in identifying more features of the condition. It is short duration study i.e. 6 weeks, Parkinson's is progressive neurodegenerative disorder, were exercises are to be continued and no follow-up was taken.

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