



Efficacy of Forced Bicycle Exercise on Patients With Parkinson's Disease

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ABSTRACT

Parkinson's disease is a chronic, progressive neurodegenerative disorder characterized by rigidity, bradykinesia, tremors and postural instability. Although a conventional exercise program is available for the patients suffering from Parkinson's disease but still it is not successful to provide global improvement to the patients. The purpose of the present study was to find the efficacy of forced bicycle exercise program in the treatment of Parkinson's disease. A total of 4 patients were assigned with three, 1-hour exercise sessions per week for 8 weeks on an ergometer bicycle. The patients were made to perform forced exercise on the ergometer bicycle with a pedalling rate of 80- 90 repetitions per minute. There was an improvement in all the components of Unified Parkinson's Disease Rating Scale (UPDRS) and Modified HoehnYahr scale after the 8 weeks intervention in all the patients.

KEYWORDS

Parkinson's disease, Forced exercise, ergometer cycle, UPDRS

Background:

Parkinson's disease is a chronic neurodegenerative disease characterized by mainly four cardinal signs bradykinesia rigidity, tremors and postural instability. There is a progressive loss of dopaminergic neurons in the substantia nigra which further projects into the striatum.¹ Although a conventional exercise approach is available to treat the patients with Parkinson's disease but still it is not successful to provide global improvement in the patients suffering from Parkinson's disease.²

In healthy individuals there is an interaction between the conscious and cognitive centres of movement to perform a motor task. But in Parkinson's as there is loss of dopamine in the dorsal basal ganglia it leads to lack of automatic and cognitive part of motor performance.^{3,4} Dopamine replacement therapy has some results in maintaining the motor performance in individuals with Parkinson's disease but with least effect on cognitive part. Recent evidences have shown that exercises play an important role in preservation and maintenance of motor performance associated with both cognitive and automatic control. Specifically the exercise intervention associated with goal based motor skill training facilitates the learning through three ways comprising instruction, feedback and encouragement to perform beyond the self-perceived capacities. Combining the both goal based motor skill training with aerobic training has improved the cognitive as well as automatic component of motor performance.⁶ Neuroplasticity is a process by which the brain encodes experiences and learns new behaviours and is defined as the modification of existing neural networks by adding or modifying synapses in response to changes in behaviour or environment, that encompasses exercise.⁷

The evidence for the effect of neuroplasticity and circuitry involved in automatic motor control using intensive exercise protocols have been demonstrated by the studies using forced bicycling as a form of forced exercise.⁹ Albert and colleagues used stationary tandem bicycle, they forced the individuals suffering from Parkinson's disease to pedal the tandem bicycle at a rate 30% more than preferred rate. Thus they combined the cognitive, goal directed and aerobic approaches as an intensive exercise form.¹⁰⁻¹¹

Forced exercise is a mode of aerobic exercise in which exercise rate is maintained mechanically to assist the patient in achieving

exercise rate more than the preferred voluntary rate of exercise. The patient moves actively the bicycle but in an active assisted manner.¹⁰ As the conventional exercise protocols have not yield with proper improvement in the clinical features in Parkinson's disease forced exercise bicycling can be a treatment of choice in treating the Parkinson's disease.

Materials and Methodology:

A total of 4 patients diagnosed with Parkinson's disease (Modified Hoehn and Yahr stage 2-3) and history of any of the cardinal symptoms of Parkinson's disease (rigidity, tremors, bradykinesia and postural instability) were included in the study. All the patients were able to walk minimum of 25 feet unassisted and had history of difficulty in activities of daily living. The patients who were unable to understand instructions required by the study, primarily wheelchair bound and all those who suffer from the presence of medical or neurological infirmity that might contribute to significant gait dysfunction were excluded from the study. Patients with systemic or circulatory illness like uncontrolled hypertension, diabetes, significant orthostasis or vascular claudication were also excluded from the study. UPDRS -iii and modified HoehnYahr scale were used as outcome measures where as ergometer bicycle was used to perform forced bicycle training.

Procedure:

The patients were assigned with three 1-hour exercise sessions per week for 8 weeks on an ergometer bicycle. They were made to perform forced exercise on the ergometer bicycle with a pedalling rate of 80-90 RPM (Repetitions per minute). The THR (target heart rate) was maintained within the same range during the whole treatment session. Concerning the safety of the patients, they were wrapped with belts to the bicycle to avoid falls. Similarly to avoid any injury to the feet, the belts were wrapped around the pedals and feet to maintain the synchronic movement while pedalling. The patients were explained the whole procedure and were instructed to inform immediately in case of fatigue or any other discomfort. During the whole procedure the therapist accompanied the patient and verbal and visual cues were continuously provided to the patient.

Each exercise session consisted of 10 minutes warm up, 40 minutes main exercise session and 10 minutes cool down session.

sion (total one hour) three sessions per week for 8 weeks. The patients were allowed to take rest during the 40 minutes main session whenever required.

Cardio-respiratory fitness was measured at the baseline and end of the treatment session using YMCA cycle ergometer submaximal test to deliver the aerobic training at a safety mode and within the normal limits of target heart rate and VO_{2max} .

Result:

There was significant improvement in the UPDRS components of the patient at the end of the 8 weeks treatment sessions.

Table 1: The demographics of the patients at baseline

Demographics	Patient A	Patient B	Patient C	Patient D
Age (yrs)	67	61	61	66
Weight (kgs)	58	52	61	49

Table 2: Comparison of mean score of UPDRS - iii and Modified HoehnYahr scale using paired sample t test.

	Pre test Mean±S.D	Post test Mean±S.D	t- value	P - value
UPDRS	27.7±6.5	8.3±6.5	58.0	.000
MHYS	2.6±.5	1.4±.9	3.8	.030

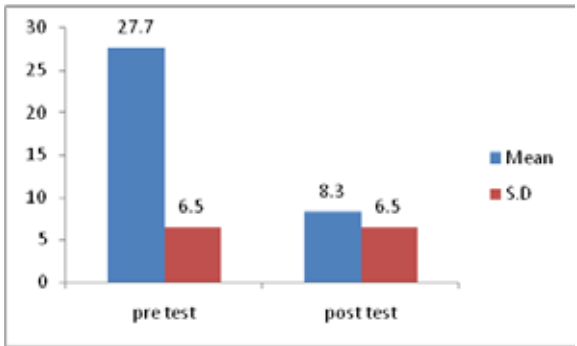


Fig. 1 Comparison of mean score of UPDRS iiipre and post intervention

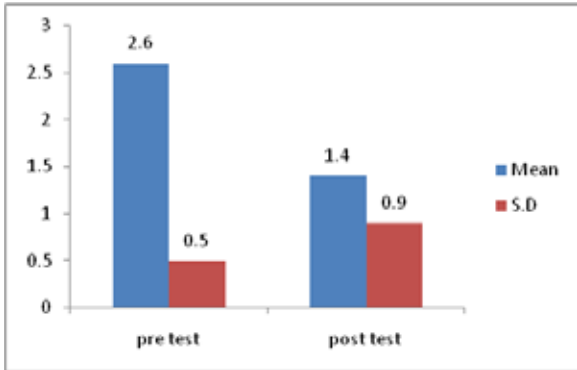


Fig. 2 Comparison of mean score of MHYS pre and post intervention

Discussion:

Forced exercise bicycling can be used as treatment of choice in the treatment of Parkinson's disease. It has shown very efficient results in 8 weeks of intervention in the HoehnYahr

scale and UPDRS- iii. During forced exercise bicycling following changes occur in the CNS of a person suffering from Parkinson's disease.

The major difference between forced and voluntary exercise is the intrinsic feedback in the form of forced pedaling in forced exercise. Forced pedaling leads to increase the afferent input from muscle spindles and golgi tendon organs in the lower extremities. This increased input leads to the release of dopamine in brain. There also occurs neural repair neural plasticity and neural protection in the CNS.In patients suffering from Parkinson's disease there is decreased cortical excitability and cortical input which leads to bradykinetic movements. This active assisted mode of exercise has increased the cortical activation too.

Albert et al (2011)determined that forced exercise results in neuroprotective mechanism and improved motor function. As in Parkinson's disease the conventional exercise intervention has not yielded global improvements. Forced exercise can be a treatment of choice and a novel approach towards the treatment of Parkinson's disease.¹⁰ Petzinger et al (2011)reviewed the role of exercise in facilitating the basal ganglia function in Parkinson's disease. Animal and human studies have shown that exercise has beneficial effect on the individuals with Parkinson's disease. Researchers have revealed that behavior training and exercise stimulates the motor performance by the phenomenon called exercise dependent neuroplasticity. There occurs adaptive and protective change in the neuronal connections of basal ganglia and related circuitry after exercises in Parkinson's disease. ¹²

Bohnen et al (2011)determined theadvances in therapeutic option in gait and balance in Parkinson's disease. It emphasized the use of non-dopaminergic approaches in the treatment of Parkinson's disease. Vigorous and forced exercise intervention should be a treatment of choice in these patients. But this exercise should be incorporated with anti-fall physical therapy.¹⁵ Albert et al (2010)investigated the reduction of freezing of gait in Parkinson's disease by repetitive robot assisted treadmill training. Four individuals with Parkinson's disease participated in the study.. All the participants reported reduction in freezing of gait. Improvement was also seen in gait velocity, stride length, rhythmicity and co-ordination of the individuals. ¹³ Redgrave et al (2010)investigated the goal directed and habitual control in basal ganglia: implication for Parkinson's disease. Studies have found that there are special territories in the basal ganglia which are responsible for goal directed and habitual actions. In Parkinson's disease there is progressive degeneration of predominately posterior putamen, which is responsible for goal directed behavior. Thus the individuals are forced on a goal directed mode, which is controlled by rostromedial striatum.¹⁶

Conclusion:

The results showed that forced exercise bicycling is a promising therapy towards the improved quality of life in patients with Parkinson's disease.Forced exercise bicycling add to the interest of patients too. It eliminates the burden of disease and its treatment also thereby reducing the anxiety and depression associated with the disease.

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