INTI JOURNAL | eISSN:2600-7320
Vol.2022:01

Comparison of the Effects of Task-Oriented Balance Training Versus Blindfolded Balance Training in Patients with Parkinson's Disease

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Abstract

The objective of this study was to evaluate the efficacy of task-oriented balance training versus blindfolded balance training in enhancing postural stability among patients with Parkinson's disease. A comparative study involving 20 participants was conducted at the Kriston Clinic over an eight-week intervention period. Eligible participants included male and female individuals, aged 50 to 55 years, diagnosed with Parkinson's disease and experiencing concerns related to falls, instability, or balance deficits. Exclusion criteria comprised coexisting neurologic conditions, significant impairments, cardiac complications, and lack of patient cooperation. Assessments were performed using the Unified Parkinson's Disease Rating Scale (UPDRS) and the Berg Balance Scale (BBS). Participants were randomly assigned into two groups: Group A (n=10) received blindfolded balance training, while Group B (n=10) underwent task-oriented balance training. Prior to commencing the interventions, each protocol was thoroughly explained and informed consent was obtained from all subjects. Baseline measurements were recorded using the UPDRS and BBS. Both groups participated in their respective training regimens four times per week for a duration of eight weeks. Upon completion, pre- and post-intervention measurements were collected and compared utilizing the UPDRS and BBS. Data were compiled and analyzed using IBM SPSS Version 20.0 software. Descriptive statistics, including mean and standard deviation, were calculated, and inferential statistics were applied using t-tests for parametric variables. Results were systematically tabulated and graphically represented. Comparison of pre- and post-intervention scores within both groups indicated a statistically significant improvement in mean values on the UPDRS and BBS ($p < 0.005$). The findings demonstrate that blindfolded balance training is more effective in improving balance among Parkinson's disease patients with balance impairments when compared to task-oriented balance training.

Keywords

Parkinson's disease (PD), Blindfolded balance training, Task oriented balance training

Submission: 11 November 2021; **Acceptance:** 13 March 2022

Introduction

Parkinson's disease is the second most common neurodegenerative disorder after Alzheimer's disease (Alves et al., 2008). It is caused by the progressive degeneration of dopaminergic neurons in the substantia nigra pars compacta, reduced striatal dopamine, and the presence of Lewy bodies (Muslimović et al., 2005; Yang et al., 2018). PD is characterized by the cardinal features of rigidity, bradykinesia, tremor, and postural instability (Yeole et al., 2017). The primary neurotransmitter dopamine is responsible for transmitting the appropriate information for the correct control of movement (Carlsson & Carlsson, 2006). Clinical symptoms appear when there is a 40% to 60% reduction of nigral neurones and striatal dopamine (De Goede et al., 2001). Parkinson's disease affects 1% to 2% of the population older than 65 years (Švehlík et al., 2009). More than 10 million people worldwide are living with PD. Incidence of Parkinson's disease increases with age, but an estimated four percent of people with PD are diagnosed before age 50. Men are 1.5 times more likely to have PD than women (Marras et al., 2018). The prevalence in India was roughly 10% of the global burden, that is, 5.8 cases (Dorsey et al., 2018). From India, crude prevalence rates (CPR) between 6 and 53/100,000 have been reported. Above the age of 60 years, the PRs were higher, being 247/ 100,000 (Razdan et al., 1994).

The term "balance control" refers to a multisystem function that strives to keep the body upright while sitting or standing and while changing posture. Balance control is needed to keep the body appropriately oriented while performing voluntary activity, during external perturbation, and when the support surface or environment changes. Faulty balance control mechanisms may contribute to fall-related injuries, restriction of gait patterns, and decreased mobility. These disabilities lead to loss of functional independence and social isolation.

Altered gait and postural instability are very close in Parkinson's disease patients (Tan et al., 2011), and despite pharmacological medication or surgical intervention for PD patients, usually show deterioration in mobility. Therefore, several non-pharmacological rehabilitation techniques were proposed (Morgan & Fox, 2016; Mestriner, 2016); however, the physical therapy techniques used the parameters and methods adopted to evaluate their effects, didn't show any congruent result (Pickering et al., 2007).

The impairment of sensory integration has been suggested to influence balance control in PD (Tan et al., 2011). Patients are unable to perceive the upright or vertical position, which may indicate an abnormality in the processing of vestibular, visual, and Proprioceptive information contributing to balance (Yeole et al., 2017). Also present is an inability to adopt movement strategies to contrast changing sensory conditions, which reflects a problem in sensory-motor adaptation (Nallegowda et al., 2004). Recent studies (Reynard & Terrier, 2015; Jacobs & Horak, 2006) supported the role of visual deprivation as a potential driver in using alternative sensory strategies to control dynamic equilibrium and stabilize gait. In particular, rehabilitative training based on the enhancement of sensorial input could be essential to improve balance and gait in PD patients (Lefaivre & Almieda, 2015). More attention should be given to adopting rehabilitation strategies which improve postural responses by means of sensorial integration afferences (Nallegowda et al., 2004). To improve the ability of older people to perform daily tasks, an exercise program was developed focusing on functional tasks of everyday life, tasks that are affected early in the aging process (Hirasing et al., 1997). The performance of functional tasks, however, is more complex and involves an interplay of cognitive, perceptual, and motor functions and is closely linked to the individual's dynamic environment (Mulder, 1991). A recent study proposed that Sensorimotor training through Blindfolded Balance Training (BBT) could be a novel, effective therapy to improve gait in PD patients by maximizing central nervous system compensation through balance perturbations. March on foam would make inputs less reliable, so with eyes closed the subject would have to rely more on the vestibular system to maintain balance (Samoudi et al., 2015).

The UPDRS was to provide a comprehensive, practical, and easy-to-administer scale that can be used across all patients regardless of severity. The scale consists of 13 items, and the score ranges from a minimum of zero (best) to 52 (worst). The Minimal Clinical Important Change (MCIC) was determined as a score between 2.3 and 2.7 (Shulman et al., 2016; Schrag et al., 2006). The Berg balance scale (BBS) is used to objectively determine a patient's ability (or inability) to safely balance during a series of predetermined tasks. It is a 14-item list with each item consisting of a five-point ordinal scale ranging from 0 to 4, with 0 indicating the lowest level of function and 4 the highest level of function, and takes approximately 20 minutes to complete. It does not include the assessment of gait. This study aimed to investigate the efficacy of blindfolded balance training (BBT) to compare the Task-oriented balance training in the improvement of balance in people with PD.

Materials and Methods

This is an experimental study of comparative (pre and post) type that was conducted in the KRISTON clinic, Chennai, Tamil Nadu, India, and it took nearly 8 weeks to complete the study. 20 samples were selected and participants were screened to ensure that they met the inclusion criteria. Parkinson's patients in the age group between 50 and 55 years, Hoehn and Yahr scale 2-3 stage, and having a risk of fall and poor balance. Both genders are equally preferred, and the patients should be medically stable. The 20 participants included in the study were then randomly allocated, either into blind folded balance training (BBT) or task-oriented balance training using a lottery method, with ten participants in each group. Blind folded balance training and task-oriented balance training are used for different needs, body parts, and intensities before the onset of the treatment protocol. The training was explained to the patient, and informed consent was taken from the patient. The baseline measurements were taken by using the Unified Parkinson's Disease Rating Scale (UPDRS) and the Berg Balance Scale (BBS). The participants of the blind folded balance training group (GROUP A – BBT) and task-oriented balance training (GROUP B – TOBT) received exercises for 45 minutes, once a day, weekly, 4 times for 8 weeks. After the 8 weeks, the post-test measurements were taken and compared using the unified Parkinson's disease rating scale and the Berg balance scale.

Flow Chart:

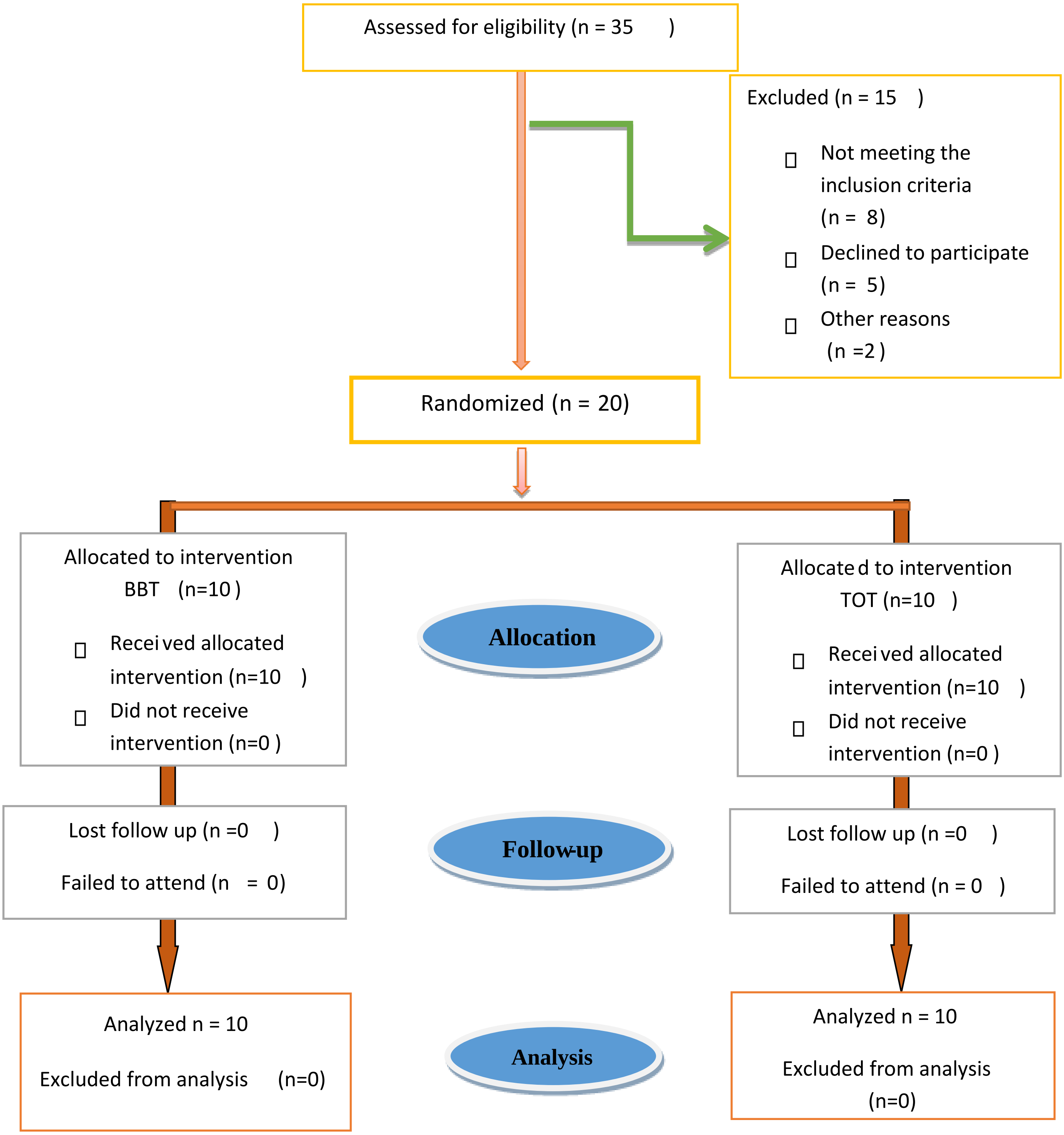

Figure 1. Flow diagram of the progress through the phases of a parallel randomized trial of two groups

The collected data were tabulated and analyzed using IBM SPSS VERSION 20.0 SOFTWARE. The collected data were analyzed and tabulated with descriptive and inferential statistics. For the descriptive statistics, the mean and standard deviation were calculated, and for the inferential statistics, the parametric variables were treated with a t-test. The results were tabulated and plotted accordingly.

Results and Discussion

Table 1 and Figure 2 show the comparison between the pre-test values of Group A and Group B; the pre-test values of UPDRS are 86.80 and 87.10, while the BBS values are 27.80 and 27.50.

Table 1. Comparison between pre-test value of group A and group B.

S. No.	Outcome	Group A (Pre-Test)	Group B (Pre-Test)
1	UPDRS	86.80	87.10
2	BBS	27.80	27.50

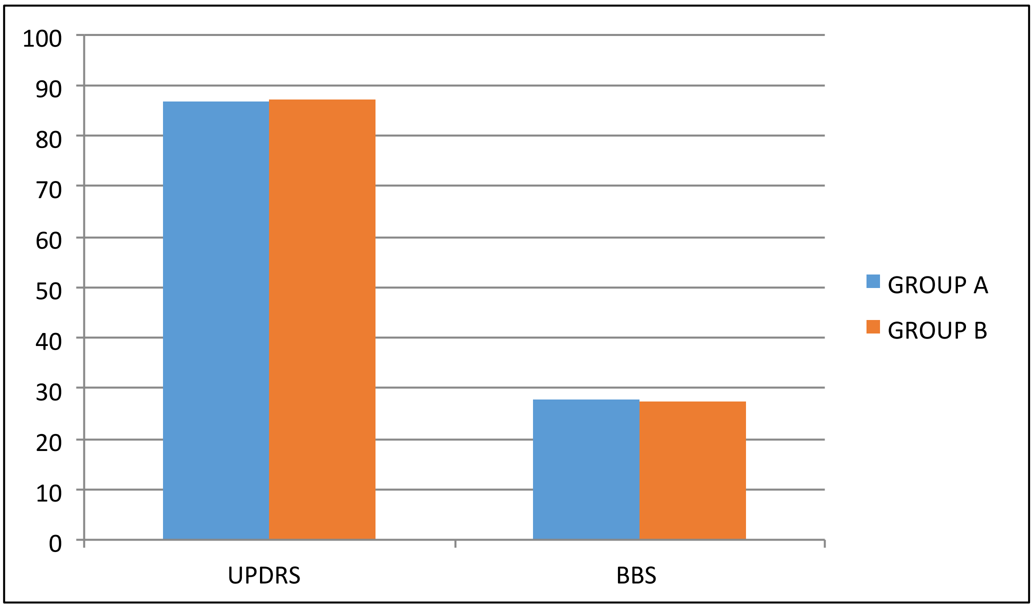

Figure 2. Comparison between pre-test value of group A and group B

Table 2 and Figure 3 show the comparison between the pre- and post-test of UPDRS and BBS in the blindfolded training group. The mean values of UPDRS are 86.80 and 66.00, while the BBS are 27.80 and 44.20. The UPDRS and BBS in the blindfolded training group have a P value < 0.005, which is significant.

Table 2. Comparison between pre- and post-UPDRS, BBS in Group-A (Blindfolded training)

No.	Test	Mean (Pre-Test)	Mean (Post-Test)	SD (Pre-Test)	SD (Post-Test)	Paired *t*-Value	*p*-Value
1	UPDRS	86.80	66.10	4.58	1.10	17.772	0.000
2	BBS	27.80	44.20	1.31	2.65	-22.364	0.000

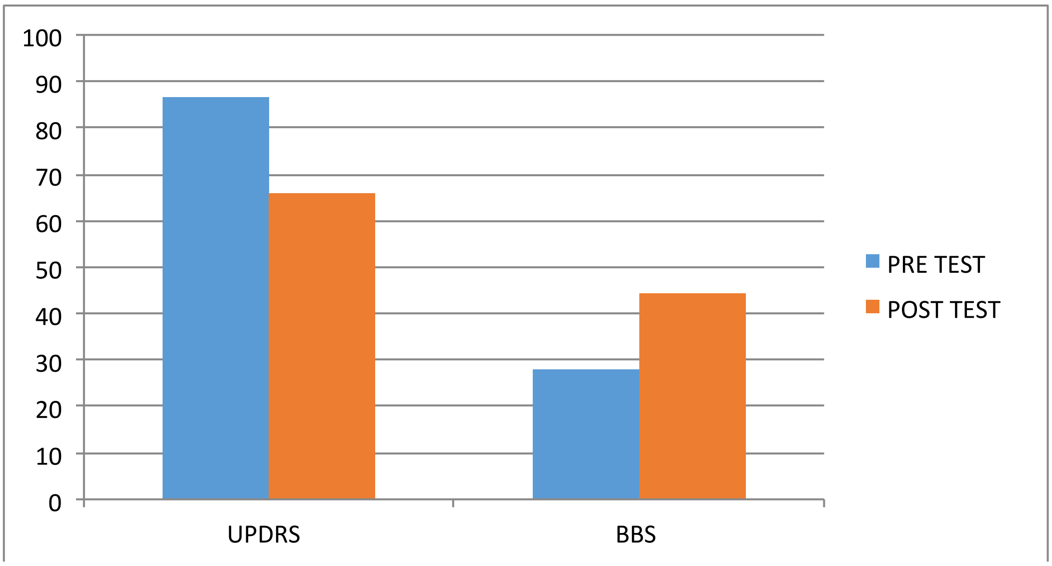

Figure 3. Comparison between pre- and post-UPDRS, BBS in Group-A (Blindfolded training)

Table 3 and Figure 4 show the comparison between the pre- and post-test of UPDRS and BBS in the task-oriented training group. The mean values of UPDRS are 87.10 and 74, while the BBS are 27.50 and 34.80. The UPDRS and BBS in the task-oriented training group have a P value < 0.005, which is significant.

Table 3. Comparison between pre- and post-group B (Task-Oriented Training)

S.No	Test	Mean (Pre-Test)	Mean (Post-Test)	SD (Pre-Test)	SD (Post-Test)	Paired *t*-Value	*p*-Value
1	UPDRS	87.10	74.00	4.30	0.82	10.78	0.000
2	BBS	27.50	34.80	1.58	1.54	-21.79	0.000

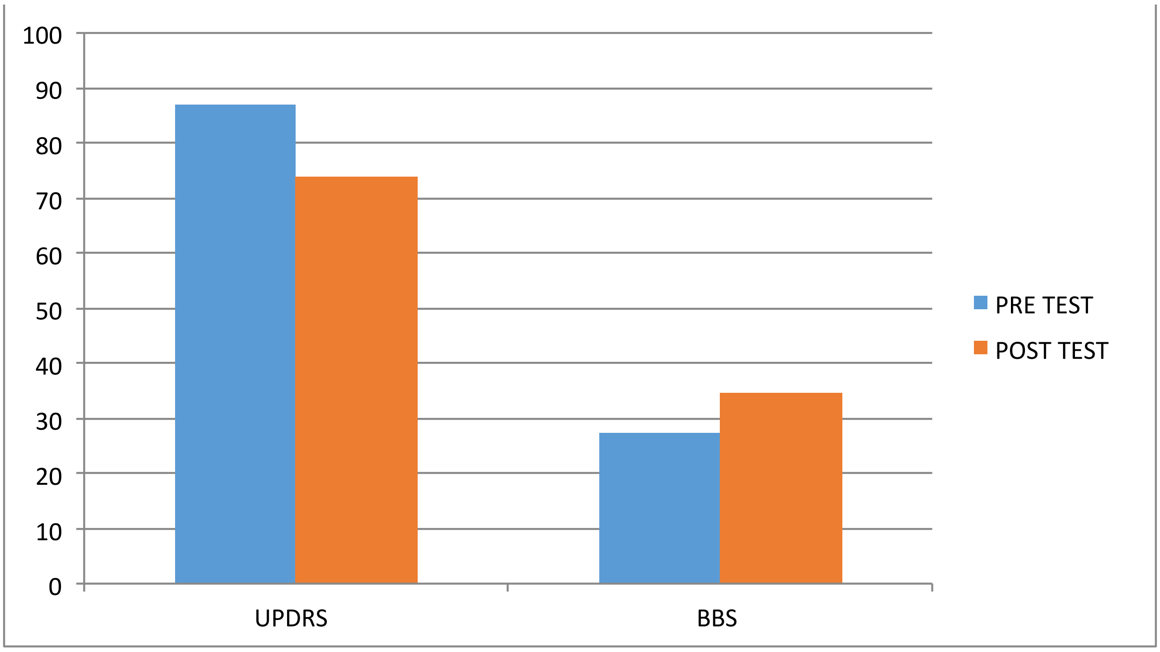

Figure 4. Comparison between pre- and post-UPDRS, BBS in Group B (Task Oriented Training)

Table 4 and Figure 5 show the comparison between the post-test values of UPDRS and BBS between the blindfolded training and task-oriented training groups. Post-test values in the blindfolded training group are 66.10 and 74 for UPDRS, while for BBS are 44.20 and 34.80. A post-test value of UPDRS, BBS of the blindfolded training group, and the task-oriented training group has a P value < 0.005, which is significant.

Table 4. Comparison of Post Test of Group A and Group-B

S.No	Post-Test	Mean (Group A)	Mean (Group B)	Standard Deviation (Group A)	Standard Deviation (Group B)	Independent *t*-test	*p*-value
1	UPDRS	66.10	74.00	1.10	0.82	-18.23	0.000
2	BBS	44.20	34.80	2.65	1.54	9.661	0.000

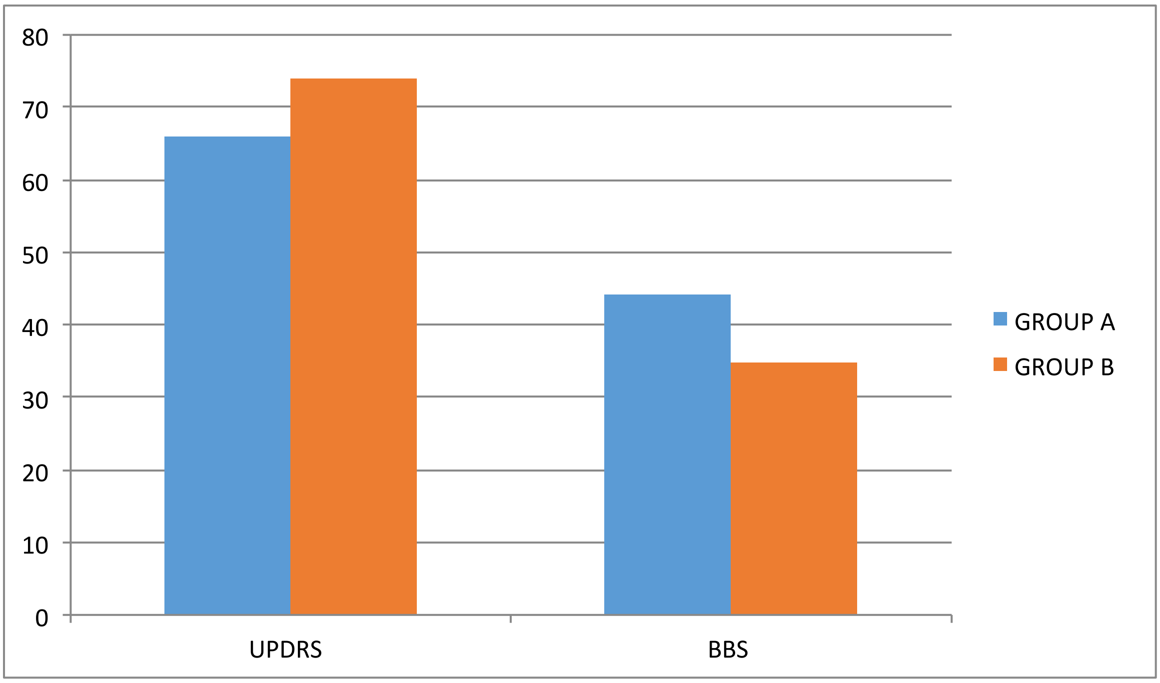

Figure 5. Comparison of the post-test of Group A and Group B

A comparison of pre-test values between Group A and Group B shows UPDRS scores of 86.80 and 87.10, and BBS scores of 27.80 and 27.50, respectively. In the blindfolded training group, mean UPDRS scores decreased from 86.80 pre-intervention to 66.00 post-intervention, while BBS scores increased from 27.80 to 44.20. These changes were statistically significant with P values < 0.005.

Similarly, in the task-oriented training group, mean UPDRS scores improved from 87.10 to 74.00, and BBS scores from 27.50 to 34.80, also demonstrating statistical significance (P < 0.005).

When comparing post-test values between the blindfolded and task-oriented training groups, the blindfolded group exhibited UPDRS and BBS scores of 66.10 and 44.20, respectively, compared to 74.00 and 34.80 in the task-oriented group. The differences between these groups were statistically significant (P < 0.005).

Parkinson's disease remains the most prevalent neurodegenerative disorder. Instability and fear of falling considerably impair quality of life, particularly among elderly individuals with Parkinson’s disease.

The present study aims to evaluate the effectiveness of blindfolded balance training versus task-oriented balance training as interventions for balance control in patients with Parkinson’s disease. Following blindfolded balance training, statistical analysis indicated notable improvements in standing balance, dynamic balance, and postural control among study participants.

Previous research supports these findings; for example, Tomlinson et al. (2012) reported reduced double stance phase duration in PD patients following blindfolded balance training, but not after traditional rehabilitation. This reduction likely reflects enhanced postural stability and improved weight transfer during stepping (Dingenen et al., 2013). Effective control of the double stance phase requires integration of sensory input from visual, somatosensory, and vestibular systems. Impairments in somatosensory integration are common in Parkinson's disease, though compensation via the vestibular system may be possible (Horak, 1996; Mergner, 1998; Muller et al., 2013).

Blindfold balance training is a supplementary rehabilitative technique that leverages visual deprivation and proprioceptive perturbation in the short-term recovery of gait among patients with Parkinson's disease (PD), likely engaging the vestibular system and its neural connections to motor areas. This intervention involves balance and walking exercises specifically designed to enhance dynamic postural control and improve balance responses. The core activities include marching in place on a foam cushion and walking on a treadmill while blindfolded, with supervised speeds gradually increasing from 1 km/hr to 3 km/hr (Tramontano et al., 2016).

It is hypothesized that vestibular-spinal stimulation facilitates appropriate Anticipatory Postural Adjustments (APAs), learned motor reflexes essential for voluntary movement. Essentially, the vestibular system predominantly modulates antigravity muscle activity and balance reactions (Peppe et al., 2007), which can subsequently be acquired and utilized by feed-forward mechanisms preceding voluntary movements.

Our findings support the hypothesis that deficits arising from visual deprivation and proprioceptive perturbation may be mitigated through compensatory sensory strategies, including reliance on the vestibular system. This approach appears beneficial in improving gait in PD patients. These results advocate for incorporating complementary rehabilitative methods based on sensorimotor stimulation into conventional rehabilitation programs for PD, potentially leading to enhanced functional outcomes within a shorter timeframe (Tramontano et al., 2016).

Additionally, we observed that blindfold balance training (BBT) contributed to overall gait improvements, influencing not only the double support phase but also the stance and swing phases of gait. Consequently, BBT demonstrates the potential to accelerate the effectiveness of physiotherapy in targeted gait rehabilitation (Tramontano et al., 2016). Further research is warranted to assess the long-term efficacy of BBT and to elucidate the underlying neurophysiological circuits and mechanisms.

Conclusion

The results of this eight-week study demonstrated that participants in the blindfolded balance training group exhibited greater improvements compared to those in the task-oriented balance training group. Both groups of patients with Parkinson's disease experienced enhanced balance following the training sessions; however, the blindfolded balance training group achieved significantly superior performance relative to the task-oriented group.

These findings indicate that blindfolded balance training is more effective than task-oriented balance training in improving balance among Parkinson's disease patients with balance impairments.

Acknowledgment

Not applicable.

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