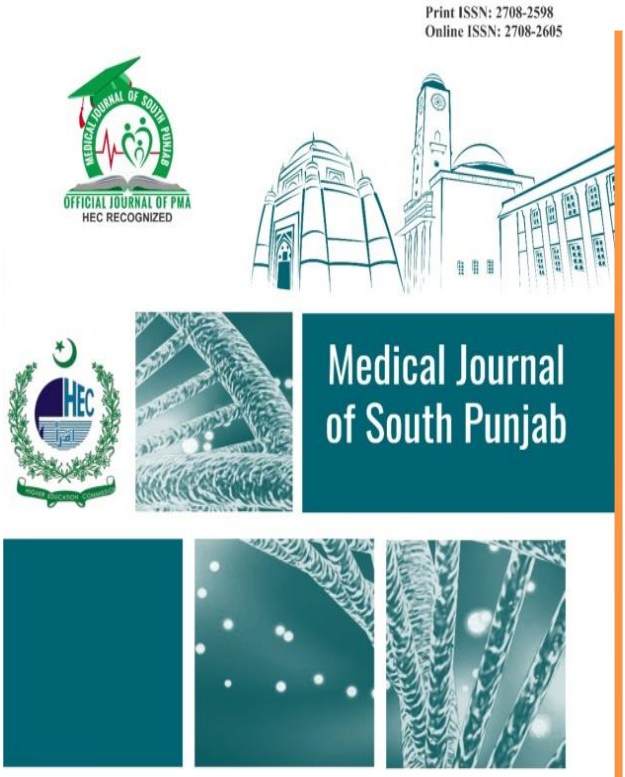
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# Comparison of neuroplasticity based balance training verses conventional physiotherapy among patients with parkinson's disease

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**Original Article**

# Comparison of neuroplasticity based balance training verses conventional physiotherapy among patients with parkinson's disease

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## ABSTRACT

**Objective:** This study aim was to compare the implications of neuroplasticity-based balance training on balance and functional mobility with conventional physiotherapy to establish the most superior intervention for Parkinson Disease patients.

**Methods:** This RCT was carried out at Amna Medicare Hospital in Multan over four months from 2nd May 2025 to 31st Aug 2026.The study included 66 participants (33 per group) aged 50–70 years with diagnosed Parkinson's disease and balance or gait impairments, taking stable antiparkinsonian medication and able to walk independently or with assistance. Group A: received balance training based on the concept of neuroplasticity (including weight shifting, obstacle negotiation, unstable surface activities and dual task training). Conventional physiotherapy consisting of range of motion, stretches, strengthens, posture and balance exercises was performed on Group B. Both groups saw 40 minutes of supervised attendance per week in a four week period (20 supervised sessions total), with 5 sessions per week, plus warm up and cool down. Following four weeks, functional mobility (Timed Up and Go) and balance (Berg balance scale) were evaluated at both baseline and after four weeks. The data were analysed in SPSS 26.0 and Microsoft Excel. The means and standard deviations of descriptive statistics were used and the Shapiro–Wilk test, paired-sample t test and independent-sample t test were also used. The criterion of the statistical significance was set to $p < .05$.

**Results**: After four weeks, there was a statistically significant balance and functional mobility improvement that occurred between the two groups ($p < .001$). Group A showed an improvement in the mean of 36.30 ± 2.30 to 48.52 ± 2.09 on the Berg Balance Scale and -1.66 to -1.34 on Timed Up and Go ($p = 0.001$ each). Cohen d values were reported were 1.49 and 1.53 respectively.

**Conclusion:** Post intervention results were better in immediate balance and functional mobility and balance training with neuroplasticity is better than traditional physiotherapy. The findings indicate that incorporating increasing challenge–task-specific tasks of diminishing stability in rehab of Parkinson disease is warranted. The difference in baseline balance-score between the groups and lack of long-term follow-up should be accounted in the interpretation.

**Keywords:** Parkinson, disease; neuroplasticity; balance training; traditional physiotherapy; Berg Balance Scale; Timed Up and Go.

## 1. INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disorder which involves degeneration of dopaminergic neurons in the substantia nigra pars compacta leading to dopamine depletion and abnormalities in motor control[1, 2]. Bradykinesia, muscle rigidity, resting tremor and postural instability are common clinical features of the disease, that gradually impair functional independence and quality of life. As a clinical feature, balance impairment is an important concern due to the increased risk of falls, decrease in mobility, and physical disability experienced by those who suffer from it[3, 4]. The number of people living with PD worldwide has risen significantly, to around 11.77 million people in total in 2021[5]. The epidemiology of rare neurological diseases in Pakistan is limited, and rehabilitation services are scarce, and the environmental restricted access to specialized neurological rehabilitation also makes disease management in Pakistan more complex[6]. Several motor symptoms can be controlled with pharmacology however balance dysfunction may remain, highlighting the relevance and added value of physiotherapy interventions to ensure mobility and functional independence.

In Parkinson's care, rehabilitative treatment is mostly performed through basic physiotherapy which consists of strengthening activities, stretching, mobilisation of different joints, gait training and postural corrections. Interventions are designed to preserve physical functioning and enhance mobility. In fact, rehabilitation strategies that focus on repetitive, task-specific, progressively challenging and cognitively demanding tasks have received attention as they target motor learning and functional adaptation, strategies based on the neuroplasticity principles[7, 8]. Balance training emphasizes the use of neuroplasticity-based balance tasks, including challenging balance tasks on unstable surfaces, dual-tasking and obstacle negotiation. Specialized balance exercises have been shown to improve balance and gait in previous research, however the results on whether or not these exercises are superior to conventional rehabilitation methods are mixed[9, 10]. Moreover, there are differences between the studies in the protocols followed and outcome measures used that make comparisons difficult. Thus, direct comparative evidence is needed to determine the relative effectiveness of these rehabilitation approaches.

In the current study the effect of balance training based on principles of neuroplasticity and that of conventional physiotherapy on balance and functional mobility was compared in Parkinson's patients. The Berg Balance Scale (BBS) was used to measure balance performance[6] and the Timed Up and Go (TUG) test was used to assess functional mobility[11]. The four-week period for both interventions was five times a week for therapy sessions. The purpose of the study was to determine if the balance training with neuroplasticity methods resulted in more balance and functional mobility improvement when compared to traditional physiotherapy. It is hypothesized that there would be a significant difference between the two intervention groups with regard to post intervention balance and functional mobility results.

## 2. METHODOLOGY

A randomized controlled trial (RCT) was conducted to compare neuroplasticity-based balance training with conventional physiotherapy in patients with Parkinson's disease. Place and duration: The study was carried out at Amna Medicare Hospital in Multan over four months from 2nd May 2025 to 31st Aug 2026.

A total of 66 participants were included in the study, with 33 participants allocated to each intervention group. Simple random sampling was used for participant recruitment. The participants were randomly

divided into Group A and Group B with the sealed envelope randomization method.

Male patients between 50 and 70 years of age were included and those diagnosed with PD by a neurophysician.Inclusion criteria: Male patients aged 50 to 70 years with clinical Parkinson's diagnosis (neurophysician confirmed) were included. Participants were shown to have imbalances or unstable gaits, had been on a stable anti-Parkinson prescription for at least two weeks, and had walked without an assistive device or with an assistive device.

Patients with other severe neurological disorders, history of stroke, traumatic brain injury, spinal cord injury, cognitive impairments that affect the capacity to comprehend or any mobility limitations due to orthopaedic surgery or severe cardiovascular conditions that limit physical activity were excluded.

The data collection consisted of demographical data, such as age, sex, disease duration, and Parkinson's disease clinical stage. The Berg Balance Scale (BBS) was used to measure balance, and scores are from 0 to 56. Functional mobility was assessed by Timed Up and Go (TUG) test that assessed standing up from a chair, walking 3 metres, turning, returning and sitting down. Baseline was conducted prior to intervention and both the outcome measures were rerun following four weeks. Group A was engaged in neuroplasticity-oriented exercises about balance, such as weight shift, obstacle negotiation, instability surface exercises and dual task exercises. Conventional physiotherapy consisting of range of motion, stretching, strengthening, gait training and postural correction exercises was given to the group B. Groups of each received 40 minutes, 5 days per week for 4 weeks.

All data were analyzed by SPSS version 26.0 and Microsoft excel. Data was presented with descriptive statistics which constituted mean and standard deviation. Shapiro-Wilk test was used for normalcy. Within group comparisons were conducted using paired sample t-test and between group comparisons were conducted using independent sample t-test. The criterion for statistical significance was the value of $p<0.05$.

## 3. RESULTS

There were 66 participants, 33 in each group. There were equal numbers of males and females in both groups with 18 (54.5%) males and 15 (45.5%) females. The mean age was 60.39 ± 5.06 years in Group A and 59.42 ± 4.72 years in Group B, with mean age of 59.91 ± 4.88 years. All outcome measures were found to be normally distributed using the Shapiro–Wilk test. The p values for the baseline BBS were 0.673 and 0.117 for Groups A and B respectively, and 0.370 and 0.156 for Groups A and B respectively for the baseline TUG. Post intervention BBS p values were 0.337 and 0.101 and TUG p values were 0.198 and 0.463, respectively. In all cases, the values were greater than 0.05, indicating that parametric tests should be employed. The two groups showed equivalent overall baseline outcomes in all but a few components of the BBS. Both groups showed improvements following the intervention, which was more notable in the dynamic balance activities. Some of the challenging tasks such as turning 360, standing on one foot and alternated foot placement in a stool were found to show improved improvement with Group A.

**Table 1: Within Group Comparison for Group A**

| Variables | GroupA (n=33) | | |
|---|---|---|---|
| | Baseline | 4th week | P value |
| | Mean ± S.D | Mean ± S.D | |
| BBS | 36.30 ± 2.30 | 48.52 ± 2.09 | <0.001 |
| TUG | 16.66 ± 0.92 | 11.34 ± 1.02 | <0.001 |

**BBS:** Group A showed an improvement in BBS scores from 36.30 ± 2.30 at baseline to 48.52 ± 2.09 after four weeks. A statistically significant improvement in balance ($p < 0.001$) was found after performing the balance training program based

on neuroplasticity, with a mean difference of −12.212.

**TUG**: Group A reduced TUG time from 16.66 ± 1.92s to 11.34 ± 1.02s after four weeks (mean difference 5.321s). This improvement was statistically significant ($p < 0.001$) suggesting that it represents an improvement in functional mobility and dynamic balance as a result of neuroplasticity-based balance training.

**BBS**: The BBS score after 4 weeks was 45.18 ± 2.38, which was a significant improvement in BBS score from the baseline score in Group B of 37.76 ± 2.32. Mean difference = −7.424 – improvement compared to conventional physiotherapy was statistically significant ($p < 0.001$).

**Table 2: Within Group Comparison of BBS for Group B**

| Variables | GroupB (n=33) | | |
|---|---|---|---|
| | Baseline | 4th week | P value |
| | Mean ± S.D | Mean ± S.D | |
| BBS | 37.76 ± 2.32 | 45.18 ± 2.38 | <0.001 |
| TUG | 16.60 ± 0.94 | 12.96 ± 1.09 | <0.001 |

**TUG:** Group B reduced TUG time from 16.60 ± 0.94 s at baseline to 12.96 ± 1.09 s after 4 wks with a mean difference of 3.639 s. Statistically significant improvement $p < 0.001$ was observed, onwards, improved functional mobility, dynamic balance after conventional physiotherapy.

**Table 3: Between-Group Comparison of Post-Intervention Berg Balance Scale**

| Variable | Group | Mean ± SD | p-value |
|---|---|---|---|
| Post-intervention Berg Balance Scale total score | Group A | 48.52 ± 2.09 | <0.001 |
| | Group B | 45.18 ± 2.38 | |

Group A had higher score in post-intervention BBS (48.52 ± 2.09) compared to Group B (conventional physiotherapy; 45.18 ± 2.38) with the mean difference of 3.33 points. The between-group difference was found to be statistically significant ($p < 0.001$) and the effect size was large (Cohen's d = 1.49) and suggested that Group A had enhanced improvement of balance.

**Table 4: Between-Group Comparison of Post-intervention Timed Up and Go time (seconds)**

| Variable | Group | Mean ± SD | p-value |
|---|---|---|---|
| Post-intervention Timed Up and Go time (seconds) | Group A | 11.34 ± 1.02 | <0.001 |
| | Group B | 12.96 ± 1.09 | |

The post-intervention TUG time for Group A neuroplasticity-based balance training (11.34 ± 1.02) was lower than for Group B = conventional physiotherapy (12.96 ± 1.09) (mean difference –1.62). This difference was statistically significant ($p < 0.001$), and had a large effect size (Cohen's d = 1.53) favoring greater improvements in functional mobility and dynamic balance for Group A.

## 4. DISCUSSION

The current randomized controlled trial compared the impact of balance training that focused on neuroplasticity, versus standard physiotherapy, on balance and functional mobility in patients with Parkinson's disease (PD). After 4 weeks both groups had recorded significant improvements in Berg Balance Scale (BBS) and Timed up and go (TUG) scores ($p < 0.001$). However, more improvements were found in Group A and this indicated the hypothesis that the balance training based on neuroplasticity was more effective than the conventional physiotherapy. Group A demonstrated an improvement in BBS scores from 36.30 ± 2.30 to 48.52 ± 2.09, compared with37.76 ± 2.32 to 45.18 ± 2.38 in Group B. This resulted in a between group difference that was statistically significant ($p< 0.001$) and large (Cohen's d = 1.49). The results are in line with Cardini et al., who found better balance improvements with balance specific exercise versus resistance and endurance exercises in PD patients[12]. Likewise, Coelho et al.showed improvements after performing challenging balance exercises[9]. Studies indicate that

progressive postural challenges/exercises and task specific exercises may help more in the ability to maintain dynamic balance[13, 14, 15].

In addition, there were huge gains in functional mobility. Group A's TUG time decreased from 16.66 ± 1.92 to 11.34 ± 1.02 seconds, whereas Group B improved from 16.60 ± 0.94 to 12.96 ± 1.09 seconds. The difference between the two groups was statistically significant ($p < 0.001$) and would be considered a large size (Cohen's $d = 1.53$). This finding is consistent with the findings of Du et al. who showed gait and balance benefits after performing dual-task training in PD[7]. There was a greater improvement in some functional abilities in Group A, potentially due to the incorporation of cognition and motor difficulties.

The superior performance of Group A could relate to the tenets of the motor learning and neuroplasticity. Disruptions in sensory integration and postural control have been reported as other senses that are affected by PD that lead to balance problems[16]. The need to include repetitive, goal-directed and skill-based exercises in order to encourage motor adaptations[17]. In addition, Liu et al. reported alterations in CMI after balance training[18]. These data may account for the improvements that were observed in the present study, but the changes in the nervous system were not directly assessed[19, 20].

Importantly, conventional physiotherapy also produced significant improvements in both outcomes, demonstrating its continued clinical value. But, more benefit may be gained by adding progressive balance exercise or weight shifting activities, or incorporating obstacle negotiation and dual task activities into traditional rehab in enhancing postural control and functional mobility, as indicated by the greater gains in Group A. From the clinical perspective, the physiotherapist should include stretching, strengthening and gait exercises in combination with balance specific exercises to offer a holistic approach to treatment.

The study had some limitations, however, given these positive results. No long-term follow-up was provided in the four week intervention, so it was not possible to assess whether the improvements remained. Moreover, recruitment may be restricted to one clinical setting, and the number of samples may be limited, which may lead to generalizability issues. Larger Multi-centre for disease events, blinded outcome assessors and higher follow up should be considered for future studies. Individual effects of dual-task training and other balance training methods should be investigated.

Overall, both interventions improved balance and functional mobility; however, neuroplasticity-based balance training produced significantly greater improvements in BBS and TUG scores, supporting its inclusion in physiotherapy programmes for patients with PD.

## 5. CONCLUSION

The study concluded that both interventions significantly improved balance and functional mobility in patients with Parkinson’s disease. However, neuroplasticity-based balance training demonstrated significantly greater improvements in BBS and TUG scores, supporting its effectiveness as a valuable approach to neurological rehabilitation.

## 6. REFERENCES

1. Alotaibi S, Alfayez L, Alkhudhair M. Parkinson's Disease: Current Treatment Modalities and Emerging Therapies. Cureus. 2024;16(12):e75647.
2. Hoskovcová M, Růžička E, Gál O, On Behalf Of The i C-PC. The Category of Conventional Physiotherapy: The Case of Parkinson's Disease Guidelines. J Pers Med. 2022;12(5).
3. Camargo CHF, Ferreira-Peruzzo SA, Ribas DIR, Franklin GL, Teive HA. Imbalance and gait impairment in

Parkinson’s disease: discussing postural instability and ataxia. Neurological Sciences. 2024;45(4):1377-88.
4. Mylius V, Zenev E, Brook CS, Brugger F, Maetzler W, Gonzenbach R, et al. Imbalance and Falls in Patients with Parkinson's Disease: Causes and Recent Developments in Training and Sensor-Based Assessment. Brain Sci. 2024;14(7).
5. Li M, Ye X, Huang Z, Ye L, Chen C. Global burden of Parkinson's disease from 1990 to 2021: a population-based study. BMJ Open. 2025;15(4):e095610.
6. Mehdizadeh M, Fereshtehnejad S-M, Landers MR, Taghavi Azar Sharabiani P, Shati M, Mortazavi SS, et al. Responsiveness of the mini-balance evaluation systems test, dynamic gait index, Berg balance scale, and performance-oriented mobility assessment in parkinson’s disease. Scientific Reports. 2025;15(1):21126.
7. Du Y-H, Ma J, Hu J-Y, Zhu L, Wang L-Y, Yang R-Y, et al. Effects of dual-task training on gait and motor ability in patients with Parkinson's disease: A systematic review and meta-analysis. Clinical Rehabilitation. 2023;37(7):942-53.
8. Imama S, Zameer Z. Emerging Paradigms in Exercise-Based Neuro-Physiotherapy for Holistic Motor and Cognitive Rehabilitation in Parkinson’s Disease: Neuro-Physiotherapy in Parkinson’s Disease. THE THERAPIST (Journal of Therapies & Rehabilitation Sciences). 2024:02-10.
9. Coelho DB, de Oliveira CEN, Guimarães MVC, Ribeiro de Souza C, dos Santos ML, de Lima-Pardini AC. A systematic review on the effectiveness of perturbation-based balance training in postural control and gait in Parkinson’s disease. Physiotherapy. 2022;116:58-71.
10. Freidle M, Johansson H, Ekman U, Lebedev AV, Schalling E, Thompson WH, et al. Behavioural and neuroplastic effects of a double-blind randomised controlled balance exercise trial in people with Parkinson’s disease. npj Parkinson's Disease. 2022;8(1):12.
11. Maiora J, Rezola-Pardo C, García G, Sanz B, Graña M. Older adult fall risk prediction with deep learning and timed up and go (TUG) test data. Bioengineering. 2024;11(10):1000.
12. Cardini R, Gervasoni E, Giannoni-Luza S, Cavalca A, Piva A, Cattaneo D, et al. Physiotherapy interventions for balance impairments in Parkinson’s disease: evidence from a systematic review and dose-response meta-analysis. npj Parkinson's Disease. 2026.
13. Hameed S, Figari-Jordan R. Parkinson's disease care in Pakistan: overcoming challenges in low- and middle-income countries. BMJ Neurology Open. 2026;8(1):e001516.
14. Sampaio T, Encarnação S, Santos O, Narciso D, Oliveira JP, Teixeira JE, et al., editors. The effectiveness of Pilates training interventions on older adults’ balance: a systematic review and meta-analysis of randomized controlled trials. Healthcare; 2023: MDPI.
15. Weise D, Claus I, Dresel C, Kalbe E, Liepelt-Scarfone I, Lorenzl S, et al. Multidisciplinary care in Parkinson's disease. J Neural Transm (Vienna). 2024;131(10):1217-27.
16. Kumar S, Goyal L, Singh S. Tremor and rigidity in patients with Parkinson’s disease: emphasis on epidemiology, pathophysiology and contributing factors. CNS & Neurological Disorders-Drug Targets-

CNS & Neurological Disorders). 2022;21(7):596-609.
17. Zikereya T, Shi K, Chen W. Goal-directed and habitual control: from circuits and functions to exercise-induced neuroplasticity targets for the treatment of Parkinson's disease. Frontiers in neurology. 2023;14:1254447.
18. Liu H-H, Wang R-Y, Cheng S-J, Liao K-K, Zhou J-H, Yang Y-R. Balance Training Modulates Cortical Inhibition in Individuals with Parkinson's Disease: A Randomized Controlled Trial. Neurorehabilitation and Neural Repair. 2022;36(9):613-20.
19. Ellis TD, Colón-Semenza C, DeAngelis TR, Thomas CA, Hilaire MS, Earhart GM, et al. Evidence for Early and Regular Physical Therapy and Exercise in Parkinson's Disease. Semin Neurol. 2021;41(2):189-205.
20. Lena F, Modugno N, Greco G, Torre M, Cesarano S, Santilli M, et al. Rehabilitation Interventions for Improving Balance in Parkinson's Disease: A Narrative Review. American Journal of Physical Medicine & Rehabilitation. 2023;102(3):270-4.