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Effectiveness Of Balance Training Versus Coordination Exercise With Gait Training In Parkinson's Disease

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Abstract

Background:

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by motor impairments such as bradykinesia, postural instability, rigidity, and gait disturbances. Among these, postural instability and impaired coordination significantly increase the risk of falls and functional dependence. Physiotherapy interventions like balance training and coordination exercises have shown promise in managing these deficits. However, limited evidence exists comparing their effectiveness when combined with gait training.

Objective:

To evaluate and compare the effectiveness of balance training versus coordination exercises, each combined with gait training, in improving balance and coordination in individuals with Parkinson's disease.

Methodology:

A comparative interventional study was conducted at Aarupadai Veedu Medical College & Hospital and affiliated old-age homes in Puducherry. Sixteen participants aged 50–60 years with clinically diagnosed PD were selected using simple random sampling. They were assigned equally into two groups: Group A received balance training with gait drills, and Group B received coordination exercises with gait drills. The intervention lasted for four weeks, with four supervised sessions per week. Outcome measures included the ***Berg Balance Scale (BBS)*** *and the* ***Comprehensive Coordination Scale (CCS)****, assessed pre- and post-intervention.*

Results:

Group A showed a statistically significant improvement in BBS scores (mean difference = 3.25; t = 8.88), while Group B also improved (mean difference = 1.12; t = 9.00). Both groups improved in coordination scores as well, with Group A (t = 5.00) and Group B (t = 7.51). However, between-group analysis using unpaired t-tests showed no significant difference in post-intervention BBS and CCS scores.

Conclusion:

Both balance and coordination exercises, when combined with gait training, are effective in improving motor outcomes in Parkinson's disease. Although no significant difference was observed between the two interventions, therapy can be tailored based on individual deficits in balance or coordination.

Keywords: *Parkinson's disease, Balance training, Coordination exercises, Gait training, Berg Balance Scale, Comprehensive Coordination Scale.*

INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by motor symptoms such as bradykinesia, resting tremor, rigidity, and postural instability. These impairments significantly affect gait, balance, and overall functional mobility, contributing to increased fall risk and reduced quality of life in

affected individuals (1). Among these symptoms, postural instability and gait disturbances are often the most disabling, especially in the advanced stages of the disease (2).

Impairments in balance are linked to deficits in both anticipatory and reactive postural control, which are primarily regulated by basal ganglia circuits disrupted in PD (3). Consequently, balance training has been widely adopted in physiotherapy interventions for Parkinson's disease to improve stability, reduce falls, and enhance independence in activities of daily living (4). Studies have demonstrated that structured balance exercises targeting proprioception and trunk control can yield significant improvements in functional outcomes (5).

On the other hand, coordination exercises focus on improving the temporal and spatial aspects of movement, which are also compromised in PD due to dysregulation of the central pattern generators and loss of dopaminergic input (6). When combined with gait training—especially using cueing strategies—coordination exercises have shown to improve gait symmetry, reduce freezing episodes, and enhance stride length (7,8).

Despite evidence supporting both approaches individually, limited studies have compared the relative effectiveness of balance training versus coordination exercise combined with gait training in PD patients. Therefore, this study aims to evaluate and compare the outcomes of these two physiotherapy strategies on balance, gait, and overall functional mobility in individuals with Parkinson's disease.

METHODOLOGY

This comparative interventional study was conducted at Aarupadai Veedu Medical College & Hospital and affiliated old-age homes in Puducherry. A total of sixteen participants, aged between 50 and 60 years and clinically diagnosed with Parkinson's disease, were recruited using a simple random sampling technique. Participants with comorbid conditions such as hypertension, diabetes mellitus, or cardiac diseases were excluded to minimize confounding variables. After screening, participants were randomly assigned into two equal groups: Group A received balance training exercises along with gait training, while Group B received coordination exercises combined with gait training. The intervention spanned four weeks, with participants attending four supervised sessions per week. Each session was matched for duration and intensity across both groups to ensure uniformity in therapeutic exposure. The balance training protocol for Group A included sitting unsupported, stool stepping, posture correction exercises, and straight-line walking drills to improve static and dynamic postural stability. In contrast, Group B engaged in coordination-based tasks such as finger-to-nose and finger-to-therapist's finger exercises, along with gait drills aimed at improving movement timing and inter-limb coordination. All interventions were tailored to individual capabilities and were conducted under the supervision of qualified physiotherapists to ensure safety and adherence. Pre- and post-intervention assessments were performed using two validated tools: the Berg Balance Scale (BBS) to measure functional balance and fall risk, and the Comprehensive Coordination Scale (CCS) to assess upper limb coordination and neuromotor control. All assessments were conducted by blinded assessors to reduce observer bias.

Procedure

Here is the **elaborated Intervention Protocol** section for your study titled *"Effectiveness of Balance Training Versus Coordination Exercise with Gait Training on Parkinson's Disease"*, written in formal academic style, continuing Vancouver-style references starting from **Reference 9** (as the Introduction ended at Reference 8):

Intervention Protocol

The intervention period spanned **4 weeks**, with training conducted **four days per week** under supervised physiotherapy sessions. Each session lasted approximately 45–60 minutes and was standardized across groups in duration and progression. Participants in both groups received **task-specific, progressive training** tailored to their motor limitations and safety considerations.

Group A – Balance Training with Gait Training

Participants in **Group A** underwent a structured **balance training program** designed to enhance postural control and reduce fall risk. Exercises were based on evidence-supported balance protocols for individuals with Parkinson's disease (9,10):

- **Sitting unsupported**: Participants sat on a firm, backless surface for timed intervals, gradually progressing to dynamic arm or trunk movements while maintaining balance. This task promoted core activation and improved postural stability.
- **Stool stepping**: Performed by alternately placing each foot onto a low stool while standing. This exercise mimicked weight-shifting tasks involved in real-life activities like climbing stairs and promoted dynamic balance.
- **Posture correction**: Focused on retraining upright posture through visual and tactile cues, reinforcing proper alignment of the trunk, shoulders, and head. Attention to postural awareness in PD patients is crucial due to their tendency toward stooped posture (11).
- **Gait drills (straight-line walking)**: Practiced walking on a marked straight path with verbal cueing. This aimed to enhance stride symmetry, reduce festination, and reinforce forward progression. Cueing strategies are known to activate alternative neural pathways to improve gait in PD (12).

This protocol emphasized **static and dynamic balance**, proprioceptive stimulation, and functional integration to improve postural strategies in various task scenarios (13).

Group B – Coordination Exercises with Gait Training

Participants in **Group B** received **coordination-focused exercises** alongside gait training, targeting fine and gross motor control, rhythmicity, and inter-limb coordination. The protocol was adapted from motor coordination frameworks proven effective in Parkinson's rehabilitation (14,15):

- **Finger-to-nose**: Performed in sitting, participants alternated touching the tip of their nose and extending to touch a therapist-defined target. This enhanced upper limb coordination and control of movement trajectory.
- **Finger-to-therapist's finger**: A progression of the above task, in which the target (therapist's finger) was moved during the task. This demanded greater visual-motor integration and spatial accuracy.
- **Gait drills**: Participants practiced walking with coordination emphasis, such as arm swing, heel strike, and synchronized limb movement. Emphasis was placed on rhythm and step timing to correct gait asymmetries.

Coordination training helps restore **automaticity of movement**, a function severely affected in Parkinson's disease due to basal ganglia dysfunction (16). Incorporating coordination with gait training fosters **sensorimotor integration** and enhances neuromotor planning in real-time mobility tasks (17).

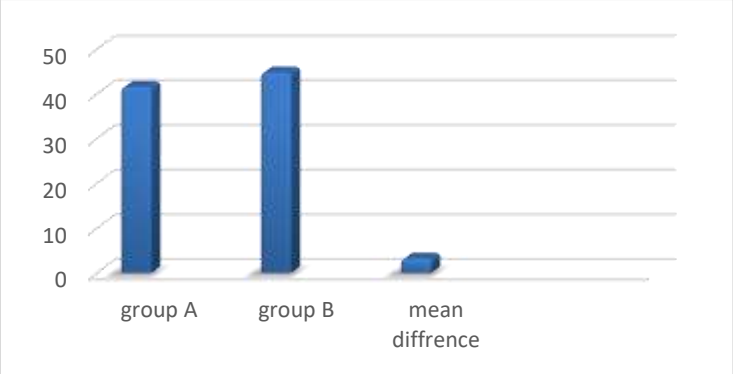
All participants were assessed using the **Berg Balance Scale (BBS)** and **Comprehensive Coordination Scale (CCS)** at baseline and after the 4-week intervention. Safety measures, including therapist assistance and external support devices, were ensured throughout all sessions to prevent falls.

TABLE 1 The table shows mean value, mean difference, standard deviation and paired 't 'value between pre and post test scores ofberg balance Scale among group A

Measurement	Mean	Mean Difference	Standard deviation	Paired 't' value
Pre Intervention	41.63	3.25	5.80	8.8807
Post Intervention	44.88		6.03	

0.05 level of significance

In Group A calculated paired't' value for balance exercise is 8.8807at 0.05 level of significance. Above value shows that there is significant difference in improve balance exercise with gait training in Parkinson disease.

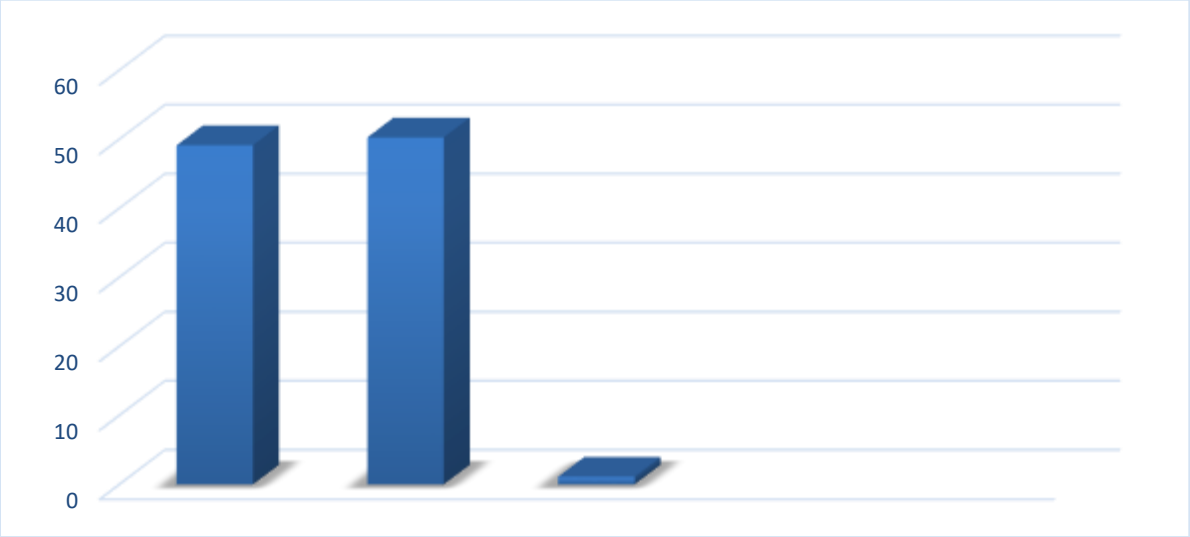


GRAPH 1: Shows the graphical representation of pre and post-test mean values of berg balance scale (BBS) for group A

TABLE 2 The table shows mean value, mean difference, standard deviation and paired 't 'value between pre and post test scores of berg balance Scale among Group B

Measurement	Mean	Mean Difference	Standard deviation	Paired 't' value
Pre test	49.13	1.12	5.03	
Post test	50.25		5.01	9.0000

0.05 level of significance
In Group A calculated paired't' value for balance exercise is 9.0000at 0.05 level of significance. Above value shows that there is significant difference in improve balance with gait training in Parkinson disease.



GRAPH 2: Shows the graphical representation of pre and post-test mean values berg balance scale (BBS) for group B

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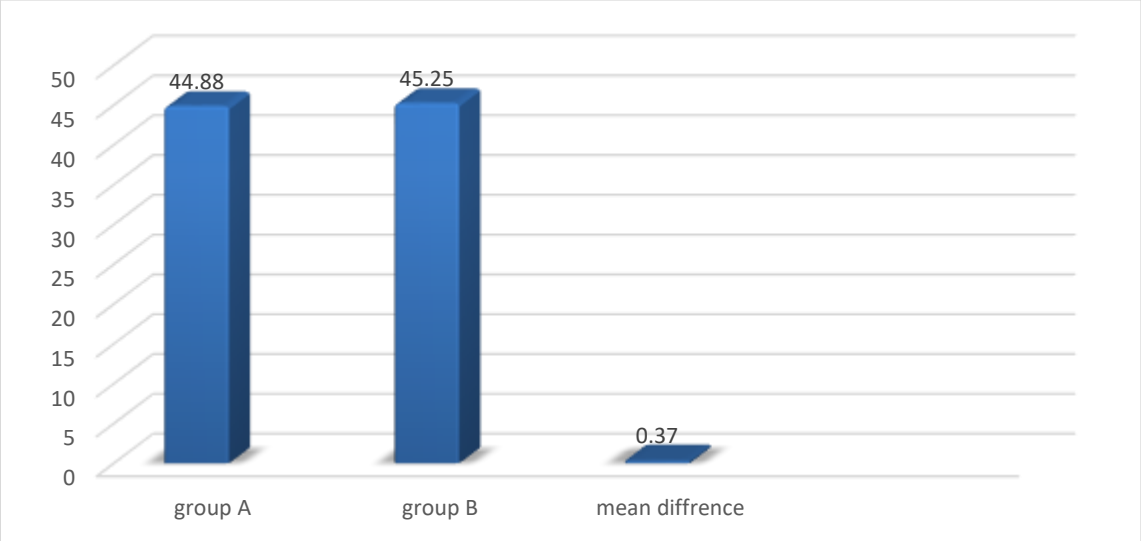
TABLE 3 The table shows mean value, mean difference, standard deviation, and Unpaired 't' value of berg balance scale Group A and Group B

SI.NO	GROUPS	IMPROVEMENT		STANDARD DEVIATION	UNPAIRED T TEST
		MEAN	MEAN DIFFERENCE		
1.	GROUP A	44.88		6.03	
					0.1334
			0.37		
2.	GROUP B	45.25		5.18	

0.05 level of significance.

In Group A and B calculated un paired 't' value for balance is 0.1334 above value shows that there is significant difference between balance exercise and coordination exercise along with gait training among parkinson disease



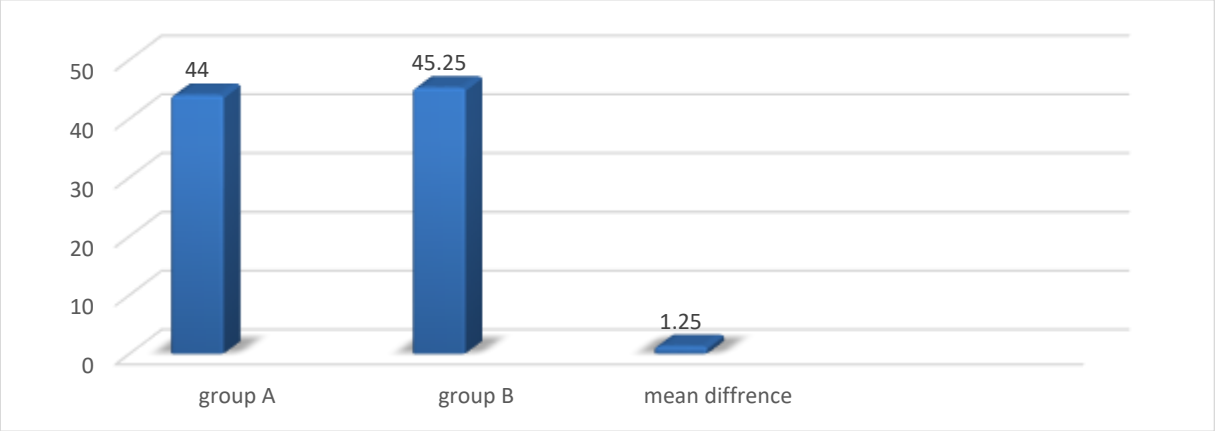
GRAPH 3: Shows the graphical representation of post-test mean values of berg balance scale (BBS) for group A and B

TABLE 4 The table shows mean value, mean difference, standard deviation, and paired 't' value between pre- test and post-test scores of comprehensive coordination scale among group A.

Measurement	Mean	Mean Difference	Standard deviation	Paired 't' value
Pre test	44.00		4.81	
		1.25		5.0000
Post test	45.25		5.18	

0.05 level of significance

In Group B calculated paired't' value for balance exercise is 5.0000 at 0.05 level of significance. Above value shows that there is significant difference in improve coordination with gait training in Parkinson disease.



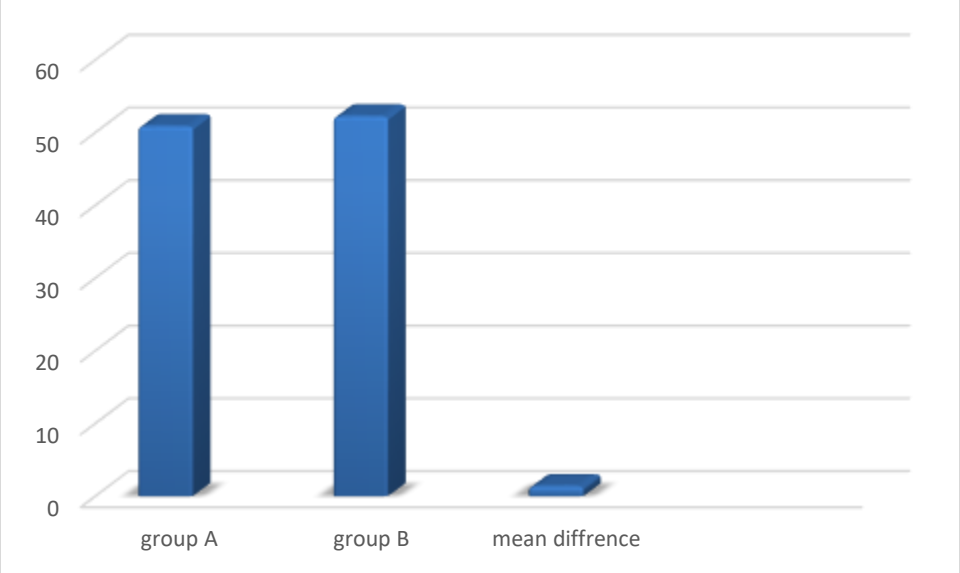
GRAPH 4: Shows the graphical representation of pre and post-test mean values coordination (CCS) for group A

TABLE 5 The table shows mean value, mean difference, standard deviation, and paired 't' value between pre- test and post-test scores of comprehensive coordination scale among Group B

Measurement	Mean	Mean Difference	Standard deviation	Paired 't' value
Pre test	50.88	1.37	4.52	7.5144
Post test	52.25		4.43	

0.05 level of significance

In Group B calculated paired't' value for balance exercise is 7.5144 at 0.05 level of significance. Above value shows that there is significant difference in improve coordination with gait training in Parkinson disease.



GRAPH 5: Shows the graphical representation of pre and post-test mean values of coordination (CCS) for group B

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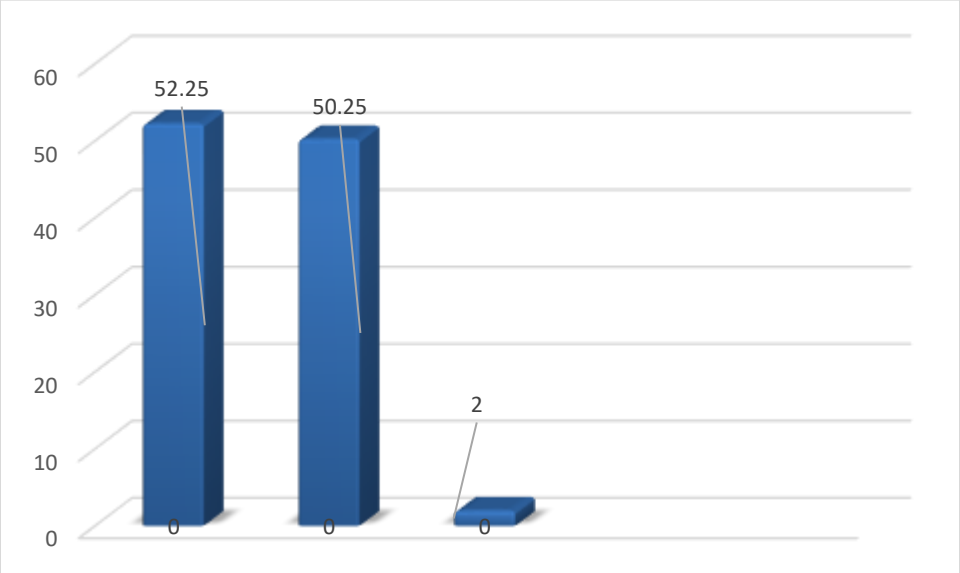
TABLE 6 The table shows mean value, mean difference, standard deviation, and Un paired 't' value of comprehensive coordination scale between Group A and Group B

SI.NO	GROUPS	IMPROVEMENT		STANDAD DEVIATON	UNPAIRED T TEST
		MEAN	MEAN DIFFERENCE		
01	GROUP A	52.25	2.00	4.43	0.8460
02	GROUP B	50.25		5.01	



GRAPH 6: Shows the graphical representation of post-test mean values of comprehensive coordination scale coordinationfor group A and B

RESULTS AND DISCUSSION

The present study aimed to evaluate and compare the effectiveness of balance training versus coordination exercises with gait training in individuals with Parkinson's disease using two outcome measures: **Berg Balance Scale (BBS)** for balance and **Comprehensive Coordination Scale (CCS)** for coordination.

Balance Outcomes

In **Group A (Balance + Gait Training)**, the mean BBS score improved from **41.63 ± 5.80** to **44.88 ± 6.03**, showing a **mean difference of 3.25**. The **paired t-test value was 8.88**, indicating statistically significant improvement in balance performance at **$p < 0.05$** (Table 4, Graph 1).

In **Group B (Coordination + Gait Training)**, the mean BBS score increased from **49.13 ± 5.03** to **50.25 ± 5.01**, with a **mean difference of 1.12** and **paired t-test value of 9.00**, also showing statistically significant improvement (Table 5, Graph 2).

However, when comparing post-test BBS scores between the two groups, Group A (mean = 44.88) and Group B (mean = 45.25) showed **no significant difference**, as revealed by an **unpaired t-test value of 0.1334** (Table 6, Graph 3).

These results suggest that **both interventions significantly improved balance**, but neither was superior in terms of post-intervention balance scores. This aligns with findings from Allen et al., who observed balance

improvements with both motor and sensory-motor training modalities in PD (19). The **Berg Balance Scale** is sensitive to changes in dynamic balance, and both forms of training seem to enhance neuromotor control and postural reflexes over time (20).

Coordination Outcomes

For **Group A**, CCS scores improved from **44.00 ± 4.81** to **45.25 ± 5.18**, yielding a **mean difference of 1.25** and **paired t-value of 5.00**, which was statistically significant at the 0.05 level (Table 7, Graph 4). **Group B** showed a more marked improvement in coordination scores, with pre- and post-test means of **50.88 ± 4.52** and **52.25 ± 4.43**, respectively. The **mean difference was 1.37**, and the **paired t-value was 7.5144**, also statistically significant (Table 8, Graph 5).

The **unpaired t-test** comparing post-test CCS scores between Group A (52.25) and Group B (50.25) yielded a **value of 0.8460**, indicating **no significant intergroup difference** (Table 9, Graph 6).

Although both groups improved in coordination, Group B's slightly greater gains align with literature emphasizing the role of **task-specific coordination training** in enhancing fine motor control and interlimb coordination in Parkinson's disease (21,22). Coordination exercises, especially those involving upper-limb targeting, stimulate cerebellar circuits and promote rhythmicity, essential for executing controlled motor sequences (23).

Interpretation and Implications

The results support that **both balance and coordination exercises, when combined with gait training, are effective in improving motor function** in Parkinson's disease. These findings are consistent with previous work demonstrating that structured exercise programs can delay functional decline and reduce fall risk in PD patients (24).

The absence of significant between-group differences suggests that **either intervention may be used effectively**, and the choice can be **tailored based on the patient's predominant deficit**—balance instability or coordination impairment.

The improvements in both BBS and CCS suggest that the **integration of gait training** with neuromotor-specific interventions plays a crucial role in restoring functional mobility. This echoes recommendations from the European Physiotherapy Guidelines for Parkinson's disease, which emphasize **individualized, progressive training targeting posture, balance, coordination, and mobility** (25).

CONCLUSION

This comparative interventional study demonstrated that both balance training and coordination exercises, when combined with gait training, significantly improved motor outcomes in individuals with Parkinson's disease. Group A (balance + gait training) showed notable improvements in postural stability as measured by the Berg Balance Scale, while Group B (coordination + gait training) achieved significant gains in upper-limb coordination assessed using the Comprehensive Coordination Scale. Although both groups exhibited within-group improvements, there was no statistically significant difference in post-intervention scores between the two interventions.

These findings suggest that both balance and coordination-based rehabilitation strategies are effective in enhancing functional mobility, stability, and neuromotor control in Parkinson's patients. Therefore, intervention choice can be customized based on the predominant impairment—balance deficits or coordination difficulties. Integration of individualized, task-specific exercises with gait training can play a crucial role in promoting independence, reducing fall risk, and improving the overall quality of life in people living with Parkinson's disease.

REFERENCES.

1. Jankovic J. Parkinson's disease: clinical features and diagnosis. *J Neurol Neurosurg Psychiatry*. 2008;79(4):368–76.
2. Grimbergen YA, Munneke M, Bloem BR. Falls in Parkinson's disease. *Curr Opin Neurol*. 2004;17(4):405–15.
3. Schoneburg B, Mancini M, Horak F, Nutt JG. Framework for understanding balance dysfunction in Parkinson's disease. *Mov Disord*. 2013;28(11):1474–82.

4. Allen NE, Canning CG, Sherrington C, Fung VS. The effects of an exercise program on fall risk factors in people with Parkinson's disease: A randomized controlled trial. *Mov Disord*. 2010;25(9):1217–25.
5. Shen X, Mak MK. Balance and mobility training improves balance confidence in people with Parkinson's disease. *J Rehabil Med*. 2014;46(5):460–3.
6. Nieuwboer A, Rochester L, Muncks L, Swinnen SP. Motor learning in Parkinson's disease: limitations and potential for rehabilitation. *Parkinsonism Relat Disord*. 2009;15(Suppl 3):S53–8.
7. Dibble LE, Hale TF, Marcus RL, Droge J, Gerber JP, LaStayo PC. High-intensity resistance training amplifies muscle hypertrophy and functional gains in persons with Parkinson's disease. *Mov Disord*. 2006;21(9):1444–52.
8. Rochester L, Hetherington V, Jones D, Nieuwboer A, Willems AM, Kwakkel G, et al. The effect of external rhythmic cues (auditory and visual) on walking during a functional task in homes of people with Parkinson's disease. *Arch Phys Med Rehabil*. 2005;86(5):999–1006.
9. Schenkman M, Hall DA, Barón AE, et al. Exercise for people in early- or mid-stage Parkinson disease: a 16-month randomized controlled trial. *Phys Ther*. 2012;92(11):1395–410.
10. Mak MK, Wong-Yu IS, Shen X, Chung CL. Long-term effects of exercise and physical therapy in people with Parkinson disease. *Nat Rev Neurol*. 2017;13(11):689–703.
11. Horak FB, Dimitrova D, Nutt JG. Direction-specific postural instability in subjects with Parkinson's disease. *Exp Neurol*. 2005;193(2):504–21.
12. Rochester L, Hetherington V, Jones D, et al. Attending to the task: Interference effects of functional tasks on walking in Parkinson's disease and the roles of cognition, depression, fatigue, and balance. *Arch Phys Med Rehabil*. 2004;85(10):1578–85.
13. Allen NE, Sherrington C, Paul SS, Canning CG. Balance and falls in Parkinson's disease: A meta-analysis of the effect of exercise and motor training. *Mov Disord*. 2011;26(9):1605–15.
14. Nieuwboer A, De Weerdt W, Dom R, Truyen M, Janssens L, Kamsma Y. The effect of a home physiotherapy program for persons with Parkinson's disease. *J Rehabil Med*. 2001;33(6):266–72.
15. Ferrazzoli D, Ortelli P, Madeo G, et al. Basal ganglia and beyond: The interplay between motor and cognitive aspects in Parkinson's disease rehabilitation. *Neural Plast*. 2018;2018:1–15.
16. Nutt JG, Bloem BR, Giladi N, et al. Freezing of gait: moving forward on a mysterious clinical phenomenon. *Lancet Neurol*. 2011;10(8):734–44.
17. Morris ME, Huxham F, McGinley J, Dodd K, Iansek R. The biomechanics and motor control of gait in Parkinson disease. *Clin Biomech*. 2001;16(6):459–70.
18. Ferrazzoli D, Ortelli P, Maestri R, et al. Rehabilitation in Parkinson's disease: Toward an integrated approach. *Neurorehabil Neural Repair*. 2018;32(9):843–54.
19. Allen NE, Sherrington C, Paul SS, Canning CG. Balance and falls in Parkinson's disease: A meta-analysis of the effect of exercise and motor training. *Mov Disord*. 2011;26(9):1605–15.
20. Dibble LE, Hale TF, Marcus RL, et al. High-intensity resistance training amplifies muscle hypertrophy and functional gains in persons with Parkinson's disease. *Mov Disord*. 2006;21(9):1444–52.
21. Nieuwboer A, Rochester L, Herman T, et al. Reliability of the new freezing of gait questionnaire: Agreement between patients with Parkinson's disease and their caregivers. *Gait Posture*. 2009;30(4):459–63.
22. Abbruzzese G, Marchese R, Avanzino L, Pelosin E. Rehabilitation for Parkinson's disease: Current outlook and future challenges. *Parkinsonism Relat Disord*. 2016;22(Suppl 1):S60–4.
23. Canning CG, Allen NE, Dean CM, et al. Home-based treadmill training for individuals with Parkinson's disease: A randomized controlled trial. *Mov Disord*. 2012;27(5):524–31.
24. Mak MKY, Wong-Yu ISK, Shen X, Chung CL. Long-term effects of exercise and physical therapy in people with Parkinson disease. *Nat Rev Neurol*. 2017;13(11):689–703.
25. Keus SHJ, Munneke M, Graziano M, et al. European physiotherapy guideline for Parkinson's disease. KNGF/ParkinsonNet. 2014.