

## The Role of Proprioceptive Neuromuscular Facilitation in Improving Balance in Parkinson Disease

**Sagar Kumar<sup>1</sup>, Mujtaba<sup>1</sup>, Dr. Zuhaira Faruqui<sup>2</sup>, Yusra Abdul Muhammad<sup>3</sup>,**  
*Senior Physiotherapist, Dr. Ziauddin University Hospital<sup>1</sup>, Asst. Manager/Asst. Professor, Dr. Ziauddin University Hospital<sup>2</sup>, Physiotherapist, Dr. Ziauddin University Hospital<sup>3</sup>*  
**Corresponding Email: [sagarsawhani660@gmail.com](mailto:sagarsawhani660@gmail.com)**

### Abstract

Parkinson's disease (PD) is a kind of neurodegenerative disorder associated with chronic motor disorders and non-motor symptoms caused by the loss of dopaminergic neurons. Current therapies improve motor symptoms but are related to long-term undesired effects. Proprioceptive neuromuscular facilitation (PNF) has been gaining significant popularity as a form of physical therapy to improve muscle strength, flexibility, and coordination in patients with PD. This systematic review has been conducted to determine the effectiveness of PNF in enhancing the ability to balance in people with PD. A thorough search was done in Google Scholar, PEDro, MEDLINE, Cochrane Library, EMBASE, and Web of Science for articles published from 2010 to 2024. The current research has included patients with PD in rehabilitation; however, non-English articles and open-access materials unavailable on websites have been excluded. Five RCTs with 16 to 60 participants were identified. The overview of the studies found that the inclusion of PNF into the rehabilitation programs had more improvement seen in balance, mainly at the Berg Balance Scale (BBS). The evidence suggested that PNF added to better balance and functional outcomes for people with PD despite the methodological variation. However, some biases were related to blinding and confounding factors. Such limitations should be addressed in future research through standardization of outcome measures and optimization of PNF protocols for clinical populations.

### Keywords

*Balance, Mobility, Parkinson Disease, Proprioceptive Neuromuscular Facilitation.*



Check for updates

**Cite as:** Kumar S, Mujtaba, Faruqui Z, Muhammad YA. The Role of Proprioceptive Neuromuscular Facilitation in Improving Balance in Parkinson's Disease. *Allied Med Res J.* 2024;2(2):326-334. Available from: <https://ojs.amrj.net/index.php/1/article/view/188/105>.

**DOI:** <https://doi.org/10.59564/amrj/02.02/34>

**Received:** 1<sup>st</sup> March 2024 , **Revised:** 24<sup>th</sup> April 2024 , **Accepted:** 14<sup>th</sup> June 2024

## Introduction

Parkinson's disease is a neurodegenerative and chronic disorder characterized by dopaminergic neuron degeneration in the Substantia Nigra. The reduced amount of dopamine synthesized in the striatum affects motor control<sup>1</sup>. Bradykinesia, rigidity, resting tremor, and postural instability are this disorder's most common motor symptoms. Other than motor symptoms, non-motor symptoms may manifest as sleep disruptions, cognitive decline, sensory alterations, and autonomic dysfunction<sup>2</sup>. Although the specific etiology of PD remains unknown, it is probably a combination of genetic and environmental factors that influence ageing<sup>3</sup>. Therapeutic strategies alleviate motor symptoms by replacing dopamine with pharmacological agents such as levodopa and dopaminergic agonists but long-term side effects and motor complications of such treatments are possible<sup>4-5</sup>. Other drugs to modify the complications of long-term levodopa include monoamine oxidase type B inhibitors, dopamine receptor agonists and the NMDA receptor antagonist amantadine<sup>4</sup>.

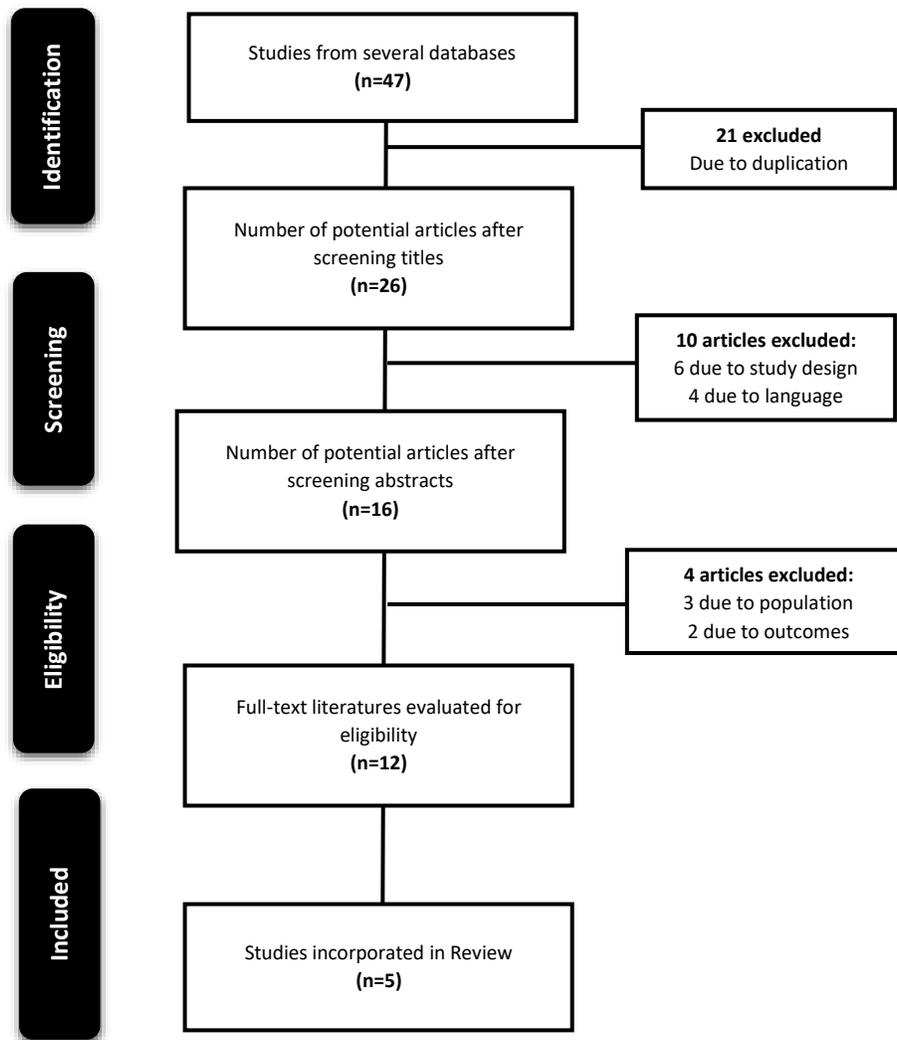
The PNF exercise treatment considerably enhances muscle strength, suppleness, and coordination<sup>6</sup>. Its wide acceptance rate is due to its considerable effectiveness in physical disability rehabilitation. The principles underlying the PNF are proprioception, meaning the body's ability to feel movement and positioning, and neuromuscular facilitation, meaning methods that initiate or increase the activity of muscles<sup>7</sup>. Several PNF procedures involve stretching with resistance movements in specific patterns to facilitate general flexibility and function<sup>8</sup>. This is particularly helpful in patients with Parkinson's disease who have impairments in motor function. These exercises reduce muscle stiffness, bradykinesia, and postural instability, the primary motor symptoms of PD<sup>9</sup>. It is speculated that PNF will increase flexibility within the muscles and coordination so that the patient has better control over their movements and reduced risk of falls, a critical concern in PD<sup>10</sup>. Moreover, this would enhance muscle strength and coordination, which helps PD patients perform daily activities more efficiently, improving their quality of life<sup>11</sup>. However, PNF's effectiveness in managing PD is yet to be established. While numerous studies have yielded positive outcomes, definitive evidence remains elusive<sup>12</sup>. This highlights the need for a comprehensive review and meta-analysis to assess the impact of PNF on PD thoroughly. Such a meta-analysis would provide valuable insights by synthesizing data from numerous studies, thereby elucidating the effectiveness of PNF in treating various facets of Parkinson's, including motor functions, cognitive capabilities, and the overall well-being of patients. Therefore, such a meta-analysis has the potential to provide valuable answers to questions about the effectiveness of PNF, guiding clinical practice and informing future research endeavors.

## Methodology

This review has been carried out using PRISMA Guidelines for Systematic Review and Meta-Analysis<sup>13</sup>. Two reviewers searched the following databases: Google Scholar, PEDro, MEDLINE, Cochrane Library, EMBASE, and Web of Science. The search utilized MeSH terms including "Parkinson's disease," "balance," "physical therapy," and "rehabilitation." The objective was to identify studies investigating the role of PNF in improving balance parameters in PD patients.

**Criteria for Studies Inclusion**

The study’s inclusion criteria included individuals with PD undergoing rehabilitation. Articles published between 2010 and 2024 were reviewed. Articles published in languages other than English, articles without readily available open access and articles for which open access could not be obtained despite contacting the authors were excluded. Relevant data was extracted using a structured data extraction form, which included fields for author names, year of publication, target population, intervention strategies used, and measured outcomes (Figure-1).



**Figure-1 PRISMA Flowchart of Studies Selection**

## Results

### *Analysis of Studies Included in the Review*

Several randomized controlled trials (RCT) investigated the efficacy of PNF in improving balance in PD patients. Shafiq et al.<sup>14</sup> conducted a trial with 60 participants aged 45 to 65, with the experimental group receiving PNF in addition to usual physical therapy. The results indicated a significant improvement in balance. Similarly, Mazhar et al.<sup>15</sup> study of 38 patients found that 12 weeks of PNF exercises improved balance significantly. Lee<sup>16</sup> study of 16 patients found a significant difference in the Berg Balance Scale (BBS) for the PNF group over the control group. Sushma et al.<sup>17</sup> focused on patients aged 40-60 years and found that the PNF group had better balance outcomes after partaking in 30-minute sessions four days a week for four weeks. Lastly, Bang et al.<sup>18</sup> studied 16 participants and discovered that trunk PNF paired with treadmill training significantly improved balance and walking ability compared to traditional training (Table-1).

### *Quality Appraisal*

The quality of the research was assessed using indicators such as selection bias, study design, confounding factors, blinding, and data collection methods. Shafiq et al.<sup>14</sup> found a low risk of bias in selection, study design, confounding variables, and data collection but a high chance of bias due to a lack of blinding. Mazhar et al.<sup>15</sup> found a low probability of bias in all metrics except those involving confounding factors. Lee<sup>16</sup> reported a minimal risk of bias in selection, study design, and data collection procedures; nevertheless, significant risks were associated with confounding factors and blinding. Sushma et al.<sup>17</sup> had low risks in all assessed criteria, indicating a solid study design. Bang et al.<sup>18</sup> had a low risk in selection, study design, confounding variables, and data collection methods but showed a high risk due to a lack of blinding. Overall, most studies presented strict methodological designs, although some had high risks of bias, particularly in the domains of blinding and confounding variables (Table-2).

Table-1 Studies Characteristics								
Author & Year of Publication	Sample Size	Target Population	Study Design	Age in Years	Intervention		Outcome	Result
					Experimental Group	Control Group		
Shafiq et al. 2023 <sup>14</sup>	60	PD Patients	RCT	45-65 years	Patients underwent PNF and regular physical therapy for 45 minutes on the lower limb thrice weekly for 12 weeks	Patients received 45 minutes of balance exercise and routine physical therapy for lower limbs thrice a week for 12 weeks	Balance via BBS	The results were in favor of experimental group ( $p < 0.05$ )
Mazhar et al. 2023 <sup>15</sup>	38	PD Patients	RCT	EG: 69.5 ± 4.07 CG: 68.9 ± 5.82	PNF exercises were performed along with routine therapy for 12 weeks (36 sessions).	Routine physical therapy treatment protocol (45 minute) for 12 weeks (36 sessions) was performed	Balance via BBS	Balance was improved more in patients who received PNF combine with routine treatment
Lee, 2023 <sup>16</sup>	16	PD Patients	RCT	EG: 65.38 ± 2.32 CG: 65.50 ± 2.26	After receiving general physical therapy, the experimental group underwent 30 minutes of PNF training for upper and lower extremity patterns	Patients underwent functional electrical stimulation treatment for the upper and lower extremities for 30 minutes following general physical therapy	Balance via BBS	There was a significant difference in BBS in the experimental group compared to the control group
Sushma et al. 2023 <sup>17</sup>	30	PD Patients	RCT	40 to 60 years	Patients performed PNF for 30 minutes a day for 4 days a week for duration of 4 weeks	Patients performed conventional training	Balance via BBS	Balance was performed in experimental group
Bang et al. 2017 <sup>18</sup>	16	PD Patients	RCT	EG: 62.75 ± 8.01 CG: 59.38 ± 4.37	Patients performed trunk PNF along with 30 minute treadmill training for 4 weeks	Patients performed conventional training along with 30 minute treadmill training for 5 days a week for 4 weeks	Balance via BBS	Combining trunk exercise using PNF with treadmill training improved balance and walking ability compared to traditional training

Table-2 Quality Assessment of Included Studies					
Study	Selection Bias	Study Design	Confounding Factors	Blinding	Data Collection Methods
Shafiq et al. 2023 <sup>14</sup>	✓	✓	✓	✗	✓
Mazhar et al. 2023 <sup>15</sup>	✓	✓	✗	✓	✓
Lee, 2023 <sup>16</sup>	✓	✓	✗	✗	✓
Sushma et al. 2023 <sup>17</sup>	✓	✓	✓	✓	✓
Bang et al. 2017 <sup>18</sup>	✓	✓	✓	✗	✓

## Discussion

This systematic study sought to determine the efficacy of PNF in improving balance in Parkinson's patients. The analyzed research, ranging from 2010 to 2024, cumulatively demonstrates that including PNF in rehabilitation regimens improves balance results. Despite changes in sample sizes, intervention durations, and methodology, measurements like the Berg Balance Scale (BBS) showed consistent gains. However, methodological assessments revealed shortcomings, such as blinding concerns and other confounding effects. A six-month trial of 60 chronic Parkinson's patients compared PNF to balance exercises combined with conventional therapy. The balancing exercise group showed significant improvements in balance compared to the PNF group ( $p < 0.05$ ), indicating that it is more effective for improving balance. However, there was no significant difference in gait improvement across the groups ( $p > 0.05$ ), showing that both techniques had equivalent results for gait enhancement. Another research of 38 patients found that PNF combined with conservative treatment resulted in significant improvements in BBS, Freezing of Gait questionnaire scores, and Functional Independence Measure (FIM) compared to conservative treatment alone. This proves the efficiency of PNF in enhancing overall functional outcomes in patients with Parkinson's. In another study, 16 patients were divided into the PNF or the functional electrical stimulation control group. The PNS group indicated considerable intra-group improvement in BBS, POMA, and TUG measurements. Moreover, the PNF group showed better results than the control group concerning POMA and TUG, thus establishing the positive effect of PNF on functional activities. Another study conducted on 30 patients comparing strategy training versus PNF techniques showed both groups to have significant improvements in balance measurements following the intervention.

Research has demonstrated that combining strategy training with conventional treatment leads to a more substantial improvement in managing balance dysfunction in PD patients than utilizing

PNF techniques alone. A recent study of 16 patients indicated that combining trunk exercises using PNF with treadmill training improved UPDRS motor scores, BBS, the 10-meter walking test, and the 6-minute walking test compared to treadmill training alone. These data indicate that PNF, when paired with particular exercises, can improve balance and walking abilities in Parkinson's patients.

## Conclusion

PNF has been shown to significantly improve balance in individuals with PD. Studies consistently found that integrating PNF into rehabilitation programs led to noticeable enhancements in balance, as measured by the BBS. However, methodological studies identified some flaws in blinding and a potential for bias, underscoring the importance of PNF in improving functional abilities and overall quality of life for people with PD.

Future studies should correct these methodological flaws and provide effective protocols for PNF adoption in clinical practice. Outcome assessments must be standardized to establish long-term effects, increase sample numbers, and conduct longer-term follow-ups. These findings could be used by healthcare practitioners to give personalized interventions for improving Parkinson's patients' balance and walking functions, resulting in better rehabilitation outcomes.

### ***Acknowledgments***

None.

### ***Conflict of Interest***

None.

### ***Grant Support and Funding Disclosure***

None.

## References

1. Krishnamurthy PT, Kumari M, Byran G, Gangadharappa HV, Garikapati KK. Neuroprotective approaches to halt Parkinson's disease progression. *Neurochemistry international*. 2022 Sep 1;158:105380.
2. Jankovic J, Lang AE. Diagnosis and assessment of Parkinson disease and other movement disorders. *Bradley's Neurology in Clinical Practice E-Book*. 2021 Mar 23;310(1).
3. Rocha E, Chamoli M, Chinta SJ, Andersen JK, Wallis R, Bezaud E, Goldberg M, Greenamyre T, Hirst W, Kuan WL, Kirik D. Aging, Parkinson's Disease, and Models: What Are the Challenges?. *Aging Biology*. 2023;1.
4. Bogetofte H, Alamyar A, Blaabjerg M, Meyer M. Levodopa therapy for Parkinson's disease: history, current status and perspectives. *CNS & Neurological Disorders-Drug Targets (Formerly Current Drug Targets-CNS & Neurological Disorders)*. 2020 Oct 1;19(8):572-83.

5. Church FC. Treatment options for motor and non-motor symptoms of Parkinson's disease. *Biomolecules*. 2021 Apr 20;11(4):612.
6. Lee JH. Effects of proprioceptive neuromuscular facilitation on components of functional physical activity in patients with Parkinson's disease.
7. Beckers D, Buck M. PNF in practice: an illustrated guide. Springer Nature; 2021 Feb 22.
8. Prentice WE. Proprioceptive neuromuscular facilitation techniques in rehabilitation. In *Rehabilitation Techniques for Sports Medicine and Athletic Training* 2024 Jun 1 (pp. 355-378). Routledge.
9. Lee DH, Woo BS, Park YH, Lee JH. General Treatments Promoting Independent Living in Parkinson's Patients and Physical Therapy Approaches for Improving Gait—A Comprehensive Review. *Medicina*. 2024 Apr 25;60(5):711.
10. Israni PD, Yadav V, Sasun AR. Effectiveness of neurorehabilitation in improving the functional recovery and quality of life of patients with Parkinson's disease: a case report. *Cureus*. 2024 Jan;16(1).
11. Carapellotti AM, Stevenson R, Doumas M. The efficacy of dance for improving motor impairments, non-motor symptoms, and quality of life in Parkinson's disease: A systematic review and meta-analysis. *PloS one*. 2020 Aug 5;15(8):e0236820.
12. Tidman M, Skotzke E. Effects of a community-based exercise program on mobility, balance, cognition, sleep, activities of daily living, and quality of life in PD: a pilot study. *Neurodegenerative Disease Management*. 2020 Feb;10(1):27-39.
13. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Moher D. Updating guidance for reporting systematic reviews: development of the PRISMA 2020 statement. *Journal of clinical epidemiology*. 2021 Jun 1;134:103-12.
14. Shafiq HH, Subazwari B, Mahmood A, Khan M, Afzal S, Dboba MM. Comparison of Proprioceptive Neuromuscular Facilitation Vs Balance exercise along with Conventional therapy for balance and gait in Chronic Parkinsons Patients. *Journal of Nursing & Healthcare*. 2023 Mar 7;8(2):113-20.
15. Mazhar T, Jameel A, Sharif F, Asghar M. Effects of conventional physical therapy with and without proprioceptive neuromuscular facilitation on balance, gait, and function in patients with Parkinson's disease. *J Pak Med Assoc*. 2023 Jun 1;73:1280-3.
16. Lee JH. Effects of proprioceptive neuromuscular facilitation on components of functional physical activity in patients with Parkinson's disease.
17. Sushma T, Udayamala E, Madhavi K, Pavani KI, Rameshwar K, Laxman EV. A COMPARATIVE STUDY ON THE EFFECTIVENESS OF STRATEGY TRAINING VS PNF TECHNIQUES TO IMPROVE BALANCE IN SUBJECTS WITH PARKINSON'S DISEASE-A RANDOMIZED COMPARATIVE STUDY. *International Journal of Pure Medical Research*. 2023 Aug 1;8(8).

18. Bang DH, Cho HS. Effects of the Trunk Exercise Using PNF Combined with Treadmill on Balance and Walking Ability in Individuals with Parkinson's Disease. *PNF and Movement*. 2017;15(3):333-41.

#### AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

**Conception or Design:** Kumar S, Mujtaba

**Acquisition, Analysis or Interpretation of Data:** Mujtaba, Faruqi Z, Muhammad YA

**Manuscript Writing & Approval:** Kumar S, Faruqi Z

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



Copyright © 2024. Kumar et al. This is an Open Access article distributed under the terms of the Creative Commons Attribution-Non-commercial 4.0 International License, which permits unrestricted use, distribution & reproduction in any medium provided that original work is cited properly.