



ORIGINAL ARTICLE

TO COMPARE THE EFFECTIVENESS OF PROPRIOCEPTIVE NEURO MUSCULAR FACILITATION VERSUS HIGH INTENSITY RESISTANCE TRAINING IN PATIENTS WITH PARKINSON DISEASE

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Aishwarya B¹, Jibi Paul^{2*}

Author:

¹MPT Student, Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute, Vellappanchavadi, Chennai, Tamil Nadu, India

Corresponding Author:

^{*2}Professor, Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute, Vellappanchavadi, Chennai, Tamil Nadu, India, E-Mail- physiojibi@gmail.com

ABSTRACT

Background of the Study: Parkinson disease is a neurodegenerative disorder affecting the physical, psychological, social, and functional status of individuals. Objective of the study is to compare the effectiveness of proprioceptive neuromuscular facilitation versus high intensity resistance training in patient with Parkinson disease. **Methodology:** It is an Experimental Study of 30 subjects, which carried out in the department of physiotherapy, Dr. MGR Educational and Research Institute, for 12 weeks after the approval from institution of review board. Both the male and female subjects diagnosed of Parkinson disease with age of 45-65 years and the disease onset of more than 6 months with limitation in movements on walking were selected based on inclusion criteria. The subjects were assigned into 2 groups, 15 in each group by randomized sampling method with lottery technique. Measurement tools used in the study were Unified Parkinson disease rating scale, Berg balance scale and Hoehn and Yahr scale. Group A received proprioceptive neuromuscular facilitation technique for about 3 sessions /one week/45 min. Group B received High intensity resistance training (HIRT for about 3 sessions /one week/45 min. **Result:** Comparative study shows significant difference in BERG Balance Scale and UPDRS Scale, with P value <0.0004 and <0.0001 respectively, but no significance on Hoehn Yahr Scale with p value 0.069 respectively. Group A found effective on BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale with mean score difference of 14.60, 28.47, 0.70, respectively with P value <0.0001, respectively. **Conclusion:** Group A intervention found more effective over Group B on BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale by considering the mean differences between the groups among patients with Parkinson disease.

Keywords: Parkinson disease, Proprioceptive Neuromuscular Facilitation, high intensity resistance training, Unified Parkinson disease rating scale, Berg balance scale, Hoehn and Yahr scale

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INTRODUCTION

Parkinson's disease (PD) is a neurological disorder primarily affecting the motor system, characterized by a variety of symptoms that can vary in severity among individuals. Here, we delve into the five primary symptoms: bradykinesia, muscle rigidity, tremors, postural instability, and akinesia¹. Parkinson's disease is caused by degenerative changes in the nervous system that causes the cerebral basal ganglia to malfunction. Patients frequently suffer from posture control and mobility issues which harm their quality of life². Basically, dopaminergic nigrostriatal system is going through the degeneration in Parkinson disease³. A specific area located in midbrain in which dopaminergic neurons are loss, is known as substantia nigra pars compacta (SN). In Parkinson disease, not only dopaminergic neurons are affected but non-dopaminergic neurons are also affected⁴.

Parkinson's disease affects over 6 million people globally, with a prevalence of 51 to 439 per 100,000 people and an incidence of 2 to 28 per 100,000 people, based on door-to-door surveys^{5,6}. Men are slightly more affected than women⁷. Both the prevalence and incidence of PD increase with age, peaking in the seventh and eighth decades. Data also suggest higher prevalence and incidence of PD in western countries than eastern countries. Because of the rapidly ageing population, the number of people affected by PD is projected to double to over 12 million by 2040, which will inevitably exacerbate the burden on healthcare systems and society^{8,9}.

Parkinsonism is an umbrella term that covers several conditions, including PD, which share similar motor symptoms, but may not have the

cardinal symptoms that lead to a specific diagnosis. There are major gaps in the understanding of the epidemiology of PD and Parkinsonism and wide variation in their management and treatment geographically.⁽⁹⁾ Parkinson disease is characterized by death of dopaminergic neurons in the substantia nigra. The pathologic hallmark of Parkinson disease is the Lewy body, a neuronal inclusion consisting largely of α -synuclein protein aggregations.

The most widely cited model to explain neuro pathological progression of Parkinson disease is the Braak hypothesis. It suggests that Parkinson disease starts (stages 1 and 2) in the medulla and the olfactory bulb. This early pathology is associated with symptoms occurring prior to the movement disorder onset, such as rapid eye movement sleep behavior disorder and decreased smell. In stages 3 and 4, pathology progresses to the substantia nigra pars compacta and other midbrain and basal forebrain structures. Pathology in these areas is associated with classic Parkinson disease motor symptoms. Parkinson disease is typically diagnosed at this stage. In advanced Parkinson disease, the pathology progresses to the cerebral cortices with onset of cognitive impairment and hallucinations¹⁰.

Parkinson disease protein aggregations are associated with death of dopamine-producing cells. Treatments supplementing dopamine is the mainstay of Parkinson disease treatment. However, other neurotransmitter systems are also dysfunctional in Parkinson disease, including serotonin, acetylcholine, and nor-epinephrine systems¹¹. In Parkinson disease the five main symptoms significantly restrict daily activities¹² leading to reduced natural movement, stiff posture, slower walking speeds, and difficulties in initiating and

stopping movement. Additionally, these symptoms can affect facial expressions and voice modulation clinical signs of bradykinesia, rhythmic tremor, rigidity postural instability¹¹.

Parkinson disease feature impairment of resting muscle tone and voluntary movement because of loss of striatal dopamine in the nigrostriatal dopamine pathway. Parkinson disease presents with a complex array of symptoms, often accompanied by other issues such as sleep disturbances, depression, or cognitive decline. Management typically involves a comprehensive treatment plan tailored to each individual's needs¹². Parkinson disease is related to dopamine released by substantia nigra compacta. Dopamine plays an important role in basal ganglia functions. During movement, the basal ganglia modify information from the cerebral cortex, the brainstem, and the cerebellum to enable precise and delicate movement. They are regulated through direct and indirect pathways¹³.

As a neurotransmitter, dopamine is an essential mediator for the activation of direct and indirect pathways. Dopamine has an activating effect on behavioral conversion and continues to play a role in reward motor learning. In individuals with PD, damage to the neurons is responsible for dopamine production in the basal ganglia of the brain results in a reduction in dopamine levels. A deficiency in dopamine, which is crucial for regulating movement, is associated with impaired motor function. One of the main pathological mechanisms of Parkinson disease involves the abnormal accumulation of alpha-synuclein and trophic-related proteins. This leads to neuronal damage and a decrease in dopamine production. Additionally, situations where the cells

responsible for promoting dopamine production are impaired, or the cells that enhance dopamine degradation are overly active, can also contribute to a decrease in dopamine levels. The symptoms of Parkinson Disease can vary in severity and type from patient to patient. Some patients only have mild symptoms, while others may have severe motor and neurological dysfunction. This diversity plays an important role in personalizing and optimizing treatment and rehabilitation methods. Parkinson disease causes a variety of symptoms related to motor control. These symptoms significantly reduce the patient's quality of life, and the importance of appropriate treatment and rehabilitation is highlighted. Accordingly, it is necessary to develop personalized treatment and rehabilitation methods that consider the individual characteristics and symptoms of patients¹⁴.

Gender differences pertaining to the incidence of PD are reflected in a 3:2 ratio of males to females, with a delayed onset in females attributed to the neuro protective effects of estrogen on the nigrostriatal dopaminergic system.⁽²³⁾ The interventions for Parkinson disease are effectively prolonged the period in which PD patients could live with the condition while managing its disabilities. As there is no cure for PD, and the condition continues to progress with significant disabilities, the role of effective physical therapy and rehabilitation management has become pivotal¹⁵.

Aim of the study: The aim of the study is to compare the effectiveness of proprioceptive neuromuscular facilitation versus high intensity resistance training in patient with Parkinson disease.

METHODOLOGY

An experimental study design was done to compare the effectiveness of proprioceptive neuromuscular facilitation versus high intensity resistance training in patient with Parkinson disease.

Study Type was pre- & post comparative study. The comparison was made before and after giving the therapy to the patient with Parkinson disease. The study was done at the outpatient department of physiotherapy, Dr MGR Educational and Research Institute. A total number of 30 Parkinson disease patients were selected for the study and the sampling method was Random sampling method. Intervention made for the study was 12 weeks with 3 sessions in a week about 45 minutes per day. Total duration of the study was 6 months.

Inclusion criteria: Parkinson disease patient, both male and female were included, Patients with age group 45-65 yrs, Patient with a score of 42 above on berg balance scale, Subjects willing to participate in the study were included for the study.

Outcome measure of the study was Balance, Posture and Functional ability. Measurement tool for the study were Berg balance scale, Unified Parkinson Disease Rating Scale, Hoehn and Yahr scale.

Intervention: The research approval will be obtained from the institutional review board of faculty of physiotherapy, outpatient department, Dr M.G.R Educational and Research Institute. A total of 30 subjects of eligible participants who had been diagnosed as Parkinson disease were selected. All the participants were ambulatory, were not

acutely ill, were able to follow simple commands and were not suffering from unstable cardiovascular disease or other uncontrolled chronic conditions that would interfere with safety and conduct of the training and testing protocol. A total number of 40 subjects were selected and divided into two groups who have fulfilled the inclusion criteria were assigned into two groups consisting of 15 subjects each.

Subjects were provided with the informed consent prior to the study. A detailed explanation about the treatment protocol was given to the patient. Demographic data like name, age, sex, chief complaints were collected and they are selected by random sampling method. During the study participants were taking Parkinson medications. Participants followed the informal schedule of medications throughout the course of the study and we tested them two hours after they had ingested their morning dose and within the same relative temporal period of their drug cycle. Parkinson disease medication was not changed during the study. All the participants were first pretested for balance and then pretested for muscle strength on separate days. Participants were pretested for balance with berg balance scale and the score with 42 and above were selected for the study.

Procedure

Group A- Proprioceptive neuromuscular facilitation: 15 subjects were given proprioceptive neuromuscular facilitation for about 45 minutes per day on lower limb. The intervention was conducted 45 minutes per day for a period of 12 weeks 36 sessions. Proprioceptive neuromuscular facilitation

exercises include D1flexion and D2 extension of lower limb, rhythmic initiation, half relax, pelvic patterns and contract relax for about 45 minutes.

training for about 45 minutes per day on lower limb. The intervention was conducted 45 minutes per day for a period of 12 weeks 36 sessions. High intensity resistance training includes sit to stand, step up on stairs, wall sit, standing March, tandem standing.

Group B- High intensity resistance training: 15 subjects were given high intensity resistance

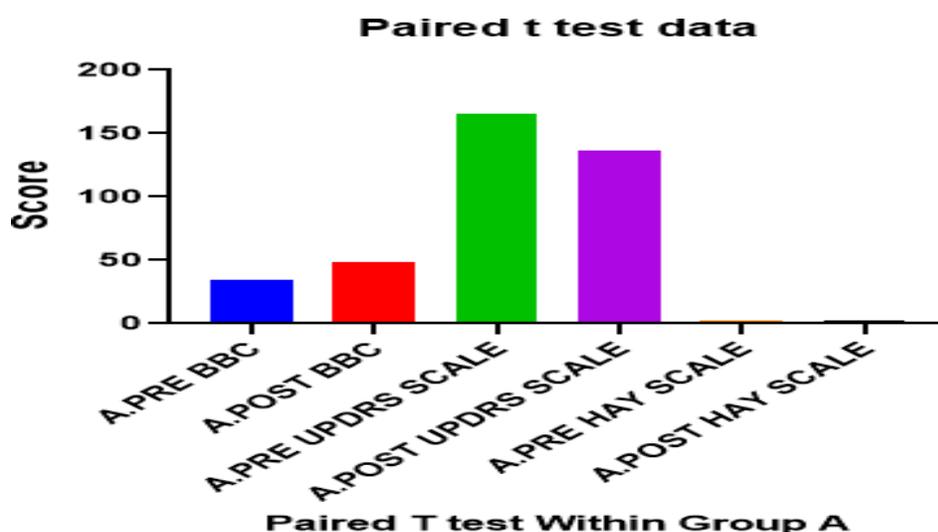
Data Analysis:

Group A: Proprioceptive Neuromuscular Facilitation

Table1: Paired t test within Group A on BERG Balance Scale, UPDRS Scale, Hoehn and Yahr Scale

GroupA	Number ofPairs	Mean Diff.	SD, SEM	df	t	P value	Sig. Diff. (P <0.05)
BERG Balance Scale	15	14.60	3.68 0.95	14	15.37	<0.0001	****
UPDRS Scale	15	28.47	0.99 0.25	14	111.3	<0.0001	****
HoehnAnd YahrScale	15	0.70	0.25 0.07	14	10.69	<0.0001	****

The above table1 shows significant difference in BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale within Group A with P value <0.0001 respectively.



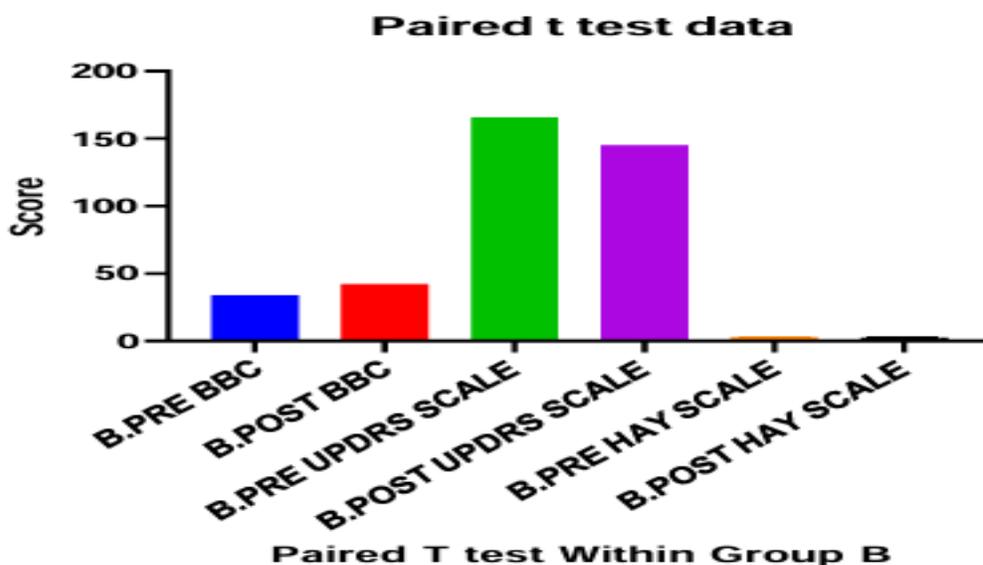
Graph 1: Presentation of BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale within Group A

Group B: High Intensity Resistance Training

Table2: Paired t test within Group B on BERG Balance Scale, UPDRS Scale, Hoehn and Yahr Scale

Group B	Number of Pairs	Mean Diff.	SD, SEM	df	t	P value	Sig. Diff. (P<0.05)
BERG Balance Scale	15	8.27	1.33 0.344	14	23.99	<0.0001	****
UPDRS Scale	15	20.60	3.75 0.97	14	21.24	<0.0001	****
Hoehn And Yahr Scale	15	0.53	0.35 0.09	14	5.87	<0.0001	****

The above table 2 shows significant difference in BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale within Group B with P value >0.0001



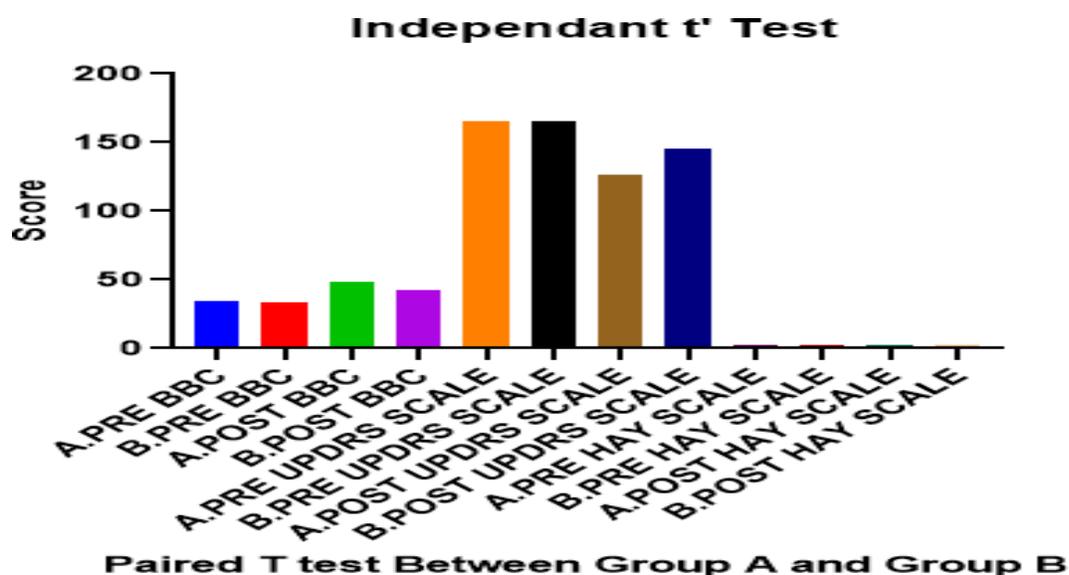
Graph 2: Presentation of BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale within Group B

Comparative Test between Group A Proprioceptive Neuromuscular Facilitation and Group B High Intensity Resistance Training

Table 3: Independent t test between Group A and Group B

Group A & B		Number of Pairs	Mean Diff. \pm SEM	R	DF	t	P value	Sig. Diff. (P<0.05)
Pre test	BERG Balance Scale	30	0.40 0.77	0.009	28	0.52	0.61	NS
	UPDRS Scale	30	0.33 1.87	0.001	28	0.18	0.86	NS
	Hoehn And Yahr Scale	30	0.00 0.09	0,00	28	0.00	0.99	NS
Post test	BERG Balance Scale	30	6.73 1.05	0.59	28	6.36	<0.000 1	****
	UPDRS Scale	30	8.20 2.02	0.37	28	4.05	<0.000 4	***
	Hoehn And Yahr Scale	30	0.16 0.08	0.11	28	1.89	0.069	NS

The above table 3 shows NO significant difference on Pre Test of BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale between Group A and Group B with P value 0.61,0.86,0.99, and Post test shows significant difference in BERG Balance Scale, UPDRS Scale, with P value<0.0004 and <0.0001 respectively, but NO significance on Hoehn Yahr Scale with p value 0.069 respectively.



Graph 3: Presentation of BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale between Group A and Group B

RESULTS

Total 30 participants of 14 male and 16 female subjects were included in the study based on specific selection criteria and divided in to 15 samples in each Group A and Group B. Participants were with age group between 46 and 57 years.

Comparative study shows NO significant difference on Pre-Test of BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale between Group A and Group B with P value 0.61, 0.86, 0.99, but Post test shows significant difference in BERG Balance Scale and UPDRS Scale, with P value <0.0004 and <0.0001 respectively, but NO significance on Hoehn Yahr Scale with p value 0.069 respectively

Group A found effective on BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale with mean score difference of 14.60, 28.47, 0.70, respectively with P value <0.0001, respectively.

Group B also found effective on BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale with mean score difference of 8.27, 20.60, 0.53 respectively with P value <0.0001 respectively.

Group A intervention found more effective over Group B intervention on BERG Balance Scale, UPDRS Scale, Hoehn And Yahr Scale with mean score difference of 14.60, 28.47, 0.70, over 8.27, 20.60, 0.53 respectively.

DISCUSSION

This study was conducted to compare the effectiveness of Proprioceptive Neuromuscular Facilitation vs High Intensity Resistance Training in patient with Parkinson disease. The pre and posttest measurement was taken using unified Parkinson disease rating scale (UPDRS), berg balance scale and Hoehn and yahr scale.

Parkinson disease is a progressive neuro degenerative disorder usually presenting in

later years of life. Parkinson disease is the neurodegenerative condition due to selective neuronal loss of Substantia Nigra and a decrease in dopamine production in the basal ganglia. It was reported that an estimated 10 million people in the world (i.e.) approximately 0.3% of the world population and 1% of those above 60 years are found to be affected with Parkinson disease. Parkinson disease is characterized by different motor symptoms like akinesia, bradykinesia, tremor and rigidity. Balance and mobility are crucial to their performance. Motor disturbances related to Parkinson disease can contribute to the decline of balance and mobility which subsequently can lead to a reduction in functional independence. Therefore, individuals with Parkinson disease experience an increase both with difficulties in performing daily activities and in the risk of falls¹⁶.

Proprioceptive neuromuscular facilitation is a type of physiotherapy treatment for Parkinson disease. It is defined as the activation of proprioceptors to promote the response of neuromuscular system. Facilitation, inhibition, strengthening and relaxation of muscular groups are used in this strategy to enhance function movement.⁽⁶⁵⁾ Proprioceptive neuromuscular facilitation is a physiotherapeutic approach option for PD. It can be defined as promoting or hastening the response of the neuromuscular mechanism through stimulation of the proprioceptors. This method aims to promote functional movement through the use of facilitation, inhibition, strengthening, and relaxation of muscle groups. Concentric, eccentric, and static muscle contractions are used, combined with gradual resistance and appropriate facilitatory procedures, adjusted to the needs of each

individual, and applied on diagonal movements.

All the parameters of the study were assessed using statistical package for social science (SPSS) version 24 with a significance level of p value less than 0.05 and a 95% confidence interval set for all analysis. The Shapiro Wilk test was used to determine the normality of the data in this study the Shapiro Wilk test showed that the data was normally distributed on the dependent values at $p > 0.05$. Hence parametric test was adopted. T test was adopted to find the statistical difference within the groups and independent t test (student T test) was adopted to find statistical difference between the groups.

The result of the study supported by another study k. Kamatchiet al 2012 "A comparative study to analyses the effectiveness of PNF versus balance exercise in Parkinsonism". This study is a randomized comparative study with 30 subjects of duration for about 4 weeks in which group A received PNF techniques and group B received balance exercise. The result shows that both groups showed the improvements in balance but PNF techniques were more effective than balance exercise in improving balance among Parkinson disease patients¹⁶.

One of the studies supported the result of current study Kumar et al 2024 "the role of proprioceptive neuromuscular facilitation in improving balance in Parkinson disease". This study is a systematic review with five randomized control trial in which PNF techniques were incorporated into rehabilitation programs. The result shows that PNF intervention led to significant

improvements in balance, primarily measured by berg balance scale. The result of our study is supported by another study Assis et al 2020" the proprioceptive neuromuscular facilitation concept in Parkinson disease A systematic review and meta-analysis". In this study PNF techniques compared to other therapies. The result shows that PNF intervention showed statistically significant improvement in gait speed compared to other therapies¹⁷.

One of the studies supported the result of current study Mazhar et al 2023 "the effects of conventional physical therapy with and without proprioceptive neuromuscular facilitation on balance, gait and function in patient with Parkinson disease". This study is a randomized controlled trial for about 38 Parkinson disease patient group A received PNF combined with conventional therapy and group B received only conventional therapy.⁽⁶⁹⁾

The result showed that group A shows the significant improvement in balance, gait and functional independence compared to group B. the result of our study is supported by another study Carvalho E et al 2015" the effects of proprioceptive neuro muscular facilitation on the functional independence measure in patients with Parkinson disease". This study shows that patients reported improvements in locomotion and sphincter control while giving PNF techniques to Parkinson disease patient¹⁸.

One of the studies supported the result of current study Shafiq et al., 2023 "comparison of proprioceptive neuromuscular facilitation vs balance exercise along with conventional therapy for balance and gait in chronic Parkinson disease patients". It is a randomized controlled trial with 60 patients in which group A received PNF techniques and group B balance

exercisewithconventional therapy for about 12 weeks. Both the groups improved in balance and gait but balance exercise showed more significant improvement than PNF¹⁹.

The result of our study is supported by another study Sushma, T. et al., 2024" Comparative Study on the Effectiveness of Strategy Training Vs PNF Techniques to Improve Balance in Subjects with Parkinson's Disease". it is a Randomized Comparative Study of 30 Parkinson disease patients in which Group A received strategy training; Group B received PNF techniques for about 4 weeks. The result shows both groups showed significant improvements in balance, but strategy training combined with conventional training was more effective than PNF techniques. One of the studies supported the result of current study Gholap, A. & Chitra, J., 2014 "A Comparative Study on the Effect of Resistance Training and PNF to Improve Balance in Parkinson's Patients —A Randomized Clinical Trial". In this study Group A received resistance training; Group B received PNF techniques. The Result shows Both resistance training and PNF techniques were effective in improving balance in PD patients, with PNF showing slightly better outcomes²⁰.

The result of our study is supported by another study Sneha, B.S. et al., 2010 "Effects of Trunk Proprioceptive Neuromuscular Facilitation on Dynamic Balance, Mobility, and Quality of Life in Parkinson's Disease "In this study 27 Parkinson disease patients were selected and they received Trunk-specific PNF exercises. the results show more Significant improvements in dynamic balance, mobility, and quality of life were observed post-training.⁽⁷⁴⁾ One of the studies supported the result of current study Bang, D.H. & Cho, H.S., 2017 "Effects of the

Trunk Exercise Using PNF Combined with Treadmill on Balance and Walking Ability in Individuals with Parkinson's Disease "It is a Randomized Controlled Trial In which subjects received PNF trunk exercises combined with treadmill training. The Result shows Combined PNF and treadmill training improved balance and walking ability in PD patients²¹.

Ethical Clearance: Ethical clearance has obtained from Faculty of Physiotherapy, Dr. MGR. Educational and Research Institute, Chennai, Tamil Nadu, India. Reference number: No: MPT (NEUROLOGY) 01/ PHYSIO/ IRB/ 2024-2025, Dated: 21/12/ 2023.

Conflict of interest: There was no conflict of interest to conduct and publish this study.

Fund for the study: It was a self-financed study.

CONCLUSION

With reference to the statistical analysis done from the data collected using berg balance scale, unified Parkinson disease rating scale, Hoeln And Yahr Scale. In this study the comparative effect of proprioceptive neuromuscular facilitation versus high intensity resistance training shows significant difference on posttest of berg balance scale, unified Parkinson disease rating scale and hoeln and yahr scale within group On comparing both the groups, Group A (proprioceptive neuromuscular facilitation) showed better improvement than the Group B (high intensity resistance training) on improving the patients with Parkinson disease. Group A (proprioceptive neuromuscular facilitation) showed a beneficial improvement in post test values when compared with Group B (high

intensity resistance training) post test values. Hence the null hypothesis was rejected and accepted as the alternative hypothesis of this study.

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