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Comparative Analysis of Proprioceptive Neuromuscular Facilitation and Task -Oriented Training to Improve Balance for Stroke Survivors

Shwetha Priya, Priyadharshini Kumar*, Kumaresan A, Sivaraghav Sathish Kumar, Suriya N
Department of Neuroscience, Saveetha College of Physiotherapy, SIMATS, Chennai, Tamil Nadu, India

Abstract

Cerebrovascular accidents otherwise widely known as stroke is a global causative factor for mortality and morbidity. Strokes impact around 13.7 million individuals in India, making them the second leading cause of death and likely the most common reason for disability. The main aim of the study is to compare the effectiveness of Proprioceptive Neuromuscular Facilitation (PNF) and Task-Oriented Training (TOT) to improve balance for stroke survivors. Total of 90 participants based on inclusion criteria and exclusion criteria will be selected. 90 participants should be divided into PNF and TOT as 45 participants in each group. Treatment duration will be for PNF group as 15 times repetitions with 3 sets and for TOT group as 10 times repetitions with 3sets. Outcome will be measured by (BBS) Berg Balance Scale and (PASS) Postural Assessment Stroke Scale. Descriptive and inferential statistics were used to tabulate and evaluate the collected data, apply the mean and standard deviation (SD) to all parameters, and use the t test to analyze significant differences between pre-test and post-test measures of the same group. The results indicate that findings are deemed statistically significant when the p-value is less than 0.0001. In this study the positive impact of 8 weeks of regular task-oriented training and proprioceptive neuromuscular facilitation for improved balance was observed. The berg balance scale and postural assessment stroke were used in this study to compare the effectiveness of task-oriented training and proprioceptive neuromuscular facilitation in patients with stroke survivors.

Keywords: *Balance, Proprioceptive Neuromuscular Facilitation, Stroke, Task oriented training.*

Introduction

Stroke is a leading cause of morbidity and mortality worldwide. According to the World Health Organization, a stroke is described as a sudden onset of widespread neurological symptoms, lasting for 24 hours or more or resulting in death, with no obvious cause other than a vascular origin [1]. Stroke is still the third highest cause of death for people in the United States of America and the leading cause of disability [2]. Stroke is most likely the most frequent cause of disability and the second most frequent cause of mortality in India [3, 4]. Approximately 13.7 million people are impacted by stroke each year, with a mortality rate of 5.5 million. Ischemic infarctions make up about 87% of strokes, and their prevalence rose significantly between 1990 and 2016, which is linked to reduced death rates and improved clinical treatments.

Strokes are primarily caused by first-time hemorrhages, with second-time hemorrhages making up between 10 and 25 percent of all cases [5, 6]. The risk of having a stroke increases by a factor of two beyond the age of 55 [7]. Stroke incidence rises with age. Women experience a larger incidence when they are younger, whereas men see a slight increase in incidence as they age [8]. It was discovered that by raising the chance of getting the illness,

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****Corresponding Author: physiopriyadharshini@gmail.com***

exposure to air pollution and particulate matter increased the fatality rate from stroke [9]. According to a study, one of the main causes of stroke is hypertension, and the severity of symptoms varies by location for stroke victims. Additional risks were identified as poor dietary practices, inactivity, and alcohol and nicotine use [10]. Regional variations in the incidence of stroke were also influenced by variations in exposure to environmental contaminants including lead and cadmium [11]. The prognosis of CVA and its long-term repercussions are greatly influenced by early diagnosis and appropriate treatment [12].

One side of the body being partially paralyzed due to hemiplegia or hemiparesis significantly limits the stroke survivors to live freely and decreases the quality of life. Apart from visual defects, difficulty in walking, dizziness, loss of balance, difficulty speaking or understanding speech, a stroke can also cause sudden paralysis or numbness on one side of the face, arm, or leg [13, 14].

Proprioceptive neuromuscular facilitation (PNF) therapy is an extremely effective therapeutic exercise for enhancing gait, dynamic balance, and muscle thickness [15]. PNF is one such rehabilitation method that uses a variety of sensory stimulation approaches to help stroke patients function better. Proprioceptive neuromuscular facilitation (PNF) is an idea of motor learning and control treatment. In order to stimulate proprioceptors in the muscles and joints, it uses concepts like physical contact, body posture, irradiation, movement timing and pattern, verbal information, manual resistance, stretch, and visual cues [16]. One of the pillars of the PNF is the irradiation principle, which is predicated on the idea that activating strong and intact muscle groups stimulates weak and injured muscles in a way that makes contraction easier [17-19].

Task-based training is a therapy approach that helps people regain or improve their ability to perform everyday activities by practicing those exact tasks repeatedly [20]. Instead of focusing solely on muscle strength or isolated impairments, this method emphasizes real-life movements and skills that are most important to the individual [21]. By repeatedly practicing functional tasks or key parts of those tasks in a natural environment, people develop more efficient and adaptable movement patterns. This approach is rooted in the idea that movement is shaped by a complex interaction between the body, the task, and the environment [22]. The goal is not just to improve movement but to enhance overall function, independence, and quality of life. In this training, patients practice motor activities that are specific to their situation and receive feedback in one form or another. In the topic of skill learning, various practice situations, feedback, and conditions of transfer are all potential contributing elements [23].

Methods

A doA double-blinded comparative study done with 90 subjects with stroke participants, aged less or greater than 55 years of stroke participants. The study was approved by ISRB 03/080/2024/ISRB/SR/SCPT. Convenient sampling was used in this study. The inclusion criteria were age will be less or greater than 55, both male and female stroke surivors, the absence of any notable neurological condition, the capacity for verbal communication. The exclusion criteria were severe pain of the affected lower extremity, muscle tone exceeding Grade 3 in accordance to Modified Ashworth Scale, stroke participants with complications of seizure, severe loss of sensation of the affected lower extremity, severe comorbidities related to kidney, liver, heart and diabetes mellitus, cognitive dysfunction to the point where it would be difficult to participate in therapy, participants with visual defects,Participants diagnosed with Ideomotor apraxia.

Study Procedure

Total of 90 participants based on inclusion criteria and exclusion criteria will be selected. 90 participants has been divided into PNF and TOT as 45 participants in each group. Treatment duration will be for PNF group as 15 times repetitions with 3 sets and for TOT group as 10 times repetitions with 3sets. Outcome will be measured by (BBS) Berg Balance Scale and (PASS) Postural Assessment Stroke Scale.

PNF Technique Group

The 45 participants with stroke randomly segregated to the PNF group will receive hold relax technique, which is uniquely modified to each participant of the group. The PNF patterns followed were Diagonal 1 which comprises of Flexion- Adduction- External Rotation pattern and Extension- Abduction- Internal Rotation along with Diagonal 2 which has Flexion- Abduction- Internal Rotation pattern and Extension- Adduction- External Rotation. The above mentioned Diagonal pattern 1 and Diagonal pattern 2 were provided for the involved lower extremity. The PNF Hold and relax technique was done with 15 repetitions with 3 sets for both upper lower extremity.

Lower extremity:

1. Flexion-abduction-external rotation (knee flexed and knee extended).
2. Extension-adduction-internal rotation (knee flexed and knee extended).
3. Flexion-adduction-internal rotation (knee flexed and knee extended).
4. Extension-abduction-external rotation (knee flexed and knee extended).

TOT Group

The 45 participants randomly allocated to Task- oriented training program received exercises in the form of activities tailored to each participants which are Stand and reach an object with symmetrical weight distribution of the lower extremities,Walking over the balance beam , Forward walking followed by backward walking, Sideway walking, Obstacle crossing, Reaching and picking up objects from the floor,Walking in unconventional walking surfaces such as unpaved roads, narrow walkable spaces, Stair climbing, Ramp walking.

The Outcome Measure utilized for this research:

1. Postural Assessment Stroke Scale
2. Berg Balance Scale

Statistical Analysis

The pre-test scores of balance was measured using Berg balance scale and Postural assessment stroke scale were assessed before the initiation of intervention and measured after 6 weeks of intervention and taken as post-test values. The Statistical analysis was performed using Independent t-test for between group comparisons and paired t-test for within-group comparisons. The data was tabulated and evaluated.

Results

The pre-test and post-test values of both control (Group A) and experimental (Group B) groups were analyzed using paired and unpaired t-tests. In Group A, assessed using the Postural Assessment Stroke Scale, the mean difference was 2.1, with a standard deviation of 0.7378 and a paired t-test value of 8.9943, which exceeded the table value. In Group B, the Berg Balance Scale showed a mean difference of 2.8, a standard deviation of 0.9189, and a paired t-test value of 9.6289, while the Postural Assessment Stroke Scale recorded a mean difference of 2.3, a standard deviation of 0.6749, and a paired t-test value of 10.7690, both exceeding table values. The unpaired t-test results indicated a significant difference between Group A and Group B for both the Berg Balance Scale ($t = 2.3529$, $df = 28$, $p < 0.05$, critical value = 2.05) and the Postural Assessment Stroke Scale ($t = 3.5395$, $df = 28$, $p < 0.05$, critical value = 2.05). These findings

suggest that task-oriented training is more effective than proprioceptive neuromuscular facilitation in improving balance in stroke survivors, as evidenced by the significant improvements observed in the experimental group compared to the control group.

Table 1. Pre-test and Post-test in Task-Oriented Training group of Berg Balance Scale

BBS	TEST	MEAN	SD	t value	p value
TOT	Pre Test	44.04	1.73	24.32	>0.0001
	Post test	48.64	1.65		

Table 2. Pre-test and Post-test in PNF group of Postural Assessment of Stroke Scale

PASS	TEST	MEAN	SD	t value	p value
PNF	Pre Test	17.18	3.39	17.81	>0.0001
	Post test	22.27	2.55		

Table 3. Post -test in Task-Oriented Training and PNF group

TEST	SCALE	MEAN	SD	t value	p value
Post test	BBS	48.64	1.65	58.17	>0.0001
	PASS	22.27	2.55		

Discussion

Stroke, otherwise known as cerebrovascular accident, is a major cause of disability globally and involves damage to the central nervous system due to a vascular origin. Patients who suffer from strokes have impairments in their physical, mental, and social functioning that affect their quality of life and made it difficult for them to perform activities of daily living (ADL). One of the primary reasons for impairment is the loss of hand function. in neuromuscular diseases and daily dependence.

The main objective of the study was to find the effectiveness of proprioceptive neuromuscular facilitation and task-oriented training to improve balance for stroke survivors with berg balance scale and postural assessment stroke scale. 90 subjects who are stroke survivors were selected for the study and divided into two equal groups – group A (PNF group) and group B (Task-oriented training group) with each group comprising of 45 participants. Subject were selected using randomised control trial. The selected subjects were present with inability to make extensive use of involved lower extremity, poor grade berg balance scale patient, present in weakness or numbness on one side of body. The participants who were randomly selected in group A were provided with proprioceptive neuromuscular facilitation while participants in group B received task oriented training. The study had a duration of 8 weeks, where the treatment was provided for 30 minutes per session for 10-15 times per week. While comparing the post- test measurements of both the groups with outcome measure berg balance scale and postural assessment stroke scale, Task oriented training intervention proved to be more effective compared to proprioceptive neuromuscular facilitation.

PNF therapy is an extremely effective therapeutic exercise for enhancing gait, dynamic balance, muscle thickness and flexibility [24]. It is also frequently used in clinical settings to help stroke patients regain their physical function PNF is one such rehabilitation method that uses a variety of sensory stimulation approaches to help stroke patients function better. PNF is a therapeutic approach focused on motor learning and control. It utilizes principles like manual contact, body positioning, stretching, manual resistance, irradiation, movement timing, movement patterns, visual cues, and verbal instructions to activate proprioceptors in the muscles and joints.

A systematic review and meta-analysis conducted by Nguyen PT, et al (2022), whose objective was to find out the effectiveness of PNF on improving balance and gait functions among chronic CVA survivors. Their study concluded that PNF demonstrated statistically significant improvements in balance, as measured by BBS, FRT, and TUG ($p < 0.05$), as well as in gait velocity, assessed through the 10MWT ($p < 0.001$), compared to the control group. These findings suggest that PNF may serve as an effective treatment approach for enhancing balance and gait speed in individuals undergoing chronic stroke rehabilitation [25].

Task-specific training has been proven to yield superior functional outcomes compared to conventional therapy. Actively incorporating task-oriented training into rehabilitation significantly enhances both functional recovery and overall health-related quality of life in stroke survivors. Recent studies further suggest that integrating task-focused exercises into daily nursing care can lead to even greater improvements [26]. Community-dwelling individuals recovering from acute stroke experience significant gains in balance self-efficacy after undergoing task-oriented walking retraining. This improvement is largely attributed to enhanced walking ability, which increases confidence in mobility and daily activities. Additionally, factors such as baseline self-efficacy, prognostic indicators, and the presence of depressive symptoms play a vital role in shaping rehabilitation outcomes. Recognizing and addressing these influences is essential for developing more effective and personalized recovery strategies [27].

Kim BH et al. (2012) examined the effects of task-oriented training on trunk control, balance, and gait in stroke patients. The study included 20 inpatients randomly assigned to an experimental group, which received task-oriented training and general physical therapy, or a control group, which received only general therapy. After four weeks, assessments showed significant improvements in trunk control, balance, and gait in the experimental group, with notable differences from the control group except for the TUG test. These findings highlight task-oriented training as a beneficial approach to enhancing mobility and recovery in stroke rehabilitation [28]. A structured, task-oriented exercise program has the potential to significantly improve balance and mobility in stroke patients across both clinical and laboratory settings. However, the observed correlations between changes in clinical and laboratory markers following the intervention were generally weak. This indicates that these outcome measures capture distinct dimensions of recovery [29].

Although traditional motor therapies can enhance motor function, it can be More challenging to apply these gains in daily life. For this reason, techniques that are relevant to real-world settings show promise for more successful functional transfer. Task-oriented training (TOT) is one of these therapeutic approaches.

A perfect task-oriented protocol would consist of both unilateral and bilateral actions directed toward a specified functional objective (much like everyday activities involving real-world items) and carried out in a setting tailored to the context. Despite the fact that resistance training can be a helpful

training method to improve and maintain muscle strength both in the short and long term following a stroke, a task-oriented rehabilitation program could not necessarily incorporate a patient-specific training load. Strength training has not been specifically included in the many studies that have been conducted using TOT protocols.

Conclusion

In this study the positive impact of 8 weeks of regular task oriented training and proprioceptive neuromuscular facilitation for improved balance was observed. Based on statistical analysis, we conclude that both the control group and experimental group improved balance over a 6-week period of time. However, the task-oriented training demonstrated significantly greater improvement in balance than the proprioceptive neuromuscular facilitation. Result suggested that there is significance difference between group A and group B in showing improvement in their balance in patients with stroke survivors.

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Conflict of Interest

The authors declare no conflict of interests.

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