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Effect of Core Stability with Proprioceptive Neuromuscular Facilitation (PNF) on Standing Balance in Post Stroke Patients

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Abstract

Stroke patients will experience a situation where the ability to move will be increasingly reduced, such as sensory disturbances, mental, consciousness, weakness in the limbs that cause difficulty standing and walking which causes balance to be disturbed and most fatally causes death. Balance disorders experienced by post-stroke patients are caused by the absence of good cooperation in the sensory system such as visual, somatosensory including proprioceptors, and vestibular and musculoskeletal which are muscles, joints, and tissues regulated by the brain so that different responses occur to changes in internal and external conditions. Stroke or Cerebro Vascular Accident (CVA) is a central nervous system disorder that most commonly causes impaired functional activity as a result of coordination disorders, balance disorders, body control disorders, sensory disturbances, and movement reflex disorders that will decrease the individual's ability to perform daily activities. This study aims to determine the effect between core stability and Proprioceptive Neuromuscular Facilitation (PNF) on the standing balance of post-stroke patients at the Stroke Center Hospital. With a quasi-experimental research method with a pretest – posttest two group design, with sampling using the Slovin formula. The number of samples was 30 post-stroke patients who met the inclusion criteria of 32 people and then randomly divided into 2 groups, namely Proprioceptive Neuromuscular Facilitation (PNF) as many as 15 people and Core Stability as many as 15 people.

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Based on the results of this study, it can be concluded that there is a significant effect of core stability training on improving standing balance in post-stroke patients at the Stroke Center Hospital. In addition, the Proprioceptive Neuromuscular Facilitation (PNF) technique also has a positive impact on the standing balance of post-stroke patients at the same location. Furthermore, it was found that there was a difference in effectiveness between the two methods, where Proprioceptive Neuromuscular Facilitation (PNF) showed more effective results compared to core stability in improving standing balance in post-stroke patients. These results provide important insights into rehabilitation interventions that can be optimized to improve balance in post-stroke patients.

Keywords: Core Stability; PNF; Standing balance.

1. Introduction

According to the World Health Organization (WHO), stroke is a symptom of a disease that is defined as a condition of brain dysfunction that occurs suddenly with clinical signs and symptoms both locally and globally that last 24 hours or more [1]. The causes of stroke are divided into two, namely: ischemic / non-hemorrhagic stroke (blockage of the arteries that flow blood to the brain) and hemorrhagic stroke / hemorrhagic (bleeding in the brain) [2]. Stroke is the leading cause of death and neurological disorders worldwide [3] and and is a major contributor to disability, thereby imposing significant economic burdens [4].

Stroke patients will experience conditions where the ability to move will be further reduced such as sensory disturbances, mental, consciousness, weakness in the limbs that cause difficulty standing and walking which causes balance to be disturbed and most fatally causes death.

Balance disorders experienced by post-stroke patients are caused by a lack of good cooperation in the sensory system such as visual, somatosensory including proprioceptors, and vestibular and musculoskeletal which are muscles, joints, and tissues regulated by the brain so that different responses occur to changes in internal and external conditions [5]. Balance impairments are prevalent among stroke survivors, with studies indicating that between 16.7% to 83% experience some degree of balance disorder [6]. These impairments can severely hinder mobility and daily activities, contributing to a sedentary lifestyle and heightened fear of falling, which further exacerbates disability [7]. Balance disorders are characterized by issues such as slow walking speed, difficulty maintaining posture, and an inability to regulate body weight transfer [8]

Based on the results of the data on stroke prevalence in South Sulawesi Province, it is 10.6%. The highest prevalence of stroke was in the age group ≥ 75 years (48.2%) [9]. The results of the last 3-month observation from September - November 2023 at the hospital. The last stroke center found was a stroke case, which was around 83 people with several recurrent patients. This case can cause disorders in the form of muscle weakness in the affected arm or leg, increased spasticity in the affected muscle, balance disorders, and coordination disorders.

Activity limitations are in the form of difficulty standing, walking, difficulty dressing, difficulty grasping, difficulty in worship, difficulty in eating, difficulty in personal hygiene and several other daily activities. Participation Retriction in the form of patients will feel disturbed in their social environment, for example in

their work which is difficult to return to as usual.

Related to the problems found in the practice field, the interventions provided are Propioceptive Neuromuscular Facilitation (PNF), ryhtmical initiation and contract relaxation techniques, as well as core stability in the form of Bridging exercises, Exercise therapy using the PNF method also has a therapeutic effect that is appropriate for patients with probelmatic complaints complaining. The purpose of PNF is for treatment at the structural and activity level, while core stability for the ability to control movement from the trunk and extremities is disturbed. So that it increases the strength of the core muscles that are responsible for maintaining spinal stability, as well as increasing the strength of weak limbs, so that it can improve balance and coordination in stroke patients.

2. Material and Method

2.1. Description of the Study Area

The study was conducted at Stroke Center Hospital, Makassar, Indonesia in June to August 2024. The type of this research is experimental using Quasi Experimental design and using pre test and post test two-group design method. The first group was given the Core Stability intervention, while the second group was given the Proprioceptive Neuromuscular Facilitation (PNF) intervention.

2.2. Population and Sample

The study population is all non-hemorrhagic post-stroke patients who experience muscle weakness in the arms or legs that cause impaired standing balance in post-stroke patients in Stroke Center Hospital as many as 32 patients. The samples in the study were all non-hemorrhagic post-stroke patients who experienced standing balance disorders who were selected as many as 30 people by purposive sampling. The sample was divided into 2 groups with a sample of 15 people each, group I was given an intervention in the form of core stability and group II was given an intervention in the form of Proprioceptive Neuromuscular Facilitation (PNF).

2.3. Collecting Data and Procedure Intervention

The data collection procedure was carried out in several stages. First, an initial test (pre-test) was conducted by examining the standing balance is measured using Berg Balance Scale on all samples before being treated. Furthermore, treatment was given for four times. Group 1 received core stability, while group 2 was given Proprioceptive Neuromuscular Facilitation (PNF). After the treatment was completed, a final test (post-test) was conducted by re-examining the standing balance is measured using Berg Balance Scale to see the changes that occurred after the intervention.

2.4. Ethical consideration and clearance

Ethical approval for this study was obtained from The Ethics Committee, Health Polytechnics of Makassar, Department of Physiotherapy, Makassar by number: No. 0552/M/KEPK-PTKMS/V/2024

3. Result

This study uses a type of quasi-experimental research using a pre-test post-test two-group design. This research was conducted in June – August 2024 at the Stroke Center Hospital Makassar. The treatment given for group 1 is Core Stability, for group 2 is PNF. Standing balance is measured using Berg Balance Scale. The intervention was given 4 times interventions, in the last intervention a remeasurement was carried out to assess standing balance is measured using Berg Balance Scale.

Table 1: Characteristics of Respondents Subject Characteristics

	Core Stability		PNF	
	n	%	n	%
Age				
a. 34-59 years	14	93,3	9	60,0
b. 60 years and above	1	6,7	6	40,0
Total	15	100	15	100
Gender				
Male	6	40,0	8	53,3
Female	9	60,0	7	46,7
Total	15	100	15	100

Table 1 shows that the gender for the treatment group with core stability is more female than male, while the treatment group with PNF is the opposite.

Table 2: Standing balance before and after intervention

Standing Balance Differences	n	Mean	SD	p-value
Core Stability Treatment Group				
Pre test	15	26,60	10,689	0,000*
Post test	15	33,80	11,353	
PNF Treatment Group				
Pre test	15	27,27	11,132	0,001**
Post test	15	37,00	12,059	

Information: *Paired sample t test, **Wilcoxon test

Based on Table 2, core stability obtained a standing balance pretest value of 26.60 and a posttest of 33.80, with a higher value indicating better balance. These results indicate a significant improvement in standing balance. The paired sample t test showed a p value = 0.000 <0.05, which means that core stability has a significant effect on standing balance. Likewise, the provision of PNF resulted in a dynamic balance pretest value of 27.27 and a posttest of 37.00, which also showed a significant improvement in standing balance. The results of the Wilcoxon test gave a p value = 0.000 <0.05, so that the provision of PNF was proven to have a significant effect on standing balance.

Table 3: Difference in standing balance scores between the two treatment groups

Changes in standing balance score	n	Mean	SD	p-value
Core Stability	15	7,20	2,569	0,037*
PNF	15	9,73	2,987	

Information: * Man Whitney test

Table 3 shows the results of the Man Whitney test obtained a p value = 0.000 <0.05. This means that there is a difference in the effect between the two treatment groups on the standing balance of post-stroke patients. The PNF treatment group showed a difference in the pretest and post-test standing balance of 9.73, greater than the treatment group with core stability which was 7.20. So, it can be concluded that PNF is more effective than core stability in improving the standing balance of post-stroke patients.

4. Discussion

Effect of core stability on standing balance of post-stroke patients

Core stability training works by strengthening the muscles that support the spine and pelvis, including the abdominal and paraspinal muscles. This increased strength helps maintain an upright posture and enables more effective weight transfer during movement. Research shows that patients participating in core stability training exhibit greater muscle activation and coordination, which are crucial for maintaining balance [10][11].

This research is in line with Granatcher et.al' s research, which states core stability affects balance by providing proximal stability for distal mobility, facilitating the transfer of torque and angular momentum between the lower and upper extremities during daily tasks. Improved core stability, which combines core strength and spinal mobility, results in better balance performance and functional mobility in older adults [11].

This exercise enhances core musculature, augments postural stability, and bolsters proprioceptive function, frequently compromised by stroke. Enhancing core stability facilitates more efficient body weight transfer, allowing patients to sustain an improved standing posture. The efficacy of this exercise is contingent upon the stroke's severity, the time elapsed since the stroke, and the patient's motivation. Core stability should be integrated with additional rehabilitation regimens for optimal outcomes.

Effect of PNF on standing balance of post-stroke patients

Research shows that PNF have a significant effect on the standing balance of post-stroke patients. PNF obtained a pretest value of 27.27 (bigger is better) and post test is 37.00 (bigger is better). This shows a significant improvement in dynamic balance.

Proprioceptive Neuromuscular Facilitation (PNF) is a physical therapy method designed to improve strength, flexibility, and coordination through proprioceptive stimulation. In post-stroke patients, standing balance is often

impaired due to neurological impairment that affects motor control and proprioceptive ability. PNF aims to improve this function by using specific movement patterns that stimulate nerves and muscles, thus assisting patients in restoring their balance.

PNF is an effective rehabilitation strategy for improving standing balance in post-stroke patients. By enhancing muscle activation[13], trunk control [14], and overall balance measures, PNF contributes significantly to functional recovery. Incorporating PNF into rehabilitation programs can lead to improved outcomes for stroke survivors, ultimately enhancing their quality of life and reducing fall risk. Continued research is necessary to further quantify these benefits and refine intervention protocols for optimal effectiveness.

This study is in line with research that states that PNF has a significant effect in improving the balance of patients after non-hemorrhagic hemiparese stroke. Core strengthening exercises with pelvic PNF can improve balance ability in hemiparese patients after non-hemorrhagic stroke [15].

PNF approaches, incorporating functional movement patterns and proprioceptive stimulation, enhance muscular strength, improve coordination, and restore postural control. PNF enhances the body's awareness of position and movement, which is crucial for balance. The efficacy is contingent upon the severity of the stroke and the engagement of the patient.

Differences in the influence of core stability and proprioceptive neuromuscular facilitation (PNF) on standing balance in post-stroke patients

The results of the Man Whitney test obtained a value of $p = 0.000<0.05$. This means that there is a difference in the influence between the two treatment groups on the standing balance of post-stroke patients. The PNF treatment group showed a difference between the pretest and post test of standing balance of 9.73, which was greater than the treatment group with core stability of 7.20. So it can be concluded that PNF is more effective than core stability in improving the standing balance of post-stroke patients.

In general, Proprioceptive Neuromuscular Facilitation (PNF) can be considered more effective than core stability in improving the standing balance of post-stroke patients due to PNF's more comprehensive approach in training motor coordination, postural control, and functional movement patterns. PNF helps patients better cope with balance challenges caused by stroke by targeting the various neuromuscular aspects involved in maintaining a standing position. On the other hand, while core stability is important for supporting balance by strengthening the core muscles, it may be less effective in addressing coordination and proprioceptive disorders directly

5. Limitations of the Study

This study has multiple limitations, including a restricted sample size, a brief intervention period, and variability in post-stroke patient circumstances that may influence the outcomes. The efficacy of specific measuring tools may exhibit diminished sensitivity to minor variations, while extrinsic factors, including patient motivation and

adherence, also contribute significantly.

6. Conclusion

Core stability exercise has a positive effect on improving standing balance in post-stroke patients at the Stroke Center Hospital. In addition, the Proprioceptive Neuromuscular Facilitation (PNF) technique is also effective in improving standing balance in post-stroke patients at the same facility. Furthermore, there is a difference in effectiveness between the two methods, where PNF shows better results than core stability in improving standing balance in post-stroke patients. These results indicate that PNF can be a more effective choice in rehabilitation interventions to improve standing balance in post-stroke patients.

7. Abbreviation

PNF: Proprioceptive Neuromuscular Facilitation

8. Competing interest

The authors declare that they have no competing interest

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