ORIGINAL ARTICLE

Effects of core strengthening and proprioceptive neuromuscular facilitation technique on the Barthel index and balance in patients with hemiplegic stroke: A quasi-experimental study

Qandeel Yousaf[1], Rabiiya Noor[2], Imran Ghafoor[3]

Abstract

Objective: To determine the effectiveness of core strengthening exercises and proprioceptive neuromuscular facilitation techniques on functional performance and balance among patients with hemiplegic stroke.

Method: The quasi-experimental study was conducted from March to August 2021 at Imran Idrees Hospital, Sialkot, Pakistan, and comprised stroke patients of either gender who were divided into proprioceptive neuromuscular facilitation group A and core strengthening group B. In both groups, the treatment was given for 6 weeks with 5 30-minute sessions per week. Functional performance and balance were measured using Barthel Index and Berg Balance Scale. Data were collected at baseline, 3 weeks and 6 weeks. Data was analysed using SPSS 22.

Results: Of the 48 patients, 24(50%) were in each of the 2 groups. There were 39(81.25%) male and 9(18.75%) female subjects with an overall mean age of 45±4.919 years. Mean Barthel Index score in group A was 62.50±7.22 at baseline and 74.79±7.14 after 6 weeks. Mean Berg Balance Score was 25.04±2.15 at baseline and 41.66±6.04 after 6 weeks (p<0.05). In group B, Barthel Index score was 61.45±6.33 at baseline and 80.83±7.61 after 6 weeks. Mean Berg Balance score was 25.33±3.38 at baseline and 47.08±5.99 after 6 weeks (p<0.05). There was a significant difference in group B scores compared to group A (p<0.01).

Conclusion: Core strengthening programme was more effective than the proprioceptive neuromuscular facilitation programme in terms of activity of daily living and balance in patients with stroke.

Keywords: Activity of daily living, Berg Balance Scale, Barthel Index, Core strengthening, Proprioceptive neuromuscular facilitation, Stroke. (JPMA 73: 2153; 2023) **DOI: https://doi.org/10.47391/JPMA.7903**

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Introduction

Stroke leads to rapid damage to brain functioning because of disruption in the blood supply to the brain. It occurs because of a blood clot causing ischaemia or haemorrhage of blood vessels.[1] With an aging population, developing countries, especially South Asian countries, such as Pakistan, should expect an increase in the number of stroke cases and a commensurate increase in the annual stroke burden. According to limited data from previous studies in underdeveloped nations, the epidemiology of stroke differs from that of Western countries.[2]

Sensory, motor, mental and perceptual loss occurs after stroke and these deficits can affect the normal functioning of an individual through impairments and impact the recovery potential of an individual.[3] Stroke survivors feel difficulty in balance maintenance as they are restricted by postural abnormality, difficulty in transferring weight, and abnormal body asymmetry.[4] These deficits are termed post-stroke syndrome, which has a negative effect on their routine activities along with the restriction related to social participation.[5] Furthermore, dynamic and static balance is also affected, contributing to the fear of falls, the risk of falls, and restraining the patient to routine activities.[6,7] Various scales can be used to assess the balance among stroke patients, particularly the Berg Balance Scale (BBS), which is used in measuring balance in older populations by determining the performance level of useful tasks.[8]

Individuals suffering from stroke can change the performance accuracy of the activity of daily living (ADL) by increasing dependence and decreasing independence. Any fitness challenge capable of impacting ADL performance leads to changes in the scores of Barthel Index (BI). ADLs are essential tasks of self-care learning during early childhood, including feeding, clothing, toiletting, grooming, bathing and transferring. These tasks can be performed efficiently by physically healthy individuals who can maintain their erect posture necessary for balance maintenance.[9] Proprioceptive neuromuscular facilitation (PNF), also known as PNF stretching, is the most efficient form of muscle flexibility training, and improves the range of motion (ROM). PNF stretching can be performed on people of all age groups focussing on

[1]Department of Physical Therapy, Imran Idrees Institute of Rehabilitation Sciences, Sialkot Medical College, Sialkot, Pakistan; [2,3]College of Rehabilitation and Allied Health Sciences, Riphah International University, Lahore, Pakistan.

Correspondence: Qandeel Yousaf. e-mail: qandeelyousaf@hotmail.com

ORCID ID. 0000-0003-0469-8103

flexibility training of a muscle and reducing the hypertonicity, promoting muscle relaxation and lengthening it. It could be used as a supplement to a daily stretching and can help achieve muscular endurance and strength, stabilisation of joint neuromuscular control, coordination and mobility. PNF techniques being used are contract-relax rhythmic initiation, hold-relax, rhythmic stabilisation, alternating isometric, slow reversal, and alternating rhythmic stabilisation, which is used to develop coordination in the muscles.[10,11]

Furthermore, core stability exercises can be characterised as recovery and enhancement in the competence of the neuromuscular system to safeguard and control the vertebral column from being injured or reinjured. These exercises rebuild coordination and maintain the control of trunk muscles and the lumbar spine.[12] Balance is maintained by the integration of the visual, proprioceptive neuromuscular and vestibular systems. Performances of these systems decline with age, leading to the enhanced risk of fall and imbalance among older adults.[13]

The current study was planned to measure the effectiveness of proprioceptive neuromuscular facilitation (PNF) and core strengthening on ADLs and balance among hemiplegic stroke patients.

Patients and Methods

The quasi-experimental study was conducted from March to August 2021 at Imran Idrees Hospital, Sialkot, Pakistan. After approval from the institutional ethics review board of Riphah International University, Lahore, the sample size was calculated using G*Power version 3.1.9.2[14] with 0.95 power of study, 5% margin of error, effect size 0.47,[15] non-centrality parameters (δ) 3.68 and critical t 2.01. The sample was raised using convenience sampling technique. Those included were patients of either gender aged 45-60 years with first-ever unilateral ischaemic stroke having at least 6-month duration who were able to walk with or without support for 10 minutes. Those with recurrent stroke, brainstem or cerebellar stroke, haemorrhagic stroke, severe spasticity (Modified Ashworth Scale grade ≥3), and severe flaccidity in the lower limbs and upper limbs were excluded.

After taking written informed consent from all patients or their attendants, the subjects were divided into PNF group A and core strengthening group B. BI was used as an outcome tool to measure the functional index, with reliability 0.89 and validity 0.96.[16] The patients were given 10 tasks to complete and the score was based on how much time or support they needed. The total score ranged from 0 to 100, with lower values indicating a higher level of nursing reliance.[17]

The second outcome tool was BBS.[18] The scale takes 10-20 minutes to assess a patient's ability to maintain balance for a set period, either in the standing position or during functional movements. The items were graded on a scale from 0 to 4, with 0 indicating inability to complete the activity, and 4 indicating completion of the task independently. Out of 56 available points, a global score was determined.[19]

In group A, PNF techniques were given for 6 weeks with 30-minute sessions 5 days per week, including a rest period of 6 minutes. The first rhythmic initiation was given for 10 minutes, followed by 10 minutes of slow reversal and 10 minutes of agonistic reversals, with a rest of 2 minutes after each 10-minute session.

In group B, core strengthening exercises were given and the participants were asked to lift alternate arms while being in a quadruped position, then alternate leg lifts gradually, and then to activate multifidus, alternate arms and legs were raised. Then different positions were performed by the participants, including trunk curls in crook lying, slight lift of the upper trunk at a 15° angle from the plinth, and this position was held for 5 seconds. Throughout the intervention, normal diaphragmatic breathing was continued by the participants.[20] In contrast, group B was given 10 repetitions with 5-second rest period for 5 days per week for 6 weeks. Data was collected at baseline, 3 weeks, and 6-week follow-up. Data was analysed using SPSS 22. Normality was checked using Shapiro-Wilks test with $p>0.05$. Repeated measurement analysis of variance (ANOVA) for intra-group, and independent t-test to make inter-group comparisons were used. Statistical significance was set at $p<0.05$ with 95% confidence interval (CI).

Results

Of the 48 patients, 24(50%) were in each of the 2 groups. There were 39(81.25%) male and 9(18.75%) female subjects with an overall mean age of 45±4.919 years (Table 1).

Mean BI score in group A was 62.50±7.22 at baseline and 74.79±7.14 after 6 weeks. Mean BBS was 25.04±2.15 at baseline and 41.66±6.04 after 6 weeks ($p<0.05$). In group B, BI score was 61.45±6.33 at baseline and 80.83±7.61 after 6 weeks. Mean BBS was 25.33±3.38 at baseline and 47.08±5.99 after 6 weeks ($p<0.05$) (Table 2). There was a significant difference in group B scores compared to group A ($p<0.01$) (Table 3).

Table-1: Demographic data.

Variables	PNF (A) (n=24) [n (%)]	Core Strengthening (B) (n=24) [n (%)]	*p*-value
Gender			
Male	22 (91.66)	17 (70.83)	0.13
Female	2 (8.33)	7 (29.16).	
Body Mass Index (BMI)			
Normal	8 (33.33)	6 (25)	0.93
Over-weight	10 (41.66)	11 (45.83)	
Obese	6 (25)	7 (29.16)	
Time since stroke (TSS) (months)			
6	6(25)	0 (0)	0.04
8	12 (50)	10 (41.66)	
10	0 (0)	4 (16.66)	
12	6 (25)	5 (20.83)	
>12	0 (0)	5 (20.83)	
Mean Age (years)	45± 4.919		

PNF: Proprioceptive neuromuscular facilitation

Table-2: Intra-group comparison.

Outcomes	PNF Group (A)		Core Strengthening(B)		
	Mean±SD	Mean Std. Error	Mean±SD	Mean Std. Error	*p*-value
Barthel Index					
Baseline	62.50±7.22	1.47	61.45±6.33	1.29	<0.01
After 3 weeks	69.58±7.35	1.50	70.00±5.89	1.20	
After 6 weeks	74.79±7.14	1.45	80.83±7.61	1.55	
Berg Balance Balance					
Baseline	25.04±2.15	0.44	25.33±3.38	0.69	<0.01
After 3 weeks	30.45±2.32	0.47	33.62±3.70	0.75	
After 6 weeks	41.66±6.04	1.22	47.08±5.99	1.23	

PNF: Proprioceptive neuromuscular facilitation *p*-value was significant at $p<.05$

Table-3: Inter-group comparison.

Outcomes	Mean Difference	Mean Error	*p*-value
The Barthel Index			
Baseline	1.04	1.04	0.59
After 3 weeks	-0.41	1.92	0.83
After 6 weeks	-6.04	2.13	<0.01
Berg Balance Balance			
Baseline	-0.29	0.81	0.72
After 3 weeks	-3.16	0.89	<0.01
After 6 weeks	5.41	1.73	<0.01

p-value was significant at $p< 0.05$

Discussion

The study showed better improvement in ADL performance in stroke patients receiving core strengthening exercises. Mean BI score significantly improved in the experimental group (p=0.008), which is consistent with earlier findings.[20] Another study reported that a positive correlation was present among these, because the spine is being stabilised by contraction of the pelvic and trunk musculature in reaction to the forces that act on the lower limb and increase the stability of the pelvis during the support phase.[21]

In the current study, PNF was effective along with core strengthening exercise for improving ADLs (p<0.00) showing significant improvement compared to core strengthening alone. The effectiveness of PNF therapy combined with the strengthening of upper limb motor impairment in ischaemic post-stroke hemiplegic patients, as well as increased limb function and ADLs, which was superior to PNF therapy alone has been reported earlier.[22] PNF is a common intervention in patients having difficulty in performing their daily routine tasks by facilitating the proprioceptors, which had a direct effect on neuromuscular coordination. For years, this has been a relevant method in therapeutic techniques. Recently, a greater emphasis on functional activities has enabled the PNF approaches to become an important feature of this type of physical activity. PNF can be included in stroke survivors' functional training.[23] Another study on stroke patients evaluated the functioning and mobility treated with core stability exercises. The findings supported the use of core stability training to help stroke patients with trunk dysfunction, and were found to benefit from core stability training based on a graded methodology after training has progressed to advanced ways for achieving the stability needed for activity performances.[24] A study stated that core stability plays a vital role in successfully performing ADLs in older and healthy subjects. BI did not show significant improvement, which may be because activities that were measured using BI happened to be different than that of the activities for which patients were being trained.[25] Another study evaluated aquatic PNF on lower extremity patterns for improving balance and ADL in 20 post-stroke patients, and concluded that improvement in balance and greater accuracy in ADL performance in the participants of the experimental group, revealing that PNF performed was beneficial for stroke patients and helped them to perform ADLs.[26]

In contrast, a study reported that regardless of cognitive status, the ADL statuses of sub-acute stoke survivors improved significantly in both groups as a result of long-term PNF use. In essence, age and mild or moderate cognitive impairment, long-term PNF/balance training improved ADLs, helped the patients to perform functional activities efficiently.[9] A study segregated patients suffering from stroke into control and PNF groups, and reported decrease in time used for performing time up and go (TUG) test, and increase in balance ability. Hence, the subjects showed improvement in maintaining balance among stroke survivors.[27]

The current study has limitations as there was no control

group which means excluding the phases of natural recovery was difficult to attain. The time frame of the study was short, and there were no patient follow-ups. Randomised controlled trial (RCTs) are recommended.

Conclusion

Core strengthening exercises had a significantly more positive impact on ADLs and in achieving optimum functional gains compared to PNF exercises in stroke patients.

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