



# Effects of Early Proprioceptive Neuromuscular Facilitation Exercises on Functional Outcome and Quality of Life in Patients with Stroke

<sup>1</sup>Poonam Chaturvedi, <sup>2</sup>Vandana Tiwari, <sup>3</sup>Ajai K Singh, <sup>4</sup>Dinkar Kulshrestha, <sup>5</sup>Pradeep K Maurya, <sup>6</sup>Anup K Thacker

## ABSTRACT

**Objective:** To evaluate the effects of proprioceptive neuromuscular facilitation (PNF) exercises on functional outcome and quality of life (QoL) in patients with acute stroke.

**Materials and methods:** Ninety patients were recruited in this study and divided into two groups: Patients admitted within 48 hours after stroke (group I, n = 41) and patients referred from elsewhere after 2 to 3 weeks (group II, n = 49). Both groups were given PNF exercises for 4 weeks. Functional outcome was assessed by Barthel Index (BI), and QoL was assessed by Stroke-Specific Quality of Life (SSQOL) scale before and after the intervention. Patients were followed up in the outpatient department of the Department of Neurology at 1, 3, and 6 months and BI and SSQOL scores were again assessed.

**Results:** Group I showed significant and better recovery in functional activities ( $p < 0.05$ ) and better QoL as compared with group II ( $p < 0.05$ ). We also compared functional outcome and QoL in ischemic vs hemorrhagic stroke ( $p = 0.284$ ) and left vs right stroke ( $p = 0.973$ ) and found there was no significant difference.

**Conclusion:** Improvement in activities of daily living may result in better QoL. The PNF exercises are very effective in improving muscle tone, functional outcome, and QoL. The PNF exercises should be given from the first day after stroke.

**Keywords:** Barthel index, Proprioceptive neuromuscular facilitation, Quality of life, Stroke.

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<sup>1</sup>Student, <sup>2,4,5</sup>Associate Professor, <sup>3,6</sup>Professor

<sup>1,3-6</sup>Department of Neurology, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

<sup>2</sup>Department of Biochemistry, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

**Corresponding Author:** Vandana Tiwari, Associate Professor Department of Biochemistry, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, Uttar Pradesh, India, Phone: +919415197228, e-mail: drvandana2166@yahoo.com

## INTRODUCTION

Stroke is the most common neurological problem in the world. It affects every aspect of life including functional outcome and QoL. Quality of life is defined as the multidimensional evaluation of physical, psychological, social, and environmental aspects.<sup>1</sup> Despite the progress made during inpatient rehabilitation, approximately 33% of stroke survivors still have deficits requiring additional rehabilitation in the community. The inability to access health care services may affect recovery and may result in declining cognition, poor QoL, and increased risk of medical complications.<sup>2</sup> Proprioceptive neuromuscular facilitation exercises are designed to promote the neuromuscular response of the proprioceptors. The PNF patterns have a spiral, diagonal direction (D1 and D2), and are in line with the topographical arrangement of the muscles, facilitating the activation of biarticular muscles.<sup>3</sup> The PNF techniques apply three-dimensional movement, stretch reflex, and resistance to promote functional movement.<sup>4</sup> Studies on effectiveness of PNF-based treatment are both conflicting and supportive.<sup>5-8</sup> Studies regarding application of PNF exercises in acute stroke are still lacking. Therefore, this study was designed to evaluate the effects of PNF exercises on functional outcome and QoL in the patients with stroke.

## MATERIALS AND METHODS

### Subjects

Ninety patients were recruited who were admitted in Department of Neurology at Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, Uttar Pradesh, India. Written informed consent was obtained from each patient or their legal relatives prior to their recruitment into the study. Patients were divided into two groups based on their hospital admission after stroke episode. Patients recruited in group I were those admitted to hospital within 48 hours after stroke and group II who were referred here from elsewhere after 2 to 3 weeks and did not receive PNF treatment earlier. The study was approved by institutional ethical clearance committee.

### Inclusion and Exclusion Criteria

Only patients with first-time stroke and between the age of 40 and 70 years were included in the study. Patients

having recurrent stroke, aphasia, severe cardiac illness (myocardial infarction), fracture, pregnancy, National Institutes of Health Stroke Scale (NIHSS) > 20, Mini-Mental State Examination < 19, any psychiatric illness, subarachnoid hemorrhage, and amputation were excluded from the study.

## Methods

Baseline data, viz., NIHSS, modified Rankin scale (MRS), and BI were recorded within 48 hours from the day of admission in both groups. Cause of stroke, whether ischemic or hemorrhagic, was recorded. Patients in both groups were given equal doses of PNF treatment, i.e., 30 minutes twice daily for 4 weeks in addition to the other medical management available at our institute. Proprioceptive neuromuscular facilitation exercises were given in cephalocaudal direction, i.e., first PNF was given for neck, trunk, scapula, pelvis, then for upper extremity and lower extremity. The patterns and techniques followed for PNF intervention were as follows:<sup>9,10</sup>

*PNF for neck:* Flexion with rotation to the left and extension with rotation to the right and vice versa, 10 repetitions of each

*PNF for trunk:* Rhythmic stabilization and alternating isometrics, 10 repetitions

*PNF for scapula and pelvis:* Anterior elevation and posterior depression; posterior elevation and anterior depression by rhythmic initiation and repeated contraction

*For upper and lower extremity:* D1 and D2 flexion and extension patterns

Again, functional activities were assessed after 4 weeks in each patient. Patients were discharged with instructions and to continue the exercises at home along with medication. Patients were further evaluated at 1, 3, and 6 months.

## RESULTS

The data were normally distributed by applying Kolmogorov–Smirnov test. Descriptive analysis was

**Table 1:** Anthropometric factors and baseline data of the both groups

Anthropometric factors	Group I, (n = 41)	Group II, (n = 49)
Age (mean ± SD)	61.3 ± 10.44	55.29 ± 11.07
GCS	14.95 ± 0.255	14.95 ± 0.218
NIHSS	6.53 ± 3.79	6.65 ± 3.49
MRS	3.72 ± 0.653	3.68 ± 0.765
Sex: M/F	33/8	31/18
Side affected: Right/left	20/26	15/29
Type of stroke		
Ischemic/hemorrhagic	26/15	38/11

done to calculate mean and standard deviation (SD) in both groups (Table 1). We applied independent t-test to compare the means in between groups and paired t-test to compare the means within group. A p-value of < 0.05 was considered significant.

The anthropometric factors [age, Glasgow Coma Scale (GCS), NIHSS, MRS] were almost similar in both groups. Patients in the both groups were conscious and oriented to time, place, and person. All the patients were having mild to moderate stroke (NIHSS < 15). There was no significant difference in performance of functional activities in both groups. Group I showed better improvement at 4 weeks, 1, 3, and 6 months (p < 0.05). The QoL was assessed at 1, 3, and 6 months. There was no significant difference in QoL in both groups at 1 month, but group I showed slightly better improvement than group II after 3 and 6 months (Table 2).

In this study, we also compared the functional outcome and QoL in the patients having ischemic and hemorrhagic stroke before and after the PNF intervention. Hemorrhagic stroke patients were having slightly better scores of BI and SSQOL, but on analysis the difference was not significant (BI, p = 0.284; SSQOL, p = 0.210). We also compared functional outcome and QoL in left and right hemispheric stroke with stroke before and after the PNF intervention. There was no significant difference in BI (p = 0.973) and SSQOL scores (p = 0.124) (Table 3).

**Table 2:** Results of assessment of functional activities and QoL within and in between groups

	Admission	4 weeks	1 month	3 months	6 months	p-value within group
<b>BI</b>						
Group I	33.97 ± 24.53	51.22 ± 25.62	74.59 ± 24.10	85.30 ± 19.26	90.20 ± 15.30	<0.001
Group II	26.95 ± 17.31	41.09 ± 18.35	62.07 ± 20.06	75.60 ± 16.09	81.82 ± 14.39	<0.001
p-value	0.127	0.037*	0.010*	0.012*	0.009*	
95% CI	(-2.03-16.09)	(0.615-19.63)	(3.11-21.92)	(2.16-17.22)	(2.10-14.64)	
<b>SSQOL</b>						
Group I			153.34 ± 48.60	185.57 ± 48.96	199.57 ± 48.01	<0.001
Group II			134.22 ± 39.88	162.71 ± 37.07	182.84 ± 34.96	<0.001
p-value			0.051 (-0.044-37.68)	0.016* (4.37-41.35)	0.054 (-0.77-35.04)	

CI: Confidence interval; \*Significant < .05

**Table 3:** QoL and functional activity scores in different cohort

	n	SSQOL	BI
Type of stroke Ischemic/hemorrhagic	90	p = 0.284	p = 0.210
Side affected Right/left	90	p = 0.973	p = 0.124

## DISCUSSION

The objective was to assess whether PNF is more effective in patients if initiated within 48 hours of stroke than when initiated later. Our results are showing improvement in both groups, but group I (patients receiving PNF exercises within 48 hours after stroke) has better improvement in functional activities (BI) than group II (Graph 1). Patients in group I were able to walk with minimum support after 1 month from the time of discharge to home. The results are also showing better QoL in group I (Graph 2). Improvement in disability leads to better QoL. Early improvement in the BI in group I may be the reason of early improvement in QoL. The PNF works on the principle that resisting the strong muscle causes irradiation effect in surrounding weak muscles and muscles of contralateral side also.<sup>4,9</sup> This results in building up of tone in flaccid and weak muscles. We tried to apply this principle in stroke patients to generate tone and voluntary control in flaccid and weaker muscles in extremities. The PNF for neck, trunk, scapula, and pelvis was given first. When tone improved in proximal muscles, we proceeded for distal segments.

Efforts were made to find efficacy of PNF exercises in other cohorts, such as ischemic *vs* hemorrhagic stroke and left *vs* right hemispheric stroke. On analysis, we found there was equal improvement in both ischemic and hemorrhagic stroke group. Studies reported earlier state that hemorrhagic stroke has higher mortality risk than ischemic strokes.<sup>11-20</sup> To our knowledge, current

study is the first to assess the effect of PNF exercises on functional outcome and QoL in acute stroke. Paolucci et al<sup>21</sup> have stated that the patients with hemorrhagic stroke have better functional prognosis but the other prognostic factors, such as stroke origin, stroke severity, age, and onset to origin interval strongly affect the functional outcome. Haacke et al<sup>22</sup> considered BI as an important predictor of QoL. They classified the scores as <30 = needs institutional care, 30 to 70 = needs some help, and >70 functionally independent.

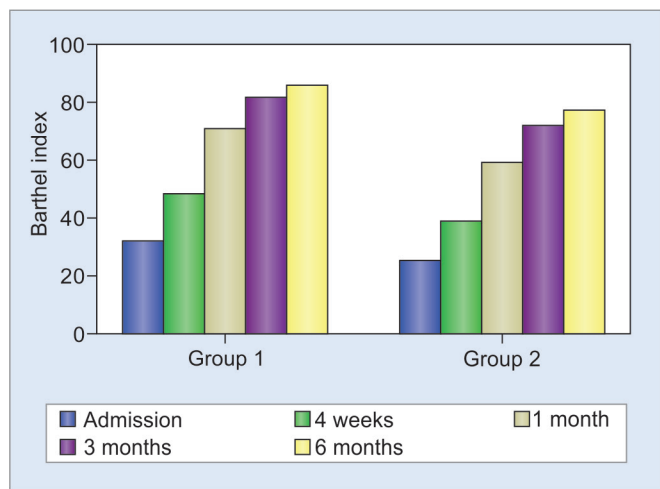
We also compared the effects of PNF exercises in left and right hemispheric stroke. Again, we found that PNF improved the functional outcome and QoL irrespective of hemisphere involvement. Our study is supported by the results of a study carried out by Nam et al<sup>20</sup> who found that the effect of paralysis on dominant hand and QoL in patients with subacute stroke is not significantly different from the effect of paralysis on nondominant hand. Paralysis of dominant hand had no added effect on QoL beyond the effect of stroke itself.

## Clinical Significance

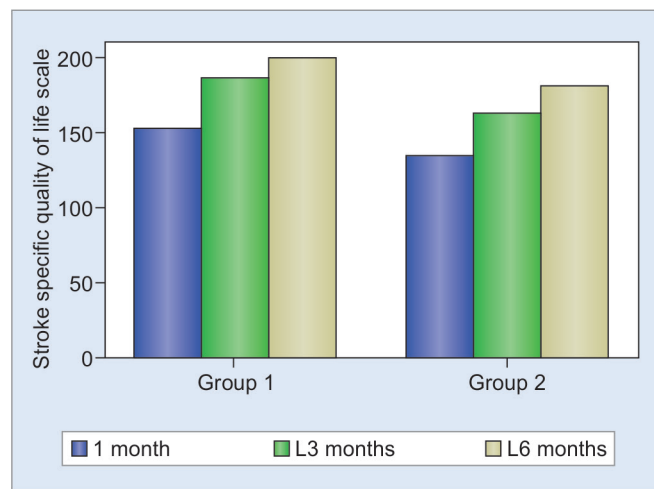
The PNF exercises are efficient to improve tone in muscles. They are very similar to our functional movements so they can be implemented to teach functional activities by the physical and occupational therapists. This may also enhance the neuroplasticity. This must be the future study.

## CONCLUSION

In our study, we found that the patients with acute stroke who received earlier PNF improved more than the patients who received PNF after 2 to 3 weeks of stroke. For better and earlier improvement, PNF must be implemented from the first day after stroke.



**Graph 1:** Increased improvement in BI in group I than in group II



**Graph 2:** Improvement in QoL in group I than in group II

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