



EFFECT OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ON PELVIS FOR IMPROVEMENT OF GAIT IN PATIENTS WITH ACUTE MCA STROKE: DOUBLE-BLINDED RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Introduction: Gait dysfunction is one of the most devastating outcomes of stroke, caused by pelvic instability, which results in asymmetry of pelvis and unequal weight-distribution on the lower extremity. **Purpose:** To analyze the effect of Proprioceptive neuromuscular facilitation on stability of pelvis on movement performance post-stroke. **Method:** A sample of 70 patients with acute MCA stroke with pelvic instability of age 50-75 was recruited. A protocol of 4-day treatment sessions was given to all the patients—the protocol comprised of PNF Rhythmic stabilization and reversal of antagonist. The trunk impairment scale (TIS), Fullerton advanced balance scale (FAB), and Wisconsin gait scale (WGS) were used to measure performance. **Results:** Analyzing within the group, WGS, TIS, and FAB show significant improvement in both the groups (p-value 0.001), while comparing intergroup post data, TIS and FAB show statistically significant improvement (p-value 0.05) while WGS shows no significant difference (p = 0.631). **Conclusion:** This study shows that interventions targeting the PNF on the pelvis in acute MCA stroke are highly effective in rehabilitation for improving walking, trunk impairment, and enhancing balance independence and quality of life.

KEYWORDS : PNF, Pelvic stabilization, Gait improvement, Motor control recovery, Neuromuscular re-education

INTRODUCTION

Stroke causes aberrant movement patterns, which leads to functional restrictions and disabilities. The most prevalent symptoms of a stroke are hemiplegia and hemiparesis, and gait impairment is one of the most devastating complications.² Gait recovery is a necessary and key goal to achieve since gait is a crucial component of functional independence.^{1,2} In this aspect, hemiplegic individuals demonstrate impairments in the selected capacity of regulated and coordinated motions, resulting in delayed stride speed and compensatory movements by the LE of the unaffected side.^{4,5}

After a stroke, weakness in half of the body is the most difficult disability that affects the walking or gait cycle.³ Following a stroke, 80% of people exhibit chronic gait abnormalities, which create walking difficulties due to unequal muscle tone, forced pattern development, impairments in sensory and motor processes, and the brain's controlling mechanism.⁵

Stability of pelvis involves the coordination of the lower trunk and hip muscles to work together effectively. Therefore, the pelvis plays a vital role in providing stability in activities requiring movement.⁶ Leaning will cause problems in the biomechanical chain.⁶ The most common symptoms include altered gait phases, slower cadence, longer ambulation time, and shorter step and stride length. Altered movement of pelvis, reduces weight acceptance on the affected lower leg and results from poor pelvic dissociation or decreased muscular control, making mobility difficult.^{6,7}

Several therapy approaches have been developed to promote independence and lessen disabilities using the neuro-developmental approach, motor learning, and motor control to improve function, and PNF is one intervene. It increases neuromuscular reactivity by activating proprioceptors.

Principles of Neuroplasticity and PNF are same as in both continued repetition of the desired task specific movement and exercises that are similar to regular activities to increase mobility, prevent more decline and increase functional independence.⁹

PNF consists of therapeutic exercises that use a proper series of facilitation and synergy patterns to attain muscle strength and neuromuscular re-education that includes facilitation, inhibition, strengthening, and relaxation of muscle groups to promote functional movements.⁸

In addition to providing trunk stability, the pelvic PNF allows lower extremity and pelvic movements. Prioritize eccentric muscular contraction and promote the study of postural reflexes by agonist activity. A variety of PNFs can be applied, depending on the site of

affection. Among them, rhythmic initiation & reversal antagonists aid in the alternation of static contractions rather than providing sufficient resistance to allow stability that intended to influence the pelvis as key control of gait pattern.⁷

Even though pelvic PNF is modest to administer and has been shown to increase gait performance but not in use frequently in ordinary rehabilitation.¹⁰ Thus, this research's purpose was to determine which therapy method would best serve patients seeking to achieve appropriate ambulation while also saving them time and providing the most appropriate care.

MATERIAL AND METHODS

In a double-blinded randomized controlled trial conducted at the Himalayan hospital over a period of 9 months, the efficacy of different therapeutic interventions for stroke rehabilitation was investigated with 70 participants, including both males and females. The study aimed to assess the impact of Task-Specific Proprioceptive Neuromuscular Facilitation (PNF) versus conventional therapy on various aspects of gait and balance in stroke patients.

STUDY DESIGN AND SETTING:

The study was a double-blinded randomized controlled trial conducted in a hospital setting in the Himalayan region.

STUDY POPULATION:

Participants included individuals aged 50 to 75 who had experienced a single unilateral stroke (specifically MCA infarct) and met several inclusion criteria:

- Brunnstrom's voluntary control grade 2 or higher in the affected lower extremity.
- Ambulatory status prior to the stroke.
- Modified Ashworth Scale (MAS) grade of 1+.
- Mini-Mental State Examination (MMSE) score greater than 24.

EXCLUSION CRITERIA INCLUDED:

- Severe cardiopulmonary disease.
- Orthopedic conditions that interfere with walking.
- Perceptual or cognitive deficits.
- Recent hip or knee replacements (THR, TKR).
- Medical instability

SAMPLING AND PROCEDURE:

Participants were randomly allocated into two groups using simple random sampling:

GROUP A (EXPERIMENTAL): 35 participants received Task-Specific Proprioceptive Neuromuscular Facilitation (PNF) targeting

the pelvis. The PNF intervention included two specific techniques: Rhythmic initiation and Reversal antagonists. Each session lasted 30 minutes, conducted twice daily for 4 days, totaling 8 sessions.

GROUP B (CONTROL): 35 participants received conventional therapy, which included a variety of exercises and activities such as strengthening exercises, pelvic bridging, mobilization with active assistance, bed mobility training, and gait training. Task-specific activities included sitting to standing with armrest support, walking forward and sideward with eyes open, and dual-task activities like picking up a ball or glass from the paretic side and placing it on the opposite side.

MATERIALS USED:

- Couch
- Chair with armrest
- Footstool
- Mirror
- Ball

ASSESSMENT AND OUTCOME VARIABLES:

Pre- and post-intervention assessments were conducted by a separate therapist following comprehensive guidelines. The outcome variables measured included:

- Wisconsin Gait Scale (WGS)
- Fullerton's Advanced Balance Scale (FAB)
- Trunk Impairment Scale (TIS)

POST-INTERVENTION ASSESSMENT:

Assessment was performed after 4 days of intervention to evaluate the effectiveness of the treatments based on the outcome measures mentioned.

This study aimed to provide insights into the relative efficacy of Task-Specific PNF versus conventional therapy in improving gait, balance, and trunk impairment in stroke patients.

DATA ANALYSIS

The data was collected and entered in MS Excel. Different statistical Analysis was performed using SPSS software version 2022. Descriptive statistics was calculated for the quantitative variable. Frequency along with percentage was calculated for qualitative variables. Shapiro-Wilk test was used to determine normality.

To evaluate the Wisconsin gait scale, the Trunk impairment scale outcome measures data within the group, and the paired T-test was used. Analysis for Wisconsin gait scale and Trunk impairment scale outcome measures for intergroup analysis, the paired T-test was used. To evaluate Fullerton's advanced balance scale outcome measure within and intergroup, the Kruskal- Wallis test was used.

RESULTS

In WGS, both the groups considered statistically significant (p value <0.001), while there is no significant difference found in intergroup comparison with p-value of .631. Both the TIS were pertaining to be significant with p values <0.001, however the intergroup comparison of the experimental group revealed a statistically significant difference (p value < 0.001). The results of the experimental group's as compare to control group rehabilitation outcomes for stroke patients were found to be statistically significant in the FAB (p-value < 0.001) and functional independence and quality of life were ultimately improved.

Table 1 : Gender frequency

	FEMALE	MALE	TOTAL
GROUP A	15	20	35
GROUP B	14	21	35
TOTAL	29	41	70

Table 2 : Affected side frequency

AFFECTED SIDE	FEMALE	MALE	TOTAL
LEFT	16	17	33
RIGHT	19	18	37
TOTAL	35	35	70

Table 3 : Pre – post Wisconsin gait scale analysis

Group	WISCONSIN GAIT SCALE		p-value
	Pre WGS	Post WGS	
	Mean±SD	Mean±SD	
A	34.94±5.058	22.77±3.835	0.0001
B	35.46±3.467	28.17±3.65	0.0001
p-value	0.003	0.631	

Group	TRUNK IMPAIRMENT SCALE		p-value
	Pre TIS	Post TIS	
	Mean ±SD	Mean±SD	
A	9.46±3.147	17.77±1.832	.001
B	7.43±3.559	14.11±3.046	.001
p-value	0.369	0.01	

Table 4 : Pre – post trunk impairment scale analysis

Group	FULLERTON ADVANCED BALANCE SCALE		Wilcoxon signed rank test
	Pre	Post	
	Median (IQR)	Median (IQR)	
A	3.00(6.00-2.00)	16.00(19.00-14.00)	0.0001
B	3.00(6.00-2.00)	11.00(14.00-8.00)	0.0001
Kruskal - wallis test	0.967	0.0001	

Table 5 : Pre – post Fullerton advanced balance scale analysis

Group	FULLERTON ADVANCED BALANCE SCALE		Wilcoxon signed rank test
	Pre	Post	
	Median (IQR)	Median (IQR)	
A	3.00(6.00-2.00)	16.00(19.00-14.00)	0.0001
B	3.00(6.00-2.00)	11.00(14.00-8.00)	0.0001
Kruskal - wallis test	0.967	0.0001	

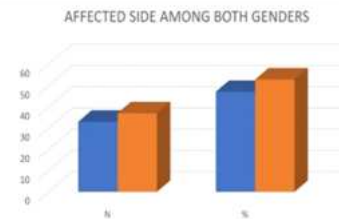


Figure 1 shows the participants in group A were 15 females and 20 males and in group B, 14 females and 21 males

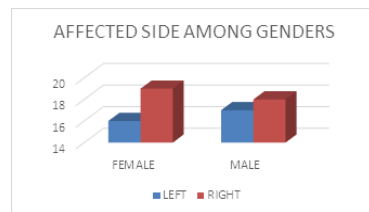


Figure 2 shows left sided affected in group A were 16 females and 17 males and right sided affected in group B 19 females and 18 males

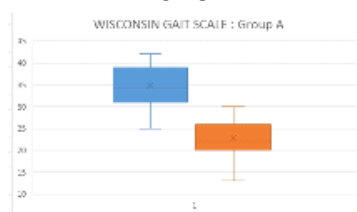


Figure 3 shows pre-post data within the Group A

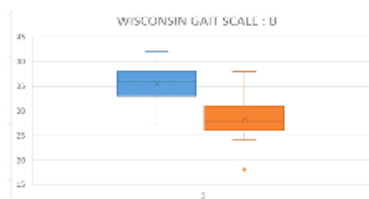


Figure 4 shows pre-post data within the Group B

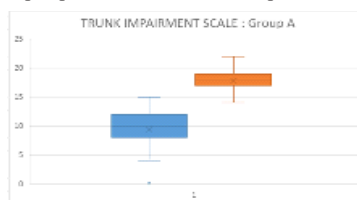


Figure 5 shows pre-post data within the Group A

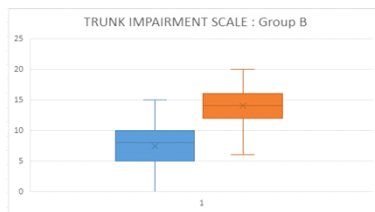


Figure 6 shows pre-post data within the Group B

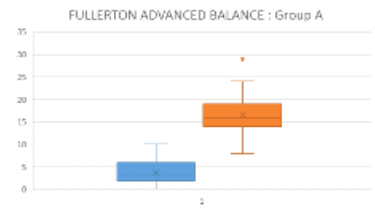


Figure 7 shows pre-post data within the Group A



Figure 8 shows pre-post data within the Group B

DISCUSSION

The study's findings provide persuasive evidence that PNF therapy targeting the pelvic improve gait, trunk dysfunction, and balance in individuals with acute MCA stroke. Kumar et al (2016) conducted study on various neurophysiologic approaches like PNF, NDT, Brunnstrom technique in subacute patients but there was a lot of variation and combination of therapies not focuses solely. The sample used in earlier research was small and varied in terms of age and the kind and onset of stroke.

Chang-Heon Kim et al (2018) documented about treadmill exercise.12

In previous studies, it has been seen the effect of PNF on pelvic, knee, and ankle for improvement of gait in Subacute and Chronic cases conducted by Vishal Sharma et al (2017), so they stated PNF as an effective treatment for gait improvement in Subacute and Chronic cases13, but in this study it solely focuses on the patients with Acute MCA Stroke only on pelvis for improvement of gait.

Another study, impact of PNF for knee and ankle muscles in subacute patients, done by Apeksha et al (2019), indicated that rhythmic stability is a beneficial approach for improving gait and balance.11.

Saifee S et al (2022) conducted study to study combine effect of NDT and PNF which stated Pelvic PNF improves pelvic function.5

While numerous studies have shown the effectiveness of various methods in enhancing gait and functional mobility, there is a lack of research specifically focusing on the use of PNF on pelvis to improve mobility, heterogeneity in the type of stroke and sample was a significant issue. In the current study, it focused on the affected side, MCA stroke and implemented an age limit to address these variations.

The purpose of the current study was to show that PNF targeting the pelvic region is effective. The WGS scores of the experimental and control groups were found to be statistically significant, but there was no significant difference observed in the intergroup comparison.

Various studies have suggested that lower extremity strength training can improve the functional performance in individuals with stroke 14 whereas in this study it has been found that improvement in balance and function because of Reversal of antagonist on pelvis.

The experimental group's significant improvement in balance (FAB) and (TIS) suggests that PNF on pelvic strategies was even more effective at increasing balance. The results provide strong evidence

that the therapies used with both groups significantly improved gait, trunk dysfunction, and balance, but PNF was valuable technique in enhancing functional mobility sooner.

CONCLUSION:

To summarize, this study found that PNF interventions focusing on the pelvis with acute MCA stroke are extremely effective in improving walking, trunk impairment, and balance, allowing them to receive the best possible rehabilitation and improve their independence and quality of life. After the treatments, there was no discernible change in the groups gait, indicating that both were equally successful. But Group A considerably outperformed Group B in terms of trunk and balance impairment, suggesting that Group A's intervention was more successful in improving balance and quality of life.

Conflict of interests

There is no conflict of interest.

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