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Comparative Effects of Proprioceptive Neuromuscular Facilitation and Task-Oriented Training on Functional Recovery in Post-Stroke Patients: A Longitudinal Randomized Trial

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ABSTRACT

Background: *Stroke remains a leading cause of adult disability, often resulting in impaired balance, mobility, and reduced quality of life. Early rehabilitation interventions such as Proprioceptive Neuromuscular Facilitation (PNF) and Task-Oriented Training (TOT) have been widely used, yet their comparative effectiveness and recovery trajectory over time remain inadequately explored.*

Objective: *To compare the effects of PNF and TOT on balance, gait, and quality of life in post-stroke patients and assess the functional recovery trajectory across an 8-week intervention period.*

Methods: *A single-blinded, randomized controlled trial was conducted involving 60 post-stroke patients within three months of onset. Participants were randomly allocated to Group A (PNF-based trunk and pelvic stabilization) or Group B (task-oriented functional training). Interventions were delivered 5 days per week for 8 weeks. Primary outcomes included the Berg Balance Scale (BBS) and Timed Up and Go Test (TUG). Secondary outcomes were the Stroke Impact Scale (SIS) and Activities-specific Balance Confidence (ABC) Scale. Assessments were conducted at baseline, week 2, 4, 6, and 8. Statistical analysis was performed using repeated measures ANOVA and independent t-tests.*

Results: *Both groups showed significant within-group improvements ($p < 0.001$); however, Group A (PNF) exhibited significantly greater improvements in BBS, TUG, SIS, and ABC scores at weeks 4, 6, and 8 ($p < 0.01$). The PNF group also demonstrated a steeper recovery trajectory, particularly between weeks 2 and 6.*

Conclusion: *PNF focusing on proximal control is more effective than TOT in improving balance, mobility, and perceived recovery in the early post-stroke period. These findings highlight the importance of early, trunk-focused neuromotor interventions in stroke rehabilitation.*

Keywords: *Gait Disorders, Postural Balance, Proprioceptive Neuromuscular Facilitation, Randomized Controlled Trial, Quality of Life, Task Performance and Analysis*

INTRODUCTION

Stroke remains a leading cause of long-term disability worldwide, significantly impairing motor function, mobility, balance, and quality of life among survivors. Globally, more than 12 million individuals experience a stroke each year, with over 80 million people living with its chronic consequences, particularly in low- and middle-income countries where access to comprehensive rehabilitation is often limited.(1, 2) The primary neurological deficits following stroke frequently involve the motor system, especially affecting trunk control, postural balance, and gait, which are crucial for independence in activities of daily living.(3)

Early and targeted rehabilitation interventions play a vital role in promoting functional recovery by exploiting neuroplasticity—the brain's inherent capacity to reorganize and adapt following injury. Within this framework, two prominent rehabilitation strategies have gained increasing attention: Proprioceptive Neuromuscular Facilitation (PNF) and Task-Oriented Training (TOT). Both approaches aim to maximize functional outcomes through differing mechanisms—PNF by enhancing neuromuscular control via proprioceptive inputs, and TOT by focusing on the repetitive execution of meaningful tasks to reinforce goal-directed motor patterns.(4, 5)

Proprioceptive Neuromuscular Facilitation (PNF) is a manual therapy technique originally developed in the 1940s by Kabat, Knott, and Voss. It utilizes specific movement patterns and facilitation techniques to enhance voluntary motor control and coordination through stimulation of proprioceptors.(6) In stroke rehabilitation, PNF has been shown to improve motor recovery, trunk stability, and postural control by engaging the patient's remaining motor units in coordinated patterns.(7) It also promotes reciprocal inhibition and irradiation, mechanisms that may be particularly beneficial in early-stage hemiplegia or hemiparesis.(8) Specifically, pelvic and trunk-focused PNF patterns have demonstrated significant efficacy in improving dynamic sitting balance and gait initiation, which are foundational to regaining independence in mobility.(9)

In contrast, Task-Oriented Training (TOT) stems from motor learning and systems theory and emphasizes the functional use of affected limbs and body segments during context-relevant activities. The core principle involves repeated practice of goal-directed tasks—such as sit-to-stand, walking, or reaching—to enhance motor performance and retention.(10) TOT aligns closely with ecological validity, as it replicates real-life motor challenges encountered by stroke survivors. This approach encourages motor relearning by integrating sensory input, postural adjustments, and cognitive engagement during functional activities.(11) The repetitive and task-specific nature of TOT can induce neuroplastic changes, reinforce residual motor pathways, and promote cortical reorganization.(12) Clinical trials have shown that TOT can lead to meaningful improvements in gait, balance, and functional independence, particularly when introduced early and practiced intensively.(13)

Despite the documented benefits of both PNF and TOT, there remains limited high-quality evidence directly comparing their relative effectiveness, especially in the early post-stroke phase (within three months), when the brain exhibits heightened plasticity and responsiveness to rehabilitation. Moreover, previous studies often assess outcomes only at baseline and post-intervention, without exploring the trajectory of recovery over multiple time points. This limits our understanding of how functional gains evolve over time with different interventions.

Understanding the temporal dynamics of recovery is crucial for optimizing rehabilitation dosing, setting realistic goals, and selecting the most effective strategies during each phase of recovery. The present study addresses this gap by employing a longitudinal randomized controlled design to compare PNF and TOT over an eight-week intervention period, with outcome measures assessed at five intervals (baseline, week 2, 4, 6, and 8). This design allows for a nuanced analysis of not just end-point differences but also the rate and pattern of functional improvement across time.

The primary outcomes in this study—Berg Balance Scale (BBS) and Timed Up and Go (TUG)—are widely accepted clinical measures of balance and mobility, while secondary outcomes—Stroke Impact Scale (SIS) and Activities-specific Balance Confidence (ABC) Scale—offer insights into self-perceived recovery and confidence during activities. By integrating both objective and subjective assessments, this study provides a comprehensive evaluation of functional recovery.

Given the burden of post-stroke disability and the need for evidence-based rehabilitation pathways, this research seeks to answer a critical clinical question: Which intervention—PNF or TOT—is more effective in promoting recovery of balance, gait, and quality of life in post-stroke patients during the subacute phase? The findings from this study may inform clinicians and rehabilitation specialists on how best to allocate resources, tailor therapy protocols, and structure early-phase rehabilitation for optimal outcomes.

METHODOLOGY

Study Design

This study was designed as a single-blinded, longitudinal randomized controlled trial (RCT) to compare the effects of Proprioceptive Neuromuscular Facilitation (PNF) and Task-Oriented Training (TOT) on functional recovery in individuals with recent-onset stroke. The study followed CONSORT guidelines for randomized trials and was conducted over a period of eight weeks, with outcome assessments at regular bi-weekly intervals.

Study Setting and Duration

The research was conducted at the outpatient rehabilitation unit of a tertiary care hospital in Sukkur, Pakistan between February 2023 and December 2024. Ethical approval was obtained from the Institutional Review Board (IRB) of BNB Women University, and written informed consent was obtained from all participants prior to enrolment.

Participants

A total of 60 post-stroke patients were recruited using a consecutive sampling technique. Participants were screened based on the following criteria:

Inclusion Criteria

- First-ever ischemic or haemorrhagic stroke confirmed by CT/MRI
- Stroke onset within the last three months
- Age between 40 and 70 years
- Mini-Mental State Examination (MMSE) score ≥ 24

- Ability to follow verbal instructions and participate in active rehabilitation
- Medical clearance to participate in physiotherapy

Exclusion Criteria

- Recurrent stroke or previous neurological conditions affecting motor function
- Severe spasticity (Modified Ashworth Scale ≥ 3)
- Unstable cardiovascular conditions or severe comorbidities
- Musculoskeletal disorders that limit mobility or balance
- Participation in any other structured physiotherapy program during the study

Randomization and Allocation

Participants who met the eligibility criteria were randomly assigned to one of two intervention groups using a computer-generated random number sequence. Allocation concealment was ensured using sealed opaque envelopes prepared by an independent researcher not involved in the recruitment or intervention process. The assessors conducting the evaluations were blinded to group allocation.

Intervention Protocols

Both groups received supervised physiotherapy sessions five days a week for eight consecutive weeks, each lasting approximately 45 minutes.

Group A – PNF Group: Participants in this group received PNF-based interventions with a focus on pelvic and trunk stability patterns. The treatment protocol included rhythmic initiation, slow reversals, and stabilizing reversals in diagonal patterns (D1 and D2) targeting the trunk and pelvis. The emphasis was on improving proximal control to support distal mobility, thereby enhancing balance and gait initiation.(14)

Group B – TOT Group: Participants in this group underwent task-oriented training, which involved repetitive practice of functional activities such as sit-to-stand transitions, step-ups, object reaching, gait training on different surfaces, and simulated daily tasks like picking up items from shelves or carrying light loads. The activities were tailored to individual functional levels and progressed weekly in complexity and resistance.(15)

Both interventions were conducted by trained physiotherapists with at least five years of neurorehabilitation experience, ensuring standardization and adherence to protocols.

Outcome Measures

Assessments were conducted at five time points: baseline (week 0), week 2, week 4, week 6, and week 8. Evaluations were performed by blinded assessors trained in standardized scoring methods.

Primary Outcome Measures

1. **Berg Balance Scale (BBS):** Assesses static and dynamic balance. Scores range from 0–56, with higher scores indicating better balance.(16)

2. **Timed Up and Go Test (TUG):** Measures functional mobility. Shorter completion times indicate better performance.(17)

3. **Secondary Outcome Measures:**

4. **Stroke Impact Scale (SIS):** A patient-reported questionnaire assessing multiple domains including strength, hand function, ADLs, mobility, and participation.(18)

5. **Activities-specific Balance Confidence (ABC) Scale:** Evaluates an individual's confidence in performing various ambulatory activities without falling. Scores range from 0–100%.(19)

All outcome tools were selected for their reliability, validity, and sensitivity in post-stroke populations.

Data Collection and Management

Demographic and clinical data were collected at baseline, including age, gender, stroke type, affected side, time since onset, and initial motor function. All data were recorded using standardized forms and double-entered into SPSS version 26.0 for analysis to ensure accuracy.

Sample Size Calculation

The sample size was estimated using G*Power software based on previous studies reporting medium effect sizes (Cohen's $f = 0.25$) for similar interventions. With a power of 0.80 and alpha set at 0.05 for repeated measures ANOVA, a total of 52 participants were required. Considering a potential dropout rate of 15%, 60 participants were recruited (30 in each group).

Statistical Analysis

Data were analyzed using SPSS version 26.0. Normality of continuous data was assessed using the Shapiro-Wilk test (Table 2). Descriptive statistics (mean ± SD) were used for demographic variables and outcome scores.

- **Within-group changes** over time were analyzed using repeated measures ANOVA, with post hoc Bonferroni correction where applicable.

- **Between-group comparisons** at each time point were evaluated using independent samples t-tests.

- Statistical significance was set at $p < 0.05$.

Ethical Considerations

The study protocol was reviewed and approved by the Human & Rehabilitation Sciences Department, BNB Women University. Participants were informed about the purpose of the study, their right to

withdraw, confidentiality of data, and potential benefits or risks. Informed consent was obtained from each participant in writing prior to participation.

RESULTS

Participant Flow and Characteristics

A total of 72 patients were assessed for eligibility. Of these, 60 participants met the inclusion criteria and were randomized equally into two groups: PNF (Group A, *n* = 30) and TOT (Group B, *n* = 30). All participants completed the 8-week intervention, with no dropouts or adverse events reported (CONSORT diagram available upon request).

Baseline Characteristics

There were no statistically significant differences between groups in terms of age, gender distribution, stroke type, or baseline functional scores, indicating successful randomization Table 1.

Table 1. Baseline Demographic and Clinical Characteristics

Variable	*Group A (PNF) Mean ± SD*	*Group B (TOT) Mean ± SD*	*p-value*
Age (years)	59.3 ± 6.1	58.7 ± 6.5	0.71
Gender (M/F)	18/12	17/13	0.79
Stroke type (I/H)	22/8	20/10	0.56
Affected side (L/R)	15/15	14/16	0.82
Time since stroke (days)	52.4 ± 9.2	53.6 ± 8.8	0.64
BBS (baseline)	29.4 ± 4.3	29.1 ± 4.7	0.81
TUG (baseline, sec)	26.8 ± 3.9	27.2 ± 4.1	0.68
ABC (baseline)	48.6 ± 7.8	47.9 ± 8.2	0.74
SIS (baseline)	49.3 ± 6.7	48.5 ± 7.0	0.65

Normality Testing

All outcome variables were normally distributed as per Shapiro-Wilk test ($p > 0.05$), justifying the use of parametric tests.

Table 2. Shapiro-Wilk Normality Test Results

Variable	W-statistic	p-value
BBS	0.978	0.31
TUG	0.982	0.44
SIS	0.969	0.22
ABC	0.981	0.40

Descriptive Outcomes Over Time

Both groups showed improvements across all measures, but Group A (PNF) consistently demonstrated greater and earlier improvements in balance and mobility.

Table 3. Mean Outcome Scores Over Time

Time Point	BBS (Group A)	BBS (Group B)	TUG (Group A)	TUG (Group B)	SIS (Group A)	SIS (Group B)	ABC (Group A)	ABC (Group B)
Baseline	29.4 ± 4.3	29.1 ± 4.7	26.8 ± 3.9	27.2 ± 4.1	49.3 ± 6.7	48.5 ± 7.0	48.6 ± 7.8	47.9 ± 8.2
Week 2	33.8 ± 4.1	31.2 ± 4.4	23.4 ± 3.2	25.1 ± 3.8	54.1 ± 6.2	51.2 ± 6.5	55.2 ± 6.7	51.5 ± 7.4
Week 4	38.6 ± 3.9	34.5 ± 4.2	20.1 ± 3.1	22.8 ± 3.5	59.8 ± 5.7	54.7 ± 6.1	62.4 ± 6.1	57.9 ± 6.5
Week 6	43.2 ±	38.1 ±	17.2 ±	20.3 ±	65.3 ±	59.1 ±	69.8 ±	63.2 ±

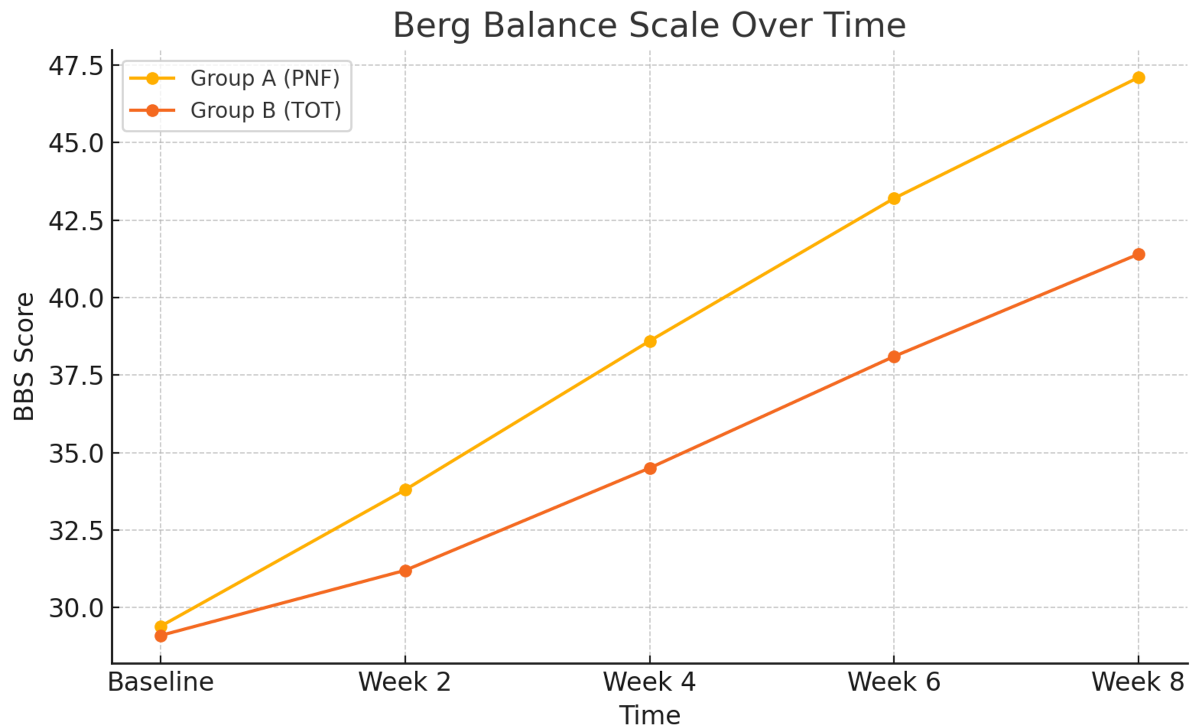
	3.7	3.9	2.8	3.1	5.1	5.8	5.6	5.9
Week 8	47.1 ± 3.3	41.4 ± 3.6	14.4 ± 2.4	17.9 ± 2.7	70.2 ± 4.6	63.4 ± 5.2	75.1 ± 5.2	68.3 ± 5.4

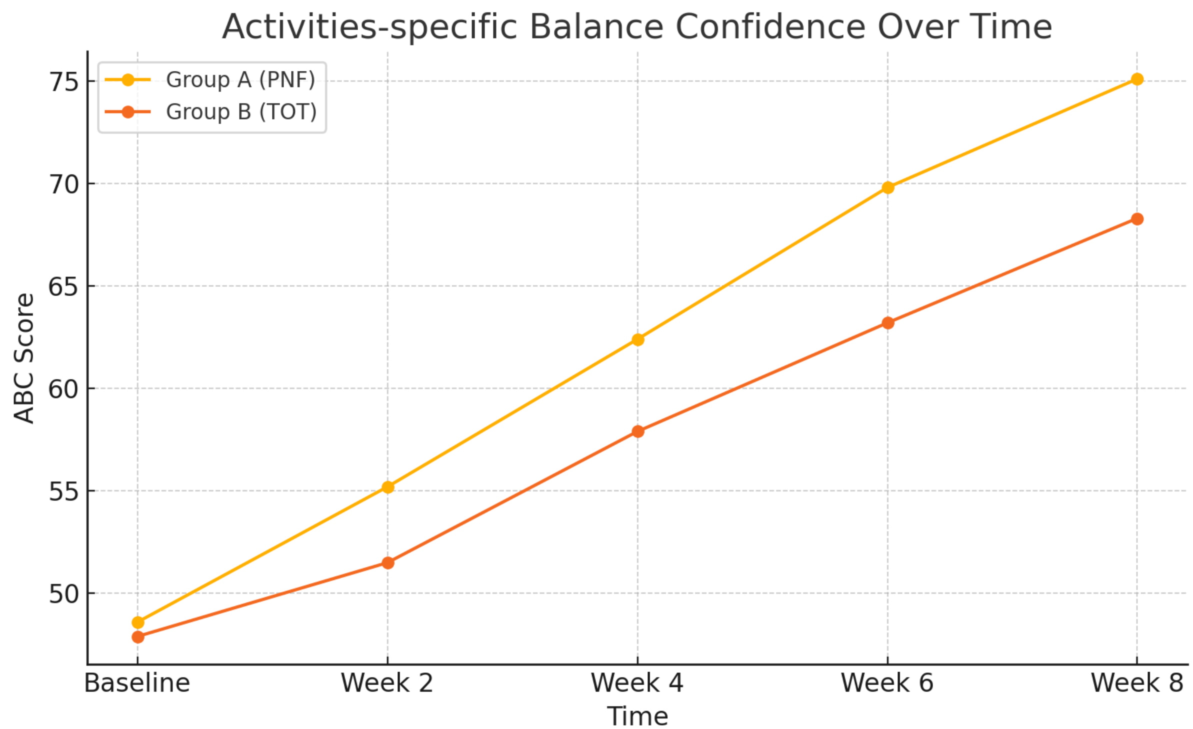
Inferential Analysis

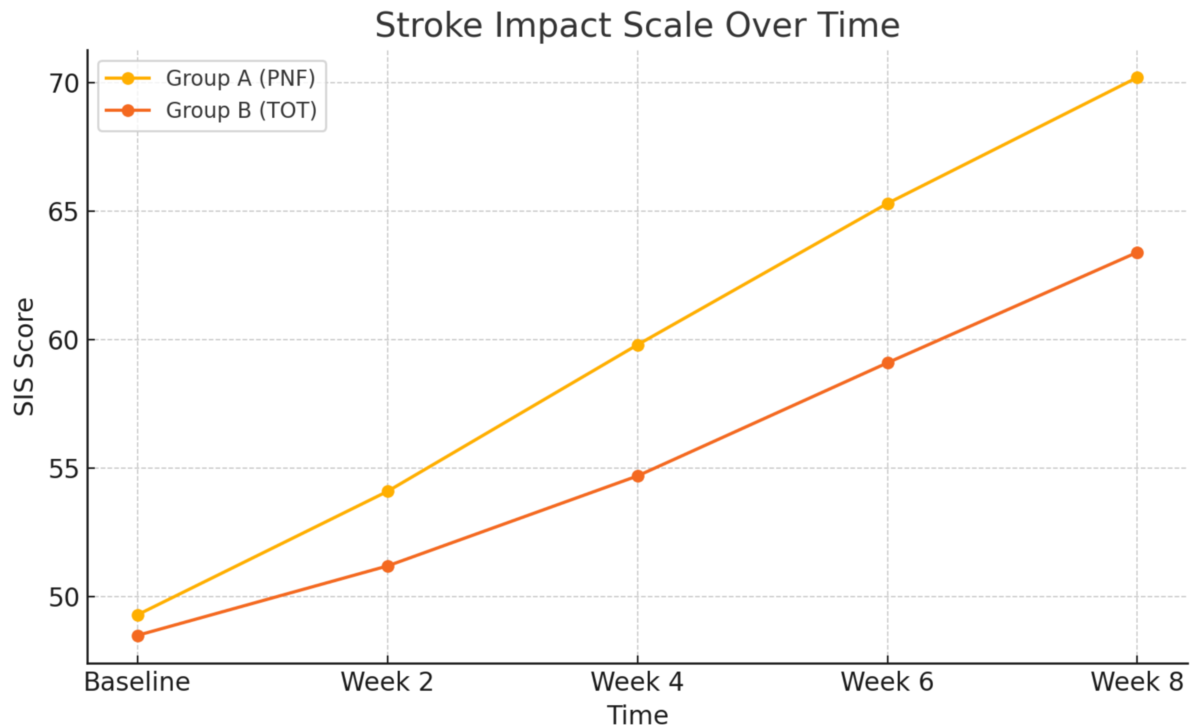
Within-group comparisons using repeated measures ANOVA revealed statistically significant improvements over time in both groups ($p < 0.001$). However, between-group comparisons (Table 4) showed significantly greater improvement in Group A for all outcomes at weeks 4, 6, and 8 ($p < 0.01$).

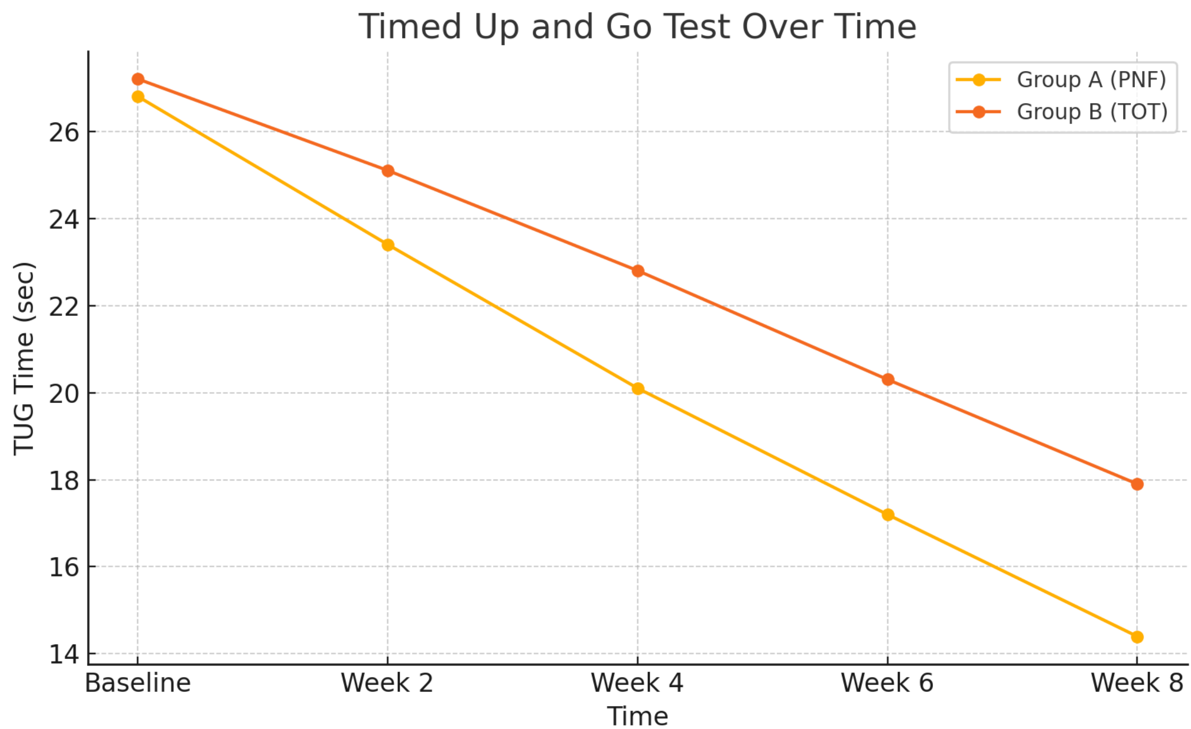
Table 4. Between-Group Comparison of Outcomes at Week 8

Outcome Measure	**Group A (PNF)**	**Group B (TOT)**	**Mean Difference**	***p*-value**
BBS	47.1 ± 3.3	41.4 ± 3.6	+5.7	<0.001
TUG (sec)	14.4 ± 2.4	17.9 ± 2.7	-3.5	0.002
SIS	70.2 ± 4.6	63.4 ± 5.2	+6.8	<0.001
ABC	75.1 ± 5.2	68.3 ± 5.4	+6.8	0.001


Berg Balance Scale Over Time
Group A (PNF)
Group B (TOT)
BBS Score
47.5
45.0
42.5
40.0
37.5
35.0
32.5
30.0
Baseline
Week 2
Week 4
Week 6
Week 8
Time


Activities-specific Balance Confidence Over Time
Group A (PNF)
Group B (TOT)
ABC Score
75
70
65
60
55
50
Baseline
Week 2
Week 4
Week 6
Week 8
Time





Participants in the PNF group demonstrated more rapid and sustained improvements in balance, mobility, and self-perceived recovery as compared to those in the TOT group. Notably, significant differences were observed from week 4 onward in all primary and secondary outcomes. These findings suggest that PNF

focusing on trunk and pelvic stabilization may yield superior functional gains in early post-stroke rehabilitation.

DISCUSSION

This longitudinal randomized controlled trial investigated the comparative effects of Proprioceptive Neuromuscular Facilitation (PNF) and Task-Oriented Training (TOT) on balance, gait, and quality of life in post-stroke patients. Over the 8-week intervention, both rehabilitation strategies led to statistically significant improvements across all measured domains; however, the PNF group demonstrated more rapid, consistent, and higher magnitude gains, particularly from the fourth week onward. These findings support the clinical superiority of trunk- and pelvis-focused PNF in early-phase post-stroke rehabilitation.

The results corroborate earlier findings that proximal stability is critical for distal motor function, especially in hemiparetic stroke survivors.(20) The emphasis of PNF on trunk facilitation likely contributed to earlier recovery of balance and postural control, as evidenced by greater improvements in Berg Balance Scale scores. This aligns with previous studies by Hwangbo et al. and Ji Yeun Lee et al., who reported significant gains in trunk control and dynamic balance using PNF-based approaches.(8, 9)

Improvement in the Timed Up and Go (TUG) test further supports the hypothesis that neuromuscular facilitation of proximal segments can translate into enhanced mobility. The reduction in TUG time was more pronounced in the PNF group, suggesting improved gait initiation, stride coordination, and lower limb control. While both groups practiced ambulation regularly, the PNF group may have benefited from the carryover effects of enhanced core stability, which previous research identifies as a mediator of dynamic movement efficiency.(21)

One of the more compelling aspects of this study was the trajectory of functional change. Unlike many previous studies that focused solely on pre- and post-intervention outcomes, this study captured progress at five intervals, enabling a nuanced understanding of how rehabilitation unfolds over time. The PNF group exhibited steeper gains between weeks 2 and 6, suggesting an early-phase neuroplastic responsiveness to proprioceptive input. This temporal trend supports the argument that timing of intervention is crucial; early delivery of structured, targeted therapy may leverage the critical window for neuroplasticity and cortical remapping.(22)

Task-Oriented Training, while effective, showed a slower and more gradual progression across all outcome measures. Although TOT emphasizes real-life task simulation and engages the patient in functional contexts, it may lack the initial neuromotor priming effect of PNF. Still, the observed gains in the TOT group affirm its value as a practical, patient-centered strategy, especially for reinforcing learned patterns and improving confidence through context-relevant training.(15, 23)

The improvements observed in the Stroke Impact Scale (SIS) and ABC Scale in both groups highlight the psychosocial and perceptual benefits of structured rehabilitation. Yet, the PNF group reported higher self-efficacy and perceived functional independence, potentially due to the earlier restoration of trunk control and mobility. These findings are clinically meaningful, as patient confidence and self-perception are directly linked to community reintegration and reduced fall risk.(24)

This study contributes to the current evidence base by:

- Providing longitudinal data on functional change patterns.
- Highlighting the relative effectiveness of PNF over TOT in the subacute stroke phase.

- Reinforcing the importance of trunk-focused interventions for early functional recovery.

LIMITATIONS

Despite its strengths, the study has certain limitations. The sample size, while adequately powered, was limited to a single center, which may affect generalizability. The blinding of therapists was not feasible due to the nature of the interventions, introducing a potential performance bias. Additionally, long-term follow-up was not conducted, so the sustainability of observed improvements remains unknown. Future studies with multicenter designs, larger samples, and 3–6-month follow-up periods are recommended to validate and expand upon these findings.

Clinical Implications

The evidence from this trial suggests that PNF may be more effective in facilitating early functional recovery in post-stroke individuals, particularly when initiated within three months of onset. Clinicians may consider incorporating structured PNF protocols, especially those targeting pelvic and trunk stability, as a foundational component of stroke rehabilitation. While TOT remains an essential modality for task-specific training, its pairing with neuromuscular facilitation techniques could offer synergistic benefits.

CONCLUSION

This randomized controlled trial provides compelling evidence that Proprioceptive Neuromuscular Facilitation (PNF) focused on trunk and pelvic stability yields superior outcomes compared to Task-Oriented Training (TOT) in the early rehabilitation of post-stroke patients. Over the 8-week intervention period, participants in the PNF group demonstrated significantly greater improvements in balance, functional mobility, and self-perceived recovery—particularly evident from the fourth week onward.

By incorporating a longitudinal assessment design, the study captured not only end-point differences but also the trajectory of functional recovery, underscoring the importance of early, targeted neuromotor interventions. While both rehabilitation strategies proved effective, the more rapid and consistent improvements associated with PNF highlight its value as a foundational approach in the subacute phase of stroke rehabilitation.

These findings support the integration of PNF techniques into routine clinical practice for stroke survivors, particularly in the first three months following onset. Future research should explore the combined or sequential use of PNF and TOT, assess long-term outcomes, and evaluate their effects in diverse populations to further inform evidence-based rehabilitation strategies.

REFERENCES

Johnson CO, Nguyen M, Roth GA, Nichols E, Alam T, Abate D, et al. Global, regional, and national burden of stroke, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet Neurology. 2019;18(5):439-58.

Feigin VL, Stark BA, Johnson CO, Roth GA, Bisignano C, Abady GG, et al. Global, regional, and national burden of stroke and its risk factors, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet Neurology. 2021;20(10):795-820.

Pollock A, Baer G, Campbell P, Choo PL, Forster A, Morris J, et al. Physical rehabilitation approaches for recovery of function, balance and walking after stroke. Cochrane Database of Systematic Reviews. 2014(4):CD001920.

Beckers D, Buck M. PNF in practice: an illustrated guide: Springer Nature; 2021.

Langhorne P, Bernhardt J, Kwakkel G. Stroke rehabilitation. The Lancet. 2011;377(9778):1693-702.

De V. Proprioceptive neuromuscular facilitation patterns and techniqes. 3ED Harper and Row. 1985:298-311.

Kofotolis N, Vrabas I, Vamvakoudis E, Papanikolaou A, Mandroukas K. Proprioceptive neuromuscular facilitation training induced alterations in muscle fibre type and cross sectional area. British journal of sports medicine. 2005;39(3):e11-e.

Hwangbo PN, Kim KD. Effects of proprioceptive neuromuscular facilitation neck pattern exercise on the ability to control the trunk and maintain balance in chronic stroke patients. Journal of physical therapy science. 2016;28(3):850-3.

Yeun Lee J, Park J, Lee D, Roh H. The effects of exercising on unstable surfaces on the balance ability of stroke patients. Journal of physical Therapy science. 2011;23(5):789-92.

Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC, et al. Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2016;47(6):e98-e169.

French B, Thomas LH, Leathley MJ, Sutton CJ, McAdam J, Forster A, et al. Repetitive task training for improving functional ability after stroke. Stroke. 2009;40(4):e98-e9.

Subramanian SK, Levin MF. Viewing medium affects arm motor performance in 3D virtual environments. Journal of neuroengineering and rehabilitation. 2011;8:1-9.

Arabzadeh S, Goljaryan S, Salahzadeh Z, Oskouei AE, Somee AS. Effects of a task-oriented exercise program on balance in patients with hemiplegia following stroke. Iran Red Crescent Med J. 2018;20(1):0.

Nguyen PT, Chou L-W, Hsieh Y-L. Proprioceptive neuromuscular facilitation-based physical therapy on the improvement of balance and gait in patients with chronic stroke: A systematic review and meta-analysis. Life. 2022;12(6):882.

Thant AA, Wanpen S, Nualnetr N, Puntumetakul R, Chatchawan U, Hla KM, et al. Effects of task-oriented training on upper extremity functional performance in patients with sub-acute stroke: a randomized controlled trial. Journal of physical therapy science. 2019;31(1):82-7.

Blum L, Korner-Bitensky N. Usefulness of the Berg Balance Scale in stroke rehabilitation: a systematic review. Physical therapy. 2008;88(5):559-66.

Chan PP, Tou JIS, Mimi MT, Ng SS. Reliability and validity of the timed up and go test with a motor task in people with chronic stroke. Archives of physical medicine and rehabilitation. 2017;98(11):2213-20.

Mulder M, Nijland R. Stroke impact scale. Journal of physiotherapy. 2016;62(2):117.

Powell LE, Myers AM. The activities-specific balance confidence (ABC) scale. The journals of Gerontology Series A: Biological sciences and Medical sciences. 1995;50(1):M28-M34.

Shumway-Cook A, Woollacott MH. Motor control: translating research into clinical practice: Lippincott Williams & Wilkins; 2007.

Karthikbabu S, Verheyden G. Relationship between trunk control, core muscle strength and balance confidence in community-dwelling patients with chronic stroke. Topics in stroke rehabilitation. 2021;28(2):88-95.

Biernaskie J, Chernenko G, Corbett D. Efficacy of rehabilitative experience declines with time after focal ischemic brain injury. Journal of Neuroscience. 2004;24(5):1245-54.

Thomas LH, French B, Coupe J, McMahon N, Connell L, Harrison J, et al. Repetitive task training for improving functional ability after stroke: a major update of a Cochrane review. Stroke. 2017;48(4):e102-e3.

Schmid AA, Van Puymbroeck M, Altenburger PA, Schalk NL, Dierks TA, Miller KK, et al. Poststroke balance improves with yoga: a pilot study. Stroke. 2012;43(9):2402-7.