

Trunk specific exercise

The steps of trunk-specific exercise were flexion, extension, rotation, lateral flexion, and forward reach. Participants were assisted in flexing and extending the trunk while sitting with their feet on the floor. They followed this with clasping the hands and moving the hands toward left and right alternatively. Upper trunk lateral flexion initiates movement from the shoulder girdle and brings the elbow towards the plinth. The forward reach exercise was performed by asking the participants to reach a flexion point at the shoulder height from a sitting position.

Procedure

Demographic and clinical variables were collected using a structured questionnaire in the interview. Both groups assessed pre-test on balance and trunk control using the Berg Balance Scale and Trunk Impairment Scale. The experimental group received the trunk-specific exercise for 45 min of 28 sessions, along with routine hospital care on a one-to-one basis. It was administered in the treatment room or at the bedside, depending on the participants' comfort during the intervention. Participants were also followed after discharge until to complete the 28 sessions of the interventions. Once the participant was discharged, from the next day onwards, the intervention continued at home during the evening. Out of 30 participants in the experimental group, four received six sessions at home, and two received eight sessions at home after getting discharged, with 22 and 20 sessions in the hospital. The participants were observed for progress and any untoward effects during an intervention. The control group received routine care at the hospital. Post-test assessment of balance and trunk control was done using the same tool at the end of one month for both experimental and control groups. Blinding for measuring outcomes by the investigators was not done. The participants in the experimental group were monitored during intervention for any untoward reaction; however, no adverse effect was reported throughout the study. The ethical principles were adhered to protect the rights of the samples and maintained confidentiality throughout the study.

Analysis

The data were analyzed by descriptive and inferential statistical methods using

SPSS statistical package (IBM SPSS Statistics, Armonk, NY). The demographic and clinical variables were described as frequency and percentage. The effectiveness of intervention within the group was calculated by paired *t* test, and the effect of intervention between the experimental and control group was compared by unpaired *t* test. A chi-square test was used to associate the post-test level of trunk control and balance control with the selected demographic and clinical variables. The probability of $p < .05$ or less was taken as statistically significant.

RESULTS

The total number of participants screened according to the inclusion criteria was 60 and were allocated into the experimental group ($n=30$) and control group ($n=30$). The demographic and clinical variables were expressed as frequency and percentage. Table 1 shows that in the experimental group, 11 (36.7%) were aged between 51 and 60 years, and 23 (76.7%) were male. Regarding clinical variables, 22 (73.3%) had an acute stroke due to ischemia; equally, 50% had affected the right and left hemispheres of the brain with involvement of the right- and left-middle cerebral artery each. Accordingly, in the control group, 10 (33.4%) were aged between 40 and 45 years, 22 (73.3%) were male, 21 (70%) had an ischemic stroke, 26 (86.7%) had an acute stroke, and the majority (73%) had affected in the right hemisphere of the brain with right mid-cerebral artery involvement.

Table 2 shows that, out of 30 participants in the experimental group, 25 (83.33%) had good trunk control and 5 (16.67%) had normal trunk control in the pre-test. In the post-test, 20 (66.67%) had normal trunk control, and 10 (33.33%) had good trunk control. In the control group, 24 (80%) had good trunk control and 6 (20%) had normal trunk control in the pre-test, and in the post-test, 23 (76.67%) had good trunk control and 7 (23.33%) had normal trunk control. Regarding balance control, all 30 (100%) had a medium risk of falls in both the pre-test and post-test of the experimental group and the control group. Regarding balance, though all 100% were under the category of medium risk of fall in pre-test and post-test of experimental and control groups, there were changes in the scoring as medium risk of fall score ranges from 21–40.

DINESH: PNF EXERCISE ON TRUNK & BALANCE CONTROL

TABLE 1. Baseline Outcome Measures

<i>Demographic Variables</i>	<i>Experimental Group</i>		<i>Control Group</i>	
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>
<i>Age in Years</i>				
40–45	7	23.3	10	33.4
46–50	6	20.0	7	23.3
51–60	11	36.7	7	23.3
61–65	6	20.0	6	20.0
<i>Gender</i>				
Male	23	76.7	22	73.3
Female	7	23.3	8	26.7
<i>Occupational Status</i>				
Private	7	23.3	8	26.7
Unemployment /Housewife	6	20.0	6	20.0
Business / Self employed	4	13.3	6	20.0
Agriculture	10	33.4	9	30.0
Retired	3	10.0	1	3.3
<i>Clinical Variables</i>				
<i>Types of Stroke According to Cause</i>				
Ischemic stroke	22	73.3	21	70.0
Hemorrhagic stroke	8	26.7	9	30.0
<i>Types of Stroke According to the Duration</i>				
Acute stroke	22	73.3	26	86.7
Sub-acute stroke	8	26.7	4	13.3
<i>Duration of Stroke Since</i>				
< 3 months	6	20.0	9	30.0
4–6 months	15	50.0	12	40.0
7 months to 1 year	9	30.0	9	30.0
<i>Part of Brain Affected</i>				
Right hemisphere	15	50.0	22	73.3
Left hemisphere	15	50.0	8	26.7
<i>Arteries Involved</i>				
Right mid-cerebral artery	15	50.0	22	73.3
Left mid-cerebral artery	15	50.0	8	26.7

TABLE 2. Comparison of TIS Score

TIS ^a	Poor (0-7)		Fair (8-10)		Good (11-14)		Normal (15-23)	
	No.	%	No.	%	No.	%	No.	%
<i>Experimental Group</i>								
Pre-test	0	0	0	0	25	83.33	5	16.67
Post-test	0	0	0	0	10	33.33	20	66.67
<i>Control Group</i>								
Pre-test	0	0	0	0	24	80	6	20.0
Post-test	0	0	0	0	23	76.67	7	23.33

^aTIS = Trunk Impairment Scale; described in terms of frequency and percentage.

Within group analysis, paired *t* tests compared the experimental group's pre-test and post-test levels of trunk control and balance. The experimental group pre-test and post-test mean trunk control and balance score was 13.40, 15.03, 25.4, and 27.07, respectively. The calculated value of *t* = 14.548 and *t* = 8.601 was statistically highly significant at a *p* < .001 level (Table 3).

In between group analysis, the post-test mean and standard deviation of trunk control in the experimental and control group was 15.03±0.96 and 13.70±1.15, whereas it was 27.07±1.48 and 25.30±1.73 in balance control in TIS and BBS outcome measured post four weeks of intervention.

The results demonstrated that the calculated independent *t* test value of *t* = 4.868

TABLE 3. Within-Group Analysis of Experimental and Control Group

S. No	Parameter	Group	Mean ± SD	Paired <i>t</i> test	
				Control Pre - Post	Experimental Pre - Post
1.	TIS	Control Pre-test	13.65±1.12	<i>t</i> = 8.651 <i>p</i> = .18 NS	<i>t</i> = 14.548 <i>p</i> = .0001 ^a S
		Control Post-test	13.70±1.15		
		Experimental Pre-test	13.40±1.04		
		Experimental Post-test	15.03±0.96		
2.	BBS	Control Pre-test	25.17±1.69	<i>t</i> = 3.562 <i>p</i> = .12 NS	<i>t</i> = 8.601 <i>p</i> = .0001 ^a S
		Control Post-test	25.30±1.73		
		Experimental Pre-test	25.40±1.81		
		Experimental Post-test	27.07±1.48		

^aP values are reported using paired *t* test for TIS and BBS.

S = significant; NS = not significant; TIS = Trunk Impairment Scale; BBS= Berg Balance Scale.

and $t = 4.252$ was statistically highly significant at $p < .001$ (Table 4). The effect size of trunk control and balance between the experimental and control group was 1.39 and 1.20 which shows the large effects and practical significance. This finding represents that PNF neck pattern and trunk-specific exercise administered to the patients with stroke in the experimental group were more effective in improving the level of trunk control and balance control than those with stroke in the control group. There was zero attrition rate due to high compliance towards exercise, and no harmful untoward adverse events occurred during the study period.

DISCUSSION

The motor impairment can be caused by a cerebrovascular accident that affects the motor neurons. Trunk control and balance are important functional outcomes after stroke, and the same deteriorates the body following a stroke. The therapeutic goal of stroke management is to facilitate an optimal structural and neuromuscular state based on the stimulation of proprioceptors. In the present study, the motor function was assessed regarding trunk control and balance. The study findings show the impairment in trunk control and balance in both experimental and control groups. All 60 participants had a medium risk for falls in the pre-test assessment. Most (80%) of them

had an acute stroke due to the involvement of the right mid-cerebral artery and were in the acute stage of stroke. As trunk muscles are primarily contributed to the stabilization of the head and trunk, the current study intensively investigated the impact of PNF neck pattern and trunk-specific exercise. The study found a significant improvement in both trunk and balance control in the experimental group after the administration of PNF neck pattern and trunk-specific exercise. It was also found that there were only positive changes in the control group due to the routine treatment protocol; however, it was not statistically significant.

This present study finding is supported by Hwangbo and Kim who concluded that PNF neck pattern exercise was shown to have a positive effect on the ability to control the trunk and maintain balance in chronic stroke patients.⁽²⁷⁾ In the current study, none were in the chronic stroke. Similarly, another study by An and Park proved that there is an improvement in mobility, balance, and trunk control in chronic stroke patients through selective trunk exercise with a neural development program.⁽²⁸⁾ A systematic review and meta-analysis of randomized controlled trials on trunk training by Van Criekinge et al. revealed a strong amount of evidence showing that trunk training can improve trunk control mobility and sitting and standing balance.⁽²⁹⁾ A study by Kim et al. demonstrated that underwater coordination movement using the PNF pattern significantly affects stroke patients' balance and gait.⁽³⁰⁾ According to the study finding of Lee et al., the PNF gait training program helps enhance the adaptation of the gait and balance in a single subject design.⁽³¹⁾ A similar finding was reported by Chithra and Joshi that PNF techniques benefit the hemiplegic population's trunk control and quality of life.⁽³²⁾ The gait training group to which PNF was applied saw improvements in their balance ability than the control group in the study by Seo et al.⁽³³⁾ The present study findings also observed the difference in post-test mean value between the experimental and control groups. It also proved a difference and significant improvement in the experimental group who had undergone PNF neck pattern and trunk-specific exercise than the control group. The participants in the experimental group became comfortable and practiced. It was also observed that this exercise was safe as it did not cause adverse effects during the study period.

TABLE 4. Between Experimental and Control Group Analysis

	Mean± S.D	Mean Difference	Unpaired t Test
<i>TIS</i>			
Experimental	15.03±0.96	1.33	$t = 4.868$ $p = .0001^a$ S
Control	13.70±1.15		
<i>BBS</i>			
Experimental	27.07±1.48	1.77	$t = 4.252$ $p = .0001^a$ S
Control	25.30±1.73		

^aP values are reported using paired *t* test for TIS and BBS.

S = significant; NS = not significant; TIS = Trunk Impairment Scale; BBS= Berg Balance Scale.

A study by Park and Moon reported that change in chair heights during trunk stability exercise using PNF was effective in bringing desirable changes in gait velocity, cadence, and stride length on the affected side of the body.⁽³⁴⁾ The current study does not observe the gait cycle and stance phase on the affected side as well as muscle strength and physical performance tasks. Very recently, Khallaf found that task-specific training effectively improves the static and dynamic postural control and trunk range of motion among sub-acute stroke patients.⁽³⁵⁾ Desai et al. conducted a study to evaluate the relationship between trunk impairment and gait in patients with a cerebrovascular accident and showed a highly significant correlation between trunk impairment and gait in subjects.⁽³⁶⁾

The minimal clinically significant difference score of the BBS and TIS was 13.4 and 14.5, which denotes the perceived benefits of PNF trunk-specific intervention by the participants. It also determined clinically essential changes in TIS and BBS among patients with stroke in response to PNF neck pattern and trunk-specific exercise. The significance of this study complements the medical intervention and renders the comprehensive care for the patients with stroke in clinical and community areas. It also motivates the researchers to conduct more extensive research and utilize this finding in today's clinical practice. In the future, the same study can focus on a large number of samples with a more extended intervention period. It can also be intervened for the upper and lower extremity motor functions. The present study suggested that conducting the PNF exercise with the different functional tasks is an adequate trunk and balance control and also assesses the quality of life, and gait, of the patients with stroke as this study is limited to the trunk and balance control. It also found that this exercise was very safe as it did not cause adverse effects during the study period. PNF neck pattern and trunk-specific exercise can be compared with other exercise or rehabilitation programs, such as acute and chronic stroke, to determine the reliability and generalize the study findings.

CONCLUSION

The present study's findings concluded that PNF neck pattern and trunk-specific exercise effectively improve balance and

trunk control among patients with stroke. Hence, this exercise can be incorporated into the routine treatment protocol, and utilized to enhance balance and trunk control, minimizing disability and improving quality of life.

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CONFLICT OF INTEREST NOTIFICATION

The authors declare there are no conflicts of interest.

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