Effectiveness Of Task Oriented Training on Balance, Mobility, Function in Subacute Stroke Patients- A Randomized Controlled Trial

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INTRODUCTION

Stroke, as defined by the World Health Organization (WHO), encompasses various clinical presentations including cerebral infarction, hemorrhagic stroke, subarachnoid hemorrhage, and unspecified pathological subtypes, with confirmation through imaging techniques when possible. In the context of India, stroke poses a substantial health challenge, being the fourth most common cause of mortality and the fifth leading source of disability [1]. The occurrence of age-associated, non-communicable disorders such as stroke is becoming increasingly prevalent [2,3,4]. Recent data indicates that the typical lifespan in India has extended to roughly 60 years. Strokes can occur due to several causes, including cerebral blood flow deficiency, brain infections, subarachnoid hemorrhage, and/or intracerebral bleeding [5]. Those who have experienced a stroke commonly face challenges with stability and locomotion [6]. Trunk control is impaired by various factors, such as muscle weakness, heightened muscle tone, unusual gait, and sensory deficits [7]. Prior studies have highlighted various factors affecting balance and mobility, such as decreased muscle mass, compromised sensory perception, and prolonged trunk muscle activation [8]. These factors directly contribute to reduced mobility [9]. Patients experiencing these impairments often face increased disability and dependence on others [10]. Furthermore, these limitations lead to decreased mobility, heightened fall risk, restricted activities, and reduced motivation to participate in various endeavors [11]. Among these factors, balance is considered the most crucial for performing numerous activities of daily living (ADLs) [12].

Stroke significantly affects an individual's walking ability, which consequently impacts their capacity to carry out everyday activities [13]. This impairment makes it difficult for stroke patients to manage multiple tasks simultaneously. The distinctive gait patterns of hemiplegic individuals hinder their ability to perform daily functions and delay their reintegration into society [14]. Consequently, restoring normal gait should be considered the primary focus of rehabilitation efforts [15,16]. Nearly 50% of stroke survivors experience physical limitations and balance issues,

which are associated with reduced participation in community-based activities [17,18]. Disability diminishes an individual's quality of life, subsequently limiting their full engagement in community activities [19,20].

Research indicates that conventional physiotherapy (CPT), encompassing mat exercises, stretching, strengthening protocols, and gait and balance training, offers significant benefits [21,22]. Sakakima et al. posit that exercise acts as a preconditioning stimulus, providing neuroprotective effects. This form of therapy is regarded as both safe and efficacious in delivering neuroprotective advantages to stroke patients in acute and chronic stages [23]. The enhanced balance observed in stroke patients is largely attributed to improved activation and stability of lower-limb muscles [24,25]. In the realm of sensorimotor and neurological physiotherapy, engaging in meaningful tasks is crucial for enhancing motor function and dynamic mobility [26]. Contemporary neurorehabilitation interventions, such as task-oriented training, lack sufficient evidence for motor learning techniques that promote neural plasticity in the central nervous system, which demand intensive task repetition [27]. This approach allows patients to adapt to diverse scenarios when executing motor tasks during activities of daily living (ADLs). However, despite noted improvements in motor function, it remains uncertain whether these advancements translate into enhanced performance of ADLs [28].

Studies indicate that Task-Oriented Training (TOT) leads to notable enhancements in motor control and performance of specific tasks related to daily activities. A crucial component of TOT for stroke survivors is the consistent engagement in active, repetitive task practice [29]. This approach encompasses a wide range of exercises and developmental techniques, which is broadly accepted in stroke rehabilitation [30]. Although training should be customized to meet individual requirements, it is vital to maintain a structured progression plan. Patients will have the opportunity to select training exercises that correspond to their particular needs and activities of daily living (ADL). Effective training programs incorporate various components, including specialized, exceptional, challenging, repetitive, diverse, and intensive task-oriented exercises [31].

This research fills a crucial knowledge gap by examining the impact of task-oriented motor training (TOMT) on balance, mobility, and functional abilities in Indian patients with subacute stroke. Although prior studies have shown the efficacy of task-oriented approaches for upper extremity function, there is a notable lack of research exploring its effects on lower limb deficits, especially in relation to daily activities. By concentrating on this underexplored area, the current study offers valuable perspectives on the potential therapeutic advantages of TOMT in improving gait, balance, and overall functionality in subacute stroke patients. The results of this investigation have significant ramifications for rehabilitation practices and could guide the creation of more effective treatment protocols for stroke patients in India and other regions.

Methods

Study Approval and Consent

The study was approved by the Institutional Review Board of MGM Institute of Physiotherapy, Aurangabad **(Letter No. MGM-ECRHS/2021/38)**. Written informed consent was obtained from all participants prior to their enrollment in the study.

Study Design and Objectives

A single-site, randomized controlled study was performed to evaluate the efficacy of combining task-oriented exercises with standard physiotherapy (Group A) compared to standard physiotherapy alone (Group B) in enhancing equilibrium, movement, and self-sufficiency in individuals recovering from recent stroke. The researchers' primary conjecture was that the addition of task-oriented exercises would yield superior outcomes compared to conventional physiotherapy by itself.

Study Setting

The trial was conducted in the Department of Neurophysiotherapy OPD, MGM Hospital, Aurangabad, with additional sites including other hospitals, research centers, and private clinics located in Aurangabad.

Participants

Forty patients diagnosed with subacute stroke were recruited. Patients were assigned to one of two intervention groups: Group A, comprising 20 patients receiving task-oriented training in addition to conventional physiotherapy, and Group B, comprising 20 patients receiving conventional physiotherapy alone.

Inclusion Criteria

The study included participants who met specific eligibility criteria: individuals experiencing their first stroke, diagnosed within the subacute phase (1-3 months post-stroke), aged 40-60 years, capable of ambulation with or without assistive devices, and able to comprehend instructions (as evidenced by a Mini-Mental State Examination score of 24 or higher). Eligible participants demonstrated a medium fall risk, indicated by Berg Balance Scale scores ranging from 20 to 40. The study population comprised both male and female patients.

Exclusion Criteria

The study's exclusion criteria encompassed individuals with balance-impairing musculoskeletal injuries, severe lower extremity spasticity, substantial limitations in passive range of motion, visual deficits affecting balance, and disorders related to sensory function, proprioception, cognition, or perception.

Randomization and Allocation

Participants were randomly assigned to one of the two intervention groups in a 1:1 ratio using dedicated randomization software for parallel-group trials. To avoid bias, the allocation was kept concealed. A statistician, who was not involved in obtaining patient consent or conducting assessments, performed the group assignments.

Intervention

The study design divided participants into two groups, A and B, each receiving different physiotherapy interventions for four weeks. Group A underwent conventional physiotherapy supplemented with task-oriented training. These additional sessions, lasting 15 minutes and occurring three times weekly, aimed to improve balance and mobility through various functional tasks. The exercises included reaching activities while sitting and standing, walking backwards,

stepping up and down, navigating obstacles, climbing stairs, transferring between bed and chair, kicking a ball while seated, and balancing on a trampoline. Group B, serving as the control, received only conventional physiotherapy for 60-minute sessions, three times per week, over the same four-week period. This standard treatment focused on proprioceptive training using weight-bearing exercises, strengthening routines for upper and lower extremities, and weight-shifting activities in seated and standing positions. The program also included static stretching for major muscle groups, such as hip flexors, adductors, hamstrings, and plantar flexors. Gait training was a crucial component, featuring parallel bar walking and treadmill exercises. All therapy sessions for both groups were conducted in an outpatient setting, supervised by experienced physiotherapists to ensure standardized care and adherence to the prescribed treatment protocols.

Task-Oriented Training

Participants in Group A engaged in exercises aimed at improving balance and mobility. In addition to standard physiotherapy, they underwent task-oriented training sessions lasting 15 minutes, thrice weekly, for a period of four weeks. The exercises included reaching while seated and standing, walking in reverse, stepping up and down, navigating obstacles, ascending stairs, moving from bed to chair, kicking a ball from a seated position, and maintaining balance on a trampoline. Prior to the actual trial, the therapist provided practice runs for the task-oriented training group members. To facilitate at-home practice, participants were given videos and images demonstrating the tasks.

Conventional Physiotherapy Training

The comparison group underwent standard physical therapy sessions lasting 60 minutes, thrice weekly, for an identical four-week duration. Both sets of participants received conventional physiotherapy, which encompassed balance training through weight-bearing exercises; muscle-strengthening activities for arms and legs; exercises to shift body weight while seated and standing; static stretches targeting hip flexors, adductors, hamstrings, and plantar flexors; and walking practice. The walking exercises consisted of ambulation between parallel bars and training on a treadmill.

Outcome Measures

The study's principal outcome indicators were balance, mobility, and functional independence. These were evaluated using three standardized instruments: the Berg Balance Scale (BBS), Timed Up and Go Scale (TUG), and Functional Independence Measure (FIM). Measurements were taken at two time points: before the intervention commenced and after the completion of the four-week treatment program. Initial assessments were conducted prior to the start of the intervention, while follow-up evaluations were performed at the conclusion of the four-week treatment period.

Consort Guidelines for Study Design

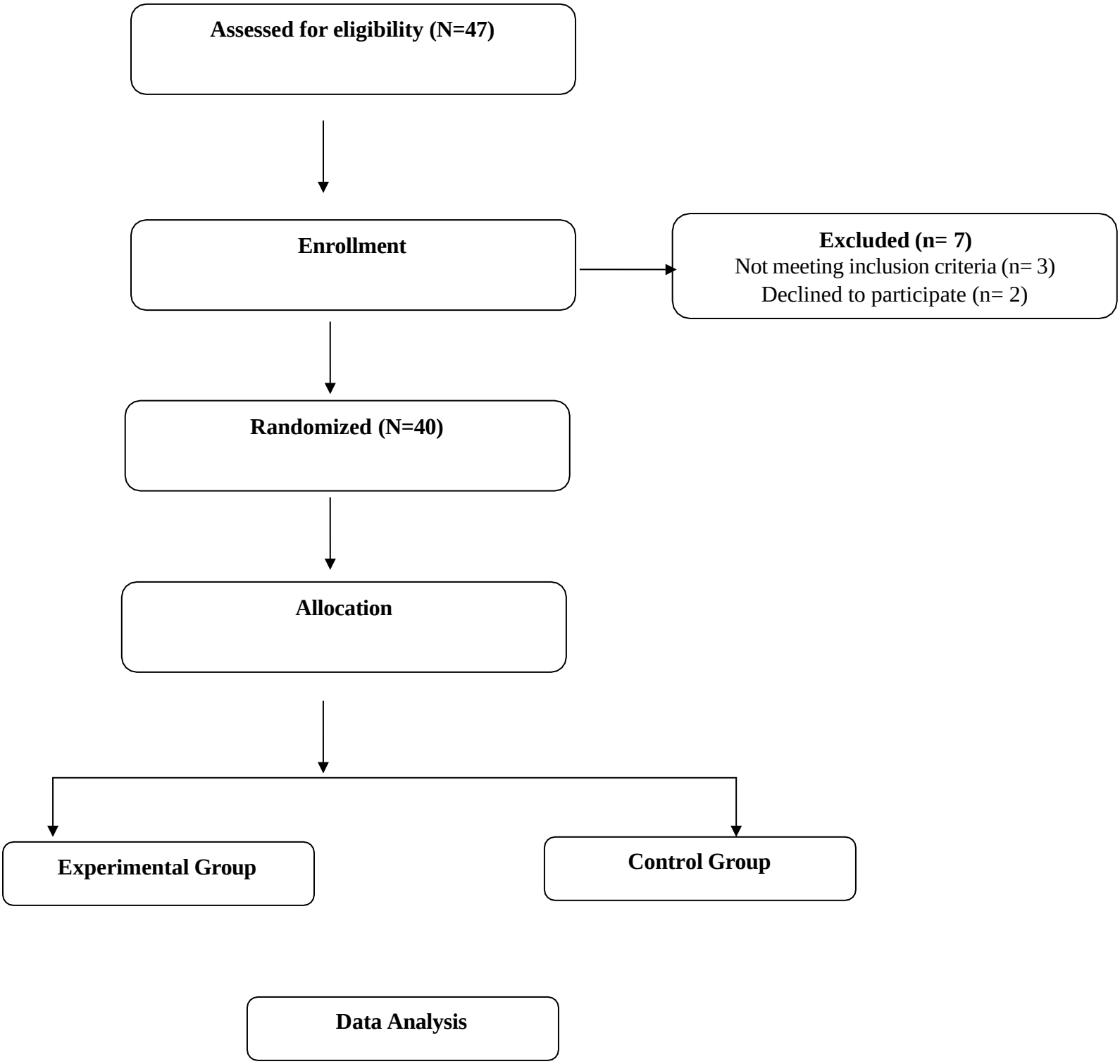

Figure 1 Participant making transition from sitting to standing

Figure 2 Participant making transition from standing to sitting

RESULT

The assessment data were collected from a pre-established spreadsheet with the baseline characteristic variable. After data collection, the data were analyzed. Data were coded and entered into a Microsoft Excel spreadsheet. The analysis was performed using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. Descriptive statistics included percentages, means, and standard deviations. The data were checked for normality before statistical analysis using the Shapiro–Wilk test. Mann–Whitney U test (for quantitative data to compare two independent observations) and Wilcoxon signed rank test (for quantitative data to compare before and after observations) were applied. The level of significance was set at $P \leq 0.05$.

Table 1 Age-Wise Distribution of Patients

Groups	Mean	Std. Devi	Minimum	Maximum	P value
Experimental	49.60	7.096	40	60	

Control	54.05	5.605	43	60	**0.03 (S)**

Table 2 Inter- Group Comparison of BBS between Experimental Group and Control Group at Pre-Intervention Level.

Groups	Mean	Std. Devi	Minimum	Maximum	P value
Experimental	35.30	4.105	28	40	
Control	34.95	4.261	27	43	0.79

Table 3 Inter- Group Comparison of TUG between Experimental Group and Control Group at Pre-Intervention Level.

Groups	Mean	Std. Devi	Minimum	Maximum	P value
Experimental	29.2050	4.57286	20.50	37.00	
Control	29.8650	4.07267	22.00	35.50	0.63

Table 4 Inter- Group Comparison of FIM between Experimental Group and Control Group at Pre-Intervention Level.

Groups	Mean	Std. Devi	Minimum	Maximum	P value
Experimental	75.80	7.509	62	87	
Control	75.20	4.697	69	88	0.76

Table 5 Inter- Group Comparison of BBS between Experimental Group and Control Group at Post Intervention Level.

Groups	Mean	Std. Devi	Minimum	Maximum	P value
Experimental	48.65	3.297	39	53	
Control	39.50	5.011	29	49	**0.001 (S)**

Table 6 Inter- Group Comparison of TUG between Experimental Group and Control Group at Post Intervention Level.

Groups	Mean	Std. Devi	Minimum	Maximum	P value
Experimental	19.42	4.13	13.20	29.00	
Control	26.05	4.24	18.00	32.20	**0.001 (S)**

Table 7 Inter-Group Comparison of BBS, TUG and FIM between Experimental Group and Control Group at Post Intervention Level.

Groups	Mean	Std. Devi	Minimum	Maximum	P value
Experimental	92.35	6.235	82	101	
Control	89.95	4.478	82	97	0.17

Table 8 Intra-Group Comparison of BBS, TUG and FIM Score in Experimental Group.

		Mean	Std. Deviation	P value
BBS	**Pre**	35.30	4.105	**0.001 (S)**

	Post	48.65	3.297	
TUG	**Pre**	29.2050	4.57286	**0.001 (S)**
	Post	19.4200	4.13274	
FIM	**Pre**	75.80	7.509	**0.001 (S)**
	Post	92.35	6.235	

Table 9 Intra-Group Comparison of BBS, TUG and FIM Score in Control Group.

		Mean	**Std. Deviation**	**P value**
BBS	**Pre**	34.95	4.261	**0.001 (S)**
	Post	39.50	5.011	
TUG	**Pre**	29.8650	4.07267	**0.001 (S)**
	Post	26.0500	4.24022	
FIM	**Pre**	75.20	4.697	**0.001 (S)**
	Post	89.95	4.478	

DISCUSSION

This study examined the efficacy of task-oriented training in enhancing balance, mobility, and function among subacute stroke patients. Pre- and post-intervention evaluations focused on balance, speed, and functional capabilities. Neuroplasticity allows the central nervous system to modify its cellular physiology and morphology in response to various stimuli. The cerebral cortex has been identified as particularly susceptible to neuroplastic changes triggered by behavioral experiences [32, 33]. Task-oriented training, a motor learning approach, aims to develop skills within specific functional contexts. Skill acquisition involves performing tasks reliably, adaptably, and efficiently. For stroke patients, this training method promotes motor relearning by improving essential functional activities and is associated with potential adaptive neuroplastic changes in the cerebral cortex, brainstem, cerebellum, and spinal cord [32,33,34,35]. Neurological alterations in the lower hemiplegic limb following a stroke impact gait patterns. Beyond muscle weakness, the

primary challenge in hemiplegic gait involves inappropriate timing of muscle activation and relaxation throughout the walking cycle.

The research study encompassed an initial evaluation of baseline data between groups prior to treatment, followed by a comparative analysis of pre- and post-intervention measurements within each cohort. Initial findings revealed no statistically significant disparities in BBS, TUG, and FIM scores between the Experimental and Control groups at the pre-intervention stage. Subsequent to the intervention, both groups exhibited statistically significant enhancements in BBS and TUG scores, while FIM scores remained statistically unchanged. A comprehensive examination of pre- and post-intervention metrics for BBS, TUG, and FIM in both groups demonstrated that Conventional PT Exercises and the integration of task-oriented training with conventional PT were equally efficacious in enhancing Balance, Mobility and Function among stroke patients.

The findings of this study was consistent to Anas Ahamad, Kannan Dhasaradharaman, et Compare the ways in which task-oriented training and balance training assist stroke patients in regaining their balance. While group A participants received task-oriented instructions, the subjects in group B received balancing training. The balance of the participants was assessed both before and after the six-month rehab program was completed using the Berg Balance Scale and Performance-focused Mobility Assessment. The six-month exercise programme revealed that improving balance in patients with stroke was more successful with the task-oriented training programmed [36].

When comparison was performed at the post-intervention level, it was found that the Experimental Group scored significantly higher than the Control Group in BBS, TUG and FIM, which shows that task-oriented training is more effective in improving Balance, Mobility and Function in stroke patients. To increase motor skills and potentially function, there are six task-oriented motor training tenets that must be followed by restricted use of the affected limbs, specific training locations widely used (repetition), skill development, task importance, awareness of efforts, and outcomes [37]. To develop effective and efficient motor abilities, task-specific training involves frequent practice of functional activity or a component of a single functional task in an open environment. The dynamic systems theory, on which task-specific training is founded, states that complex interactions among the body's numerous subsystems, the task at hand, and the environment lead to movement behavior [38]. The goal of rehabilitation employing task-specific training is to enhance function across all performance domains by focusing on function, participation, and quality of life [39].

Fatih et al. (Nov 2019) demonstrated that Task-Oriented Circuit Training with Aerobic Training (TOCT-AT) led to significant improvements in various aspects of mild-to-moderate Parkinson's disease (PD) compared to Aerobic Training (AT) alone. These improvements included better balance, enhanced gait performance, increased functional mobility, greater balance confidence, reduced disease severity, and improved quality of life. The study involved both experimental and control groups engaging in 30 minutes of AT, followed by a ten-minute rest period. Subsequently, the intervention group underwent TOCT three times weekly for a duration of eight weeks. The results indicate that integrating multiple training approaches may lead to enhanced performance in real-world activities and daily living for PD patients, particularly in terms of balance and gait improvements [40]. Harvey et al. (2009) noted that while research is advancing innovative post-stroke recovery methods, the mechanisms remain largely unclear. Despite many rehabilitation centers using traditional compensatory techniques, there is a growing adoption of task-oriented

methods. Neuroscientific studies show that motor retraining in affected limbs is linked to neuroplastic changes in the cerebral cortex and other CNS areas. Task-oriented training, which focuses on skilled motor practice, is essential for neural reorganization and CNS "reprogramming." Therefore, intensive task-oriented training should be an integral part of rehabilitation for anyone with stroke-induced motor deficits [41].

This research aligns with the findings of Anne Shamway Cook, who emphasized a task-oriented approach in their book. This approach focuses on therapeutic interventions tailored to the specific skill being acquired. To enhance participation and reduce mobility restrictions, it involves treatments aimed at minimizing impairments, optimizing gait strategies to effectively meet walking requirements, and adapting functional gait abilities to various tasks and environmental conditions. While not utilizing preambulation skill training, this method employs both partial and complete practice to retrain functional gait strategies. Considerable emphasis is placed on practicing gait across diverse tasks and environmental settings [26]. The current study demonstrates that the enhancement of coordinated multijoint movements, which effectively maintain postural control, led to improved balance, mobility, and function. Furthermore, the active implementation of task-oriented training in stroke survivors resulted in better functional outcomes and overall health-related quality of life. In conclusion, task-oriented training proves more beneficial for stroke patients compared to conventional physiotherapy, offering greater improvements in mobility and balance.

CONCLUSION

Both task-oriented training combined with conventional physiotherapy and conventional treatment alone improve balance, mobility, and function in stroke patients. However, those receiving task-oriented training alongside conventional physiotherapy showed greater improvements in balance and mobility. Therefore, task-oriented training is an effective adjunct to conventional physiotherapy for treating stroke patients.

LIMITATION

The small sample size of this study limits the generalizability of the findings. Additionally, the analysis focused solely on short-term benefits related to mobility, balance, and function without exploring long-term effects. The study included only subacute stroke patients, and the short duration of the intervention, spanning just four weeks, further restricts the scope of the conclusions that can be drawn.

RECOMMENDATION

The study's results have crucial clinical implications for enhancing stroke rehabilitation. Combining Task-Oriented Training (TOT) with conventional physiotherapy demonstrates potential in improving balance and mobility beyond standard treatments. TOT's versatility suggests possible benefits for other neurological disorders, particularly in individuals with high fall risk. Future studies should include larger samples and investigate TOT's impact across all stroke recovery phases. Moreover, additional research is needed to ascertain TOT's long-term effects and the consequences of detraining post-intervention.

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