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Effectiveness of Task-Oriented Gait Training on Functional Ambulation in Post-Stroke Patients

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ABSTRACT

Background: Gait impairment is a major cause of long-term disability after stroke, and conventional physiotherapy often yields limited restoration of community-level ambulation. Task-oriented gait training (TOGT), grounded in motor learning principles, may enhance functional walking by engaging patients in repetitive, goal-directed tasks that mimic real-world gait demands. **Objective:** To evaluate the effectiveness of an eight-week TOGT program compared with conventional physiotherapy on functional ambulation in post-stroke patients. **Methods:** In this randomized controlled trial, 60 adults with subacute stroke were allocated to TOGT or conventional physiotherapy (30 per group). Both groups received supervised 45-minute sessions, five days per week for eight weeks. Outcomes including gait speed (primary), 6MWT distance, FAC, TUG, cadence, step symmetry, BBS, and mobility rating were assessed pre- and post-intervention. **Results:** TOGT produced significantly greater gains in gait speed (+0.30 vs +0.16 m/s; between-group Δ = 0.14 m/s, $p < 0.001$), 6MWT distance (+100 vs +50 m, $p < 0.001$), FAC (+1.4 vs +0.9, $p = 0.002$), and TUG (−6.6 vs −3.9 s, $p = 0.004$). Regression analysis showed TOGT independently predicted higher post-treatment gait speed ($\beta = 0.12$, $p < 0.001$). **Conclusion:** Task-oriented gait training is superior to conventional physiotherapy for improving multidimensional gait outcomes after stroke. **Keywords:** Stroke rehabilitation; task-oriented training; gait speed; functional ambulation; randomized controlled trial

Introduction

Stroke remains a leading cause of long-term disability worldwide, with gait impairment representing one of the most functionally debilitating consequences. Regaining independent ambulation is consistently ranked as a top rehabilitation priority by stroke survivors, yet conventional physiotherapy often yields slow or incomplete recovery of community-level gait performance (1). Over recent years, task-oriented training approaches grounded in motor learning theory have gained increasing attention for their potential to enhance functional ambulation by repeatedly engaging patients in context-specific walking tasks that induce neuroplastic adaptation (2). Unlike traditional impairment-based methods, task-oriented gait training (TOGT) directly targets the performance of meaningful gait activities under progressively challenging conditions, thereby strengthening motor control, coordination, and endurance in a way that more closely mirrors real-world walking demands (3).

Despite growing evidence suggesting that task-oriented paradigms outperform standard physiotherapy in improving gait speed, walking endurance, and functional ambulation post-stroke, much of the available evidence arises from small, heterogeneous studies with methodological limitations, underpowered sample sizes, and brief intervention durations (4). Recent randomized controlled trials and meta-analyses, including those by Lee (2019), Kim (2022), and Wang (2020), have reported superior gains in gait speed and endurance among patients receiving task-oriented training; however, gaps persist regarding the magnitude of benefit in subacute populations and the generalizability of findings to neurorehabilitation settings in South Asia, where contextual differences in rehabilitation resources, patient characteristics, and stroke presentations may influence treatment response (5–7). Additionally, few studies have examined multiple gait-related domains concurrently including symmetry, balance, cadence, and mobility ratings, limiting comprehensive understanding of how TOGT influences overall functional ambulation.

To address these knowledge gaps, this study evaluated the effectiveness of an eight-week task-oriented gait training protocol compared with conventional physiotherapy among post-stroke patients in neurorehabilitation units in Rawalpindi. Using validated functional measures and rigorous randomized controlled methodology, the study aimed to determine whether TOGT produces greater improvements in gait speed, endurance, functional ambulation classification, dynamic balance, and mobility. The research question guiding this trial was: Does task-oriented gait training lead to significantly greater improvements in functional ambulation compared with conventional physiotherapy in post-stroke patients? The primary hypothesis was that TOGT would yield superior gains in gait speed after eight weeks of intervention.

Materials and Methods

This randomized controlled trial was conducted across neurorehabilitation units in Rawalpindi over an eight-week intervention period, designed to evaluate the comparative effectiveness of task-oriented gait training and conventional physiotherapy in improving functional ambulation among adult post-stroke patients (8). Participants were recruited through consecutive sampling from inpatient and outpatient rehabilitation referrals, and those meeting eligibility criteria were randomly allocated in a 1:1 ratio to either the TOGT group or the conventional physiotherapy group. Inclusion criteria encompassed adults aged 40–75 years with a first-ever ischemic or hemorrhagic stroke diagnosed by neuroimaging, residual lower limb motor impairment, ability to follow simple commands, and baseline gait impairment as defined by a Functional Ambulation Category (FAC) score of 1–4. Patients were excluded if they had unstable cardiovascular disease, severe cognitive impairment, untreated musculoskeletal disorders limiting ambulation, or concurrent participation in another rehabilitation program. After screening, eligible individuals provided written informed consent before entering the study.

Randomization was performed using a computer-generated sequence with allocation concealment, and assessors blinded to group assignments conducted all outcome evaluations. Baseline demographic and clinical data, including age, sex, stroke type, affected side, comorbidities, and duration since stroke, were documented prior to intervention. Participants in both groups attended supervised sessions five days per week for eight weeks, with each session lasting 45 minutes. The TOGT protocol emphasized repeated practice of task-specific gait activities progressively graded in complexity, such as overground walking, variable-speed walking, obstacle negotiation, directional changes, and functional mobility tasks requiring dynamic balance. The conventional physiotherapy program consisted of standard impairmentbased lower limb strengthening, range-of-motion exercises, balance training, and unsupported walking using therapist-guided progression.

Outcome measures were collected at baseline and immediately post-intervention using standardized instruments. The primary outcome was gait speed assessed through the 10-Meter Walk Test (10MWT). Secondary outcomes included walking endurance via the Six-Minute Walk Test (6MWT), balance evaluated with the Berg Balance Scale (BBS), functional ambulation using the FAC, mobility via patientreported mobility rating, step length symmetry ratio, cadence measured in steps per minute, and functional mobility assessed with the Timed Up and Go (TUG) test. Operational definitions adhered to international standards for stroke rehabilitation assessment (9). To minimize measurement bias, all tests were administered under identical environmental conditions, and the same evaluator conducted both baseline and follow-up assessments. Confounding was addressed statistically by adjusting for baseline values in analysis of covariance models. Missing data were minimal and handled using complete-case analysis because patterns suggested data were missing completely at random.

Sample size estimation targeted detection of a clinically meaningful difference of 0.16 m/s in gait speed with 80% power and 5% significance, yielding a required sample of 60 participants. Statistical analysis was performed using SPSS v26. Between-group differences in change scores were examined using ANCOVA adjusting for baseline measures. Correlation analyses employed Pearson coefficients to explore relationships between ambulation parameters, and multiple linear regression identified independent predictors of post-treatment gait speed. All tests were two-tailed with a significance threshold of $p < 0.05$. Ethical approval was obtained from the institutional review board, and all procedures adhered to the Declaration of Helsinki. Measures were taken to ensure data integrity, including standardized assessor training, secure data storage, predefined analysis protocols, and continuous monitoring for protocol adherence.

Results

Baseline characteristics were comparable between groups, with no statistically significant differences in age ($p = 0.756$), sex distribution ($p = 0.796$), stroke type ($p = 0.818$), baseline gait speed ($p = 0.678$), or other clinical parameters, confirming successful randomization. Following eight weeks of intervention, the TOGT group demonstrated significantly greater gains in all functional ambulation outcomes. Gait speed improved by 0.30 m/s in the TOGT group compared with 0.16 m/s in the conventional group, producing a between-group mean difference of 0.14 m/s (95% CI 0.09–0.19; $p < 0.001$).

Table 1. Baseline Characteristics of TOGT vs Conventional Physiotherapy Groups

Variable	TOGT (n = 30)	Conventional (n = 30)	Total (n = 60)	p-value
Age (years), mean ± SD	58.4 ± 9.6	59.2 ± 10.2	58.8 ± 9.9	0.756
Sex, n (%)	0.796			
Male	18 (60.0%)	16 (53.3%)	34 (56.7%)	
Female	12 (40.0%)	14 (46.7%)	26 (43.3%)	
Stroke type, n (%)	0.818			
Ischemic	24 (80.0%)	22 (73.3%)	46 (76.7%)	
Hemorrhagic	6 (20.0%)	8 (26.7%)	14 (23.3%)	
Affected side (Right/Left)	16/14	18/12	34/26	0.602
Duration since stroke (months), mean ± SD	4.8 ± 2.2	5.1 ± 2.4	5.0 ± 2.3	0.612
Comorbidities				
Hypertension	22 (73.3%)	24 (80.0%)	46 (76.7%)	0.556
Diabetes mellitus	12 (40.0%)	14 (46.7%)	26 (43.3%)	0.605
Baseline gait speed (m/s)	0.48 ± 0.14	0.46 ± 0.15	0.47 ± 0.14	0.678
Baseline 6MWT distance (m)	168 ± 52	162 ± 56	165 ± 54	0.712
Baseline FAC score	2.8 ± 0.9	2.7 ± 0.8	2.8 ± 0.8	0.756
Baseline TUG (s)	22.4 ± 4.8	23.1 ± 5.2	22.8 ± 5.0	0.612
Baseline BBS	38.6 ± 6.2	37.8 ± 6.6	38.2 ± 6.4	0.678

Table 2. Pre- and Post-Intervention Functional Ambulation Outcomes (8 weeks)

Outcome	TOGT Pre	TOGT Post	Conv Pre	Conv Post	Mean Δ Difference (95% CI)	p-value*
Gait speed (m/s)	0.48 ± 0.14	0.78 ± 0.12	0.46 ± 0.15	0.62 ± 0.13	+0.14 (0.09–0.19)	<0.001
6MWT distance (m)	168 ± 52	268 ± 62	162 ± 56	212 ± 58	+50 (28–72)	<0.001
FAC score	2.8 ± 0.9	4.2 ± 0.7	2.7 ± 0.8	3.6 ± 0.8	+0.5 (0.2–0.8)	0.002

Outcome	TOGT Pre	TOGT Post	Conv Pre	Conv Post	Mean Δ Difference (95% CI)	p-value*
TUG (s)	22.4 ± 4.8	15.8 ± 3.6	23.1 ± 5.2	19.2 ± 4.4	−2.7 (−4.5 to −0.9)	0.004
Step symmetry ratio	0.68 ± 0.12	0.88 ± 0.08	0.66 ± 0.14	0.78 ± 0.10	+0.08 (0.04–0.12)	<0.001
Cadence (steps/min)	78 ± 14	98 ± 12	76 ± 16	88 ± 14	+8 (3–13)	0.002
BBS	38.6 ± 6.2	48.4 ± 4.8	37.8 ± 6.6	43.2 ± 5.6	+4.4 (2.2–6.6)	<0.001
Mobility rating (0–10)	4.2 ± 1.6	7.8 ± 1.2	4.1 ± 1.8	6.4 ± 1.4	+1.3 (0.7–1.9)	<0.001

Table 3. Correlation Matrix of Post-Intervention Ambulation Measures

Variable	Gait Speed	6MWT	FAC	TUG	Cadence	BBS	Symmetry
Gait Speed	1	0.88	0.82	−0.84	0.78	0.80	0.76
6MWT	0.88	1	0.78	−0.80	0.74	0.76	0.72
FAC	0.82	0.78	1	−0.76	0.70	0.74	0.68
TUG	−0.84	−0.80	−0.76	1	−0.72	−0.78	−0.70
Cadence	0.78	0.74	0.70	−0.72	1	0.68	0.66
BBS	0.80	0.76	0.74	−0.78	0.68	1	0.70
Symmetry	0.76	0.72	0.68	−0.70	0.66	0.70	1

Table 4. Multiple Linear Regression Predicting Post-Treatment Gait Speed

Predictor	β	SE	t	p-value	95% CI
Group (TOGT = 1)	0.12	0.03	4.00	<0.001	0.06–0.18
Baseline gait speed	0.58	0.08	7.25	<0.001	0.42–0.74
Duration since stroke	−0.02	0.01	−2.00	0.050	−0.04–0.00
Stroke type	0.06	0.04	1.50	0.139	−0.02–0.14
Affected side	0.04	0.03	1.33	0.188	−0.02–0.10
Baseline BBS	0.01	0.00	2.50	0.015	0.00–0.02
Age	−0.01	0.00	−2.50	0.015	−0.02–0.00
Sex	−0.02	0.03	−0.67	0.506	−0.08–0.04
Comorbidities	−0.04	0.03	−1.33	0.188	−0.10–0.02

Walking endurance improved by 100 m versus 50 m, respectively, yielding a significant advantage of 50 m (28–72; $p < 0.001$).

Functional ambulation classification increased by 1.4 points in the TOGT group compared with 0.9 in the control group ($p = 0.002$). Substantial improvements were also seen in TUG, with a −6.6 s reduction in the TOGT group versus −3.9 s in the conventional group ($p = 0.004$). Step length symmetry, cadence, balance (BBS), and mobility ratings all showed significantly greater improvements under TOGT (all $p \leq 0.002$). Strong correlations were observed across ambulation parameters, with gait speed displaying robust positive associations with 6MWT distance ($r = 0.88$) and BBS ($r = 0.80$), and strong negative associations with TUG ($r = -0.84$). Regression analysis identified TOGT participation ($\beta = 0.12$, $p < 0.001$) and higher baseline gait speed ($\beta = 0.58$, $p < 0.001$) as significant independent predictors of post-treatment gait speed.

Discussion

This randomized controlled trial demonstrated that an eight-week protocol of task-oriented gait training produced significantly superior improvements in functional ambulation compared with conventional physiotherapy among post-stroke patients. The magnitude of change observed in gait speed, endurance, balance, and mobility aligns closely with previous controlled trials and meta-analyses, including those by Lee (2019), Kim (2022), and Wang (2020), which collectively support the premise that repetitive, context-specific task practice accelerates motor recovery through enhanced neuroplastic adaptation (10– 12). The present findings further reinforce the principle that purposeful walking activities embedded in real-world functional contexts promote more rapid and sustainable gains than impairment-focused exercises that do not adequately challenge the neuromotor system.

Improvements in gait speed were particularly notable, exceeding the minimal clinically important difference for stroke survivors and indicating meaningful functional recovery. Strong correlations between gait speed and other outcomes including balance, endurance, symmetry, and mobility underscore the interdependent nature of gait domains and the global influence that task-oriented training exerts across motor subsystems. The regression analysis confirmed that TOGT was an independent predictor of post-treatment gait speed even after adjusting for demographic and clinical confounders, highlighting the treatment's robust effect irrespective of baseline characteristics.

The substantial improvement in walking endurance suggests that repeated task-specific practice enhances both aerobic capacity and motor control efficiency, enabling participants to sustain longer bouts of ambulation. Similarly, gains in step symmetry and cadence reflect improvements in bilateral coordination and rhythmic gait patterning, which are often challenging to achieve through conventional physiotherapy alone. These findings support assertions from motor learning literature that practicing whole-task walking activities yields more transferable improvements than isolated component training (13).

The significant reduction in TUG time and increase in FAC and BBS scores collectively demonstrate enhanced dynamic balance and functional mobility, which are critical determinants of fall prevention and community ambulation. Given that balance impairments frequently limit stroke survivors' capacity to reintegrate into daily living activities, the observed improvements have important implications for long-term independence. Notably, task-oriented approaches may also enhance patient motivation by engaging individuals in meaningful, goal-directed tasks, potentially contributing to better training adherence and performance intensity (14).

Conclusion

Task-oriented gait training produced significantly greater improvements than conventional physiotherapy in gait speed, endurance, balance, symmetry, and functional ambulation among poststroke patients over eight weeks, demonstrating its efficacy as a superior rehabilitation approach and offering strong clinical justification for its integration into routine neurorehabilitation practice.

DECLARATIONS

Author Contributions:	Concept: UK; Design: BK; Data Collection: UK; Analysis: BK; Drafting: UK.
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