Original Research Article

Comparison of dual-task specific training & conventional physiotherapeutic interventions in ambulation of left hemiplegic stroke patients: a randomized control trial

Abstract

Background: Physiotherapeutic interventions help in the motor relearning and functional recovery of stroke patients with motor impairments of the upper and lower limbs. Among the various physiotherapeutic interventions, dual-task training has been proven significantly effective in the functional recovery of stroke patients. The aim of this study is to compare the effectiveness of dual-task training (DTT) and conventional physical therapy in ambulatory left-hemiplegic stroke patients.

Method: This RCT was conducted at the King Hospital, Swat, from March 2019 to August 2019 on chronic left-hemiplegic stroke patients. The patients recruited for the study on the basis of set inclusion criteria were randomised into 2 groups: the treatment group received DTT, while the control group received conventional physical therapy. The DTT menu intervention contained the following: slowly walking forward, backward, and sideways on a smooth, non-slippery surface while holding an 80-gram sandbag in hand. The CPT group received conventional physiotherapy, which included mat activities, strengthening and stretching exercises, and ambulation and gait training. Pre- and post-test clinical data were collected and analysed on SPSS 22 for spatial and temporal variables for CPT and DTT by using 10MWT and TUG (10-Meter Walk Test and Time Up and Go Test, respectively) along with step length, cadence, cycle time, and stride length.

Results: Of the 32 patients, there were 16 (50%) in each of the groups that both had 18 males (56%) and 14 females (44%). The mean age recorded in the CPT was 58.20 6.20 and in the DTT 58.27 6.12 years. Baseline clinical parameters among both groups were almost identical ($P > 0.05$). Post-test score showed improvement of gait variables (temporal and spatial), 10MWT score, cadence, step length, stride, and cycle time in DTT as compared to CPT (P 0.05).

Conclusion; Dual-task training and conventional physical therapy significantly improve the functional ability of the left-hemiplegic patients on all gait, temporal, and spatial parameters.

Keywords; Stroke, dual task training, conventional physical therapy, gait & ambulation

Introduction; Stroke is the 3rd cause of death globally; from 1990–2007, age-standardised years of life lost (YLL) increased by 12.9% (10.6–15.2) and from 2007–2017 by 12.1%, while the stroke incidence increased from 5.29 million (5.22–5.40) to 6.17 million (6.4–6.33) from 2007–2017. Thus, it increased DALYs (disability-adjusted life years) due to multifaceted morbidity and effects of longevity from 3.54 to 9.66% in the period 1990–2013, as reported in the GBD statistic (Global burden of the Diseases)[1-2]. High-income countries (HIC) recorded a 42% decrease in strokes, while low- and middle-income countries (LMIC) showed a 100% increase in the last 3–4 decades. The statistics record that there are around 62 million stroke survivors globally, and 1/3 of them are living with severe disabilities.[4]. It has been

estimated that more than 80% of DALYs occur in LMIC.[3, 4.] In spite of the recent effective advancements made in the management of stroke, such as thrombolytic and endovascular interventions, stroke remains one of the most common causes of disability worldwide [2–5]. Post-stroke disability is still a major health burden [6–9.] There is variation in the rehabilitation programs provided to stroke patients worldwide, and the quality and content of the programme depend mostly on the medical and financial resources.[9].

Stroke post-acute care is given usually in the inpatient rehab centers or in the patient's home and is sponsored by Medicare in the USA. [10]. Medicare expenditure on stroke is 15% of all other health-related expenditures [8, 9]. The outcome measures and effectiveness of stroke rehabilitation programs have been surveyed through different registries such as EROS (European Register of Stroke) and CERISE (Collaborative Evolution of Rehabilitation in Stroke across Europe); however, greater variations exist among the countries in the union in their stroke-specific rehabilitation programs (9–14). In Asian countries, including Pakistan, post-stroke rehabilitation is carried out in inpatient rehabilitation facilities for a period of 4-6 months after the patient's discharge from the acute hospital. Functional recovery is the goal of these centers for stroke patients, but due to the unstructured rehab program, greater variations are usually found by studies.[1,15,16]. Physiotherapeutic interventions help in the motor relearning and functional recovery of stroke patients with motor impairments of the upper and lower limbs [15–17]. Among the various physiotherapeutic interventions, dual-task training has been proven significantly effective in the functional recovery of stroke patients. [1]. The aim of this study is to compare the effectiveness of dual-task training (DTT) and conventional physical therapy in ambulatory left-hemiplegic stroke patients. DTT involves performing dual tasks at the same time, and its impact is examined on the gait parameters (spatial and temporal variables). It has been reported that DTT improves the step-stride length and walking speed of stroke patients [16, 18, 19]. It has been reported that DTT, along with conventional physical therapy such as mat activities, strengthening and stretching exercises, balance training, and gait training, is statistically effective in improving the ambulatory capacity of chronic stroke patients [20–22].

Methodology; The RCT was conducted at the King Hospital in Swat from March 2019 to August 2019 on chronic left-hemiplegic stroke patients. The ethical approval and consent were taken from the hospital administration and the study's participants, respectively. The sample size was calculated (23, 24) to achieve 80% power and an alpha value of 95%. Based on the connivance sampling, male and female left hemiplegic stroke patients, aged 40–64 years, who were medically stable and willing to participate in the study, were included in the study. Left-hemiplegic patients with other complications such as bed ulcers or contractures, patients with cognitive impairments, speech and language impairments, patients with orthopedic lower limb problems such as fractures, TIA patients, and right-hemiplegic patients were excluded. The patients recruited for the study on the basis of set inclusion criteria were randomised (lottery method) into 2 groups: the treatment group received DTT, while the control group received conventional physical therapy (CPT). The treatment group was exposed to DTT along with stretching and strengthening exercises for 30 minutes four times a week for four weeks. The DTT menu intervention contained the following: slowly walking forward, backward, and sideways on a smooth, non-slippery surface while holding an 80-gram sandbag in hand. The CPT received conventional physiotherapy, which consisted of mat activities, strengthening and stretching exercises, and ambulation and gait training for 30 minutes four times a week for four weeks. Pre- and post-test clinical data were collected and analysed on SPSS 22 for spatial and temporal variables for DTT and CPT by using 10MWT and TUG (10-Meter Walk Test and Time Up and Go Test, respectively) along with step length, cadence, cycle time, and stride length. The independent variables of this RCT were a) CCPT and b) DTT, and the dependent variables of

the study were a) cadence, b) stride length, c) step length, d) walking speed, e) 10MWT, and f) TUG test. For the comparison of the demographic information of the left-hemiplegic patients, an independent t-test was used, and for the pre- and post-interventions A paired t-test was used for the comparison of dependent variables within the group data with a P value > 0.05.

Results; Of the 32 patients, there were 16(50%) in each of the group that both had 18 males (56%) & 14 females (44%). Mean age recorded in CPT was 58.20± 6.20 & in the DTT 58.27± 6.12 years. Baseline clinical parameters among both groups were almost identical (P>0.05). Post-test score showed improvement of gait variables (temporal & spatial), 10MWT-score, cadence, step-length, stride & cycle time in TG as compared to CG with P<0.05). (Table-1)

Table-1: Comparison of the patient's demographic data of CPT & DTT

Variables	Treatment group (TG) N=16	Control group (CG) N=16
Age	58.27± 6.12 (P=0.72)	58.20± 6.20
Gender (Male)	9 (28%)	9 (28%)
(female)	7 (22%)	7 (22%)
Hemiplegic side	16 (100%)	16 (100%)

Pre-intervention mean step length of DTT was 48.48 ± 3.5 cm & for the CPT 47.87±4.6 cm while post-intervention stride length for the DTT 96± 8.2 cm & for the CPT was 95.50±9.4 cm. (Table-2)

Table-2: Comparison of the gait parameters score of CPT & DTT before treatment (baseline score)

Variables	Treatment group (DTT) N=16	Control group (CPT) N=16	P-value
Step length(cm)	48.48 ± 3.5	47.87±4.6	0.36
Stride length (cm)	96± 8.2	95.50±9.4	0.44
10MWT (cm/s)	85.34± 11.20	82.30± 12.8	0.55
TUG (s)	25.10± 2.4	26.74 ±1.34	0.42
Cycle time (s)	1.25±0.09	1.15±0.08	0.40
Cadence (steps/min)	94.50± 3.45	95.50± 3.50	0.13

Post-intervention mean step length of DTT was 56.48 ± 9.5cm & for the CG 49.87±3.6 cm while post-intervention stride length for the DTT 105± 8.2cm & for the CPT was 98.50±7.4cm. (Table-3)

Table-3: Comparison of the gait parameters score of CPT & DTT after treatment

Variables	Treatment group (DTT) N=16	Control group (CPT) N=16	P-value
Step length(cm)	56.48 ± 9.5	49.87±3.6	0.001
Stride length (cm)	105± 8.2	98.50±7.4	0.01
10MWT (cm/s)	103.34± 8.20	80.30± 9.8	0.001
TUG (s)	10.10± 2.4	19.74 ±2.34	0.001
Cycle time (s)	1.02±0.037	1.11±0.086	0.001

Cadence (steps/min)	104.50± 4.45	98.59± 3.90	0.001

Discussion;

The purpose of this randomised controlled trial (RCT) was to examine the efficacy of two distinct rehabilitation regimens for individuals with hemiplegic stroke. One group of patients in this study underwent dual-task specialized training, which most likely included exercises aimed at enhancing the ability to do several activities at the same time. The other group received traditional physical therapy, which is a normal rehabilitation approach. The goal was to determine which intervention was more effective in improving the ambulation (walking capacity) of chronic stroke patients. The provided text discusses the positive effects of a therapeutic approach known as DTT (Dynamic Treadmill Training) on improving gait speed in stroke patients.[1-2]

In the realm of stroke rehabilitation, DTT emerges as a promising avenue for enhancing gait speed. The current study underscores its effectiveness, echoing findings from research on chronic stroke patients with similar objectives. Notably, DTT is deemed safe for community ambulation, with a recommended walking speed of 110 to 150 cm/s in various social and environmental contexts. Comparative insights from Dean et al. reveal that stroke survivors experienced a notable gain in gait speed post-treatment, mirroring the current study's results. Moreover, the mean patient age in this study aligns with earlier research, emphasizing the consistency of findings in this area.[2-3]

What's striking is the consistent pattern of improved walking speed after DTT, corroborated by controlled trials and additional studies. Interestingly, the frequency of training sessions may influence outcomes, with more frequent sessions in this study potentially contributing to superior results. Intriguingly, a different study with the same length of treatment showed significant improvements in the "Timed Up and Go" (TUG) test. This shows how DTT can be used to help stroke patients with different parts of their mobility. These findings collectively underscore the potential of DTT as a valuable tool in stroke rehabilitation, offering hope for improved outcomes and enhanced quality of life. [1-3.]

The results of this RCT revealed that the group that received dual task training improved significantly in several spatial and temporal gait metrics when compared to the group that received standard physiotherapy. This shows that dual task-specific training, which had higher results in this controlled experiment, may be a more useful method for helping hemiplegic stroke patients improve their walking skills. Overall, the title of this study suggests that it will compare these two rehabilitation strategies and highlight the possible benefits of dual task training in the context of stroke therapy.[4-7.]

The findings of this randomised controlled trial (RCT) show a significant improvement in gait speed among left hemiplegic stroke patients, which is consistent with the findings of a previous study on chronic stroke patients with motor impairments.[6-12]. It is worth noting that in ordinary social and environmental circumstances, a walking pace of 110–150 cm/s is regarded as adequate [3, 8]. Gait speed improved dramatically from 85 cm/s to 103 cm/s in this trial, reflecting an 18 cm/s increase. This improvement is consistent with the findings of Dean et al. and Iqbal et al., who found 12.6 cm/s and 16 cm/s speed increases, respectively [13–15].

The average age of stroke patients in this trial was around 58 years, with no statistically significant difference between the treatment and control groups, as demonstrated by a p-value of 0.72. These age demographics are similar to those seen in earlier studies, including those of stroke patients aged 16–20. CPT for the Timed Up and Go (TUG) test, this RCT showed improvements in all gait parameters following Dual-Task Training (DTT) interventions. This is consistent with the findings of other stroke studies [14–16]. However, it contrasts with another study including 20 stroke patients, which found that DTT therapies improved TUG scores [21–25]

Furthermore, following DTT therapies, a quasi-experimental investigation found significant improvements in cadence but no statistically significant changes in other gait characteristics such as step length and stride length [11–13.] These disparities could be related to differences in sample size, hemiplegic side (right hemiplegia), and reduced DTT dosage compared to this RCT, which included 32 participants and gave DTT four times per week for four weeks.

Dual-Task Training (DTT) improves the functional capacities of people who have had a left-hemiplegic stroke when combined with standard physical treatment. This enhancement affects several aspects of gait timing and spatial features. These findings add to the expanding body of evidence demonstrating the efficacy of DTT therapies in stroke recovery. When dual-task training is used in conjunction with traditional physical therapy, it results in significant improvements in the functional abilities of stroke patients with left-side hemiplegia. These enhancements cover several aspects of their walking patterns' timing and spatial characteristics. The findings of this study add to the growing body of literature highlighting the benefits of dual-task training in the setting of stroke rehabilitation [11, 16, 23, 17.]

A significant increase in cadence was observed following dual-task training (DTT) interventions in a quasi-experimental study, while statistically significant improvements in other gait parameters, including step length and stride length, were not detected. The DTT interventions comprised four weeks of 40-minute sessions each day, three times a week [11–14]. Several factors can contribute to the disparity in the outcomes of this quasi-experimental study: (A) The study's sample size was rather small. B) The participants in the study suffered a right hemiplegic stroke. C) The DTT dosage in this investigation was lower than in a cited randomised controlled trial (RCT) with a sample size of 32 that delivered DTT four times per week for four weeks [27–32].

Another study found that dual-task training (DTT) improved motor dual-task performance, which is consistent with the findings of this randomised controlled trial (RCT). An inter-group study of gait temporal and spatial factors such as step length, stride length, and cadence demonstrated significant improvements comparable to those found in this RCT.[12-13].

Conclusion; Dual-task training and conventional physical therapy significantly improve the functional ability of the left-hemiplegic patients on all gait, temporal, and spatial parameters. CPT and DTT effectively improved the walking abilities of chronic stroke patients. Notably, patients who underwent DTT exhibited substantial enhancements in all aspects of their walking performance, both spatial and temporal, when compared to those who received CPT. This highlights the superior effectiveness of DTT in promoting gait recovery among individuals with chronic stroke.

Limitations; It includes: a) a small sample size; b) single-centre recruitment. c) Uncontrollable confounding variables such as medications, nutritional status, and psychosocial status of the enrolled

stroke patients D) The RCT was not registered with any registration authority and, therefore, does not have a trial number.

Ethical Approval:

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

Consent

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

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