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Effect of Class Circuit Therapy on Balance and Gait in Hemiparetic Patients

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Keywords
Hemiparesis, Balance, Gait, Class Circuit Therapy, Functional Ambulation Category, Balance Evaluation Systems Test.

Abstract
Background: Hemiplegia occurs when brain tissue is damaged on one side of the body but not the other. Stroke survivors commonly have difficulties with balance and walking. For stroke patients with hemiparesis, Class Circuit Therapy (CCT) is a form of task-specific training (TST) that comprises practicing in a circuit-like pattern. The study's objective was to assess how Class Circuit Therapy affected the balance and gait of hemiparetic cases. Methods: One hundred forty hemiparetic patients from the Out Patient Department, Krupanidhi College of Physiotherapy, home care facilities, and hospitals in and around Bengaluru. Forty-eight people were evaluated, and those who met the selection criteria for the study. Over six weeks, the group underwent Class Circuit Therapy five times for forty-five minutes each. Gait was evaluated using the Functional Ambulation Category, while the balance was evaluated using the Balance Evaluation Systems Test. Findings: The intervention group demonstrated better improvement in gait performance for the Functional Ambulation Category and Balance in all aspects of the Balance Evaluation Systems Test, including biomechanical constraints, stability limits, transitions, reactive, sensory orientation, and gait stability, after completing the 6-week of intervention. Novelty and applications: The study concludes that class circuit therapy improves balance and gait performance, generates a competitive and supportive environment, promotes social contact among stroke patients, and enhances their skills and confidence.

1. Introduction

A focused impairment of brain function with a suspected vascular aetiology that lasts longer than 24 hours or results in death is known as a cerebrovascular accident [1]. Regarding adult disability, neurological impairment due to stroke is the most common cause of death [2]. A stroke is a potentially fatal neurological disorder caused by the interruption of blood supply to the brain due to the formation of blood clots or embolisms, the rupture of the brain blood vessel, or both [3]. Ischemic stroke and haemorrhagic stroke are the two forms of stroke. Ischemic stroke can come in two different forms. The most frequent type of stroke, haemorrhagic stroke, which includes subarachnoid and cerebral haemorrhage, is caused by blood vessel rupture [4]. Both thrombotic ischemic and embolic ischemic stroke can be caused by blockages of the major cerebral arteries or by smaller branches of these arteries piercing deeper regions of the brain [4, 5]. Compared to 4.66 million in 1990, the anticipated prevalence rate in 2010 was 5.87 million, a rise of 26% over the preceding two decades [6]. According to demographic surveys, stroke incidence rates climbed by 56-117/100,000 between 1979 and 2008 in low- and middle-income countries, while they fell by 163-94/100,000 in high-income countries [7]. Abnormal heart rhythms, high cholesterol, alcohol abuse, diet, stress, physical inactivity, obesity, hypertension, cardiovascular disease, diabetes mellitus, smoking, high cholesterol levels, and contraception with high oestrogen dosages [8, 9].

Clinically speaking, stroke causes speech impairment along with sensory deficits, motor

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impairments, mental fuzziness, numbness, and cognitive and perceptual problems. Gait, coordination, and balance are primarily impacted [10]. Eighty-three percent of stroke patients have high balance impairment, which increases their risk of falling. Integrating ocular, vestibular, and somatosensory information into the central nervous system (CNS) is a challenging process underlies human balance control. Control your center of gravity to stay within your support base with minimal weight shifting is essential for maintaining balance [11]. After a stroke, motor impairment results in a loss of motor control, performance, and mobility, while muscle weakness and voluntary movements slow down gait speed. Reduced weight bearing on the afflicted side, walking speed, standing, sitting, turning, getting out of bed, and stair climbing are some elements that affect the patient's quality of life [12, 13]. Asymmetrical gait raises the risks of articular joint degradation in the nonparetic lower limb and bone density loss in the paretic limb, has a more significant metabolic cost, and shortens the time needed for the paretic limb to transition from single-limb to the more stable double-limb support phases [14]. Hemiplegia is a loss of function on one lateral aspect of the body caused by damage in one half of the brain. Primary lesions occur in the two highest tract divisions, thalamus opticus, and corpus striatum. The symptoms appear on the same side of the face paralysed and opposite limbs affected but not always opposite to the lesion [15, 16].

Mirror Therapy [17], resistance and aerobic training [18], and Wobble Board exercises are some physiotherapy approaches that can help stroke survivors with their balance and gait [19]. Morgan and Anderson (1953) developed Class Circuit Therapy at the University of England [20]. CCT is a subset of TST that emphasizes functional gait-related tasks and incorporates the repetition of activities in a circuit or series of departments for more than two people at once [21]. Training improves range of motion, strength, and walking ability [22]. According to recent studies, circuit training can enhance most physical activities and lessen fall anxiety as well as conventional therapy [23]. Van Wissen and Blanchard [24] proved that Circuit Class Therapy significantly improves stroke patients' motor performance and walking capacity. Lee and Kim [25] demonstrated that Class Circuit Therapy was influential in the balance and mobility of chronic stroke patients by using task-related circuit training. Therefore, the uniqueness of this study was to determine how CCT patients with Hemiparetic balance and gait.

2. Materials and Methods

The institutional ethics committee's clearance from Krupanidhi College of Physiotherapy (Ref. No.: EC-MPT/21/PHY/017) was taken to undergo the study to collect the samples. All hemiplegia subjects were described in the study, and informed consent was taken from them. A pre-post-test experimental design was employed for the investigation, and a random sample technique was applied to the sampling process. The research was carried out on One hundred forty hemiparetic patients from the Out Patient Department, Krupanidhi College of Physiotherapy, home care facilities, and hospitals in and around Bengaluru. The study duration was from June 2021 to June 2022. Forty-eight individuals were evaluated, including those who met the selection criteria.

Patients having a middle cerebral artery lesion [26] and those who could walk at least 10 meters with or without aid were considered eligible [17]. Mini-mental examination state> 24, Aged 40-60 years, males and females are included. Hemorrhagic stroke patients, Sensory or global aphasia, Visual and auditory deficits [27], A history of epilepsy or recent seizures in the last six months, bone fracture(s), or surgery of the limbs and/or spine resulting in a restriction of strength or movement, are excluded. Six weeks of therapy consisted of one session each day, five days a week. The trial lasted an entire year.

2.1 Procedure: Class Circuit Therapy

The subjects attended circuit treatment classes five times a week for six weeks. All of the circuit therapy classes were attended by the subjects under the direction of one physiotherapist. Circuit therapy includes two courses of challenging exercises lasting 40 minutes each, separated by 1-minute rest breaks and a 4-minutes cool-down time. Therefore, the organized protocol took 45 minutes to complete one session.

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There were two types of complex exercises standing and sitting. The first category included sit-to-stand exercises from various heights, standing with feet together; reaching and picking objects; turning while standing; and single-leg standing. The second category includes stair climbing, carrying an object while walking, stepping forward and sideways, and quick walking. These exercises were explicitly tailored so that the level of complexity matched the subjects to the functional level progression.

2.2 Outcome Measures

Functional Ambulation Category and Balance Evaluation Systems Test

2.3 Statistical Analysis

Data were evaluated using SPSS for Windows (version 29.0). Demographic data and outcome variables were calculated using descriptive statistics. For hemiparetic patients, the functional ambulation category (gait) and the balance evaluation systems test (balance) were utilized to determine the significant differences between the variables using Paired T-test. To find the significance level as desired, 5%.

3. Results

Table 1: Age and BMI of study subjects-descriptive statistics

Variables	Mean	Std. Deviation
Age in years	52.46	6.585
BMI	27.890	5.5142

It is inferred from table 1 that the mean age of the study subjects was 52.46.32±6.585 of 40 to 60 years, and the BMI of the study subjects was 27.890±5.5142 kg/m^2 of 17.10 to 46.40kg/m^2.

Table 2: Frequency Distribution for Gender of study subjects

Gender	Frequency
Male	23
Female	25

It is inferred from table 2 that more responses were received from the female compared to male subjects.

Table 3: Outcome Measures Pre and Post-treatment evaluation

Tests	Pre-test Mean	Post Test Mean	Mean difference	Std. Deviation	t	p	Significance
Functional Ambulation Category	2.77	4.21	-1.438	0.501	-19.866	0.001	Highly Significant

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Biomechanical Constraints	48.333	75.000	-26.6667	7.1459	-25.854	0.001	Highly Significant
Stability Limits	53.968	77.976	-24.0079	5.3766	-30.936	0.001	Highly Significant
Transitions	52.199	72.801	-20.6019	5.9503	-23.988	0.001	Highly Significant
Reactive	40.856	60.995	-20.1389	5.9134	-23.595	0.001	Highly Significant
Sensory Orientation	41.806	63.611	-21.8056	6.7006	-22.546	0.001	Highly Significant
Stability in Gait	28.472	44.841	-16.3690	4.7014	-24.122	0.001	Highly Significant
BESTest	2.460	3.659	-1.1999	0.1556	-53.433	0.001	Highly Significant

The paired "t" test revealed that the outcome of the study of all variables had significantly improved, as shown in Table 3. There was a significant change in gait, as evidenced by the mean difference between the pre-and post-test scores for FAC, which is -1.438, biomechanical constraints of BESTest pre-test Mean ± SD (48.333 ± 10.0589) and post-test Mean ± SD (75.000 ± 10.5185). The pre-and post-test mean biomechanical constraint score difference is -26.6667. Stability limits of BESTest pre-test Mean ± SD (53.968 ± 8.7493) and post-test mean ± SD (-77.976 ± 7.6484). The average score for stability limitations before and after the intervention is -24.0079. Transitions of BESTest pretest Mean ± SD (52.199 ± 9.6388) and posttest Mean ± SD (72.801± 10.5807). The mean transition test score difference between the pre and post-tests is -20.6019. Reactive of BESTest pretest Mean ± SD (40.856 ± 8.4596) and posttest Mean ± SD (60.995 ± 10.4715). The mean difference between the pre and post-test scores for reactive is -20.1389. Sensory orientation of BESTest pre-test Mean ± SD (41.806 ± 11.0652) and pos test Mean ±SD (63.611 ± 11.0839). The variation of pre and post-test scores for sensory orientation is -21.8056. Stability in the gait of BESTest Mean ± SD (28.472 ± 6.6977) and post-test Mean ± SD (44.841 ± 7.9094). The difference between the pre and post-test scores for gait stability is -16.3690. BESTest pretest Mean ± SD (2.460 ± 0.2875) and posttest Mean ± SD (3.659 ± 0.3481). The difference between the pre and post-test for BESTest is -1.1999. All variables in BESTest show there was a significant improvement in balance. According to all variables, FAC, biomechanical constraints, stability limits, transitions, reactive, sensory orientation, gait stability, and BESTest are statistically significant ($p=0.001$, $p<0.05$), indicating high significance.

4. Discussion

Patients with stroke indicate dependence on others because of impaired walking ability and balance. Restoring independent gait and balance is the main aim of rehabilitation [28]. Circuit training groups can be attributed to increases in lower limb muscle strength and endurance and increased speed, balance, and gait [29]. Thus, the study aimed to examine the effects of Class Circuit Therapy in hemiparetic patients. Thus, the study's goal was to assess how effective class circuit therapy is towards the balance and gait of hemiparetic patients. This study showed that FAC was advantageous for balance and gait. In a study carried out on 81 patients by Daniel Treacy *et al* [30], similar results were found in the balance; the average values increased from 3.27 (0.84 to 5.70) to 3.41 (−0.56 to 7.38) in the intervention group. Catherine *et al* [31], had demonstrated in a study of 9 subjects, with two

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Journal of Coastal Life Medicine

groups of 5 in the experimental and 4 in the control group, that balance was improved by using step test ranges Mean ± SD (6.2 ± 4.4) to (10.3 ± 4.4) in the experimental group than the control group. Malik *et al* [23] study was done on 30 subjects, with two groups of 15. Each group balance was improved in the experimental group than in the control group the mean value of the pre-test score (31.60 ± 6.62) and the post-test score (51.00 ± 6.39). Although there was no significant effect on the balance among stroke subjects using a step test, the mean values were 0.37 CI, -0.06 to 0.80, and BBS 0.25 CI, -0.14 to 0.49 in a study [32]. Coralie English *et al* [33] found that there was no statistically significant difference between the effects of CCT and other interventions for functional mobility as measured by the timed up and go test; the mean was -3.08 sec, 95% CI, -7.59 to 1.43, p=0.18; and for balance measured using the BBS; the mean was 0.86, 95% CI, -1.02 to 2.74, p=0.37.

Neuroplasticity refers to the brain's ability to change and "rewire" existing connections in light of new information [34]. In response to therapy, the brain picks up new behaviors and relearns those it has forgotten. Specificity, repetition, and intensity are a few tenets of control principles that incorporate experience-dependent neuroplasticity [35]. This technique may improve motor performance by activating the parietal lobe and motor-related parts of the brain; when a person observes and mimics a movement, it stimulates a circuit of neurons in the premotor and parietal cortex [36].

5. Limitations and Recommendations

There were 48 participants in this research. It is possible to use more significant samples to generalize these results. Only six weeks were spent doing the intervention. It can be done for a more extended period to get healthier results. After six weeks, the follow-up was not examined; however, the intervention's long-term effects may have been assessed.

6. Conclusion

Class circuit training was simple and safe to administer, as it provided individual tailored face-to-face treatment and intensified physiotherapy for stroke patients. According to the findings above, it can be deduced that circuit gait training boosts balance and gait performance, encourages social contact among stroke patients, and fosters a competitive and encouraging environment, further boosting their skills and confidence.

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