

A Study on the Effects of Curved Path Gait Training and Multi-Directional Step Exercise with Weight Shifting on Balance and Gait in Patients with Stroke

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Abstract: ***Background:** Stroke commonly causes gait and balance impairments that may restrict functional independence and increase fall risk. **Objective:** To compare the effects of curved path gait training and multi-directional step exercise with weight shifting on gait and balance in individuals with stroke. **Methods:** Twenty participants aged 50 to 70 years were allocated to two groups in a quasi-experimental study. Group A received curved path gait training, while Group B received multi-directional step exercise with weight shifting. Outcomes were assessed before and after 8 weeks using the Figure-of-8 Walk Test and Timed Up and Go Test. **Results:** Both groups showed statistically significant improvements in gait and balance, with greater improvement observed in Group A. **Conclusion:** Both interventions improved the measured outcomes, while curved path gait training produced greater gains in complex gait performance and dynamic balance in this sample.*

Keywords: Stroke, Curved path gait training, Multi-directional step exercise, Balance, Gait

1. Introduction

Stroke is a cerebrovascular disorder that produces a neurological deficit and may persist beyond 24 hours [3]. It remains a major cause of long-term disability worldwide [3]. Approximately 80% of strokes are ischemic, commonly related to thrombosis or embolism, whereas hemorrhagic stroke results from rupture of a cerebral vessel [1], [5].

Following stroke, deficits in balance, uneven weight distribution, and reduced gait efficiency are frequently observed [2], [8]. Many individuals preferentially transfer their center of gravity toward the unaffected side, which can compromise postural stability and increase the risk of falls [20], [29].

Curved Path Gait Training (CPGT) requires the individual to walk on circular or curved trajectories. The continuous changes in direction demand repeated postural adjustments and coordinated control of different body segments [12], [14]. Such practice may facilitate neuromuscular control and dynamic balance during walking [17], [23].

Multi-Directional Step Exercise (MDSE) combined with weight shifting requires stepping forward, backward, laterally, and diagonally while moving body weight between the limbs [26]. This task-oriented approach is intended to improve functional mobility and encourage loading of the affected limb [20], [27].

2. Need for the Study

Stroke is an increasing health concern in India, and many survivors continue to experience limitations in gait and balance. Conventional rehabilitation approaches may not address all of the demands involved in dynamic walking and directional changes [24].

Therefore, examining task-specific approaches such as CPGT and MDSE may help determine their effects on functional mobility, weight-bearing symmetry, and independence in people recovering from stroke.

3. Materials and Methodology

Study Design: Quasi-experimental study

Study Setting: Department of Physiotherapy, Sree Abirami Hospital, Coimbatore

Sample Size and Sampling Technique: The method used to allocate the 20 participants to Group A and B is Convenience sampling method and each group consist of 10 members.

Group A underwent Curved Path Gait Training and Group B underwent Multi-Directional Step Exercise with weight shifting. A brief explanation was given to the participants and informed consent is bought.

Treatment session: 30 mins 4 times a week for 8 weeks

Study Duration: 6 months

Treatment Duration: 8 weeks

3.1 Selection Criteria

Inclusion Criteria:

- Age 50-70 years
- Both genders
- MMSE score > 24
- First-time unilateral stroke
- Post-stroke duration $\geq$ 6 months

Exclusion Criteria:

- Cognitive impairment
- Visual deficits
- Dementia
- Severe comorbidities

3.2 Outcome Measures

Balance: Timed Up and Go Test (TUG) [34], [35]

Gait: Figure-of-8 Walk Test (F8W) [30], [31]

3.3 Procedure & Treatment Protocol

Participants were assessed before and after intervention.

Group A - Curved Path Gait Training (CPGT)

- Warm-up (5 min)
- Walking along circular paths (large, medium, small circles)
- Direction changes (clockwise & anticlockwise)
- Cool-down (5 min)

Group B - Multi-Directional Step Exercise (MDSE)

- Warm-up (5 min)
- Side, forward, backward stepping
- Weight shifting toward affected limb
- Wall-supported walking
- Cool-down (5 min)

4. Data Analysis and Results

Table 1: Figure-of-8 Walk Test (Gait)

Group	Pre Mean $\pm$ SD	Post Mean $\pm$ SD	t-value	p-value
Group A	36.62 $\pm$ 1.614	31.88 $\pm$ 1.553	14.72	< 0.05
Group B	37.54 $\pm$ 0.826	36.30 $\pm$ 0.939	11.09	< 0.05

Table 2: Timed Up and Go Test (Balance)

Group	Pre Mean $\pm$ SD	Post Mean $\pm$ SD	t-value	p-value
Group A	25.30 $\pm$ 1.231	22.38 $\pm$ 1.061	10.17	< 0.05
Group B	25.44 $\pm$ 1.195	24.02 $\pm$ 1.087	7.103	< 0.05

Table 3: Between Group Comparison

Outcome	Group A	Group B	t-value	Significance
F8W	31.88 $\pm$ 1.553	36.30 $\pm$ 0.939	7.701	Significant
TUG	22.38 $\pm$ 1.061	24.02 $\pm$ 1.087	3.414	Significant

5. Discussion

The present study found significant improvements in gait and balance following both interventions. The magnitude of improvement was greater in the CPGT group than in the MDSE group [4], [18].

Walking on a curved trajectory requires repeated changes in direction and ongoing control of the body segments. This increased task demand may promote coordination of the trunk, pelvis, and lower limbs and may contribute to better dynamic balance and functional walking performance [14], [17], [22], [23].

MDSE provides repeated practice of weight transfer and directional stepping, which can support postural stability and affected-limb loading. Compared with curved walking, however, it may provide a different level of challenge to the complex control required during continuous curved-path gait [26], [27].

6. Conclusion

Both curved path gait training and multi-directional step exercise with weight shifting improved gait and balance outcomes in individuals with stroke. In this study, curved path gait training produced greater improvements in functional gait performance and dynamic balance than multi-directional step exercise. These findings support its potential use as a component of stroke rehabilitation, although larger studies with longer follow-up are needed to confirm the results.

7. Limitations

- Small sample size
- Short intervention duration
- No long-term follow-up
- Limited outcome measures

8. Recommendations

- Larger sample size studies
- Long-term follow-up
- Use of advanced gait analysis tools
- Combination therapies

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