

An Experimental Study to Analyze the Efficacy of Backwards Gait Training on Balance and Weight Bearing Asymmetry on Sub-Acute Stroke Patient

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Abstract

Background: Stroke is the leading cause of long-term disability and death, and the second leading cause of death worldwide. The first month after a stroke is a vital period since the brain goes through major plastic changes during this time. Motor learning studies emphasize the significance of experience and learning in functional rehabilitation. Because training is a potent stimulator of neuroplasticity, the addition of a focused rehabilitation strategy can improve recovery by maximizing brain reconfiguration. Backward Walking Training (BWT) is an adjuvant therapeutic and rehabilitation method to improve proprioception, muscle strength, intra-limb coordination, and balance. Studies examining its effects on balance and weight bearing asymmetry are lacking.

Objective: To determine the effect of BWT on balance and weight bearing asymmetry in sub acute stroke subjects.

Results: The difference between the pre- and post-test results within the group for balance on Berg Balance Scale (BBS) as well as the weight on the affected and unaffected Lower Limb (LL) on the Body Weighing Machine (BWM) are both deemed to be significant for paired T-Test. According to conventional standards, when comparing pre- and post-test results for balance and the difference in weight between the two groups for the affected and unaffected Lower Limb (LL) on the BWM for the experimental and control groups using Unpaired T-Test, it can be inferred that the difference is statistically significant.

Conclusions: When combined with conventional physiotherapy as opposed to conventional physiotherapy alone, backwards gait training has a modestly greater impact on balance and weight bearing asymmetry. Berg balance score and weight bearing asymmetry can both be improved in stroke patients using BWT as an addition to standard care (moderate evidence).

Keywords: sub-acute stroke, backwards gait training, balance, weight bearing asymmetry

Introduction

According to World Health Organisation, Stroke is defined as “rapidly developing clinical signs of

focal or global disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin”. Ischemic stroke is the most

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common type, affecting about 80% of individuals with stroke, and results when a clot blocks or impairs blood flow, depriving the brain of essential oxygen and nutrients.¹

Clinically, a variety of focal deficits are possible, including changes in the level of consciousness and impairments of sensory, motor, cognitive, perceptual, and language functions. To be classified as stroke, neurological deficits must persist for at least 24 hours. Motor deficits are characterized by paralysis (hemiplegia) or weakness (hemiparesis), typically on the side of the body opposite the side of the lesion.²

In 2016, 5.5 million deaths and 116.4 million Disability adjusted Life Years (DALYs) were caused by stroke, with an incidence of 13.7 million and 80.1 million prevalent cases globally. Survivors often have long term disability, reduced proprioception, balance impairment, gait alteration, coordination deterioration and high risk of falling.^{3,4}

It was observed that 70% of the total body weight is borne by the unaffected leg while some researchers reported the difference between the proportions of the body weight borne by either leg (asymmetry) to be 27%. Falling is a very common complication after stroke, with as many as 50% to 70% of the people who return home from the hospital or rehabilitation center experiencing falls. These falls can have severe consequences such as hip fracture and decreased physical activity due to fear of falling. Improvement of postural stability is, therefore, an important goal in stroke rehabilitation.⁵

Backward walking (BW) is a simple and effective method for adjuvant treatment and rehabilitation. It can improve proprioception, muscle strength, intra-limb coordination and balance, assess the severity of impairment of coordination and motor ability, and predict falls in the elderly. BW helps reduce knee strain and improve gait and balance post stroke.

Different from forward walking (FW), the gait and lower extremity biodynamics of stroke patients will significantly change during BW.⁶

Backward walking is an intervention that may be valuable for enhancing balance and self-efficacy to improve mobility function after stroke. It has been used in orthopedic rehabilitation as it produces less

mechanical strain on the knee joint while backward running is an effective means for increasing strength and power of the quadriceps.

Backward walking training challenges postural stability, which is essential for dynamic balance activities. Straube et al⁶ reported improvements in dynamic balance after training individuals post stroke in variable stepping contexts.

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Backward walking to improve gait and dynamic balance post stroke is a more recent application and appears to offer a number of potential benefits.⁷

Materials and Methods

Source of Data

Neurology ward and Physiotherapy OPD, Mazumdar Shaw Medical Centre, Narayana Health City, Bangalore.

Methods of Data Collection

Population :	Subjects with stroke, at least 30 days-6 months post onset
Sampling :	Randomized Allocation
Sample size :	60 Subjects

Study Duration: This study was completed in 9 months including Data collection and analysis from the month October' 2021 to June' 2022.

Inclusion Criteria:

1. First CVA diagnosed by neurologist and confirmed by CT Scan or MRI
2. Onset of stroke at least 30 days to 6 months-old
3. Age of 45-60 years
4. Able to maintain upright standing posture with moderate assistance
5. Hemiparesis causing problems with unilateral limb movement

6. Ability to follow commands (MMSE SCORE ≥ 24)⁸
7. Stable medical condition
8. No sensory deficits

Exclusion Criteria:

1. Have any orthopedic and degenerative conditions
2. Have any neuropathies and myopathies
3. Have any neurological conditions causing movement disorders such as Parkinson's disease, Spinal Cord Injury, epilepsy etc.
4. Have other uncontrolled health conditions such as Diabetes etc.

The subjects who fulfilled the above-mentioned inclusion and exclusion criteria were selected for the study after obtaining a written informed consent. There were a total of 60 participants who were divided into 2 groups of 30 each.

Outcome Measures:

1. **Berg Balance Scale:** The BBS is valid, reliable, and sensitive to change in people with acute stroke. Studies of various elderly populations (N = 31-101, 60-90 + years of age) have shown high intrarater and interrater reliability (ICC = .98, 14, 15 ratio of variability among subjects

to total = .96-1.0, 16 rs = .8817). Test-retest reliability in 22 people with hemiparesis is also high (ICC=.98).⁸

2. **Weighing Scale:** Two bathroom weighing scales were needed to check weight bearing asymmetry between two lower limbs.

Results

Data Analysis

The data collected on baseline characteristics and outcome measures of acute stroke subjects were carefully collected, recorded and analyzed through MS Excel. The level of significance was set at 5% level (0.05).

Following Statistical techniques were used:

- Range, mean and standard deviation was used to describe the pre and post test outcome measures.
- Paired t-test- To see the difference between pre and post measurements within the group.
- Unpaired t-test- To see the difference between pre and post measurements between the groups.
- MS-EXCEL and MS-WORD were used to generate the tables and graphs suitably.

Experimental Group

Table 1: Range, mean and SD of outcome measures of sub-acute stroke subjects in the experimental group

Si. No.	Outcome Measures	Experimental Group				Paired T-Test
		Pre Test		Post Test		
		Range	Mean±Sd	Range	Mean±Sd	
1.	BBS	30-42	36.8±4.24	36-52	44.6±4.95	13.16
2.	WEIGHT ON AFFECTED LL. ON BWM	17-34.2	25.94±5.29	20-39	28.93±5.25	5.34
3.	WEIGHT ON UNAFFECTED LL. ON BWM	29.2-55	36.53±5.43	26-47	34.24±4.29	5.75

Control Group

Table 2: Range, mean and SD of outcome measures of sub-acute stroke subjects in the control group

Si. No.	Outcome Measures	Control Group				Paired T-Test
		Pre Test		Post Test		
		Range	Mean±Sd	Range	Mean±Sd	
1.	BBS	32-48	39.21±3.97	40-52	43.71±4.56	1.44
2.	WEIGHT ON AFFECTED LL. ON BWT	17-30	26.2±4.23	25-32	29.15±3.87	8.43
3.	WEIGHT ON UNAFFECTED LL. ON BWT	29-55	35.76±5.98	26-45.5	33.14±5.04	7.67

Table 3: Comparison between difference of pre and post test outcome measures of sub-acute stroke subjects in between groups

Si. No.	Outcome Measures	Difference of Pre and Post-Test	
		Control	Experimental
		Mean±SD	Mean±SD
1.	BBS	6.25±2.82	7.25±3.26
2.	WEIGHT ON AFFECTED LL. ON BWT	2.15±2.9	2.44±1.85
3.	WEIGHT ON UNAFFECTED LL. ON BWT	1.88±2.09	2.28±1.89
BETWEEN GROUP COMPARISONS: Unpaired T-Test	<ul style="list-style-type: none"> • BBS: $t = 1.27$, $P \text{ value} = 0.21$, S • Wt on Affected LL. On BWT: $t=0.46$, $P \text{ value}=0.64$, NS • Wt. on Unaffected LL. On BWT: $t=0.77$, $P \text{ value}=0.44$, NS 		

NOTE: S- significant; NS-not significant

By conventional criteria, this difference between two groups for weight on affected and unaffected LL on BWT is considered to be not statistically significant.

Discussion

The present experimental study was conducted to analyze the efficacy of backwards gait Training on balance and weight bearing asymmetry on a sub-acute stroke patient. BWT's unique movement patterns⁹ make it much more popular in sports and rehabilitation. To the best of our knowledge, BWT has been shown to a beneficial impact on the rehabilitation of post-stroke¹⁰, knee osteoarthritis¹¹, diabetic foot syndrome¹², Parkinson's disease¹³, cerebral palsy¹⁴, low back pain¹⁵, and anterior cruciate ligament reconstruction patient¹⁶. Furthermore, Thomas KS et al.¹⁷ hypothesized that BW necessitated higher metabolic, neuromuscular, cardiovascular, and perceptual demands. It has also been demonstrated to be advantageous to optimize cardiopulmonary function¹⁸.

For four weeks, the intervention was given five days a week for 35 to 45 minutes each time.

Employing the Berg Balance Scale and the bathroom weighing scale as outcome measures, pre- and post-assessments were performed.

Within the group results

The experimental group showed considerable improvement in balance and weight bearing

asymmetry post-test, correlating with motor learning studies. The control group also showed improvement, as did the experimental group.

Between Group Results

This study found a significant improvement in balance and weight bearing asymmetry, with the mean difference between the experimental and control groups being statistically significant. The combined movement of the hip extensor, knee flexor, and ankle dorsiflexion was used to break the limb synergy pattern and gain neuromuscular control.

Also much improved is balance. The explanation might be that when walking backwards, visual cues are negated. The subject is under immense pressure in these conditions, and in order to meet the demand, various receptor systems such as proprioception, kinesthetic sense, protective reflex, and neuromuscular control were all recruited. As a result, balance abilities are significantly improved. Therefore, this study shows that backward walking combined with conventional physiotherapy is a successful strategy.

Grobbelaar R et al.²⁰ hypothesized that backwards gait training could improve balance and weight bearing asymmetry in a patient with sub-acute stroke. BWT has been shown to be beneficial in various conditions, such as post-stroke, knee osteoarthritis, diabetic foot syndrome, Parkinson's disease, cerebral palsy, low back pain, and anterior cruciate ligament reconstruction. For four weeks, the intervention was given five days a week for 35 to 45

minutes each time. Outcome measures included the Berg Balance Scale and the bathroom weighing scale.

Although several researchers questioned the safety of subjects moving backward, none of the subjects in this study fell. The gradual deployment of a training programme for backward walking in a secure setting may be the cause.

Conclusion

The impact of BGT on sub-acute stroke patients was extensively examined and evaluated in this study.

It can be concluded that backward gait training combined with conventional physiotherapy is shown to be significantly more effective at improving balance and correcting weight bearing asymmetry than conventional therapy alone.

Ethical clearance: Taken from Narayana Health Academics Ethics committee, Approval Date: 21/02/2022. Approval Number: NHH/AEC-CL-2021-791. Written informed consent was obtained from all participants prior to their inclusion in the study.

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