

Original Article

# Relationships of Stroke Patients' Gait Parameters with Fear of Falling

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**Abstract.** [Purpose] The purpose of this study was to assess the correlation of gait parameters with fear of falling in stroke survivors. [Subjects] In total, 12 patients with stroke participated. [Methods] The subjects performed on a Biodex Gait Trainer 2 for 5 min to evaluate characteristic gait parameters. The kinematic gait parameters measured were gait speed, step cycle, step length, and time on each foot (step symmetry). All the subjects also completed a fall anxiety survey. [Results] Correlations between gait parameters and fear of falling scores were calculated. There was a moderate degree of correlation between fear of falling scores and the step cycle item of gait parameters. [Conclusions] According to our results, the step cycle gait parameter may be related to increased fall anxiety.

**Key words:** Fall anxiety, Gait parameter, Stroke

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## INTRODUCTION

About 60% of stroke patients experience posture and balance problems during gait<sup>1)</sup>. Generally, they prefer to use the less affected side than the affected side for weight-bearing load during gait. This can lead to an asymmetric body posture, and the development of abnormal weight shifting in gait<sup>1)</sup>. These conditions can limit the motion of stroke patients, and increase their risk of falls<sup>2)</sup>. When stroke patients return to their homes, about 56% of them experience falls within 2 months<sup>3)</sup>. Such falls can lead to the development of secondary impairments and disability in the nervous system and orthopedic problems. According to a previous study, stroke patients may have problems with the quality of their gait cycle (e.g., gait speed, poor endurance, reduced quality, and adaptability in walking patterns, and coordination of the legs<sup>4)</sup>). Also, these conditions cause deceleration control to increase, while acceleration control decreases during gait. Again, this can lead to increased compensatory movements and asymmetric gait patterns<sup>4, 5)</sup>. Consequently, these gait problems can result in balance impairment, and then falls. Previous studies have demonstrated that stroke patients have increased fear or anxiety during gait, and a high level of anxiety increases the risk of depression. These symptoms can lead to a reduced quality of life<sup>6)</sup>. Many studies have demonstrated a relationship between falls and quality of life, even though they did not compare gait parameters with psychological aspects, such

as fall anxiety. Thus, in this study, we investigated the gait parameters and fear and anxiety of stroke patients.

## SUBJECTS AND METHODS

Twelve patients with stroke (mean age: 50.75±11.07 years; five females, seven males) participated in this study. All the participants provided their written informed consent before entering this pilot study. The inclusion criteria were a history of only one documented stroke event, no orthopedic disease, a Mini-Mental State Examination score above 25, and the ability to walk more than 10 m without a cane. The Biodex Gait Trainer 2 is a device which is used to assess and train the walking performance of patients with neurologic gait dysfunction. It consists of a treadmill with an instrumented deck that monitors and records kinematic gait parameters including gait speed, step cycle, step length, and time on each foot (step symmetry). Surveys have been developed to assess fear of falling. The simplest assessments of fear of falling are single questions. Lachman et al.<sup>7)</sup> developed the "Survey of Activities and Fear of Falling in the Elderly" (SAFE) measure that assesses fear of falling and also provides an index of activity avoidance due to fear. Responses use a four-point Likert scale (1 = not at all sure to 4 = very sure). Gait analysis was performed on the Biodex Gait Trainer 2 for 5 min. Characteristic gait parameters, including differences between the affected and unaffected sides, were assessed. All subjects walked on the Gait Trainer treadmill at a speed of 3 km/h wearing normal shoes. Before the experiment, they received instructions concerning the test procedure and walked for 3 min as a warm up and to adapt to the step speed and equipment. We told the subjects that they should try to maintain a comfortable gait speed, continuously. We measured gait parameters

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**Table 1.** Correlation of gait parameters and fall anxiety (N=12)

	Gait parameters					
	Gait speed	Step cycle	Step length (affected)	Step length (unaffected)	Time on each foot (affected)	Time on each foot (unaffected)
SAFE	-0.432	-0.581*	-0.112	-0.070	-0.289	0.289

while subjects walked on the equipment. All participants underwent a fall anxiety assessment. SPSS software (ver. 22.0; SPSS Inc., Chicago, IL, USA) was used to analyze correlations between gait parameters and fear of falling. Comparisons of correlations between gait parameters and fear of falling were assessed using Spearman's rank correlation test. A  $p$  value  $< 0.05$  was considered to indicate statistical significance.

## RESULTS

Correlation between gait parameters and fear of falling scores were calculated. A moderate degree of correlation between fear of falling score and the step cycle item of gait parameters was found ( $p < 0.05$ ). No other gait parameter showed a significant degree of correlation with the fear of falling score ( $p > 0.05$ ) (Table 1).

## DISCUSSION

Many stroke patients feel a sense of loss over problems of gait ability. Indeed, gait disability can limit the independent living of stroke patients<sup>8</sup>. Many stroke survivors have a hard time maintaining their balance due to decreased weight shifting ability and stability<sup>8</sup>. A previous study found that gait patterns of stroke patients are slow and require excessive effort, and the patients showed uncoordinated movements in both legs<sup>1</sup>. It has also been demonstrated that gait speed is related to the ability to maintain balance. Patients with balance impairment show increased feet support time, and reduction in gait speed is a risk for falls, increasing anxiety<sup>9</sup>. Our study confirmed the possibility that certain gait parameters are associated with increased fear and anxiety. We found a moderate degree of correlation between the fear of falling score and the step cycle. A previous study demonstrated that the slow gait speed phenomenon was related to a decrease in cadence and a shortened stride length. Moreover, compared with healthy people, stroke patients show decreased cadence and increased gait cycles, which lead to an increased double-stance phase and stance phase of the unaffected side leg<sup>4</sup>. Indeed, our study showed that a decreased step cycle was associated with fear of falling scores, indicating that a decreased step cycle leads to increased fear of falling during gait. It can be demonstrated

that asymmetrical limb support slows the step cycle<sup>10, 11</sup>. We hypothesize that one cause of this is the development of abnormal weight shifting in the step cycle, which makes subjects feel uneasy about falling<sup>10, 11</sup>. Generally, the step cycle is considered to be a temporal gait parameter<sup>10, 11</sup>. Thus, we suggest that temporal parameters are likely to be more closely related to falling anxiety than spatial gait parameters. Moreover, problems with functional independence skills affect the quality of life of stroke patients. Mence<sup>12</sup> indicated that people with stroke could feel joy just by walking in the street. Thus, enhancing gait ability is an important means of improving the lives of stroke patients.

## REFERENCES

- 1) Johannsen L, Broetz D, Karnath HO: Leg orientation as a clinical sign for pusher syndrome. *BMC Neurol*, 2006, 6: 30. [[Medline](#)] [[CrossRef](#)]
- 2) Adegoke BO, Olaniyi O, Akosile CO: Weight bearing asymmetry and functional ambulation performance in stroke survivors. *Glob J Health Sci*, 2012, 4: 87-94. [[Medline](#)]
- 3) Mackintosh SF, Hill K, Dodd KJ, et al.: Falls and injury prevention should be part of every stroke rehabilitation plan. *Clin Rehabil*, 2005, 19: 441-451. [[Medline](#)] [[CrossRef](#)]
- 4) Bowden MG, Balasubramanian CK, Neptune RR, et al.: Anterior-posterior ground reaction forces as a measure of paretic leg contribution in hemiparetic walking. *Stroke*, 2006, 37: 872-876. [[Medline](#)] [[CrossRef](#)]
- 5) Balasubramanian CK, Bowden MG, Neptune RR, et al.: Relationship between step length asymmetry and walking performance in subjects with chronic hemiparesis. *Arch Phys Med Rehabil*, 2007, 88: 43-49. [[Medline](#)] [[CrossRef](#)]
- 6) Kressig RW, Wolf SL, Sattin RW, et al.: Associations of demographic, functional, and behavioral characteristics with activity-related fear of falling among older adults transitioning to frailty. *J Am Geriatr Soc*, 2001, 49: 1456-1462. [[Medline](#)] [[CrossRef](#)]
- 7) Lachman ME, Howland J, Tennstedt S, et al.: Fear of falling and activity restriction: the survey of activities and fear of falling in the elderly (SAFE). *J Gerontol B Psychol Sci Soc Sci*, 1998, 53: 43-50. [[Medline](#)] [[CrossRef](#)]
- 8) Mauritz KH: Gait training in hemiplegia. *Eur J Neurol*, 2002, 9: 23-29, 53-61. [[Medline](#)] [[CrossRef](#)]
- 9) Baer HR, Wolf SL: Modified emory functional ambulation profile: an outcome measure for the rehabilitation of poststroke gait dysfunction. *Stroke*, 2001, 32: 973-979. [[Medline](#)] [[CrossRef](#)]
- 10) Shim S, Yu J, Jung J, et al.: Effects of motor dual task training on spatio-temporal gait parameters of post-stroke patients. *J Phys Ther Sci*, 2012, 24: 845-848. [[CrossRef](#)]
- 11) Lee IH, Park SY: A comparison of gait characteristics in the elderly people, people with knee pain, and people who are walker dependent people. *J Phys Ther Sci*, 2013, 25: 973-976. [[Medline](#)] [[CrossRef](#)]
- 12) Mence VH: The relation between everyday activities and successful aging: a 6-year longitudinal study. *J Gerontol B Psychol Sci Soc Sci*, 2003, 58: S74-S82. [[Medline](#)] [[CrossRef](#)]