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Quantitative gait analysis in patients with dementia with Lewy bodies and Alzheimer's disease

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Abstract

Gait disorders in people with dementia have been documented in a number of studies. There is some preliminary evidence suggesting there may be a relationship between dementia type and gait abnormality. Quantitative gait analysis has not previously been reported for people diagnosed with dementia with Lewy bodies (DLB). Therefore, this study aimed to quantify gait patterns of people with DLB and compare them with those of people with Alzheimer's disease (AD) and control subjects. Two groups of 10 subjects divided according to a diagnosis of DLB and AD, and 10 control subjects underwent gait analysis using an electronic walkway. Participants were required to walk at self-selected slow, preferred and fast speeds. There were no differences between the DLB and AD patient groups for any of the measured gait variables. Velocity and stride length values were significantly reduced in both patient groups compared to the control group at all speeds and percentage of time spent in double limb support was significantly increased in both patient groups compared to the control group at all walking speeds. Significant correlations were found between gait speeds and gait outcome variables. Spatiotemporal gait characteristics of people with AD and DLB are similar, but significantly different from the normal population.

Keywords: Gait disorder; Walking; Lewy body disease; Alzheimer disease

1. Introduction

Gait disorders are common in people with dementia and a number of studies have documented various changes in the walking patterns of people with dementia compared with controls [1–4]. These changes include decreased velocity and stride length and increased variability. This is of interest for a number of reasons. Falls in people with dementia, which occur at a higher frequency than in cognitively normal older people and with increased risk of serious injury [5–9], have been associated with changes in walking patterns [8,10–13]. Gait disorders have also been identified as predictors of dementia [14].

van Iersel et al. [15] recently reviewed the literature on quantitative gait analysis in dementia. They concluded that there is evidence of consistent differences between the walking patterns of older people with and without dementia. All studies cited in their review were of people with Alzheimer's disease (AD) and one study also included a group with vascular dementia. These two disorders together were thought to account for most cases of dementia [16]. However, dementia with Lewy bodies (DLB) is now thought to be the second most common form of dementia making up 15–25% of cases [16].

There is some preliminary evidence that people with DLB walk with reduced velocity and step length compared to people with AD [17,18] suggesting there may be a relationship between dementia type and gait abnormality. Allan et al. [19] found that patients with AD scored better using a scale measure of gait and balance activities than those with non-Alzheimer's dementias such as DLB and suggested that such assessments can augment the diagnostic process. Changes in gait characteristics of people with

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dementia may also have the potential to be used to monitor disease progression and measure outcomes both in research and clinical practice [15]. However in order to achieve this, methods of measuring gait must provide reliable, detailed and sensitive data such as is available with quantitative methods of gait analysis. To our knowledge there have been no studies using quantitative gait analysis of people with a specific diagnosis of DLB. We hypothesized that people with DLB would have greater gait abnormalities than those with AD.

Therefore, this study aimed to quantify gait patterns of people with probable DLB, compare them with those of people with AD and control subjects, and try to distinguish between DLB and AD patients on the basis of gait characteristics.

2. Methods

2.1. Subjects

A total of 30 subjects, comprising three groups of 10 (8 males, 2 females) divided according to a diagnosis of DLB, AD and healthy controls, participated in this study. The University Human Ethics Committee approved the aims and procedure. Thirteen subjects with DLB and AD consecutively referred to Neurology and Geriatric Departments at a local public hospital were invited to participate in the study by one neurologist (JM). In each of the DLB and AD groups, two people declined to participate and one person initially agreed but was unable to participate due to ill health at the time of testing, leaving 10 subjects in each group. The diagnosis of probable DLB was made using a careful and conservative application of the McKeith criteria [16] including neuropsychological tests. The diagnosis of AD used the National Institute of Neurological and Communicative Disorders and the Alzheimer's Disease and Related Disorders Association (NINCDS–ADRDA) classification [20]. Further confirmation of the diagnosis of DLB was available for 6 of the 10 subjects in the DLB group using the results of dopamine transporter imaging with a Beta-CIT ligand, one of the new items included in the most recent clinical diagnostic criteria for DLB [21]. The inclusion criteria were the ability to walk 100 m without assistance or use of a gait aid and also to follow instructions for the testing procedure. Subjects were excluded if they reported any other neurological, orthopedic, respiratory, circulatory or visual condition, which affected their gait.

Control subjects were recruited from a database of research volunteers for gait studies. They were included if they had no symptoms of musculoskeletal, neurological or other problems, which would affect their gait.

Age and height measures were similar between the three groups and these characteristics are summarized in Table 1. Mini-Mental State Examination (MMSE) scores [22] are also listed along with medications and scores from the motor examination section (items 18–31) of the Unified Parkinson's Disease Rating Scale (UPDRS) [23], which were used to document the presence of extrapyramidal motor signs in subjects with dementia. Gait aid usage over rough ground and long distances provides further information about functional mobility.

2.2. Apparatus

The spatial and temporal parameters of subjects' gait were measured using a GAITRite® system (CIR Systems Inc., 60 Garlor Drive Havertown, PA 19083), comprising an electronic walkway connected to a Windows based personal computer (PC) via an interface cable, and GAITRite® GOLD, Version 3.3hb software.

The GAITRite® walkway is a carpet, 8.3 m long and 0.89 m wide, in which sensor pads are embedded, giving an active area of 7.32 m long and 0.61 m wide. Individual sensors in the pads are arranged 12.7 mm apart in a (48 × 576) grid pattern and allow detection of footstep pressure as a subject walks on the carpet. Data are sampled at a rate of 80 Hz.

Gait spatial and temporal characteristics are processed and stored using the application software. The GAITRite® system has been shown to be a valid and reliable measure of gait [24,25].

2.3. Procedure

After subjects gave written consent, measurements of their height and weight were taken along with a brief medical history. Cognition and motor tests were then administered by

Table 1
Subject characteristics

	Lewy body dementia	Alzheimer's disease	Control
Age, years, mean ± S.D.	73 ± 5	76 ± 6	72 ± 7
Height, m, mean ± S.D.	1.68 ± 0.10	1.73 ± 0.09	1.73 ± 0.08
Levodopa medication, *n*	4	0	0
Cholinesterase inhibitors, *n*	8	8	0
Psychotropic medication, *n*	4	2	1
MMSE score, mean ± S.D.[a]	23.5 ± 4.0	20.0 ± 5.8	28.7 ± 1.2
UPDRS motor examination score, mean ± S.D.[b]	27.1 ± 9.4	2.7 ± 4.2	Not tested
Use of gait aid over uneven surfaces/long distances, *n*	3	3	0

[a] Maximum = 30.
[b] Maximum = 108.