

Balance and Gait Impairment in Transient Ischemic Attack and Minor Stroke

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Background: There has been little research into gait and balance impairment in transient ischemic attack (TIA) and minor stroke, despite these conditions affecting large numbers of people and the potential impact on function. The aim of this study was to determine the impact of TIA and minor stroke on gait and balance. *Methods:* Twelve people with TIA or minor stroke without previous gait/balance problems and 12 age- and sex-matched controls were recruited. Participants (mean age 67 years) underwent a comprehensive assessment including physiological, balance, and gait measures (clinical and computerized [NeuroCom/GAITRite]). Matched-pairs analysis was undertaken. *Results:* Groups were similar in body mass index, vision, leg proprioception/strength, and reaction time. Cognition was worse in the TIA/minor stroke group: mean Montreal Cognitive Assessment score 22.2 versus 26.6, $P = .001$. People with TIA/minor stroke were significantly worse on all but one clinical test. Median scores for TIA/minor stroke versus control were as follows: Timed Up and Go (TUG), 9.4 versus 7.6 seconds, $P = .019$; TUG dual task, 12.3 versus 8.5 seconds, $P = .012$; Four Square Step Test, 10.9 versus 7.2 seconds, $P = .006$. Mean Step Test score for TIA/minor stroke versus control was 14.1 versus 17.7, $P = .021$. The TIA/minor stroke group also had significantly worse performance on computerized tests: increased turn time/sway, increased step length, slower comfortable/fast gait speeds, and greater proportion of gait cycle spent in double support. *Conclusions:* This study found that people with TIA/minor stroke have gait and balance dysfunction despite having no obvious physiological impairments. Intervention studies aimed at improving balance and gait in this population are needed. **Key Words:** Transient ischemic attack—minor stroke—gait—balance—stroke recovery—rehabilitation.

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Transient ischemic attack (TIA) and minor stroke are common cerebrovascular events, affecting hundreds of thousands of people worldwide. Although exact incidence and prevalence is unknown,¹ it is estimated that the incidence of TIA may be as high as 1.1 per 1000 per year¹ and that minor stroke and TIA may account for up to about 80% of all cerebrovascular disease.² TIA has been defined as stroke-like symptoms which resolve and do not result in any lasting neurologic deficit,¹ whereas minor stroke refers to symptoms that last longer than 24 hours but result in nondisabling functional deficit.³ Despite the fact that TIA and minor stroke are characterized by transient or minor symptoms, there is increasing evidence that people with these conditions experience longer-term problems, including in

cognition,⁴ fatigue,⁵ changes in intracortical excitability,⁶ and psychosocial difficulties.^{7,8} However, there is limited evidence regarding the impact of TIA and minor stroke on balance and gait, and no published studies which evaluate balance and gait performance using a comprehensive suite of measures. Consequently, the aim of the project was to determine the presence and extent of gait and balance impairments in people with TIA or minor stroke. We hypothesized that people with TIA or minor stroke would have worse gait and balance performance compared to similarly aged individuals without these conditions.

Methods

We undertook a cross-sectional observational study with age- and sex-matched controls. We invited consecutive patients from outpatient clinics at a metropolitan hospital in Melbourne, Australia, to participate if they: (1) had a diagnosis of TIA or minor stroke confirmed by a neurologist; the diagnosis was made according to clinical presentation and as per the definition of the American Heart Association/American Stroke Association⁹ and confirmed by 2 stroke neurologists; strokes were classified as minor stroke if the National Institutes of Health Stroke Scale (NIHSS) score was less than 5^{10,11}; (2) were living in the community at home or in a retirement village; (3) aged 50 years or older; (4) reported no falls in the year before TIA/minor stroke; (5) were able to communicate in English; and (6) were able to provide informed consent. Patients were excluded if they: (1) had a current or past history of conditions affecting balance or walking; (2) were taking medication known to affect balance/coordination; or (3) reported psychological disorders including depression and anxiety. A comparison group of people without TIA or minor stroke but otherwise fulfilling the inclusion/exclusion criteria and matched for age and sex were recruited through a register of volunteers.

All participants received a one-off assessment at a gait/balance laboratory consisting of the following:

Demographic and Health Information

- Age, sex, body mass index, health conditions, medications, and physical activity
- Neurologic information: symptoms, NIHSS score, and neurologic findings

Clinical Tests and Questionnaires

- Vision: visual acuity (Snellen chart), visual contrast sensitivity (Melbourne Edge Test¹²), visual fields (Visual Field Confrontation Test¹³)
- Proprioception of both knees¹⁴
- Cognition: Montreal Cognitive Assessment (MoCA)¹⁵
- Hand reaction time¹⁴

- Fear of falling: Falls Efficacy Scale-International,¹⁶ a measure used to evaluate concern about the possibility of falling. Scores are reported as the sum across 16 items according to concern (not at all = 1, somewhat = 2, fairly = 3, very = 4; maximum score, 64)
- Five Times Sit-to-Stand Test,¹⁷ an indicator of lower limb strength
- Fatigue: Chalder Fatigue Scale,¹⁸ a measure used in assessing poststroke fatigue. Scores are reported as total score (sum across 11 items according to level of fatigue: better than usual = 0, no more than usual = 1, worse than usual = 2, much worse than usual = 3; maximum, 33) and bimodal score (sum across 11 items according to dichotomized level of fatigue: better or no more than usual = 0, worse or much worse than usual = 1; maximum, 11)

Clinical Balance Measures

- Step Test: a dynamic balance test¹⁹
- Timed Up and Go Test (TUG) (single and dual task involving subtraction of serial 3 seconds): measures of functional mobility^{20,21}
- Functional Reach Test: a standing balance test²²
- Four Square Step Test: a measure evaluating speed of rapid stepping forward, to both sides and backward²³

Laboratory Balance Measures

We assessed balance using the NeuroCom Balance Master system (Natus Medical Incorporated, Clackamas, OR) according to a standardized protocol.²⁴ The tests included the following:

- Modified Clinical Test of Sensory Interaction on Balance (CTSIB), a test of postural sway under 4 conditions (eyes open/closed, on firm/foam surfaces, reported as sway velocity in degrees/second using composite results from 4 conditions)
- Limits of Stability (LOS), a test of weight shift amplitude within the body's LOS (reported as a percentage of theoretical maximal excursion using composite results from 8 directions)
- Step Quick Turn, a test of speed and stability in turning (average of 3 trials in each direction, reported as the worse turn time in seconds and in degrees/second for sway velocity)

Laboratory Gait Measures

We used the GAITRite Walking system (CIR Systems Inc/GAITRite, Sparta, NJ). Three types of tests were conducted: self-selected comfortable pace, self-selected comfortable pace with dual task (serial 7 subtraction), and self-selected fast pace. Participants completed 3 trials for each condition, with data combined and averaged for

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