



Tai Chi for reducing dual task gait variability, a potential mediator of fall risk, in individuals with Parkinson's disease: A pilot randomized controlled trial



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Background

Parkinson's disease (PD) is one of the most common neurodegenerative disorders, occurring in about 1% of the population over the age of 60. Loss of mobility and cognitive function are primary concerns for individuals with PD, leading to reduced ability to accomplish functional tasks, impaired balance, increased fall risk, and an overall reduced quality of life.

In PD, dual tasking (DT, i.e. performing a cognitive and motor task simultaneously) further reduces an already impaired automaticity of gait and exacerbates fall risk. Higher gait stride-time variability while performing a cognitive task reflects poorer cognitive-motor coordination and is predictive of falls.

Tai Chi is a multi-component mind-body exercise that shows promise as an intervention for treating PD symptoms and possibly delaying progression. Tai Chi integrates balance, flexibility, and neuromuscular coordination training with a number of cognitive components, which together may result in benefits to PD above and beyond conventional exercise. Tai Chi has been shown to reduce falls in PD and DT gait variability in healthy adults.

Study Aims

To explore the impact of Tai Chi on gait outcomes in early-stage PD utilizing a 'dual task' paradigm, i.e., combining motor and cognitive challenges.

Specific Aim 1: To assess the feasibility of recruiting and retaining individuals with PD into a 6-month randomized controlled trial of Tai Chi exercise.

Specific Aim 2: To collect preliminary data on the safety and efficacy of Tai Chi in improving gait dynamics, cognitive and physical function, and quality of life in individuals with PD.

Methods

Study design:

Two-arm waitlist-controlled RCT comparing 6-months of Tai Chi (TC) plus usual care (UC) to UC alone.

Eligibility criteria:

- Inclusion:** TC naïve adults, aged 40-75, diagnosed with idiopathic PD within the past 10 years with limited disease progression
- Exclusion:** Diagnosis of any form of atypical parkinsonism, history of central nervous system condition, orthopedic impairment, or other disease that could likely contribute to a gait disturbance or parkinsonism, history of dementia or severe psychiatric illness, acute illness requiring hospitalization within the past 3 months, history of deep brain stimulation or other brain surgery, regular use of walking aid

Tai Chi intervention:

- PD-tailored 6-month TC program
- Two 1-hour classes per week led by experienced instructors
- Home practice with instructional DVD 60-min per week

Assessment visits:

- Baseline, 3-month, and 6-month time points
- Conducted at the Motion Analysis Lab at Spaulding Rehabilitation Hospital
- Subjects asked to withhold PD-related medications for 12 hours prior to visit

Procedure:

- Steady-state gait dynamics assessed during over ground walking at preferred speed
- Subjects performed four 90-second trials, walking either quietly (2 trials) or while performing a cognitive task (serial subtraction by 3)

Primary outcome:

- DT (serial subtraction) gait stride-time variability

Equipment:

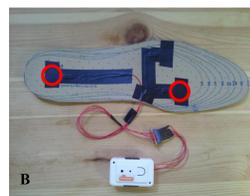


Figure 1. A) Wearable Shimmer sensors (3-axis accelerometers) were placed on the wrists, chest, thighs, and ankles. B) Insole with Force Sensing Resistors (FSRs) connected to a Shimmer sensor.

Statistical Analysis

Comparisons were made using random-slopes model with a shared baseline. The shared baseline assumption, enforced by omitting a treatment main-effect term, properly reflects the true state of the population sampled prior to randomization and has the advantage of adjusting for any chance differences at baseline in a manner similar to ANCOVA (Analysis of Covariance).

Results

Recruitment and compliance:

- 32 eligible subjects enrolled and randomized to TC (n=16) or UC (n=16) over 3 separate cohorts
- 78% completed both follow-up visits
- 50% of TC participants attended at least 70% of classes; 75% completed at least 70% of home practice

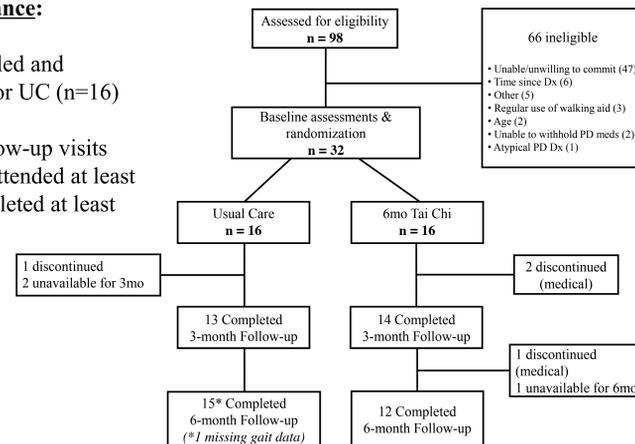


Figure 2. Flow chart of subject recruitment, enrollment, and study participation.

Population:

Baseline Characteristic	Tai Chi (n=16)	Usual Care (n=16)
Age – AVG ± SD	65.7 ± 3.86	62 ± 7.77
Gender – n (%)		
Male	9 (56.3%)	7 (43.8%)
Female	7 (43.8%)	9 (56.3%)
Race – n (%)		
White	16 (100%)	16 (100%)
Ethnicity – n (%)		
Non-Hispanic	16 (100%)	14 (87.5%)
Unknown		2 (12.5%)
Education (yrs) – AVG ± SD	20.2 ± 8.46	17.56 ± 2.31
Employment Status – n (%)		
Employed	9 (56.3%)	10 (62.5%)
Retired	6 (37.5%)	5 (31.3%)
Unemployed	0 (0.0%)	1 (6.3%)
Disabled	1 (6.3%)	0 (0.0%)
BMI (kg/m ²) – AVG ± SD	28.2 ± 5.52	26.9 ± 5.82
Physical Activity Status (0 – 10 scale) AVG ± SD	4.1 ± 1.93	4.31 ± 2.73
Duration of Disease (yrs) AVG ± SD	2.9 ± 2.38	2.9 ± 2.20
Taking PD Meds – n (%)	14 (87.5%)	15 (93.8%)
Hoehn & Yahr Stage – n (%)		
2	11 (68.8%)	13 (81.3%)
2.5	5 (31.3%)	3 (18.8%)
UPDRS Motor Score (0 – 108 scale) AVG ± SD	26.38 ± 9.64	20.63 ± 8.69

Table 1. Baseline characteristics of subjects.

Safety:

- No adverse events (AEs) occurred during or as a direct result of Tai Chi exercise
- Over the course of the study, 12 AEs were reported by 9 subjects (4 in TC, 5 in UC); all AEs were unrelated to the study and included:
 - Back pain (x5)
 - Falls/injuries (x4)
 - Illness (x2)
 - Pain

Results, continued

Gait outcomes:

Six-month reductions in DT (serial subtraction) gait stride-time variability were larger in TC (14.1%) vs. UC (1.0%) (effect size 0.29; p=0.47).

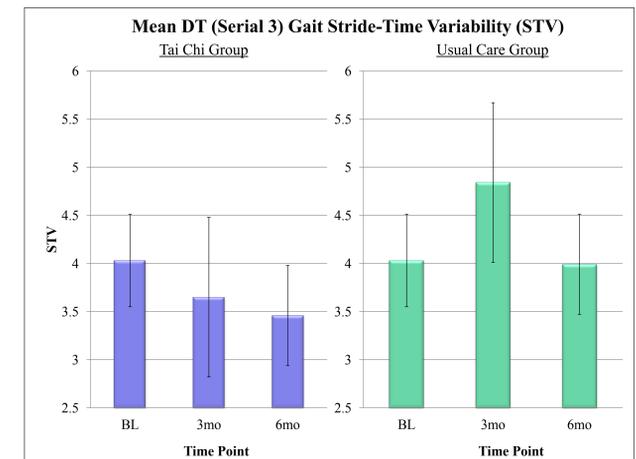


Figure 3. Mean stride-time variability (STV) during DT (serial subtraction) walking at baseline, 3- and 6-months by group.

Secondary outcomes:

Statistically non-significant positive trends were observed in PD-related quality of life (PDQ-39), activity-specific balance confidence, physical activity level, and single-leg stance time.

Power calculations based on preliminary findings suggest that if the effect of TC could be increased to yield a 25% improvement in DT gait variability (a magnitude associated with a clinically meaningful reduction in falls) through improved TC compliance or a longer exposure period, a sample size of 114 (57 per group) would provide 80% power for a future trial.

Conclusions

Tai Chi was well received and safe; recruitment proved to be feasible, however, measures to improve adherence need to be considered.

An adequately powered clinical trial to test the efficacy of Tai Chi in improving cognitive-motor interactions in PD is warranted and feasible.

Acknowledgments

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