

# Effect of Tai Chi Ball Exercise on Functional Mobility in Mild-Moderate Parkinson Disease

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## Letter to Editor

Parkinson's disease (PD) is a neurodegenerative disorder of the basal ganglia that affects approximately 1.5% of adults over the age of 65 [1]. This proportion is higher in PD, where approximately 40% of patients use some form of alternative therapy for treatment of PD symptoms [2]. These therapies may include aerobic exercise, strength training, Tai Chi, Qigong, Yoga, acupuncture, and dance among others. Comparing with Tai Chi, Tai Chi Ball (TCB) event is consisting of more whole-body rotational and multi-segmental circular movements with sequential weight shifting. TCB training tasks require fine equilibrium control [3]. The movement of TCB enhances the Parkinson patients with mild central nervous system function, and that has all active roles in rehabilitation [4]. The purpose of this study was to investigate whether Tai Chi Ball exercise may be an appropriate treatment strategy for patients with PD.

## Methods

Fifty patients (aged 65.85 ± 9.67 years) with mild to moderate PD (PD duration was 7.2 ± 3.5 years, Hoehn and Yahr stage= 2.5 ± 0.7)

were randomized into two groups, 25 of the Tai Chi Ball exercise group (TCBG) and 25 of the control group (CG). Subjects gave written informed consent to participation in the study as approved by the ethics review committee of the Beijing Sport University. TCBG, offered 4 times a week for 6 months, this included the warming-up (10 min), the TCB exercise (40 min), and the cool down exercise (10 min). TCB exercise is a moderate-intensity, corresponding approximately to 40% to 60% of VO<sub>2max</sub>. Exercise intensity control method as heart rate (HR)=170 Age. CG received no intervention. The Berg balance scale (BBS), timed up and go (TUG), 6-minute walk test (6MW), gait speed (m/s), stride length (m), stride time (s) double support (% GC), CV stride length, CV stride time, Unified Parkinson's disease rating scale, freezing of gait (FOG), part III (UPDRS-III) were measured for each subject at baseline and 6 months later. The tests were performed in the practically-defined "off" medication state (i.e. at least 12 hours after intake of anti-parkinsonian medications) to reflect the underlying pathological state.

| Outcome measure | Intervention group  | Time                 |                   |   |
|-----------------|---------------------|----------------------|-------------------|---|
|                 |                     | Baseline mean (± SD) | 6-MFU mean (± SD) | Intervention x-time interaction p value |
| UPDRS-III       | TCBG (n=21)         | 27.6 ± 4.34          | 22.6 ± 3.7 ac     | 0.039                                   |
|                 | CG (n=22)           | 27.3 ± 5.16          | 28.7 ± 4.6        | 0.081                                   |
|                 | p value: TCBG vs CG | 0.965                | 0.03              |   |
| BBS             | TCBG (n=21)         | 42.8 ± 9.67          | 50.6 ± 8.85bd     | 0.0008                                  |
|                 | CG (n=22)           | 42.2 ± 11.02         | 41.5 ± 12.15      | 0.956                                   |
|                 | p value: TCBG vs CG | 0.998                | 0.0007            |   |
| TUG (s)         | TCBG (n=21)         | 11.4 ± 1.85          | 10.2 ± 1.67 ac    | 0.045                                   |
|                 | CG (n=22)           | 11.1 ± 1.78          | 12.1 ± 3.1        | 0.581                                   |
|                 | p value: TCBG vs CG | 0.928                | 0.037             |   |
| 6-MWT (m)       | TCBG (n=21)         | 364.1 ± 28.51        | 373.4 ± 18.8 ac   | 0.043                                   |
|                 | CG (n=22)           | 367.3 ± 32.42        | 362.8 ± 29.57     | 0.889                                   |
|                 | p value: TCBG vs CG | 0.973                | 0.041             |   |

|                   |                     |               |                |       |
|-------------------|---------------------|---------------|----------------|-------|
| FOG               | TCBG (n=21)         | 8.10 ± 1.52   | 7.43 ± 1.21    | 0.154 |
| (out of 24)       | CG (n=22)           | 7.95 ± 1.59   | 8.18 ± 1.91    | 0.813 |
|                   | p value: TCBG vs CG | 0.844         | 0.117          |       |
| Gait speed (m/s)  | TCBG (n=25)         | 0.80 ± 0.49   | 0.88 ± 0.43 ac | 0.041 |
|                   | CG (n=25)           | 0.79 ± 0.52   | 0.73 ± 0.41    | 0.084 |
|                   | p value: TCBG vs CG | 0.952         | 0.021          |       |
| Stride length (m) | TCBG (n=21)         | 1.09 ± 0.16   | 1.10 ± 0.10    | 0.878 |
|                   | CG (n=22)           | 1.08 ± 0.23   | 1.08 ± 0.18    | 0.998 |
|                   | p value: TCBG vs CG | 0.874         | 0.607          |       |
| Stride time (s)   | TCBG (n=21)         | 1.316 ± 0.078 | 1.258 ± 0.054  | 0.217 |
|                   | CG (n=22)           | 1.321 ± 0.082 | 1.337 ± 0.06   | 0.584 |
|                   | p value: TCBG vs CG | 0.847         | 0.106          |       |
| Double support    | TCBG (n=25)         | 29.58 ± 8.21  | 27.87 ± 6.58   | 0.089 |
| (% GC)            | CG (n=25)           | 29.49 ± 9.57  | 29.91 ± 8.49   | 0.375 |
|                   | p value: TCBG vs CG | 0.785         | 0.075          |       |
| CV Stride length  | TCBG (n=21)         | 5.91 ± 1.78   | 5.95 ± 1.57    | 0.732 |
|                   | CG (n=22)           | 5.89 ± 1.89   | 5.86 ± 1.72    | 0.756 |
|                   | p value: TCBG vs CG | 0.898         | 0.509          |       |
| CV Stride time    | TCBG (n=21)         | 5.097 ± 2.13  | 5.024 ± 1.35   | 0.587 |
|                   | CG (n=22)           | 5.095 ± 1.98  | 5.098 ± 1.76   | 0.918 |
|                   | p value: TCBG vs CG | 0.943         | 0.572          |       |

Numbers in parentheses represent the standard error. ap <0.05 compared with baseline. bp <0.01 compared with baseline. cp <0.05 tai chi ball compared with control after 6 months. dp <0.01 Tai Chi Ball compared with control after 6 months. 6-MFU=6-Month Follow-Up; TCBG=Baduanjin Qigong Group; CG=Control Group UPDRS-III=Unified Parkinson's Disease Rating Scale, part III; BBS =Berg Balance Scale; TUG=Timed Up-and-Go; 6 MWD=6-Minute Walk Distance; FOG=Freezing of Gait CV Stride Length=the coefficient of variation (CV=(SD/mean) \*100) for Stride Length CV Stride Time=the coefficient of variation (CV=(SD/mean) \*100) for Stride Time

**Table 1:** Means and standard deviations of performance measures over two repeated tests for the two groups.

## Results

A significant ( $p < 0.05$ ) increase in the BBS, 6-MWT(m), Gait speed (m/s), and decrease in the TUG, UPDRS-III score were found in TCBG after 6 months of TCB exercise. But there was not the case for the control group, which remained at the same level as pretest performance (Table 1).

## Discussion

In the present investigation, data analysis indicated the UPDRS III, BBS, 6-MWT, Gait speed, and TUG improved significantly ( $p < 0.05$ ) in the TCBG compared to the CG after a 6-month intervention (Table 1). Changes noted on A conservative 5 point, or 20%, change on the UPDRS was the clinically relevant cut off for those in stages I-III who had received 6 months of pharmacological treatment [5]. TCBG reached the clinical cut off 5 points. On the BBS, a five-point change is the minimal detectable change (MDC) for clinical significance in those

with parkinsonism [4], which is matched by our interventions' statistically significant. 8-point increase on the BBS. The result is consistent with that TCB improves balance, health physical fitness, biochemical indexes and decrease the risk of falls in elders, patients with type 2 Diabetes, and Parkinson [6-8]. The TCBG increased in 6-MWT, Gait speed and decreased 9.68% in the TUG, across the 6-month TCB exercise. TCB exercise includes a series of individual graceful movements, constant weight shifting with different rotational and multi-segmental circular movements, changes in the base of support from double to single leg standing, and is known for its benefit to balance function. The result is consistent with that the long-practice of TCB produced a positive impact on muscle strength, endurance and muscle reaction time is likely to have contributed to the improvement in the walking speed [8,9].

The results of this study recommend Tai Chi Ball exercise may have the potential to improve the Parkinson patients with mobility function, and that has all active roles in rehabilitation.

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## Author Contributions

**Chun-mei Xiao:** Study concept and design, performed the experiments, acquisition of subjects and/or data, analysis and interpretation of data, and preparation of first draft and final manuscript, Acquisition of funding.

**Yong Kang:** performed the experiments, acquisition of subjects and/or data, Writing/review/editing of manuscript, analysis, and interpretation of data, providing facilities/equipment, Providing subjects.

**Yong-Chang Zhuang:** Performed the experiments, acquisition of subjects and/or data, providing facilities/equipment, providing subjects.

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