THE INFLUENCE OF TAI CHI TRAINING ON LOCOMOTOR ABILITY IN PARKINSON'S DISEASE

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INTRODUCTION

Postural control during dynamic activities such as initiating gait and locomotion, requires the integration of multiple sensory and motor pathways so that the central nervous system can coordinate the anticipatory/postural and intentional /movement components of the task. Persons with Parkinson's disease (PD) exhibit a marked deficit in maintaining equilibrium during transitions between states of static and dynamic equilibrium, such as during gait initiation, termination, or turning. Indeed, disturbance of gait initiation (GI) is well documented in patients with PD (Hass, 2005). PD is also associated with locomotor disturbances resulting in decreased gait speed, step length, and joint excursions (Morris, 2001).

Several investigators have studied whether pharmacologic administration, task specific external cueing, attentional strategies, movement amplitude training, and/or weight supported treadmill training could improve these deficits in GI and locomotion. However, few studies have evaluated whether exercise therapy can be beneficial for improving movement initiation and gait.

We suggest that Tai Chi (TC) training may be particularly beneficial for improving gait initiation and locomotor deficits in this population. First, TC training can lead to improved anticipatory postural adjustments during gait initiation in transitionally frail older adults. TC improved the mechanism by which forward momentum is generated and improved coordination during gait initiation, suggesting improvements in postural control (Hass, 2005). Second, Tai Chi has been shown to improve postural stability and musculoskeletal fitness (Klein, 2004), parameters that are known to influence locomotor ability in PD. Thus, the purpose of this study was to evaluate the effectiveness of Tai Chi for improving locomotor function in PD.

METHODS

Twenty-three sedentary patients with idiopathic PD (mean age 66.6 yrs, *SD* 6.4; mass 79.1 kg, *SD* 15.4; height 174.7 cm, *SD* 8.1; Hohen and Yahr 2.2 *SD* 0.4) were recruited from the metropolitan area. Patients were randomized to receive either Tai Chi training or Qi-Gong meditation twice weekly for 16 weeks. Investigators were blinded to group assignment.

Tai Chi training emphasized physical movements, mind/body coordination, and meditation. Participants performed 8 Tai Chi forms during the 60-minute sessions. The 60-minute Qi-Qong treatments emphasized prolonged, intense contemplative, or deep meditation in two postures, "sitting Chan" and "lying Chan" (seated and lying supine on floor mats.)

Prior to GI and gait analysis, participants were fitted with retroreflective markers according to the Helen Hayes marker

system. Ground reaction forces (GRF) were sampled at 360 Hz from force plates (Bertec Corp., Columbus, OH) embedded within a 8m walkway. Kinematic data were captured at 60 Hz using a six camera 3D Optical Capture system (Peak Performance, Englewood, CO). All data were time synchronized in the Peak Motus analysis system. GRF and kinematic data were exported to in-house software for inverse dynamics calculations.

GI trials began with the participant standing quietly on the force platform with a self-selected stance width. Following a verbal cue, the participants initiated walking and continued walking for several steps. For each participant, six trials were performed at a self-selected pace. The center of pressure trajectory during GI was divided into three periods and five dependent variables were computed: displacement and average velocity in the anterior/posterior and medial/lateral directions and movement smoothness.

For the gait trials, a starting position was selected near one end of the walkway so that foot contact would occur on the force platforms in a normal stride. A trial was discarded if the participant's foot was not completely on the force platform or if the participant made visibly obvious stride alterations. Each subject performed a minimum of eight successful trials.

Our primary hypothesis was that differences would be observed in the dependent variables between the 2 intervention groups over time during the 3 COP trace periods. Three separate 2× 2 (Group × Time) multivariate analysis of variance (MANOVA) were used to test for overall group differences while controlling for type I error. Separate analyses of variance (ANOVAs) were then performed for follow-up testing when appropriate. The dependent variables of interest during the gait trials (gait velocity, stride length, % stance, % double limb support, and step duration) were compared using a Group × Time repeated measures analysis. We used an a priori level of .05 or less. The Bonferroni procedure was used to adjust the overall type I error rate for the follow-up tests.

RESULTS AND DISCUSSION

In this single blind study, the statistical evaluation failed to identify any Group × Time interactions or any Group or Time main effects for any of the dependent variables of interest during the GI and gait analyses. This finding is surprising considering that in follow up interview the Tai Chi participants all reported having benefited from the exercise and they perceived their balance had greatly improved. It is possible the twice-weekly exposure to the Tai Chi forms might not have been sufficient to induce a significant adaptive response. Further, the 16-week duration may not have provided sufficient time for learning of the Tai Chi forms.

SUMMARY/CONCLUSIONS

Based on this preliminary investigation it appears that 16 weeks of Tai Chi training is not effective for inducing improved locomotor ability in patients with PD defined by the magnitude of impairment used in this study.

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