

TAI CHI TRAINING ALTERS LOCOMOTOR DYNAMICS IN THOSE WITH PERIPHERAL NEUROPATHY

B. Manor, Ph.D., L. Li, Ph.D.

INTRODUCTION

Individuals with peripheral neuropathy (PN) are at increased risk of falling [1]. Manor et al [2] reported that these individuals also demonstrate altered locomotor dynamics during treadmill walking. Specifically, PN is associated with increased stride duration variability, as well as exaggerated lower-extremity joint “local instability” [3] at relatively fast walking speeds.

Lockhart & Lui [4] recently demonstrated that relatively greater locomotor variability and local instability are each linked to increased fall risk in healthy older adults. An attempt to determine whether exercise training can reduce locomotor variability and local instability within the PN population is thus warranted. The purpose of this pilot study was to examine the effects of Tai Chi training on locomotor dynamics in individuals with PN.

METHODS

Twelve individuals (>55 yrs old) with physician-diagnosed PN were recruited. Inclusion criteria included 1) the ability to walk unassisted for 6 min, and 2) foot sole sensory loss as defined by an inability to detect the 5.07 gauge Semmes-Weinstein monofilament (North Coast Medical, Inc) at five weight-bearing sites of the foot sole.

Subjects initially completed an overground 6-minute walk test. Average speed during this test was calculated to determine “fast walking speed” (100% FWS). Subjects completed a 3-min warm-up of treadmill walking at 100% FWS. Although habituation may take longer, this duration was chosen to limit fatigue. Subjects then completed 3-min trials at 100%, 80%, and 60% FWS.

Sagittal-plane joint position data were acquired using one high-speed camera (60 Hz) and reflective markers on the hip, knee, and ankle. Stride durations were calculated from consecutive knee joint flexion maximums. Stride duration variability was calculated by determining the standard deviation away from the mean stride duration. Joint angle variability was calculated by time-normalizing individual strides to 100 points, averaging consecutive strides to produce ensemble curves, and calculating the average standard deviation away from this curve [5]. Short-term and long-term local instability were determined by computing finite-time Lyapunov exponents over predetermined linear scaling regions [3,6].

Group-based, instructor-led Tai Chi training was completed (6 wks, 3 sessions/week, 1 hr/session). This modified Yong Style of Tai Chi emphasized coordinated whole-body movements, meditation, and controlled breathing. Progression was based upon instructor discretion.

As walking speed influences locomotor dynamics [7], post-testing consisted of treadmill walking at pre-test speeds. Additionally, a fourth trial was completed at the average speed calculated from a post-test 6 minute walk. However, these data were not included in this analysis.

Joint angle variability and short- and long-term local instability were averaged across joints. Repeated-measures ANOVAs were completed on each dynamic variable with test (pre, post) and speed (60, 80, 100% FWS) as between and within subject factors.

RESULTS AND DISCUSSION

Average Tai Chi attendance was 16 ± 2 sessions. Compared to pre-test, subjects walked with decreased short-term local instability ($F_{1,24} = 5.57$, $p = .02$) at post-test. A trend towards reduced stride duration variability was also observed ($p = .06$). No pre-post differences were observed for long-term local instability or joint angle variability, and no variable was differentially affected across the tested treadmill speeds.

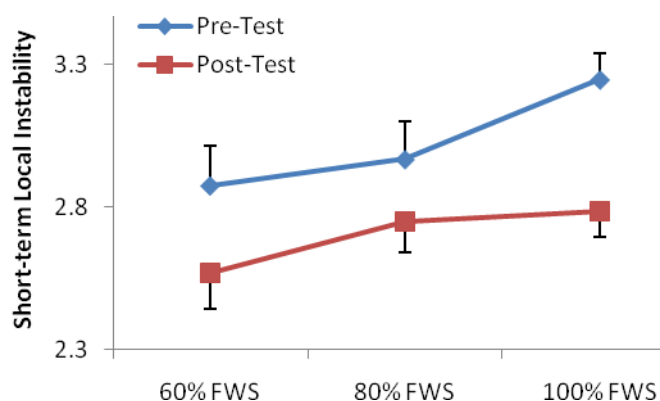


Figure 1: Pre- and post-test lower-extremity joint short-term local instability as a function of “Fast Walking Speed” (FWS) percentage. Post-test values were lower ($p = .02$), but were not differentially affected across speeds.

CONCLUSIONS

As little as 6 wks of Tai Chi training may effectively decrease the local instability and variability associated with treadmill walking in individuals with PN. Future well-controlled, prospective studies should examine this possibility, as well as the relationship between Tai Chi-related alterations in locomotor dynamics, functional outcomes, and falls within this population.

REFERENCES

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