# THE IMMEDIATE EFFECTS OF TAI CHI ON POSTURAL STABILITY

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Tai Chi has been reported to be effective in improving postural stability in older adults but the acute effects of Tai Chi on healthy young adults, however, has yet to be investigated. Therefore, the purpose of this pilot study was to explore if there was an interaction effect between eye and surface conditions on measures of mean sway velocity (MSV) and 95% ellipitcal area (EA). The pre-/post-test measures of postural stability from 15 participants under eyes open and eyes closed and firm/foam surface conditions were examined. Change scores for MSV and EA were obtained by substracting pretest from posttest data after completing a 5-posture form Tai Chi exercise. A two-way ANOVA was conducted to examine the interaction effect between the eye and surface conditions for MSV and EA. The results demonstrated that Tai Chi did not acutely effect postural stability.

**KEYWORDS:** Postural control, multi-component exercise, balance.

**INTRODUCTION:** Tai Chi originated in 17th century China as a new form of Kung Fu (Wayne & Kaptchuk, 2008). Tai Chi distinguished itself from the quicker, more agile martial arts, with its slower, more methodical movements (Wayne & Kaptchuk, 2008). These characteristics have led some to describe Tai Chi as both a choreographed dance and moving meditation (Field, 2011; Jin, 1992). Traditionally, Tai Chi is performed in a semi-squatting position, with movements which continuously shift the body weight across both legs (Xu, Li, & Hong, 2003). When practiced, the performer's attention is placed on the speed, force, and trajectory of the body; such that, postures flow into one another in a slow, even, and smooth manner (Xu et al., 2003). It is perhaps a consequence of these characteristics that researchers report that Tai Chi may improve the postural stability of its practitioners (Xu et al., 2003). There have been several studies exploring the various aspects of long-term Tai Chi interventions in relation to different populations especially in older and pathological individuals but less in younger and healthier populations. Therefore, the purpose of this pilot study was to examine the acute postural effects of a single Tai Chi session on healthy young adults under eyes open (EO)/eyes closed (EC) and firm/foam surface conditions.

**METHODS:** After ethical approval was obtained from the academic institutional research ethics board, recruitment of participants began using the following inclusion/exclusion criteria. A total of 15 participants between the ages of 18 to 35 years, with no previous history of Tai Chi practice, were invited to participate. Prospective participants were excluded if he/she possessed any health conditions which may have influenced postural stability such as a history of concussion, peripheral neuropathy, vestibular impairment, sensory loss in the feet, or impaired vision which was not corrected with eyewear (Wayne & Kaptchuk, 2008). Participants completed a Physical Activity Readiness Questionnaire for Everyone to screen for any health conditions which would require medical clearance prior to participating in physical activity.
Following recruitment, 15 (n=15) participants (5 males; 10 females) completed this pilot study. Participants were led through a 2-min traditional Tai Chi warm-up. After warming up the joints, participants rubbed the palms of his/her hands up and down his/her calf, quadriceps, hamstring, gluteal, upper arm, forearm, and neck muscles. The purpose of which was to stimulate blood flow and prepare the body for Tai Chi. Once the participant completed his/her warm-up, the Advanced Mechanics Technologies Incorporated© force platform (Watertown, MA, U.S.A.) was zeroed, and the participant was asked to stand on the force platform. A 35.37-centimeter (cm) screen was placed 172 cm in front of the participant. The height of the screen varied between each participant, as it was adjusted to be at the participant's eye level. On the screen, an "X" was displayed, which the participant was asked to stare at during all EO conditions. This technique was implemented to prevent the participant's gaze from wandering,

as changes in the distance between the eyes and the object of focus could affect postural performance (Schubert, Kirchner, Schmidtbleicher, & Haas, 2012.). Before each trial, the participant stood barefoot and quietly (arms relaxed on either side of the body and feet shoulder width apart) under an EO condition, then under an EC condition. Each trial lasted 70 s with data sampled at 200 Hz. Following the data collection on the firm surface of the force platform, the participant was asked to stand quietly on a foam surface Airex® Balance-pad (Sins, AG, Switzerland). Data was also collected under an EO and EC condition. After the four pre-intervention test conditions were completed (EO/EC on a firm surface, EO/EC on a foam surface), the participants engaged in a 15-min Tai Chi intervention. Prior to performing the intervention, a 3 min video of a Tai Chi Master instructor performing a 5-posture form was viewed. The participant was asked to visualize him/herself performing the Tai Chi form as he/she watched; the purpose of which was to help the participant understand the movement more clearly prior to performing it. The participant viewed the video twice, then followed along with it three times. The forms consisted of the following positions (in order of occurrence): commencing, wave single hand (right and left), lazily tying coat, six sealings four closings (right and left), and single whip (right and left). Immediately following the intervention, post-intervention postural stability measures were taken, with the same protocol as the pre-intervention measures. A 2 (eye condition) x 2 (surface condition) two-way ANOVAs were conducted to determine if there was an interaction effect between the independent variables on acute change scores of mean sway velocity (MSV) and 95% elliptical area (EA) from pre- to post-treatment.

**RESULTS:** Descriptive statistics for change scores for EA and MSV are summarized in Table 1. There was no statistically significant two-way interaction effect between the eye conditions and surface conditions on EA, $F(1,14)=2.333$, $p=.149$, and no statistically significant main effect on EA for surface conditions, $F(1,14)=0.666$, $p=.428$.. There was a statistically significant main effect on EA for the eye conditions, $F(1,14)=4.98$, $p=.042$, partial $\eta^2=.262$ (see figure 1). There was an increase in EA under the eyes closed conditions in comparison to the eyes open conditions as highlighted in Table 1.

**Table 1. 95% Elliptical Area ($mm^2$) and Mean Sway Velocity (m/s) Change Scores**

| Condition | 95% Elliptical Area Mean ± Standard Deviation | Mean Sway Velocity Mean ± Standard Deviation |
|---|---|---|
| Eyes Open Firm Surface | -.0153 ± .06 | -.0086 ± .07 |
| Eyes Open Soft Surface | .0222 ± .03 | .0067 ± .03 |
| Eyes Closed Firm Surface | .0027 ± .03 | .0239 ± .07 |
| Eyes Closed Soft Surface | .0324 ± .09 | .0803 ± .04 |

There was also no statistically significant two-way interaction effect between the eye conditions and surface conditions on MSV, $F(1,14)=1.682$, $p=.216$. There was a statistically significant main effect on MSV for the eye conditions, $F(1,14)=14.751$, $p=.002$, partial $\eta^2=.513$ and for surface conditions, $F(1,14)=4.524$, $p=.05$, partial $\eta^2=.244$ (see figure 2). There was an increase in MSV under the eyes closed conditions in comparison to the eyes open conditions and when standing on a soft surface compared to a firm surface as highlighted in Table 1.

**DISCUSSION:** The purpose of this pilot study was to examine the acute postural effects of a single Tai Chi session on healthy young adults under EO/EC and firm/foam surface conditions. The current findings revealed that having the eyes open versus closed may impact on the EA and that eye condition and surface type (soft versus firm) impacts on the MSV.

These findings are consistent with previous work that reported that longer term Tai Chi interventions improved postural stability under EC, EO, firm, and foam surface conditions (Ghandali et al., 2017; Guan & Koceja, 2011). Additionally, it should be noted that the greater physical conditioning an individual possesses, the greater intensity and/or duration of training

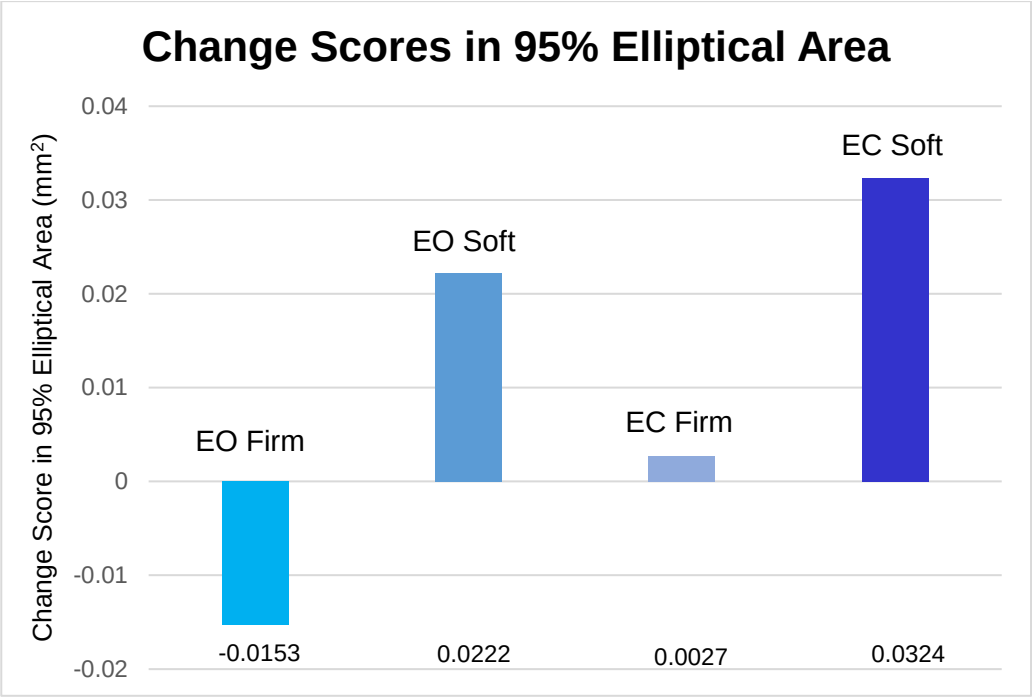


**Figure 1**. Change scores in EA across surface and eye conditions.

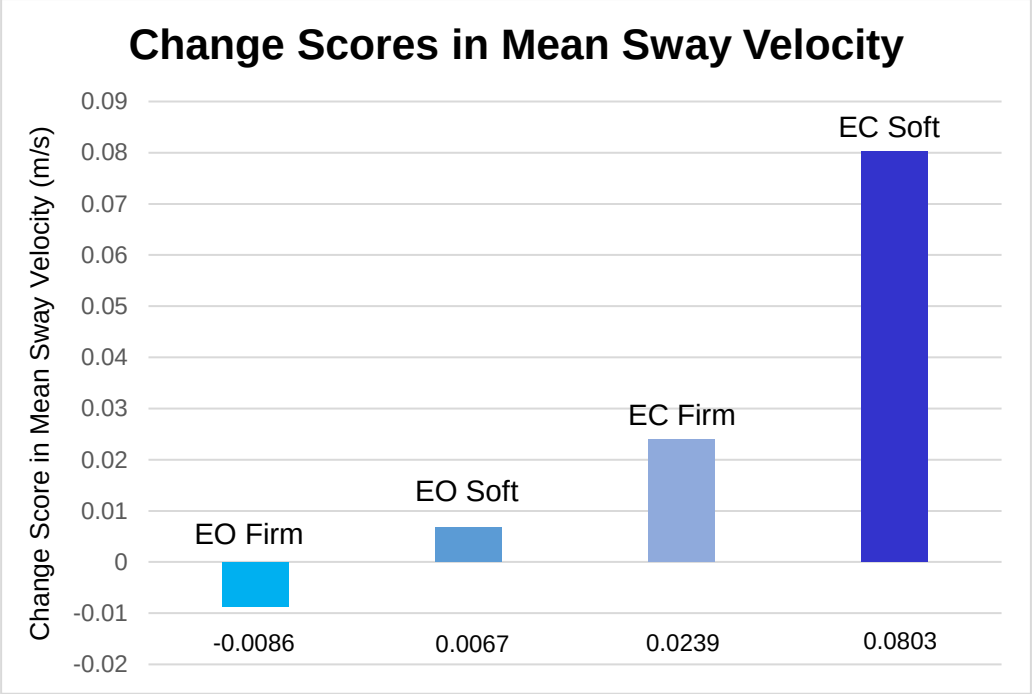


**Figure 2**. Change scores in MSV across surface and eye conditions.

required to produce significant changes (Lesinski et al., 2015). The current parameters used for the training session revealed that the variables of eye condition and surface type should be used as they do impact on the EA and MSV but more research on the duration required to produce optimal changes in the select populations is required.

Consequently, since all participants were healthy young adults without balance impairments, it was possible that the Tai Chi intervention did not provide adequate challenge to produce significant results. Although only studied among older adults, prior research has observed that

Tai Chi practice may influence ankle proprioception (Xu, Hong, Li, & Chan, 2004; Wayne & Kaptchuk, 2008; Zhang, Sun, Yu, Song, & Mao, 2015.). It has been suggested that the effect Tai Chi has on ankle proprioception is a result of Tai Chi's slow movements, as the exercise moves the joint through a broad range of motion but since this was a young, healthy sample, the response may be different. Another contributing factor may be Tai Chi's emphasis on placing the performer's attention on joint angles and body position; which thereby, increases conscious awareness of specific joint position and movement (Xu, Hong, Li, & Chan, 2004; Zhang, Sun, Yu, Song, & Mao, 2015). Changes to muscle activation within the ankle may be behind these proprioceptive changes. As such, future research should explore the acute effects of changes both on muscle activity and patterning along with MSV and EA as this would not have been evident with the current measurement techniques reported.
Tai Chi is a complex intervention that integrates physical, cognitive, spiritual, and social components (Wayne & Kaptchuk, 2008) which may not be captured in a single post-intervention measure nor may its effects be replicated in using a recorded video as a platform for delivery. It may be prudent to assess postural stability after multiple sessions, as well as, include multiple repeated measures following the intervention to determine any effects and monitor these changes over time to see how long they may last. Yet, the results show that healthy young adults provide a good reference as a control group to examine the effect of Tai Chi on young adult populations with balance problems. Future research may also help to determine how pre-recorded Tai Chi lessons versus a live exercise session may impact postural stability and balance.

**CONCLUSION:** The aim of this pilot study was to investigate the immediate effects of a single Tai Chi session on the postural stability of healthy young adults. The findings of this pilot study revealed that the eye condition used or the surface type produced changes in MSV and EA following a single Tai Chi intervention delivered via video training. Further exploration on the use of this form of exercise in young healthy adults to help understand both the short term and long-term effects, optimal duration, and biomechanical mechanisms behind any changes found is required.

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