

What is the effect of a 6-week beginner Tai Chi Chuan exercise class on selected balance measures on healthy college students?

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Introduction

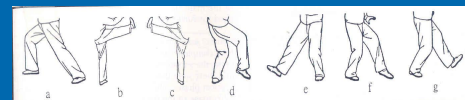
- Tai Chi Chuan (TCC)
 - Shown to improve balance in elderly
 - No studies - young adults re: balance
- Thus, focus on assessing the effects of TCC in young adult population re: balance
 - help prevent balance problems later in life?



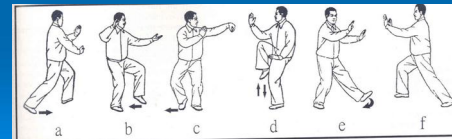
Objective and hypothesis

- Objective: to examine the effects of a 6-week beginner TCC exercise program on selected balance measures in healthy college students
- Hypothesis: TCC participants will demonstrate significant improvements after 6 weeks:
 - Limits of Stability (LOS)
 - Forward Lunge
 - Single Leg Stance (SLS) with Eyes Open/Closed (EO/EC)
- Why we chose these balance measures...

Basic forms of TCC³



Foot Patterns



Stepping Patterns

Clinical evidence on TCC and the elderly

- Balance – improves:
 - Dynamic balance control, balance confidence, and performance on balance tests⁴⁻⁹
- Gait – improves:
 - Initiation and forward momentum¹⁰
 - Trunk and lower extremity (LE) range of motion¹¹
 - Knee strength and endurance¹²
 - LE control and proprioception¹³
- Falls
 - Lack of evidence to support the use of TCC for fall reduction^{14,15} though isolated studies show positive correlation¹⁶⁻¹⁹
 - Effective method to maintain gains from balance and strength training^{20,21}

Clinical Evidence on Balance Master

- Dearth of research - validity
 - Of the Balance Master (BM) as an assessment tool as a whole
- Ample research – reliability
 - Compares BM to Berg and Functional Reach
 - Evidence exists for LOS, lunge, & SLS EO/EC



Reliability

- LOS
 - Normal adults: high²²
 - Sway with EO
 - Movement time to target
 - Path length to targets
 - Stroke patients: high²⁴
 - Movement path and time
 - Multiple day assessments²⁵
 - No significant differences across days
- Lunge and SLS
 - Reliability is best for dynamic tests rather than static tests²³
 - Dynamic
 - movement time and path
 - Static
 - amount of sway with eyes closed

Methods: Subjects

- Inclusion Criteria
 - Intervention group:
 - Enrolled in HHP 056
 - 6 weeks of biweekly instruction
 - Control group: Enrolled in PSY 101
 - No change in physical activity
 - Complete activity diary
 - Independent in self care and ambulation
 - Signed consent form
- Exclusion Criteria
 - Self report 1 check box:
 - Taking meds affecting balance and CV conditions
 - MD diagnosis of neurological, vestibular, CA, CV disease or dysfunction
 - Medical diagnosis of ortho LE injury or balance disorder
 - Ankle sprain in past 6 mo. or recurring ankle sprains
 - Uncorrected visual deficits



Method: Subjects

- Dropouts occurred due to:
 - Noncompliance
 - Did not attend post-test measurements
 - Secondary to lack of desire or dropped class
- Results:
 - 4 dropouts
 - Intervention: 3
 - Control: 1



Methods: Subjects

Subjects' characteristics

	Intervention group	Control group	Both groups
n	12	15	27
Mean age	27	18	22
Maximum age	58	19	58
Minimum age	18	18	18

Methods: Measurement


- Pre- and Post-tests:
 - Height
 - Proper foot placement
 - Age (pre-test only)
 - Analyzed for homogeneity
- Balance test methods:
 - Randomized the test order
 - Drew numbers from hat which corresponded to specific protocols in BM
 - One run through for practice, then second test took actual assessment
- Balance tests:
 - LOS
 - 8 directions
 - Lunge, SLS
 - 3 trials per leg

Methods: Balance Test Definitions

- LOS
 - how far one can lean their body in a given direction without losing balance, stepping, or reaching for assistance.
- SLS EO
 - measures how much/fast one sways while standing on either the right or left foot with eyes open. Tested on a firm surface.
- SLS EC
 - same as SLS EO except eyes are closed during the test.
- Forward lunge
 - assesses certain features of the movement as one completes a forward lunge.
 - A lunge starts in the standing position and consists of a long step forward onto one leg and then pushing back with that same leg to return to the standing position.


Methods: Setting

- Clinical setting of the study
 - Quiet environment
 - No observers other than researchers
 - 2 subjects tested in different room
 - scheduling difficulties



Data Analysis: Pre test

- Pre-test:
 - T test to determine any significant difference from intervention group and control group



Data Analysis: Post test

- Post-test
 - SPSS software
 - Repeated measure ANOVA
 - Significance level:
 - $P \leq 0.05$
 - SLS EO/EC
 - Calculated mean difference in MS Excel
 - Analyzed trends:
 - Control vs. intervention (pre and post-test)

Results: Pre-test

- T-test
 - Age
 - Not homogenous
 - Data $P \geq 0.05$
 - Intervention group – 2 age outliers
 - Height
 - Homogenous
 - $P \leq 0.05$

Comparison of intervention and control group for Forward Lunge measures

Measure	Intervention (Pre-test)	Intervention (Post-test)	Control (Pre-test)	Control (Post-test)	Pre vs Post (p)	Pre vs Post/Control vs Intervention (p)
Forward Lunge						
mean distance L	47.50	47.83	43.53	45.73	0.19	0.33
mean distance R	49.17	48.83	44.13	46.40	0.27	0.14
mean impact index L	22.08	20.83	19.53	16.20	0.03	0.31
mean impact index R	25.50	26.83	23.07	20.80	0.61	0.08
mean contact time L	0.91	0.91	1.16	1.24	0.12	0.10
mean contact time R	0.90	0.90	1.24	1.29	0.80	0.51
mean force impulse L	95.00	94.08	118.07	123.60	0.29	0.14
mean force impulse R	95.92	95.62	126.79	133.20	0.66	0.66

Discussion: Forward Lunge

- Statistical significance of mean impact index L (pre vs post)
 - Questionable
- Significance of mean impact index R (pre vs post/intervention vs control)
 - Positive trend but questionable (not statistical)

SLS EO/EC

Definitions of Dep. Variables

- Mean center of gravity sway velocity composite (°/sec)
 - average of the mean center of gravity sway velocity scores for all conditions—sum of the means divided by the number of conditions
- Mean length of balance for left/right lower extremity EO/EC
 - average length of balance on stance leg expressed in seconds

Results: SLS EO/EC

Comparison of intervention and control group for SLS measures

	Single leg stance EO		Single leg stance EC		mean center of gravity sway velocity composite
	mean length of balance L	mean length of balance R	mean length of balance L	mean length of balance R	
Intervention (Pre)	3.53	10.00	9.80	7.39	8.12
Intervention (Post)	2.58	10.00	10.00	8.76	8.69
Intervention Difference	-0.95	0.00	0.20	1.36	0.57
Control (Pre)	2.99	9.88	9.88	8.13	8.44
Control (Post)	3.18	10.00	9.76	7.52	8.83
Control Difference	0.19	0.12	-0.12	-0.60	0.39

Discussion: SLS EO/EC

- Trends indicated:
 - Experimental group:
 - towards improvement
 - sway, mean balance of right leg (EO & EC)
 - mean balance of left leg (EC)
 - Control group:
 - improvement on mean length of balance on the left foot (EO) and mean length of balance on the right foot (EC)
 - The trend was not as positive vs. the intervention group
 - Explanation:
 - TCC biweekly instruction and out of class practice sessions
 - learning curve
 - coincidence

Results: LOS

Comparison of intervention and control group for LOS measures

Measure	Intervention (Pre-test)	Intervention (Post-test)	Control (Pre-test)	Control (Post-test)	Pre vs Post (p)	Pre v Post C vs I (p)	Direction Pre v Post C vs I
Limits of stability							
reaction time composite (sec)	0.86	0.70	0.86	0.82	0.01	0.09	0.02
movement velocity composite (degrees)	4.70	5.75	5.53	5.98	0.08	0.13	0.19
end point excursion composite (%)	87.82	92.36	87.86	83.43	0.96	0.02	0.02
maximum excursion composite (%)	99.27	102.09	99.14	96.50	0.95	0.02	0.05
directional control composite (%)	80.18	78.45	78.57	78.43	0.49	0.56	0.25

Discussion: LOS

- Reaction time
 - Both groups showed statistically significant improvement after 6 weeks (pre vs post)
 - Explanation:
 - May be due to practice
 - Direction had a statistically significant impact on performance
 - Explanation:
 - TCC biweekly instruction and out of class practice sessions
 - Direction affects reaction time

Discussion: LOS

- Movement velocity (pre vs post)
 - Both groups had a statistically significant improvement
 - Explanation:
 - Practice/learning curve

Discussion: LOS

- End point excursion
 - Intervention group had stat. significant improvements
 - Improvement in anticipatory (feed-forward) movement planning
 - Explanation:
 - TCC practice anticipatory movements
 - Direction had influence
 - Intervention group had a statistically significant improvement
 - Direction affects end point excursion
 - Explanation:
 - TCC practices directional anticipatory movements

Discussion: LOS

- Maximum excursion
 - Intervention group demonstrated statistically significant improvements
 - Improvement in corrective (feedback) movement control
 - Explanation
 - Practice of TCC may enhance corrective mechanisms

Conclusion

- 6-week Tai Chi intervention on novice practitioners demonstrated that there is a moderate measurable effect on selected balance measures
- Hypothesis of improvements:
 - Practice of Tai Chi
 - Learning curve of the Balance Master
- Future research needed
 - Better methodological and subject quality

Limitations and Future Recommendations: Subjects

- Larger sample size
 - Ameliorate effects of subject drop-out
 - More accurate statistical analyses
 - Intervention group
 - multiple beginner Tai Chi classes
 - same instructor
- Novice practitioners
 - Explicit age range
 - correspond to age range for BM's normative data
 - Loose-fitting clothes during balance testing
 - Extra set of baggy shorts or pants

Limitations and Future Recommendations: Methods

- Blinded observers
 - another person to recruit participants
- Testing environment
 - Isolated, consistent, free of distraction
 - Stored
- Balance Master
 - Need foot placement instructions for taller subjects (LOS)
 - Normative data for age <20 years old
- Long-term intervention
 - ≥ 12 weeks

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Questions?