

EFFECT OF TAI CHI EXERCISE ON COUNTER-MOVEMENT JUMP IN AGED ADULTS

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INTRODUCTION

Age-related decline in muscle ability will increase the difficulty in daily functional activities. In particular, decline in muscle ability of lower extremities would be have great influence on execution of basic locomotion (e.g. chair rising, climbing or step down stairs, and regaining balance from forward fall) and increase the risk of fall. In order to prevent loss of muscle function, exercise has been recommended. Training programs for the elderly are often designed as multicomponent training that typically consists of a combination of strength, balance and flexibility exercise [1, 2]. Tai Chi exercise is an event that could improve muscle strength, flexibility and balance for the elderly [3, 4, 5]. Meanwhile, most daily locomotion involve coupled eccentric muscle action and concentric muscle contractions (so-called stretch-shortening cycle: SSC) and a combination of multiple joints and muscles. However, only few studies have involved SSC and dynamic movement with a combination of multiple joints and muscles for aged people, as performed in a counter movement jump (CMJ) test. It is suggested the dynamic CMJ could be an easy-use test to estimate the strength and leg stiffness for aged people [6]. To our knowledge, there is a lack of studies concerning maximal CMJ performance of aged people who have regular Tai chi exercise. Therefore, the purpose of this paper was to estimate the effect of Tai Chi exercise on CMJ in aged people.

METHODS

Seven male and 4 female healthy aged adults were recruited (n=11; age=71.34±3.74yrs; height=160.18±5.18cm; mass=57.24±6.0kg). Volunteers signed a consent form after being informed of all risks, discomforts and benefits associated with the procedure. All subjects had Tai Chi exercise habit (e.g. at least 3 times per week, 1hr per time). Subjects were asked to keep their hands on the hip to perform maximal CMJ on a Kistler force platform (1000Hz) was synchronized with the Vicon ten cameras (250Hz) to record the ground reaction force and kinematic data. Three maximal jumps were performed, and the highest jump was selected for further analysis. Eccentric phase was defined as the duration from start position to zero body COM vertical velocity, and concentric phase was defined as from zero body COM vertical velocity to take-off. All variables were to compare with the previous studies associated with the same movement and procedure in the aged people.

RESULTS AND DISCUSSION

Table1. shows the results of TC aged subjects and healthy aged adults reported by Caserotti et al.[7,8] performing maximal CMJ. The duration, peak vertical force and displacement of COM during eccentric phase show no difference between TC aged subjects and healthy aged adults, while several variables show significant difference during concentric phase (shorter duration, larger peak vertical force, larger velocity_{-take off}, higher jump height, larger peak power, larger force_{-peak power}). Despite there were 7 males and 4 females in TC aged group, the TC aged people exhibited

better performance than healthy aged males in the studies [7,8]. The results including shorter duration, larger peak vertical force, larger velocity_{-take off}, higher jump height, larger peak power, larger force_{-peak power} in concentric phase revealed the aged people may effectively enhance the muscle abilities of lower extremities through TC exercise training, such as contraction speed, muscle strength, and power. Furthermore, the type of muscle contraction during CMJ which involve coupled eccentric muscle action and concentric muscle contractions is similar to most daily functional activities (e.g. climbing a relative high step, stepping down from a stair or sidewalk, and rapidly reversing a forward fall). As a result, the muscle function of aged people examined during the maximal CMJ may reflect the functional performance in everyday activities. And the age-related decrease in muscle power, strength, and speed is associated with impaired those functional activities. It is suggested that designing Tai Chi exercise as a physical activity program be recommended for aged people.

Table 1: the results during performed maximal CMJ

	TC aged subject(n=11) Mean(SD)	healthy older1 Mean(SD)	healthy older2 Mean(SD)
Eccentric phase			
duration(ms)	565(9.94)	-----	-----
peak vertical force (Nkg ⁻¹)	17.885(1.94)	16.8(3.0)	16.01(2.48)
Dis. of COM(cm)	20.86(7.54)	24.3(5.6)	-----
Concentric phase			
duraton(ms)	278(67.8)	341.3(89.8)	
peak vertical force(Nkg ⁻¹)	20.78(1.70)	-----	17.72(2.07)
peak vetical velocity(m/s)	1.843(1.44)	-----	1.64(0.21)
Dis. of COM(cm)	31.51(7.74)	31.5(5.4)	-----
velocity _{-take off} (ms ⁻¹)	1.712(1.78)	1.40(0.2)	1.36(0.26)
jump height(cm)	15.17(3.17)	10.3(3.4)	9.85(3.51)
jeak power(W/kg)	30.812(2.97)	23.5(3.8)	23.01(4.09)
velocity _{-peak power} (ms ⁻¹)	1.665(0.12)	1.52(0.2)	1.50(0.20)
force _{-peak power} (Nkg ⁻¹)	18.54(1.52)	15.5(1.3)	15.39(1.39)

Data of healthy older1 cited from Caserotti et. al.[8]; Data of healthy older2 cited from Caserotti et. al.[7].

CONCLUSIONS

The TC aged people exhibited shorter duration, larger peak vertical force, larger velocity_{-takeoff}, higher jump height, larger peak power, larger force_{-peak power} in concentric phase on CMJ. It is suggested that regular Tai Chi exercise could be designed in a physical activity program and can benefit daily functional activities in aged people.

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