EFFECT OF TAI CHI EXERCISE ON OBSTACLE CROSSING IN AGED ADULTS

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INTRODUCTION

Maintainance of the body's balance, together with precise swing foot control, is essential for successful obstacle crossing. Imbalance of the whole body during obstacle crossing may cause inappropriate movement of the lower extremities or striking an obstacle with the swing foot, and result in a fall. The aged people with descresed physical abilities, such as muscular strength, flexibility, balance, face more challenges during obstacle crossing. In order to reduce the risk of fall during obstacle crossing, it is critical to increase physical abilities through engaging in exercise regularly.

The researches indicated the muscular strength, flexibility, balance were increased when people participate in Tai Chi Chuan regularly[1,2,3]. We think those improvements will also have influence on the performance of obstacle crossing. There have been many studies investigate the effect of age during obstacle crossing[4,5]. However, there still is a lack of knowledge concerning how the elderly regularly engaged in Tai Chi Chuan maintain or adjust the motion of whole body during obstacle crossing. Therefore, the purpose of this study was to investigate the different height obstacle crossing behaviors in the aged people engaged regularly in Tai Chi Chuan.

METHODS

Thirteen(M=8;F=5) healthy aged adults(age= 70.46±3.22yrs; height= 160.46 ± 7.13cm; mass= 58.64 ± 7.0kg) who engaged in Tai Chi exercise(at least 3 times per week, 1hour per time) were recruited for this study. Subjects were instructed to walk along a 10-m walkway, step over the obstacle, and continue walking along the walkway, all at a preferred speed while barefoot. Two upright standards and a light-weight crossbar presented a single obstacle at a height of 10%, 20%, and 30% leg length (approximately equal to 5%, 10%, and 15% body height). The obstacle was a plastic pipe (length=1.5m, diameter= 2cm). The obstacle was attached to the upright standards in such a way as to easily dislodge if contacted. The obstacle height was randomly selected for each trial with three trials collected for each height. 3-D kinematics data were collected at 250Hz using a ten-camera Vicon motion capture system with a set of 36 reflective markers placed on bony landmarks of each subject. ANOVA with repeated measures was used to compare variables among three heights during the crossing stride by setting the significant level of α=.05.

RESULTS AND DISCUSSION

Table1. shows the results of statistical analyses for selected parameters. The results revealed that increasing obstacle height resulted in linear increases of the following variables; Stride time and vertical motion, and peak upward COM velocity, and resulted in linear decreases in stride velocity. Those trends are similar to the results of healthy aged adults reported by Hahn & Chou [6]. Except for the variables mentioned above, there's no significant height effect on others in this study.

Table1: variables of aged people obstacle crossing

	10% Mean(SD)	20% Mean(SD)	30% Mean(SD)	p valu
stride time(s)*	1.26(0.18)	1.32(0.12)	1.40(0.13)	<.0
stride velocity(m/s)*	1.102(0.22)	1.018(0.16)	0.969(0.14)	
stride length(BH%)	81.32(7.67)	80.76(8.93)	78.94(6.52)	
leading foot				
toe clearance(mm)	198.33(59.78)	189.77(36.54)	190.56(46.48)	
heel-obstacle distance(LL%)	25.96(9.19)	24.71(6.93)	22.38(5.12)	
trailing foot				
toe clearance(mm)	193.22(76.42)	188.17(68.69)	165.06 (57.07)	
toe-obstacle diatance(LL%)	34.89(5.96)	33.77(2.50)	35.76(3.78)	
AP COM motion(BH%)	84.29(7.99)	82.82(6.23)	83.59(5.96)	
ML COM motion(inter-asis%)	12.68(4.78)	15.41(5.67)	15.30(4.46)	
vertical COM motion(BH%)*	4.19(0.78)	5.10(0.50)	6.06(0.69)	<.05
peak AP COM velocity(m/s)	1.32(0.22)	1.28(0.18)	1.29(0.18)	
peak MLCOM velocity(m/s)	0.142(0.39)	0.143(0.44)	0.162(0.41)	
peak upward COM velocity(m/s)*	0.337(0.075)	0.386(0.067)	0.443(0.071)	<.05

***significant difference among heights, p<.05**

It is suggested that there's age-dependent decrease in AP ROM of the COM [6]. However, comparing with the results of young adults(< 80%BH) reported by Chou et al.[7], no age-dependent decrease in AP COM motion was observed in TC subjects. We speculate Tai Chi Chuan training emphasized on transition of COM at a slower pace. As a result, TC aged subjects may achieve longer AP motion during obstacle crossing. The healthy aged adults' trailing toe clearance (mean<150mm), trailing toe-obstacle diatance (10%=24.94; 20%= 24.60; 30%=24.24), and leading heel-obstacle distance(10%=18.40; 20%=16.38; 30%=15.09) reported by Lu et al.[5] were less than TC aged subjects'. These would reduce the risk of contacting obstacle. This indicated the older adults used a more conservative strategy when compared to young adults[5]. The TC aged subjects also take a more conservative strategy, and able to achieve a larger range of motion due to better physical locomotion abilities. Finally, the likehood of striking directly obstacle and then fall incidence would decrease.

CONCLUSIONS

TC aged subjects increase stride time, vertical COM motion, and peak upward velocity to negotiate increasing height obstacles. Comparing with previous studies, no age-dependent decrease in AP COM motion exist in TC subjects. The TC aged people also used a more conservative strategy(larger trailing toe-obstacle and leading heel-obstacle distance, and leading and trailing toe clearance) to achieve a larger displacement due to better physical locomotion abilities.

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