

Kinematical Analysis of Tai Chi Chuan Players during Gait and Balance Test and Implication in Rehabilitation Exercise

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Abstract : Background—Tai Chi Chuan (TCC) is a type of traditional Chinese martial art and is considered a benefiting physical fitness. Advanced techniques of motion analysis have been routinely used in the clinical assessment. However, so far, little research has been done on the biomechanical assessment of TCC players in terms of gait and balance using motion analysis. Objectives—The aim of this study was to investigate whether TCC improves the lower limb conditions and balance ability using the state of the art motion analysis technologies, i.e. motion capture system, electromyography and force platform. Methods—Twenty TCC (9 male, 11 female) with age between (42-77) years old and weight (56.2-119 Kg), and eighteen Non-TCC participants (7 male, 11 female), weight (50-110 Kg) with age (43- 78) years old at the matched age as a control group were recruited in this study. Their gait and balance were collected using Vicon Nexus® to obtain the gait parameters, and kinematic parameters of hip, knee, and ankle joints in three planes of both limbs. Participants stood on force platforms to perform a single leg balance test. Then, they were asked to walk along a 10 m walkway at their comfortable speed. Participants performed 5 trials of single-leg balance for the dominant side. Also, the participants performed 3 trials of four square step balance and 10 trials of walking. From the recorded trials, three good ones were analyzed using the Vicon Plug-in-Gait model to obtain gait parameters, e.g. walking speed, cadence, stride length, and joint parameters, e.g. joint angle, force, moments, etc. Result— The temporal-spatial variables of TCC subjects were compared with the Non-TCC subjects, it was found that there was a significant difference ($p < 0.05$) between the groups. Moreover, it was observed that participants of TCC have significant differences in ankle, hip, and knee joints' kinematics in the sagittal, coronal, and transverse planes such as ankle angle (19.90 ± 19.54 deg) for TCC while (15.34 ± 6.50 deg) for Non-TCC, and knee angle (14.96 ± 6.40 deg) for TCC while (17.63 ± 5.79 deg) for Non-TCC in the transverse plane. Also, the result showed that there was a significant difference between groups in the single-leg balance test, e.g. maintaining single leg stance time in the TCC participants showed longer duration (20.85 ± 10.53 s) in compared to Non-TCC people group (13.39 ± 8.78 s). While the result showed that there was no significant difference between groups in the four square step balance. Conclusion—Our result showed that there are significant differences between Tai Chi Chuan and Non-Tai Chi Chuan participants in the various aspects of gait analysis and balance test, as a consequence of these findings some of biomechanical parameters such as joints kinematics, gait parameters and single leg stance balance test, the Tai Chi Chuan could improve the lower limb conditions and could reduce a risk of fall for the elderly with ageing.

Keywords : gait analysis, kinematics, single leg stance, Tai Chi Chuan

Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development

Conference Location : Chicago, United States

Conference Dates : December 12-13, 2020