THE KINEMATICAL PATTERNS OF LOWER LIMB JOINTS FOR BASIC SHUTTLECOCK KICKING

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INTRODUCTION
The shuttlecock kicking is a kind of Chinese folk exercise that wide currency for a long time. Shuttlecock kicking exercise mainly one’s wrist and lower extremities, and it has the particular feature the dynamical performance of variety kicking skills and momentary mobility positions to strengthen the agility and coordination of lower extremities. It is not only kicking skills subtly, highly safety to exercise and space required low. The exercise of shuttlecock kicking could be the previous incarnation of sports in lower extremities such as soccer or Taekwondo. The Xiao Wu, kick, is the element of learning shuttlecock kicking. The combination of kicking low and kicking high is always practice and performance in order to apply to develop the technique of figure kicking with individual style. The purpose of this study is to investigate the kinematical characteristics of low extremity joints for the performance of basic shuttlecock kicking under kicking low and kicking high. This study also compares the difference of the elite players and novice players in selected kinematical parameters.

METHODS
Ten elite shuttlecock kicking players (11-12-year-old and continuous basic kick over 100 times) and ten novice shuttlecock kicking players (11-12-year-old and continuous basic kick less 5 times) were the volunteers who served as the participants for this study. Three twi-axial electrogoniometers (Biometrics system) and a tri-axial accelerometer (BioPac system) were mounted at hip joint, knee joint, ankle joint, and the superior metatarsal of kicking leg respectively. The BioPac MP100 system and AcqKnowledge 3.7.2 version were used to acquire (1000Hz) the information of kinematical parameters. The participants were asked to perform the basic shuttlecock kicking high (shuttlecock flight over the height of head) and low (shuttlecock flight under the height of head) continuously. The software of Origin 7.0 and SPSS 10.0 were used to analyze the patterns and to compare the difference of kinematical data in t-test with an alpha level of .05.

RESULTS AND DISCUSSION
The results showed that the total time per kick, time of knee flexion start to peak hip flexion angular velocity, and time of knee flexion start to peak knee flexion angular velocity were no any difference significantly between the elite players and the novice players for kicking low continuously (p > .05). But the angular displacement at ankle inversion and hip abduction in the elite players were larger significantly than the novice players for kicking low continuously (p < .05). The angular displacement at hip flexion in the elite players were less significantly than the novice players to perform kicking low continuously (p < .05). During the kicking low movement, the elite players showed fixed the ankle joint and to flex the hip joint and knee joint lightly first, and then to perform the hip joint abduction. The hip joint abduction seems to represent the control parameter mainly that was indicated the smoothing curves in hip abdution to knee flexion, hip flexion, and ankle inversion diagram. But for the novice player, it showed that was evident hip flexion and hip adduction at the beginning to kick, and the control of low extremity joints were instability during the impact phase.

CONCLUSIONS
The elite player could set his foot in well position first until before the shuttlecock impact on foot for the aiming control, and accelerate the action joints unhurriedly for an adapted kicking.