

The Kinematical Analysis of the Taekwondo Sparring Players' Bandal Chagi in Kinematics

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The purpose of this study is to provide scientific data about the most effective performance of the Bandal Chagi, which is used very frequently in Taekwondo competitions. For this study, to analyze the changes in kinematics, two groups of subjects were selected from welterweight Taekwondo players. One group has four skilled players who have had more than 10-years' experience and got a prize in national championships, while the other group has four unskilled players who have had no experience winning a prize for Taekwondo. For motion analysis, 7 Cameras (MX13) Vicon Motion System captured the kinematic data. Polygon Viewer was used to output the three dimensional data. The results of analyzing the necessary time of action, angle-change in every joint, and changes in body center of mass (com) in kinematics are as follows: 1. when players are in competition, Bandal Chagi can be practiced more effectively if one's knee joint angle-change is larger than the change of the angle between players' supporting leg and kicking leg. 2. Bandal Chagi can be practiced effectively when hip joint's angle-change forms the maximum flexion at the point where the kicking leg and supporting leg crossover. 3. Bandal Chagi can be performed effectively when one hyper-extends their hip while extending their upper-body. In conclusion, when training for Taekwondo kyorugi competitions, for players to apply the Bandal Chagi more effectively, players must be trained to enhance knee joint, hip joint and extension in pulling back upper-body action.

key words: Bandal Chagi, ankle joint, knee joint, hip joint, center of mass(com), hyperextension

Introduction

With Taekwondo having become a formal world sporting event, the need for repeated research for its improvement has become evident. With the huge

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advancement in technique and training methods of foreign players, it has become unavoidable for Korean players, who want to maintain their superiority in Taekwondo, to recognize the overwhelming urgent need for research for improving physical conditioning, technique and competition.

There is nothing more important for modern day Taekwondo competition in the 3 rounds of 2 minutes, than the ability to accurately comprehend/read the opposite players' attacking motion by the observation of their posture, position, and footwork (step) and to be able to react quickly and penetrate their defenses with either an attack or a counterattack(Lee, 1998). In this short reaction time, even though there are a large number of defensive choices for defense and attacking kicks, the *bandal chagi* similar to the motion of the front kick with the rotation of the trunk just before the point of impact is being using very frequently in competition (Kukkiwon, 2007).

The *bandal chagi* is more effective than the back kick as a defensive kick, and it can be used more in competition than other defensive techniques as a counter attack. In competition, the counter attack *bandal chagi* motion involves the back step and then the switching of the two legs while kicking out with the back leg. The *bandal chagi* is used frequently, and there are various methods of its application, but the success rate of its scoring depends vastly on the players' posture. It is a counter attacking technique where the defender does not receive a hit but where he/she hits the attacking player, which is rarely to be seen in competition. A difference in highly skilled players' ability can be observed by their movement of the center of gravity, explosion and reaction time. According to Mun (2004), the *bandal chagi* requires the optimum motion of each segment when players are moving the back step and crossing over legs to reach the impact, so as to be able to move with accuracy and stability the body's center of gravity. The movement of the physical body and performance of motion arises from the coordinated muscle contraction and relaxation to move the joints in a consecutive manner (Ha, 2002). In Ahn's kinematic report on the front kick, it was shown that the start comes from the throwing like movement, which progresses into a pushing motion. However, because of the rotation starting from the lower limbs and to the trunk, it is difficult to be classified as purely a kicking motion (Shin et al., 2004). In the restricted situation where the kinematic data can be recorded, even with the same segments involved, the motion's characteristics change.

A throwing/kicking motion can be described by the state of movement from the proximal joints to the distal joints, i.e. the proximal linear velocities, joint angle