ELEMENTARY SCHOOL BOYS' SOCCER KICK SKILL ANALYSIS

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The purpose of this study is aimed to analyze elementary school boys' kicking skills on the perspective of motor skills. The data is collected by Vicon Motion Analysis System (250Hz). The parameters include the compare of the instant joint angles and the time proportion during the process of the kicking toward the different kick performance groups. The participants are 36 elementary boy soccer players (age: 11.7±0.3 yrs; height: 1.42±0.13 m; weight: 37.5±13.0 kg). The subjects were divided to two groups according to the instance kicking ball speed. The result indicated that the high ball speed group players have greater extremity joint angles than the low ball speed group. No difference was found on the time proportion during the process of the kicking. We suggest that the learning of kicking skill can start with the lower speed in the beginner stage.

KEY WORDS: soccer, motor skill, angle of joints

INTRODUCTION: Without the age limitation set by FIFA World Cup, every country has substantial support its best players to join in the game. In order to raise the overall soccer teams' competition strength, many countries get their branches downwards to the players, and therefore, the cultivation of child and teenager players become extremely important. The golden age of a child is between 8 and 12 years old (Ono et, 1996) and the report also pointed out that the children in this stage bear fast musculoskeletal growth and the gradually complete development of their brains. If we can find the variety and appropriate of motor skills and abilities in this stage, then the cultivation can be beneficial to their growth in the future (Scammon, 1930).

Kicking a ball is a very complicated movement, the upper extremity play the role in creating the right conditions for an effective kick. The quick trunk flexion and rotation towards the kick side, accompanied by fast arm flexion and adduction on the non-kick side, contribute to an explosive muscle contraction and permit a powerful whip-like movement of the kicking leg (Shan & Westerhoff, 2005). Furthermore, the lower extremity has to control the ball well, as well as to run and support the weight of the whole body. Therefore, a player has to be equipped with several basic motor abilities if he or she wants to kick well. According to a research, when a soccer player is kicking a ball, there is a high relationship between the highest speed of the ball, and the torque of hip muscle contraction and knee muscle elongation (Narici, Sirtori, & Mognoni, 1988). Other on the result of the research, the average of the highest speed is 22.7 ± 1.6 m/s, and the maximum angular velocity of the leg is 45.2 ± 6.4 rad/s (Gourgoulis, Aggeloussis, Antoniou, & Mavromatis, 2002), which shows the importance of basic motor skills. For the point view of motor control that different task demand will constrain the performance of kick motion. The successful kick contains two factors the powerful kick and accurate which the ball must reach the target. As already explained, when the player is instructed to hit the ball accurately, joint and segment velocities are lower as opposed to a fast and powerful kick performance (Eleftherios & Athanasios, 2007).

Nowadays, it is more and more obvious that the excellent athletes become younger and younger; therefore, it is important to study the characteristics of skills of the athletes in every stage, especially in the elementary school stage. The main purpose of this study is aimed to analyze elementary school boys' kicking skills according to the perspective of motor skills.

METHODS: Participants were 36 male elementary school students (age: 11.7±0.3 years old; height: 141.5±13.0 cm; weight: 37.5±13.0 kg), and the consent forms were obtained for all the subjects and their parents. The VICON Motion Analysis System (Vicon Motion Systems Ltd., West Way, Oxford OX2 0JB, UK) was used to get all the related data, and the whole system includes 6 M2 video cameras (250Hz). The Workstation and Bodybuilder software attaching to VICON Motion Analysis System was used to do the reflective ball coordinate calculation, and the data smoothing (general cross-validatory quintic spline routine); in addition, the Mathcad math software（Parametric Technology Corporation., USA) was used to calculate the 3d coordinates and joint angles, and SPSS 19.0 statistics software was used to do the statistics analysis. The independent sample t test was used to test the differences of the angles of lower extremity joints and the time proportion of the kicking process between high ball speed group [HBSG] and low ball speed group [LBSG]. The level of significance is α=.05.

Before the experiment started, all of the participants warmed up their bodies to their best status so that we could start testing. We attached the reflective balls to the participants. In order to reduce the inaccuracy, all of the reflective balls were attached by the same person who with the experience.

The goal of rectangle target zone (height 2 m from the ground, wide 3 m) was set up on the wall which vertical on the ground. And the distance from the ball which set on the ground start point to the centre of the target is 12 yard (10.97 m). The ball was placed on the start point of ground and the instep-kick was assessed (Figure 1). The kicking processes including four durations: run-up, backward, front kick and following durations (Figure 2).
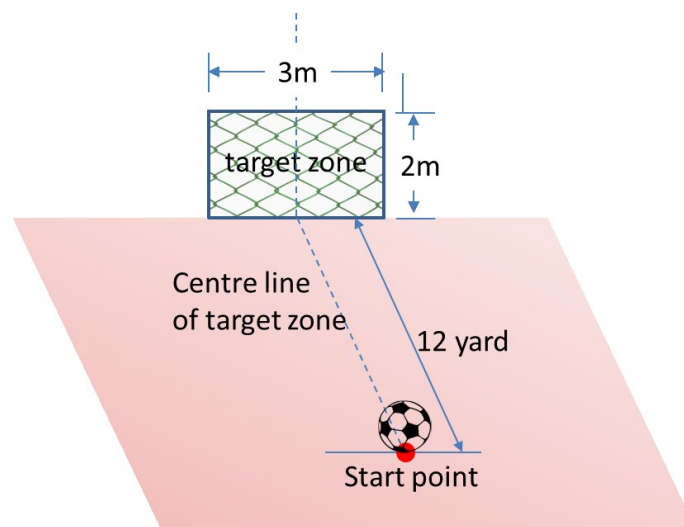

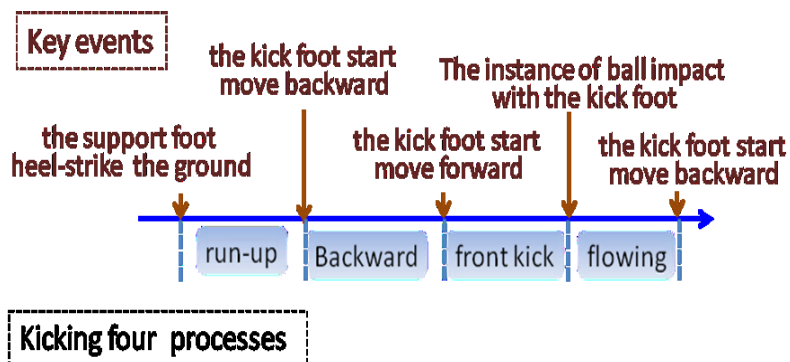**Figure 1 The layout of experiment**

Figure 2 The four kicking processes and key events

The instance of ball impact with the kick foot event was judged by the images of Vicon system. According the pilot study results of participants' kick ball speeds, the grouping criteria of HBSG and HBSG is 55.0 km/hr. When the experiment started, all the participants would be tested their kick motions, and three successful trials (kick the ball within the target zone) data of each player were collected. The sample for each participates test data was according the highest kick speed of each participates' 3 successful trials.

RESULTS AND DISCUSSION:

1. The comparison of instance kick ball speed and the angles of joints

The instant ball speeds between HBSG (21 players; 59.3$\pm$1.6 km/hr) and LBSG (15 players; 52.7$\pm$1.7 km/hr) reach the significant difference ($p<.05$). Based on the result, we have the followings discussions: toward the HBSG, the average angle of shoulder joint is 54.9$\pm$7.5 degree, the average angle of hip joint is 156.1$\pm$10.9 degree, and the average angle of knee joint is 139$\pm$10.7 degree; as for the LBSG, the average angle of shoulder joint is 35.7$\pm$10.1degree, the average angle of hip joint is 131.4$\pm$16.6 degree, and the average angle of knee joint is 107.3$\pm$9.5 degree.

Compared the kinematics differences between kicking with dorsum of foot and an inside foot passing, the angles of hip and knee joint when compacting the ball are 158$\pm$9 and 132$\pm$13 degree (Levanon& Dapena,1998), which are close to the HBSG of the study. That result showed that the angle of joints at the instance of the kick of the HBSG tends to be higher than that of LBSG (Figure 3).
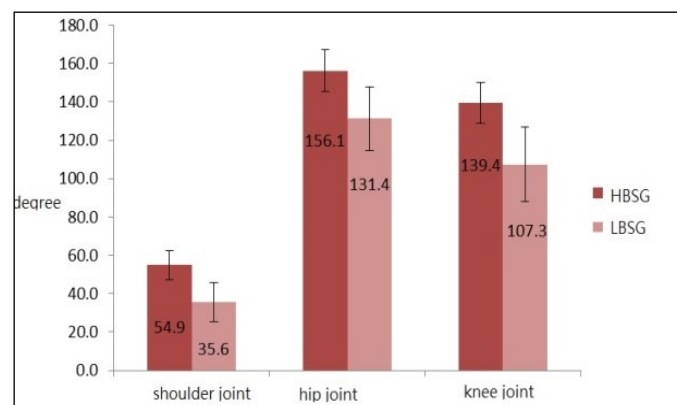

Figure 3: The degree of different joint angles in HBSG and LBSG

2. Time Proportion of Kicking Process

The time proportion of these four parts of the HBSG is as following: 25.0% of the whole time for run-up, 21.9% for the backward, 22.7% for the front kick and 30.4% for following durations. As for the LBSG: 25.6% of the whole time for run-up, 21.4% for the backward, 20.8% for the front kick and 32.2% for followings. The statistics analysis (one-way ANOVA, repeated measures) result showed that there is no difference ($p>.05$) between the time proportion of two groups and different joints, which states that the time proportion of both groups tend to be the alike skill types (Figure 4).

Just like what Shapiro and other researchers (1981) found in the chart comparing the angles of hip and knee joints at 4 different moving speeds (3 km/hr、7 km/hr、9 km/hr、12 km/hr): the movement patterns of different moving speeds are pretty similar, so the kicking skill of different ball speed are alike.
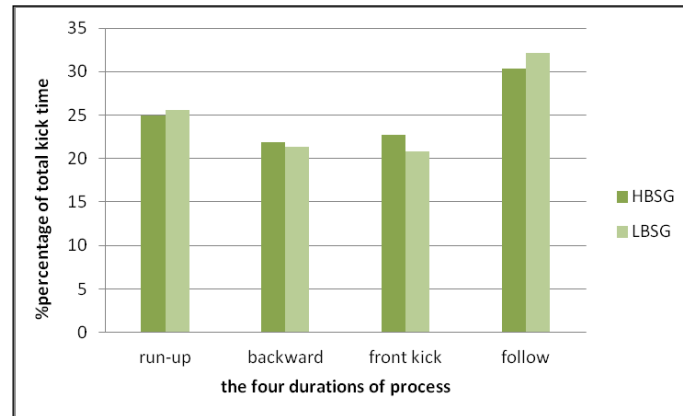
Figure 4: The scale of time proportion of kicking process in HBSG and LBSG

CONCLUSION: The angle of lower extremity joints at the HBSG tends to be higher than that of LBSG. And the time proportion of both groups tends to be the similar. The speed of the ball has no effect to the time proportion parameters. Toward the soccer beginners, the low speed kick motion can help the players to steadily practice the kick skill which is the similar motor skill content of high speed kick motion. After their technique becomes mature or enhance the muscle strength, the speed of the ball will elevate. This research has probed the motor skill character of kick ball. The participants were focused on the elementary school students, and we suggest that the future study can focus on the differences between players in different stages and performance levels.

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