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BIOMECHANICS OF ACCURATE INSTEP KICK IN FUTSAL

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The purpose of this study was to investigate the biomechanical parameters of instep kicking towards specific targets of the goal in Futsal. Twelve females from national soccer team in Taiwan were recruited in this study. Each subject was asked to perform instep kick of a stationary ball (size 4) toward targets in the four corners of the goal in Futsal. VICON motion analysis system and Kistler force plateform were used to collect the kinematics of the lower limb and the ground reaction forces and moments, respectively. The results showed that kicks towards the bottom targets demonstrated significantly greater ball velocity than towards the top targets (p= 0.00). In addition, the hip joint moment of supporting leg was significantly greater when kicking towards top targets of the goal (p= 0.01). The results of this study could provide training guidelines for coaches and players.

KEY WORDS: biomechanics, Futsal, accurate instep kick.

INTRODUCTION: Futsal is one kind of soccer game. Recently, futsal become more and more popular around the world. However, there were only limited studies about futsal in biomechanics until now (Fabio, Lilian, Paulo & Sergio, 2010; Ozaki, Sunam & Ishii, 2010). There are some differences between futsal and soccer. In futsal, the ball and the goal are smaller than soccer that they are probably the reasons to affect the kicking movement. Besides, the goal keeper will occupy most space in the goal to increase the score difficulty. Thus, players need to increase the accuracy of the shot for scoring. However, previous studies were focused on maximum instep kicking (Orloff, Sumida, Chow, Habibi, Fujino, & Kramer, 2008; Shan, 2009; Fabio et al., 2010). The biomechanical parameters are still unclear in accurate instep kick. Therefore, the aim of this study was to analyze the difference on biomechanical parameters during instep kicking towards a top or a bottom target on the right and left sides of the goal in futsal.

METHODS: Twelve female players were recruited in this study. All participants were from Taiwan national soccer team with a mean experience of 12.2±2.2 years (ages: 22.6±2.1 years old, body heights: 163.5±4.5 cm, body weights: 58.4±3.8 kgw). All of subjects were right-footed and had no history of lower limb, spinal or neurological injury within six months. Participants were asked to sign the consent form after they understood the experimental procedures. After a 10-minute warm up, they were asked to perform instep kicking a stationary ball (size 4) toward a top or a bottom target on the right and left sides of the goal from a marked penalty spot (6 meter) in futsal. All the targets were needed to score three times successfully in a randomized manner. VICON motion analysis system was used to collect the kinematic data of the lower limbs and the ball. One Kistler force plateform was used to record the ground reaction forces and moments of the supporting leg. The ball velocity-foot velocity ratio was calculated through the ball velocity and the foot velocity. Kicking phase corresponded to the period when the initial contact of supporting leg (force plate recording initiated) until maximum hip flexion of the swing leg. There were one-minute rests between trials to avoid fatigue. One-way ANOVA was used to compare the biomechanical difference between four targets.

RESULTS: The mean and standard deviation of the ball velocity, foot velocity and ball velocity-foot velocity ratio were shown on Table 1. The results showed that the ball velocity of bottom targets demonstrated significantly greater than the top targets on the right and left sides of the goal (p= 0.00). There was no significant difference found on foot velocity and ball

velocity-foot velocity ratio. The peak hip joint moment of supporting leg was shown on Figure 1. The top targets showed significantly greater hip flexor moment than the bottom targets on the right and left sides of the goal (p= 0.01). The hip joint force of supporting leg was found no significant difference among all targets (Figure 2).

Table 1. Ball Velocity, Foot Velocity, Ball velocity-foot velocity ratio (mean ± standard deviation)

	LT	RT	LB	RB
Ball Velocity (m/s)*	17.1 ± 1.2	17.2 ± 1.1	18.1 ± 1.7	18.7 ± 1.1
Foot Velocity (m/s)	11.3 ± 5.5	11.7 ± 6.5	11.5 ± 6.2	13.9 ± 7.4
Ball velocity-foot velocity ratio	1.5 ± 1.1	1.5 ± 1.1	1.6 ± 1.2	1.3 ± 0.8

Key: LT = the top target on the left, RT = the top target on the right, LB = the bottom target on the left, RB = the bottom target on the right.
*Significantly different, $P < 0.05$.

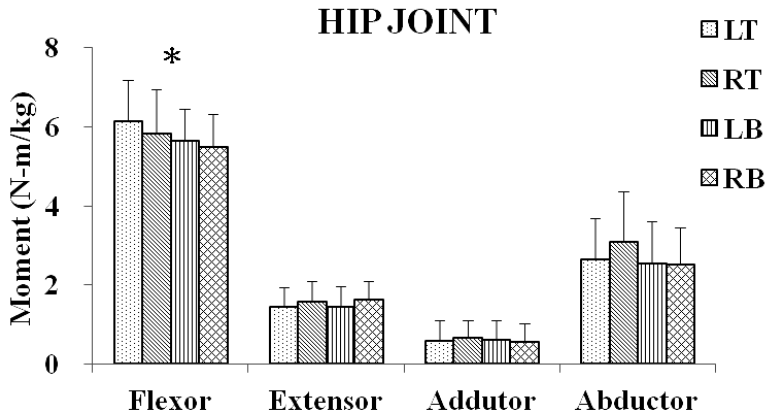

Figure 1: The hip joint moment of supporting leg (LT = the top target on the left, RT = the top target on the right, LB = the bottom target on the left, RB = the bottom target on the right). *Significantly different, $P < 0.05$.

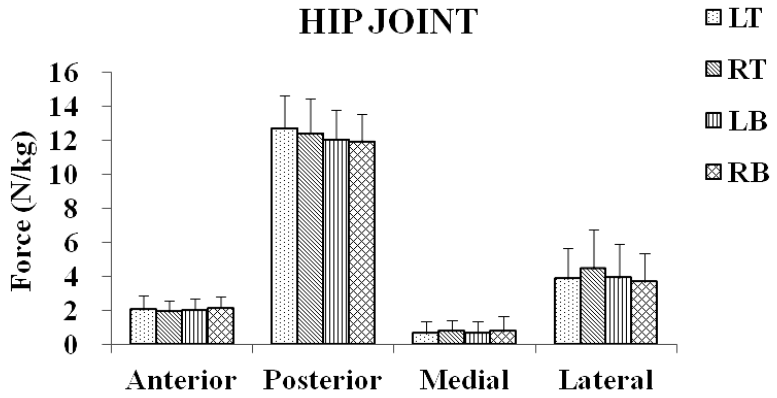

Figure 2: The hip joint force of supporting leg (LT = the top target on the left, RT = the top target on the right, LB = the bottom target on the left, RB = the bottom target on the right).

DISCUSSION: The ball velocity was found significantly different between top targets and bottom targets; however, the mean values in the current study were lower than Fabio's study (2010). Lees & Nolan (2002) reported that the ball velocity under the condition of speed was faster than that of accuracy during the instep kick. The result of this study also showed that the ball velocity reduced because of the accurate instep kicking. The ball velocity was affected by the velocity of the foot before the ball contact. Thus, the ball velocity-foot velocity ratio has

been considered as an index of a successful kick (Katis & Kellis, 2007). Our findings on foot velocity and ball velocity-foot velocity ratio with female subjects were similar to the previous study (Barfield, Kirkendall & Yu, 2002).
Lees & Nolan (1998) reported that the placement of the support foot had received little interest in the research literature, even kinetic data have been of interest for some time with two-dimensional flexion/extension moments widely reported (Lee, Asai, Andersen, Nunome & Sterzing, 2010). The full three-dimensional hip joint forces and moments were reported in this study. And there was a significant difference found on hip flexor moment. The results suggested that training program could focus on hip flexor moment of supporting leg to increase kick accuracy.

CONCLUSION: The biomechancial differences of lower limbs during instep kicking towards specific target in futsal were reported in this study. The findings suggested that the player can select bottom targets to score successfully with a faster ball velocity under the condition of accuracy. Also, the muscle strength of the hip flexor on the supporting leg could promote accuracy on top targets.

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