THE EFFECTS OF APPROACH ANGLE AND TARGET POSITION ON INSTEP KICKING ACCURACY AND BALL SPEED WITH SKILLED SOCCER PLAYERS

Ali Shamsi Majelan[1], Farhad Rahmani-Nia[2], Ali Asghar Norasteh[2], Arsalan Damirchi[2]
[1]Faculty of Physical Education and Sport Sciences, University of Guilan, Rasht, Iran,
[2]Faculty of Physical Education and Sport Sciences, University of Guilan, Rasht, Iran

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Abstract
Kicking accuracy and ball speed are the most important indicators of a successful soccer instep kick. The purpose of this study was to examine the effects of target position and approach angle on ball speed and kicking accuracy of powerful soccer instep kicks. Ten skilled adult soccer players (age: 25.9 ± 5.5 years; height: 1.79 ± 0.06 m; mass: 72.6 ± 7.5 kg) kicked a total of twenty-four powerful instep kicks using a standard size 5 ball, at two 0.6 x 0.6 m right and left targets from their self-selected approach angle, 30ş and 45ş (direction of the kick was 0ş). Kicking accuracy and ball speed were analysed by two high-speed cameras at 300 fps. The mean values for ball velocity of the three approach angles were higher for left target than right target ($p < 0.05$), there was no significant difference between two position of target in kicking accuracy. For each target separately, results revealed that there was no significant difference between approach angles in kicking accuracy and ball speed. Our results suggest that, for right-footed players, the instep kicks toward left goal corner target is more speed than right target.
Key Words*: instep kick; approach angles; soccer player; position of target.*

INTRODUCTION

Soccer kick is the main offensive action during the game and the team with more kicks on target has better chances to score and win a game (kellis and katis, 2007). Successful kicks need to be fast and accurate, especially when kicking on goal in order to surprise the goalkeeper. Previuous studies investigated the relationship of kicking accuracy and speed with various factors. The approach angle is one of the most important aspects which has a significant effect on soccer kick success (Isokawa and Lees, 1988; Kellis et al.,2004; Opavsky, 1988; Roberts et al., 1974). An angled approach is commonly used as it orientates the body to gain greater hip and knee flexion range of motion, and enables the kicking leg to be tilted in the frontal plane so that the foot can be placed further under the ball, thus enabling better ball contact (Lees and Nolan, 1998). Isokava and Lees (1988) reported that there were no significant differences between approach directions, but the maximum swing velocity of the leg was achieved with an approach angle of 30 degree and maximum ball speed was achieved with an approach angle of 45 degree. Self-selected approach angles around 43° have been reported by Egan and colleagues (Egan et al., 2007), supporting previous research that found an approach angle of around 45° generated maximum ball speed (Isokawa & Lees, 1988). Plagenhoff (1971) believed that the two primary factors in determining ball velocity were (1) effective mass of the foot, and (2) foot velocity immediately before ball contact. His findings provided evidence that foot velocity before impact was similar with straight and angled approaches, yet the angled approach yielded greater ball velocity. This led to the conclusion that the primary differences in ball velocity were based on greater "effective mass of the foot" with an angled approach rather than foot

velocity at ball contact (Hay, 1996; Plagenhoef, 1971). Most of these studies investigated the relationship between the approach angle and ball and leg speed.

There are few data to our knowledge has examined the association between the approach angle and kicking accuracy. In only study Scurr and Hal (2009) investigated the effects of approach angle on penalty kicking accuracy. Seven male amateur recreational soccer players kicked penalties at a 0.6 x 0.6 m target from their self selected approach angle, 30ş, 45ş and 60ş. They revealed that there was no significant difference in kicking accuracy between the approach angles. Difference in straight-line approach compared with an angled approach is probably due to the reduced rotation of the pelvic girdle before the initial stage of the forward motion of the thigh (Bull Andersen and Dorge, 2011). Scurr and Hal (2009) pelvic rotation was significantly greater from the 45ş and 60ş approach angles compared to 30° and the self - selected approach angle. Greater pelvic rotation allowing it to move through a greater range of motion throughout the kick and enables the player to remain in contact with the ball for a longer period of time, increasing the possibility of a more accurate kick (Barfield, 1998).

To our knowledge, in all of studies on soccer kick accuracy, participant was instructed to kick the ball towards a target in center or one corner of goal gate (Brown et al, 1993; lees and Nolan, 2002; Dichiera et al, 2006; Gheidi and Sadeghi, 2010) and

there is no experimental evidence to compare the kicking accuracy in different position of target. It is likely that change in target position effects on contribution of kicking muscle groups and kicking kinematic and thereby the ball kicking speed and accuracy. Accordingly, the purpose of this study was (I) to examine the differences of ball speed and kicking accuracy between kicking toward two targets in right and left corner of gate, and (II) to examine the influence of different approach angles on kicking accuracy and the speed of the ball when kicking a stationary ball.

METHODS

Subjects

Ten skilled adult soccer players (Table 1) who had no history of major lower limb injury or disease, volunteered to participate in this study after providing their informed consent. All of the participants had a minimum of seven years of experience playing soccer, with a training frequency of at least three a week. As all participants preferred to kick the ball using their right leg, the right leg was considered the preferred leg. Each subject wore personal soccer shoes and informed written consent was received before testing began. The Human Research Ethics Committee at Guilan University approved the study procedures.

Table 1. Subject characteristics

N	Age(years)	Height(m)	Weight (kg)	Experience(years)
10	25.9 ± 5.5	1.79 ± 0.06	72.6 ± 7.5	11.5 ± 4.5

Procedures

After warming-up and familiarization trials, subjects kicked a total of twenty-four powerful instep kicks using a standard size 5 ball, at two 0.6 x 0.6 m targets positioned in the right and left corners of a 20 centimeter thick mat. This mat, approximately 6 meters wide and two meters in height, was used to reduce rebound of the ball, preventing damage of the equipment. The distance between the centre of the targets and ball position is 7m and the distance from ground is 120 cm. The centre of the targets was marked with a plus sign. Three different approach angles were used; subjects' self-selected approach angle, 30ş and 45ş with 0ş perpendicular to the mat. Three experimental approach angles was used in a random order; these were marked clearly on the astro turf for subjects to follow. The length of the approach was self-selected by subjects to simulate the actual kick situation. Twelve trials were recorded in each target divided into four kicks in each approach angle.

All kicks were visually recorded using two digital cameras (Casio EX-F1, 300 Hz, 720 × 576). One was placed behind the kicker and the other was placed to the side. Cameras were placed at angle of 90 and an external light was used to synchronize the two video cameras. The direct linear transformation (DLT) method was used to analyse accuracy and ball speed. The center of the ball was also digitized in its initial stationary position and in 6 frames after it left the foot. Accuracy was recorded as the distance from the centre of the ball to the centre of the target in centimetres. Following kick accuracy and speed analysis, the most accurate and most speed kick in each condition for each target was selected to compare performance.

Statistical Analyses

The software package SPSS V18 was used in the data analysis. All data were checked for normality using the Kolmogorov-Smirnov test. An independent samples t-test was used to examine the differences in the kicking accuracy and ball speed between the right and left targets. The effect of different approach angles on kicking accuracy and ball speed was determined using oneway analysis of variance (ANOVA) and LSD post-hoc test. A significance level of $p < 0.05$ was considered statistically significant for this analysis.

RESULTS

The mean and standard deviations for the kicking accuracy and ball speed during soccer instep kicking between three different approach angles in two targets are presented in Figures 1 and 2. The t-test indicated that the ball speed toward left target was significantly higher than that of the right target, but there was no significant difference between two position of target in kicking accuracy (Table 2). In each target, the players were displayed similar ball speeds for three approach angles. ANOVA results also revealed that there was no significant difference between approach angles in kicking accuracy for each target separately (Table 3).

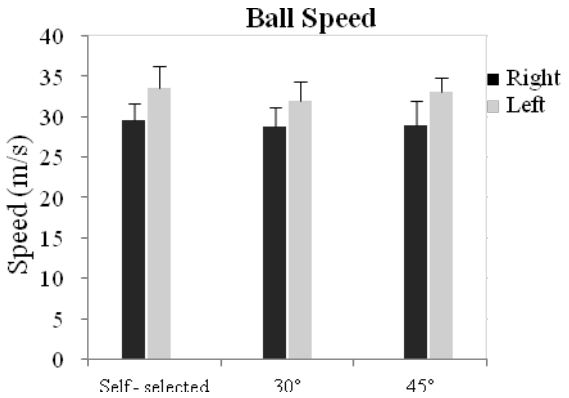

Figure 2. Ball speed of the kick at impact under each approach condition in two targets.

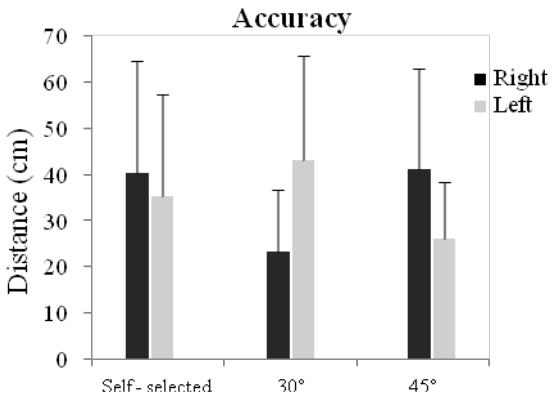

Figure 1. Kicking accuracy of the kick at impact under each approach condition in two targets.

Table 2. Differences between two targets in each approach angle (t-test)			
		T	P
Ball speed	Self-selected	3.59	0.003*
	30˚	2.76	0.015*
	45˚	3.23	0.006*
Accuracy	Self-selected	-.433	.672
	30˚	2.15	0.053
	45˚	-1.69	.119
* P < 0.05			

Table 3. Differences between three approach angles in each target (ANOVA)			
		F	P
Ball speed	Right	1.01	0.38
	Left	0.11	0.89
Accuracy	Right	1.54	0.24
	Left	1.99	0.16

DISCUSSION

The most important indicators of a successful soccer kick are accuracy of kick and the speed of the ball. In the present study the most accurate and most speed kick in each condition for each target was selected to compare performance. Therefore 6 most speed kicks and 6 most accurate kicks were selected for each subjects. The results of this study showed that ball speed toward left target was significantly higher than that of the right target (P<0.05), but there was no significant difference between two position of target in kicking accuracy. To our knowledge, no study has reported ball speeds and accuracy compared with two position of target, thus our results cannot be compared to previous research. However, in actual situation of soccer training and match, soccer players often aim for one corner when taking a kick, due to the goalkeepers central positioning. A kick in one side of the goal with sufficient ball speed may prevent the goalkeeper from interfering with the path of the ball before the ball was inside the goal. So the positioning of the target in one corner of the goal provides more ecological validity to the methodology. Although from actually experiences change in target position, right or left of goal, effects on contribution of kicking muscle groups and kicking kinematic and thereby the ball kicking speed and accuracy, today no scientific data regarding are available. For right-footed players, when shooting to the right corner of the goal compared to left corner, may alter sagittal and frontal movement directoins of both leg in kicking motion. In our study, it seems that players perform fast kicks toward left corner of goal due to their more knee extention and hip flexion efficacy, while in kicking toward right corner, players should adopt hip adduction as well as knee extention and hip flexion due to the direction of their approach. However, kinematic researches are needed to confirm the above suggestions.

In this study when targets take into consideration separately, there were no significant differences in ball speed and kicking accuracy between the approach angles. This is in agreement with Scurr and Hall (2009). They examined (recreational players) the effects of approach angle on kicking accuracy and ball speed of penalty kicks toward one target positioned in the lower right corner of a full size goal. In the case of right target, ball speed under the three approach conditions in present study (Self selected: 29.3 ± 2.1; 30˚: 28.8 ± 2.2; 45˚: 29.1 ± 2.9) was higher than that reported by Scurr and Hall (2009) (Self selected: 25.15 ± 2.07; 30˚ 24.23 ± 2.30; 45˚ 24.47 ± 2.12). In both studies players instructed to kick powerfull. Difference in result of these two studies is probably due to skill level of subjects. With skilled players Isokawa and Lees (1988) reported an approach angle of 30ş to 45ş to be optimal due to maximum shank and ball velocity, but they did not measure accuracy of the kick. Also, Bull Andersen and Dorge (2011) revealed that the maximal speed of the ball declines to approximately 95% with a straight-line approach compared with an angled approach with a self-selected speed of approach. This is probably due to the reduced rotation of the pelvic girdle before the initial stage of the forward motion of the thigh in the straight-line approach compared with the angled approach. In angled approach pelvic move through a greater range of motion throughout the kick and enables the player to remain in contact with the ball for a longer period of time, increasing the possibility of a more accurate kick (Barfield, 1998). Wider approach angles also led to an increase in thigh abduction at impact, enabling the kicking foot to be placed further under the ball, which may improve ball contact (Scurr and Hall, 2009). In this study, we investigated instep kicks under 30 and 45 approach angles, are near to players self- selected approach angle reported in previous studies (Isokawa and Lees 1988, Egan et al., 2007), so it was assumed that no significant differences in approch angles may be due to minor changes in kinetic and kinematic parameters of instep kicking in this approach angles.

However, there are some limitations to this method particularly in relation to ecological validity of a skill performed in an artificial (indoor) environment, as few soccer matches are played under these conditions. The players were taken from several different clubs and thus we were not able to document in detail the type, frequency and intensity of the training sessions.

Conclusion

It is concluded that, for right-footed players ball speed toward left target was significantly higher than right target kicks, but there was no significant difference between two position of target in kicking accuracy. Also, the results of this study support previous findings, since there was no significant difference in kicking accuracy or ball speed between the approach angles.

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EFEKTI UGLA PRILASKA I POZICIJE METE NA PRECIZNOST ŠUTA IZ KORAKA I BRZINU LOPTE KOD ISKUSNIH FUDBALERA

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Sažetak
Preciznost šuta i brzine lopte su najvažniji pokazatelji uspješnog šuta iz koraka kod fudbalera. Cilj ove studije je da se istraži utjecaj pozicije mete i prilaznog ugla na brzinu lopte i preciznost šuta kod snažnih šuteva iz koraka. Deset vještih i iskusnih fudbalera (starost: 25.9 ± 5.5 godina; visina: 1.79 ± 0.06 m; težina: 72.6 ± 7.5 kg) su šutirali ukupno 24 snažna šuta iz koraka koristeći loptu standardne veličine 5, na dvije lijeve i desne mete dimenzija 0.6 x 0.6m iz odabranog ugla prilaza od 30ş i 45ş (pravac udarca je bio 0ş). Preciznost šuta i brzina lopte su analizirani dvjema kamerama visoke brzine od 300 fps. Prosječna brzina lopte za tri prilazna ugla je bila viša za lijevu metu nego za desnu metu (p<0.05). Što se tiče preciznosti nije bilo veće razlike između dvije pozicije meta. Za svaku metu posebno, rezultati su pokazali da nema značajne razlike između ugla prilaska i preciznosti i brzine lopte. Naši rezultati sugerišu da za dešnjake šut iz koraka prema meti u lijevom uglu gola ima veću brzinu nego za metu u desnom uglu.

Ključne riječi: *šut iz koraka, uglovi prilaska, fudbaler, pozicija mete.*

Correspondence to:

Ali Shamsi Majelan,
PhD Student, Exercise Physiology,
Faculty of Physical Education and Sport Sciences,
University of Guilan,
Rasht, Iran.
Phone: 0098 911 931 2443,
Fax; 0098 131 669 0582,
P.O.Box: 41889-48655.
Email: alishamsim@yahoo.com

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