

Relationship between speed and accuracy of instep soccer kick

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Abstract

Purpose The purpose of this study was to identify the relationship between the speed of instep kick and its accuracy in experienced soccer players.

Material and method The monitored group consisted of U19 category soccer teams (n = 20, age = 18.4 ± 0.4 years, body height = 182.7 ± 5.8 cm, body weight = 77.0 ± 6.3 kg). The ball velocity was recorded using a Stalker ATS radar gun and accuracy of kicking was assessed using 2D kinematic analysis.

Results The average speed of the best instep kick trial was 108.8 ± 7.5 km.h⁻¹. The players achieved high stability of instep kick velocity, when the difference in percentage between the best and worst kick was 6.1 ± 4.6 %. The average distance between the ball and centre of the target was 62.6 ± 28.3 cm in the best trials. However, concerning kick accuracy, we recorded high variability of accuracy when the average difference between the best and worst trial was 56.8 ± 19.6 %. In case of the fastest kicks, we found a negative trend in the relationship between speed and accuracy $r = -0.17$ ($p > 0.05$). On the contrary, in trials with lowest speed there was a positive relationship between the variables $r = 0.34$ ($p > 0.05$).

Discussions and conclusions Results showed high stability of kicking speed regarding dominant leg. On the contrary, the parameter of kick accuracy revealed high variability. The research showed that the most accurate kicks were found at speeds between 90-102 km.h⁻¹, which is approximately 80-90 % of maximal kicking speed.

Key words: accuracy, kick, skill, soccer, velocity

Introduction

Kicking is one of the most fundamental ball-based soccer skills. Its execution can be divided from the perspective of the kicked ball's movement into kicks with high ball velocity and kicks with maximal accuracy. When trying to achieve high ball velocity and long trajectory, instep kick is used. The side-foot kick is the most accurate kick over shorter distances and it is the most frequently used type of soccer kick. There are a number of studies dealing with biomechanics and movement kinematics (Levanon and Depena, 1998) in terms of spatial analysis and kinematics of leg segments during the instep kick and also in terms of angular positions – time and angular velocity curve during the kick as well as linear kinematics of the involved joints (Lees, 1996; Lees and Nolan, 1998). Kicking is a crucial moment in every match since its number and efficiency influence the final score; therefore, soccer players should master it so that they would also be able to successfully kick or pass the ball when fatigued. Kicking technique is very important and it is necessary to realize that speed and accuracy of kick are influenced by several mechanisms and factors (Barfield, Kirkendall & Yu, 2002). The angle of running to the ball is one of the most important aspects which significantly affects soccer kick speed (Isokawa & Lees, 1988; Kellis & Katis, 2004; Opavský, 1988). Kicking accuracy, or inaccuracy, is influenced by many factors ranging from mistakes in a player's approach to the kick, position of the supporting leg during the kick, movement of the kicking leg – its swing and placing the foot on the ball (so called contact properties). Ball speed depends on the velocity of the foot (segments) upon impact as well as the quality of ball - foot impact (Asai et al., 2002; Bull-Andersen et al., 1999; Lees and Nolan, 1998; Levanon and Dapena, 1998). Position of the supporting leg is very important because the supporting leg is considered to be responsible for body stabilization and it is assumed that it has a positive effect on kicking performance (Lees, Asai, Andresen, Nunome & Sterzing, 2010).

The purpose of the present study is to identify and describe the relationship between speed and accuracy of instep kick in experienced soccer players.

Material and method

Study sample

The monitored group consisted of U19 category soccer teams (n = 20, age = 18.4 ± 0.4 years, body height = 182.7 ± 5.8 cm, body weight = 77.0 ± 6.3 kg). Participants were regularly trained by qualified coaches, took part in training sessions 6-times a week and played one match a week and they had been playing soccer for 11.2 years on average. Participants recruited were not injured or recovering from injury at the time of testing.

Assessment of kicking performance (ball velocity and accuracy)

The ball velocity was recorded after instep kick using a STALKER ATS (Applied Concepts, Inc., Plano, Texas, USA) radar gun. Tests were carried out in the course of one day after a standard 20 minute warm-up when the players performed shots at goal with the dominant leg. The players conducted 3 maximum effort trials with the dominant leg (DL) at a distance of 11 m from the measuring device with the aim of transferring the ball into the target (centre of the goal). The target was formed using 2 red expanders (width of 2 cm) that were stretched in vertical and horizontal planes. Kicking accuracy was recorded using 2D kinematic analysis. Kicking accuracy was determined as the absolute distance between the centre of the ball and the target using TEMA Biomechanica software, version 2.3.

Statistical analysis

The processed data are presented in Tables and Figures. To determine the relationship between the variables we used Pearson's correlation analysis. To reject the null hypothesis we worked with the risk of $p < 0.05$. IBM® SPSS® version 19.0 statistical software was used for processing the results. Results are expressed as arithmetic mean \pm standard deviation.

Results

The average speed of the best instep kick trial was $108.8 \pm 7.5 \text{ km.h}^{-1}$ (Table 1). The players achieved high stability of instep kick speed when the difference in percentage between the best and worst kick was $6.1 \pm 4.6 \%$. Intra-individual assessment revealed the greatest difference in a goalkeeper (19.4 %). Kicking accuracy was also recorded and is presented in Table 2.

Table 1. Instep kick speed in the tested players

Player	Kicking speed				
	Trial 1	Trial 2	Trial 3	Best	%diff
Pl. 1	99	99	95	99	4.0
Pl. 2	116	125	127	127	8.7
Pl. 3	112	111	113	113	1.8
Pl. 4	115	120	112	120	6.7
Pl. 5	112	104	117	117	11.1
Pl. 6	106	110	110	110	3.6
Pl. 7	112	111	115	115	3.5
Pl. 8	96	92	96	96	4.2
Pl. 9	113	113	111	113	1.8
Pl. 10	106	91	101	106	14.2
Pl. 11	103	108	105	108	4.6
Pl. 12	95	99	96	99	4.0
Pl. 13	105	102	109	109	6.4
Pl. 14	100	99	103	103	3.9
Pl. 15	106	107	97	107	9.3
Pl. 16	87	108	101	108	19.4
Pl. 17	103	111	110	111	7.2
Pl. 18	98	101	102	102	3.9
Pl. 19	103	107	106	107	3.7
Pl. 20	105	103	101	105	0.7
x	104.6	106.2	106.6	108.8	6.1
SD	7.4	8.4	8.2	7.5	4.6

The average distance between the ball and the centre of the target was $62.6 \pm 28.3 \text{ cm}$ ($0.626 \pm 0.283 \text{ m}$) in the best trials. Only one player achieved a distance greater than 1 meter in the parameter of accuracy (Player 4 – central defender). However, we recorded high variability of accuracy when the average difference in percentage between the best and worst trial was $56.8 \pm 19.6 \%$. In case of the fastest kicks, we found a negative trend in the relationship between speed and accuracy $r = -0.17$ ($p > 0.05$) (Figure 1). On the contrary, in trials with lowest speed there was a positive relationship between the variables $r = 0.34$ ($p > 0.05$) (Figure 2).

Table 2. Instep kick accuracy in the tested players

Player	Kicking accuracy				
	Trial 1	Trial 2	Trial 3	Best	%diff
Pl. 1	1.362	1.373	0.567	0.567	58.7
Pl. 2	0.889	1.131	1.303	0.889	31.8
Pl. 3	2.694	0.836	1.429	0.836	69.0
Pl. 4	2.226	1.324	1.605	1.324	40.5
Pl. 5	0.522	0.413	0.606	0.413	31.8
Pl. 6	1.738	1.347	0.44	0.44	74.7
Pl. 7	0.565	0.757	1.42	0.565	60.2
Pl. 8	1.943	0.126	1.149	0.126	93.5
Pl. 9	0.692	0.921	1.073	0.692	35.5
Pl. 10	2.410	0.961	0.607	0.607	74.8
Pl. 11	0.600	0.899	0.998	0.600	39.9
Pl. 12	0.769	1.143	0.869	0.769	32.7
Pl. 13	0.565	1.112	1.313	0.565	57.0
Pl. 14	1.077	0.122	0.967	0.122	88.7
Pl. 15	1.227	0.228	0.829	0.228	81.4
Pl. 16	0.632	1.085	0.741	0.632	41.8
Pl. 17	1.224	1.515	0.888	0.888	41.4
Pl. 18	1.457	0.649	0.951	0.649	55.5
Pl. 19	1.247	0.877	2.012	0.877	56.4
Pl. 20	2.542	0.723	0.807	0.723	71.6
x	1.319	0.877	1.029	0.626	56.8
SD	0.715	0.409	0.393	0.283	19.6

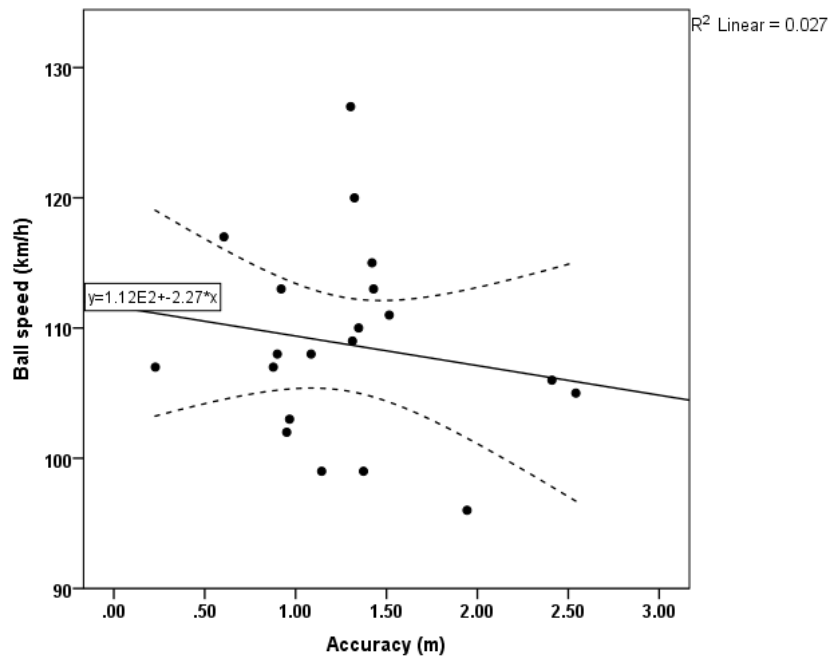


Figure 1. The relationship between speed and accuracy in kicking with highest ball velocity

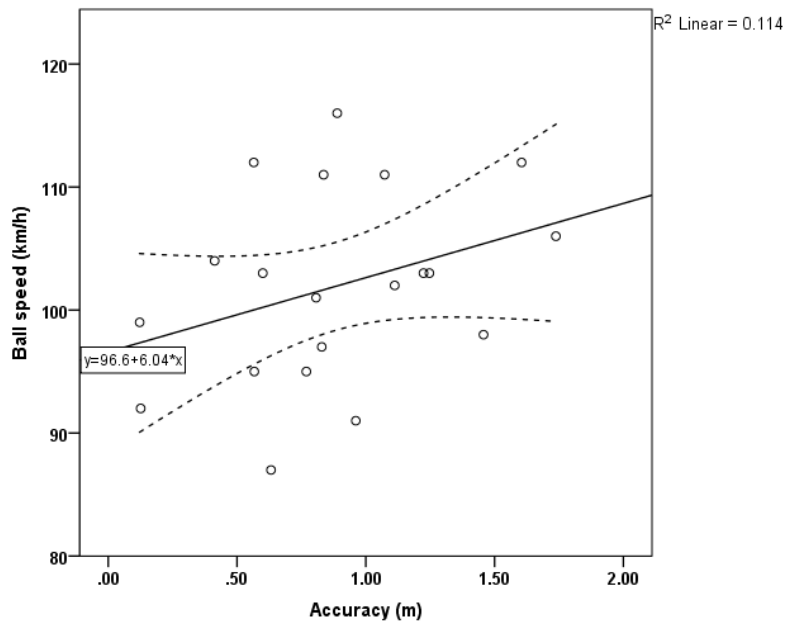


Figure 2. The relationship between speed and accuracy in kicking with lowest ball velocity

Discussion

The kick is the main offensive action during the game. Kicking speed and accuracy are two main attributes that characterize successful kicking, especially in shots at goal, so that players would be able to surprise the goalkeeper. Kicking speed in soccer players has been the topic of several studies. Cometti (2001) studied kicking speed in professional soccer players where the average speed of instep kick achieved a value of $106.37 \text{ km}\cdot\text{h}^{-1}$, which is comparable with our results. However, other studies suggest that our participants achieved above-average values compared with results of other authors. Apriantono, Nunome, Ikegami, & Sano (2006) measured the average ball velocity in instep kick $94.68 \text{ km}\cdot\text{h}^{-1}$ and similar value, $95 \text{ km}\cdot\text{h}^{-1}$, was also found in another study (Barfield, 1995). Taina (1993) tested kicking speed in 15 subjects who achieved average ball velocity $96.02 \text{ km}\cdot\text{h}^{-1}$. Nunome et al. (2002) monitored 5 elite players, who were high-school students, and their performances achieved a level of $100.8 \text{ km}\cdot\text{h}^{-1}$. In our study, young elite soccer players achieved average ball velocity at the level of $108.8 \pm 7.5 \text{ km}\cdot\text{h}^{-1}$ when kicking with the dominant foot. The best trial was kicked by player 2, whose field position was goalkeeper, and his fastest kick amounted to a value of $127 \text{ km}\cdot\text{h}^{-1}$. Although training of shots at goal occurs usually in all players in a team at the same intensity, we can observe only a few players in each team who have a so called *strong shot*, which is especially decided by two factors, namely muscular disposition and kicking technique (Kollath, 2006), when muscular disposition purposefully firms the metatarsal during contact with the ball and is necessary for developing maximal acyclic speed of lower limb swing (Buzek, 2007). In our study sample, it was goalkeepers who were considered to have the strongest shot (player 2, 4, 5) when their best kicks with their preferred leg achieved values over $117 \text{ km}\cdot\text{h}^{-1}$. What is typical for goalkeepers is that they often kick the ball from the goal area over long distances, which can only be achieved with high ball velocity. The percentage ratio between the best and worst kick was $6.1 \pm 4.6 \%$, which indicates high stability of the players' performance. A strong kick does not mean that it will be always successful because kicking accuracy has a great influence on its successful completion. In our examined players, the average distance between the ball and centre of the target was $62.6 \pm 28.3 \text{ cm}$ ($0.626 \pm 0.283 \text{ m}$) in best trials. Only one player achieved a distance greater than 1 meter in the parameter of accuracy (Player 4 – central defender). However, we recorded high variability of accuracy when the average difference in percentage between the best and worst trial was $56.8 \pm 19.6 \%$. We found great variation in kicking accuracy from the perspective of players' field positions. The smallest deviations were found in midfielders; on the contrary, the greatest differences were found in goalkeepers. Muscular activation is more difficult when attempting to kick accurately (Dicks & Kingman, 2005) as there is finer control of the lower limb movement and there also can be differences in muscular activation during kicking at various targets and accurate kicking largely depends on different activation of muscle during the kicks at the target positions (Kellis & Katis, 2007; Scurr et al., 2011). A number of studies dealt with maximal ball speed during instep soccer kick and its relationship with kicking accuracy (Andersen & Dorge, 2011; Lees & Nolan, 2002; Tillaar & Ulvik, 2014; Muller & Brandes, 2015). Andersen & Dorge (2011) found in their study that the most accurate kicks were performed in cases when ball velocity achieved 85% of maximal speed. Lees & Nolan (2002) argue that optimal kicking accuracy shall be achieved when ball velocity decreases to 75% of its maximum. Tillaar & Ulvik (2014) tried to find the most satisfactory compromise between

kicking speed and accuracy when kicking with both dominant and non-dominant leg using various types of instructions for accuracy and speed in experienced soccer players. Soccer players were randomly given between 1 and 4 instructions what to focus on during the kick. The results showed that once players focused on kicking accuracy ball speed was automatically slower in kicking using both dominant and non-dominant leg.

In our study, in case of the fastest kicks, we found a negative trend in the relationship between speed and accuracy $r = -0.17$ ($p > 0.05$). On the contrary, in trials with lowest speed there was a positive relationship between the variables $r = 0.34$ ($p > 0.05$).

Conclusions

The study investigated the relationship between kicking speed and accuracy in experienced soccer players. The results showed high stability of ball velocity when kicked using the dominant leg. On the contrary, the parameter of accuracy revealed high variability. Some differences also appear with respect to field position in both parameters; kicking accuracy and speed. The results showed that the most accurate kicks were performed at speeds between 90-102 km/h, which is approximately 80-90 % of maximal kicking speed. Further research should be focused on monitoring the relationship between kicking speed and accuracy in the non-dominant limb, its variation under fatigue and type of kick. As long as kicking speed and accuracy are the main determinants of kicking success, it is necessary to stimulate these attributes for both lower limbs in the training process.

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