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An Analysis of Angular Velocity at Various Joints for inside Instep Soccer Kick by Different Level Players

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Abstract:

The purpose of this study is to analyze the angular velocity at various joints for inside instep soccer kick by different level players. To conduct this study ninety-nine players were randomly selected from nation, state and district competition. These players are treated as high, middle and low level players respectively. The subjects wear complete soccer kit. Fifteen minute warm up should be done before the experiment. The subjects performed three trails for instep kick from a preferred distance and with maximum effort on a stationary ball. The kicking motion was recorded using JVC HD video cameras in a field setting. The shutter speed of the camera was fixed at fast speed (1/4000 fast shutter speed allow fast-moving subject to capture one frame at a time vividly) in order to eliminate the blur while video recording. The identified trails were played with the help of Hero Video of Hero Super Player 3000 software to make separate clips of each player for separate kicking skills. The separate clips were then opened on to the Motion Analysis Tool (MAT) software. The software to identify the number of frames, angles, displacement, time and kinematics variables. SPSS Software used for to calculate Analysis of Variance (ANOVA) with Least Significant Difference (LSD) post hoc test to determine the means significant difference between different level players during soccer kicks. The result of this study is angular velocity of ankle and knee joints both contributes significantly in inside

instep kick to cause variation in the ball velocity of all level players. But none of the joint's angular velocity significantly differed to contribute to cause variation in ball velocity.

Key words: Soccer, Kinematics, Angular Velocity, Inside instep kick

Introduction

Soccer is a fall field sports that is extremely popular in many countries. Young children love to play all version of soccer since it is a fast moving, running, and vigorous game. Soccer players work very hard to keep in shape, and to improve their kick. The uniqueness of using the feet to stop and propel the ball the majority of the time makes the skills difficult to learn as well as interesting, for this reason a great deal of practice is necessary to gain control and accuracy in the use of soccer kick. Most of the players don't know that there is a scientifically correct way of going about doing this. Most researches by means of sports biomechanics on soccer have found some very interesting facts that all soccer players would do well to learn. Science and technology boost all researchers develop around the world in field of sports. The scholars have a number of studies relating performance and advancement of soccer players at every mode of game with used biomechanical analysis skills which it to boost sports excellence. The instep soccer kick is the most widely studied (Lees and Nolan 1998; Nunome et al. 2006; Apriantono et al. 2006). A comprehension of the biomechanics of soccer kicking can support the coaching procedure. Coaching experience, combined with knowledge of a mechanical model of the desired performance, is regarded as essential for a coach to standard performance (Elliott 2001; Lees 2002).

For the inside of the foot kick, the kicking foot is turned outward and the leg is bent at the knee diagonally backward and outward. The inside instep kick has been selected for analysis due to number of researches is less carry out on these

areas. Successful kick depends on different factors like angular distance, displacement, speed and velocity of the kick that is well illustrate using biomechanical analysis. Earlier reviews have revealed that biomechanics of soccer movements in-detail (Lees 1996; Lees and Nolan 1998). The (2D) kinematics of the lower limb segments during instep soccer kicks have been previously assessed (Lees 1996; Lees and Nolan 1998). This include analysis of angular distance and angular velocity curves during the kick with the linear kinematics of the different joints. Before the impact of the foot, the speed was higher, the duration of foot-ball contact was shorter and the ball speed was highest. For this, the ball-to-foot speed ratio has been considered as a successful kick (Asami and Nolte 1983; Kellis et al. 2004; Lees and Nolan 1998; Nunome et al. 2006).

Material & Methods

Participants

The ninety nine soccer players from high, medium and low level (Thirty from each group) were selected for this study. All participants were in good health and do not have any injury in the lower extremity. Each participant wore his normal soccer kit and boots.

Experimental Protocol

All participants were pre-selected before the testing date through personal contact. All the selected players had readily agreed and volunteered to act as subject for the study. All participant completed an individual warm up and then. The subject delivered inside instep kicking by using the right leg. The below table show the age, weight and height of the subjects.

The anthropometric data of the subject

VARIABLE	LEVELS	MEAN
AGE (Years)	HIGH	20.48
	MEDIUM	14.09
	LOW	14.21
WEIGHT (kg.)	HIGH	63.12
	MEDIUM	53.76
	LOW	49.24
HEIGHT (cm)	HIGH	171.29
	MEDIUM	161.28
	LOW	164.10

Table 1

Data collection and analysis

The study was conducted on the field setting. The film recordings were conducted on sunny and clear weather on the soccer ground. Each subject was permitted free approach angle and distance run for the kick. Standard ball (weight 450 grams) was used for all subjects and for the kick. Two cameras would be used for this study. One camera was positioned perpendicular to the sagittal plane and parallel to the mediolateral axis (camera optical axes perpendicular on the sigittal plane) as their kicking leg giving approximately a 90° between their respective optical axes. The camera will focus on the lower limb of the subject when the subject in full swing of kicking foot to get a better outlook. Video footage was captured with JVC Hard Disk video cameras. The cameras were set at sports mode and the sampling rate of the video camera was fifty fields per second. The identified trail were played with the help of Hero Video of Hero Super Player 3000 software to make individual clips of each player for individual kicking skills. The separate clips were then opened on to the Motion Analysis Tool (MAT) software. This software provides to identify the angles, displacement, time and number of frames. Kinematics parameter investigated throughout the kicking motion.

Statistical Analysis

SPSS Software used for to calculate Analysis of Variance (ANOVA) with Least Significant Difference (LSD) post hoc test to determine the means significant difference between different level players during inside instep soccer kicks.

Results

Description of Angular Velocity at Various Joints for Different Level Players of Inside Instep Soccer Kick

		SS	**df**	**MS**	**F**
ANKLE	Between Groups	52.72	2	26.36	2.99
	Within Groups	845.12	96	8.80	
KNEE	Between Groups	80.59	2	40.29	3.72
	Within Groups	1038.62	96	10.82	
HIP	Between Groups	322.37	2	3.24	0.96
	Within Groups	328.84	96	3.36	

Table 2 ANOVA

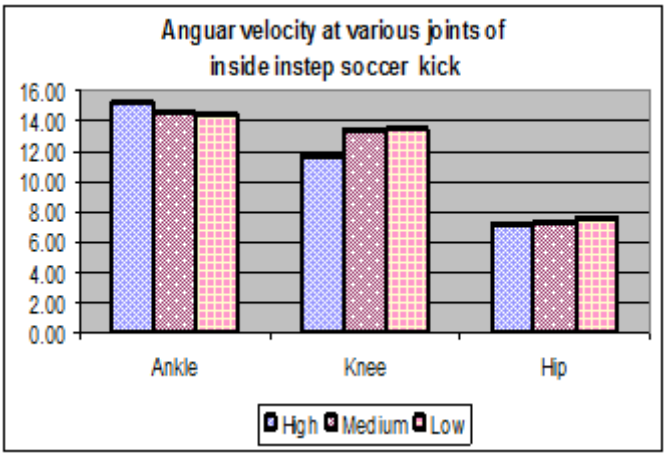
Result of ANOVA (Table-2) reveals that the calculated value of F = 2.99 and 3.72 for angular velocity of ankle and knee joints respectively during soccer inside kick of different level male soccer players showed significant difference. Whereas calculated value of F = 0.96 for angular velocity of hip joint showed no significant mean difference. Thus, the Least Significant Difference (LSD) has been calculated to determine the existence of significant difference amongst different level players at various joint's angular velocity during inside instep kick.

Dependent variable	Levels (I)	Levels (J)	Difference (I-J)	Sig.
ANKLE	HIGH	MEDIUM	1.61*	0.03
	MEDIUM	LOW	0.14	0.85
	LOW	HIGH	1.47*	0.05
KNEE	HIGH	MEDIUM	1.71*	0.04
	MEDIUM	LOW	0.35	0.66
	LOW	HIGH	2.07*	0.01
HIP	HIGH	MEDIUM	0.25	0.58
	MEDIUM	LOW	0.37	0.41
	LOW	HIGH	0.62	0.17

Table 3 Multiple Comparisons

* The mean difference is significant at the .05 level.

The comparisons of Least Significant Difference (LSD) for mean of angular velocity of joints during inside soccer kick has been computed and presented in Table-3. The table reveals that high and medium levels; high and low levels for ankle joints, high and medium levels; high and low levels player for knee joint showed significant mean difference. Whereas medium and low level players for ankle joint; medium and low level players for knee joint, high and medium level; medium and low level and high and low level players for hip joint showed no significant mean difference for angular velocity during inside instep soccer kick.



Graph 1

Discussion

The result of investigations accomplished by Kellis et al. 2004 and Nunome et al. 2006 showed that the speed of the foot before impact is the higher, foot-ball contact is shorter and speed of the ball is high. For this, the foot to ball speed ratio has been measured as an index of a useful kick. Nunome et al. (2002) show that the angular velocity of the hip increased the side-foot kick rapidly during the leg- acceleration phase, while the instep kick's angular velocity was small. The angular velocity of hip rotation was significantly greater than the side-foot kick.

Angular velocities also affect the linear velocity of the foot, which in turn affects the velocity of a ball of soccer kick, this is as a result of summation of segmental velocities (Isokawa& Lees, 1998) it also formed that when compared non-dominant kicking leg with the dominant kicking leg it is found that the dominant kicking leg produce greater ball distance. The angular velocity of shank improves as the knee extends in the direction of the ball. The angular velocity of shank is the product of the moments exerted by the muscles at knee joint, linear acceleration and angular velocity of the thigh also produce the moment (Putnam 1991). Angular velocity of the knee at ball contact (13640/s) was lesser than 15400/s for the distance kicking group and the 13900/s for the small kicking group (Baker and Ball 1996).

Noland and Feeley (2001) found that the kick patterns were difference between the experience and novice payers' angular velocity for hip joints. The left foot experienced players kick exhibit a maximum (flexor) velocity of 741 degrees/second and the minimum (extensor) angular velocity was 418 degrees/second while the right foot novice player kick exhibit a maximum (flexor) angular velocity 235 degrees/second and minimum (extensor) only 286 degrees/second.

This has been stated that the shank maximal angular velocity was achieved on average 9 m/s before the foot contacted

with the ball (Luhtanen 1988). Velocities of ankle and toe achieved their uttermost height just before contact and from 40-50 m/s after the highest velocity of the knee. Swing leg's time is the time from the landing of the non kicking foot until the impact with ball. The duration of times for swing phase of the kick has been recorded between .13 and .15 second. This is recommend that there are two kinds of kicking model surrounded by the instep kick: one used a lengthy backswing and had a more kicking time, the another used backswing and moved the lower leg quickly by knee extension which effect a little time of kicking (Isokawa and Lees 1988).

Conclusion

The result of the study indicated for angular velocity at various joints of different level players of inside instep kick that velocity of ankle and knee joints showed significant mean difference. But, angular velocity of hip joint showed insignificant mean differences among different levels. However, high and medium level; and high and low level players for ankle and knee joint showed significant mean difference, whereas medium and low level player showed insignificant mean difference. The angular velocity of ankle and knee joints both contributes significantly in inside instep kick to cause variation in the ball velocity of all level players. But none of the joint's angular velocity significantly differed to contribute to cause variation in ball velocity.

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