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The Relationship of the Selected Biomechanical Variables on the Performance of Kicking for Distance in Soccer

Dr. Baljinder Singh Bal[1], Parminder Jeet Kaur[2], Davinder Singh[3]

[1] Department of Physical Education (T), Guru Nanak Dev University, Amritsar, Punjab, INDIA
[2] Department of Physical Education, Baring Union Christian College, Batala, Punjab, INDIA
[3] Department of Physical Education (T), Guru Nanak Dev University, Amritsar, Punjab, INDIA

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Abstract. The aim of the study is to to assess the relationship between selected biomechanical variables with the performance of kicking for distance in soccer. Fifteen randomly selected male students aged 18-25 years from Guru Nanak Dev University, Amritsar (Punjab, India) volunteered to participate in the study. The data was collected by the help of BIOKIN 4.5-2D motion analysis system. The Pearson's product moment correlation coefficient method was used to measure the relationship between selected biomechanical variables with the performance of kicking for distance in soccer. The level of significance was set at 0.05.The angle of knee joint and hip joints have significant relationships with the performance of subjects during the stance. The angle of knee joint and hip joint significantly influences the performance of kicking for distance in soccer. Training focussing on the development of hip joint and knee joint is recommended.

Keywords: Soccer Kicking – Biomechanics- Biokin Motion Analysis.

1. Introduction

The game of soccer is one of the most popular team sports worldwide. 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. There is a wide range of skills which form the foundation of soccer performance but only one has been the real subject of detailed biomechanical analysis. Kicking is without doubt the most widely studied skill in soccer. Although there are many variations of this skill due to ball speed, ball position, nature and intent of kick, the variant which has been most widely reported in the literature is the maximum velocity instep kick of a stationary ball. In contrast, some skills such as throwing in and goal keeping skills have received little attention, while a vast range of others, for example, passing and receiving the ball, tackling, jumping, running, sprinting, starting, stopping and changing direction have not been the subject of detailed biomechanical analysis at all. For this reason, improvement of soccer kick technique is one of the most important aims of training programs in young players (Weineck, 1997). In the sport of soccer, kicking is one of the most fundamental and frequently used skills. In mature, skillful, soccer athletes used the kick involves a complex interaction of angled approach to the ball, subsequent support foot contact (SFC) with the ground accompanied by sequential transfer of momentum from proximal to distal body segments in the swing or kicking limb. Following the angled approach the support foot is placed alongside and adjacent the ball with the toe of the support foot pointed in the intended direction of ball movement. Finnoff (2002) suggested a valid and reliable method of measuring accuracy, is to measure the distance of the ball from a specific target. This method provides information on the degree of accuracy as opposed to simply the ability to hit or miss the target (2). There is limited research on the biomechanical aspects of kicking for distance in soccer and identification of kinematic variable differences may play a critical role in teaching and training of aspiring young female soccer players (3). The majority of kinematic data reported in the earlier literature has been analysed using two-dimensional, sagittal plane methodologies (4) Few three-dimensional studies have been conducted (5, 6). As a result this study

[1] Corresponding author. Tel.: +91-9876448434.
E-mail address: bal_baljindersingh@yahoo.co.in

was undertaken to find out the relationship between selected biomechanical variables with the performance of kicking for distance in soccer.

2. Material and Methods

2.1. Subjects

Subjects: The study was approved by the Ethics Committee of Directorate of Sport in Guru Nanak Dev University, Amritsar, India. All participants were informed about the study aim and methodology as well as about the possibility of immediate acceptance at any time of the experimentation. Subjects agreed to the above conditions in writing. Fifteen randomly selected male students of the Guru Nanak Dev University, Amritsar (Punjab, India), aged 18 – 24 years, volunteered to participate in the study.

2.2. Methodology

The performance of each subjects kicking for distance was taken. The maximum distance covered by the ball in air from the starting line or point to the first drop of the ball on the ground was recorded in meters. The data was collected by the help of Biokin-2D motion analysis system V4.5 method and the kicking performance of the subject in soccer (Fig.1) at the moment of stance, at the moment of execution and at the moment of follow-through. The biomechanical variables selected in the study at the moment stance, at the moment of execution and follow-through was:

A- Angular displacement
B- Angular velocities
C- Angular acceleration
D- Angle of elbow joint
E- Angle of shoulder joint
F- Angle of Knee joint
G- Angle of ankle joint
H- Angle of hip joint

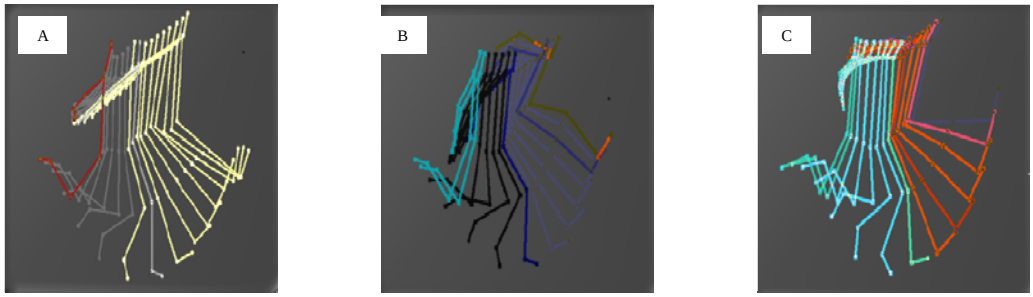

Figure 1: Kicking for distance in soccer, A- Movement of stance; B- Movement of execution; C- Movement of follow-through

3. Data Analysis

The Pearson's product Moment Correlation Coefficient (r) method was used. The level of p= 0.05 was considered significant.

4. Results

The study was carried out to assess the the relationship of the selected biomechanical variables on the performance of kicking for distance in soccer. The statistical analysis of data collected on fifteen (N=15) subjects. For each of the chosen variable, the results pertaining to significant relationship between selected biomechanical variables on the performance of kicking for distance in soccer was assessed by Pearson's Product Moment Correlation coefficient Method and is presented in following tables:

Table 1: Relationship of Selected Linear and Angular Measurements with Performance of Kicking for Distance in Soccer during Stance

Sr. No.	Variables	Coefficient of Correlation	Significance Level
1	Angular displacement	0.082220	P=0.7238
2	Angular velocities	0.06902	P=0.8269
3	Angular acceleration	0.2861	P=0.3213
4	Angle of elbow joint	0.5899	P=0.0044
5	Angle of shoulder joint	0.1126	P=0.6894
6	Angle of knee joint	0.3781	P=0.1310
7	Angle of ankle joint	0.5667*	P=0.0356
8	Angle of hip joint	0.09825	P=0.7476

Table-1 revealed that during the stance the angle of ankle joint has significant relationships with the performance as obtained 'r' value is greater than the tabulated value. However, the obtained value of coefficient of correlation in other all kinematics variables were less than the required value at selected level of significance, these selected angular kinematics variables at selected moment have shown insignificant relationship with the performance of subjects.

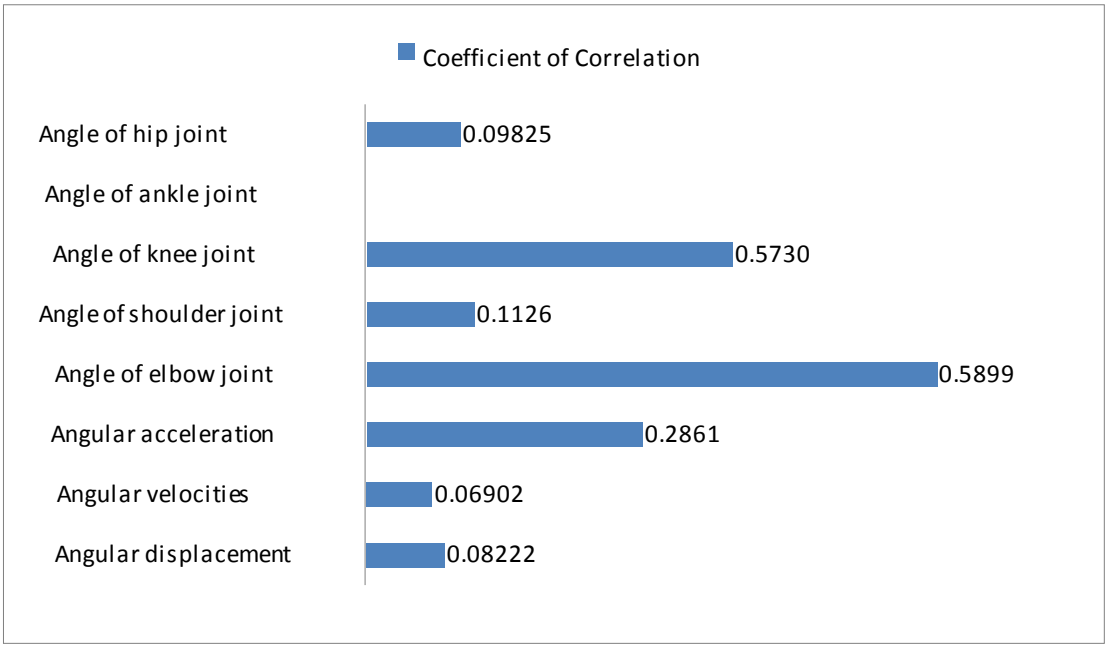

Figure 2: Relationship of Selected Linear and Angular Measurements with Performance of Kicking for Distance in Soccer during Stanc

Table 2: Relationship of Selected Linear and Angular Measurements with Performance of Kicking for Distance in Soccer during Execution

Sr. No.	Variables	Coefficient of Correlation	Significance Level
1	Angular displacement	0.1713	P=0.5415
2	Angular velocities	0.0042643	P=0.9769
3	Angular acceleration	0.2310	P=0.3668
4	Angle of elbow joint	0.01231	P=0.9425
5	Angle of shoulder joint	0.04692	P=0.8881
6	Angle of knee joint	0.5730*	P=0.0355
7	Angle of ankle joint	0.001530	P=0.9788
8	Angle of hip joint	0.5176	P=0.0379

Table- 2 revealed that during the execution the angle of knee joint has significant relationships with the performance as obtained 'r' value is greater than the tabulated value. However, the obtained value of coefficient of correlation in other all kinematics variables were less than the required value at selected level of significance, these selected angular kinematics variables at selected moment have shown insignificant relationship with the performance of subjects.

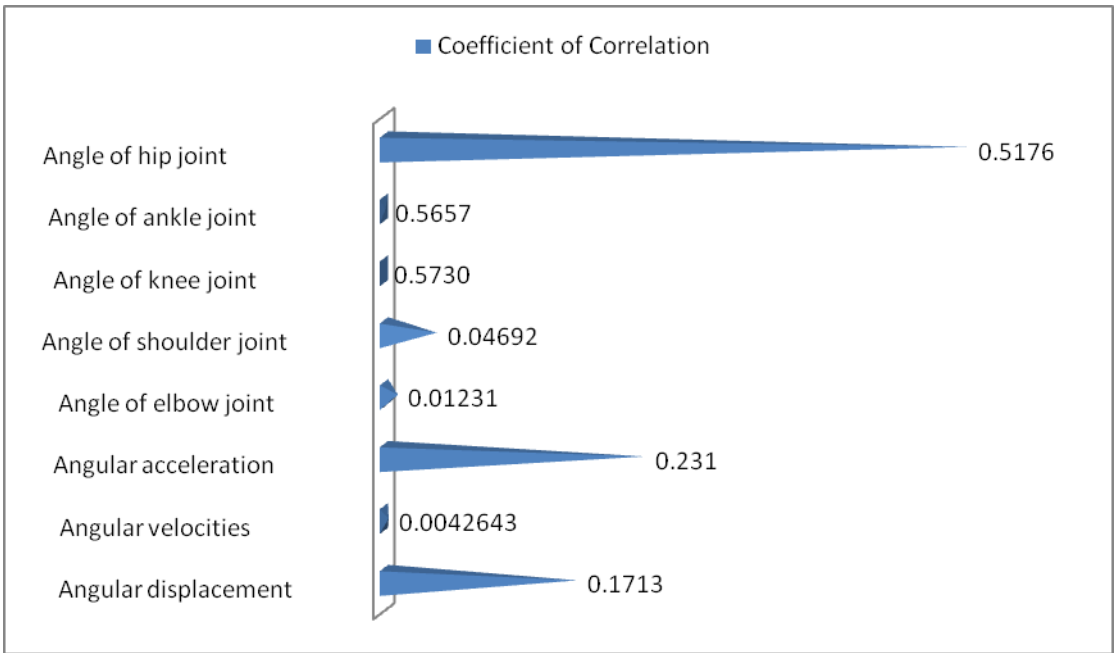

Figure 3: Relationship of Selected Linear and Angular Measurements with Performance of Kicking for Distance in Soccer during Execution

Table 3: Relationship of Selected Linear and Angular Measurements with Performance of Kicking for Distance in Soccer during Follow-Through

Sr. No.	**Variables**	**Coefficient of Correlation**	**Significance Level**
1	Angular displacement	0.08905	P=0.7269
2	Angular velocities	0.3500	P=0.1746
3	Angular acceleration	0.2196	P=0.3817
4	Angle of elbow joint	0.02935	P=0.8961
5	Angle of shoulder joint	0.02843	P=0.8843
6	Angle of knee joint	0.6013	P=0.0116
7	Angle of ankle joint	0.1232	P=0.6318
8	Angle of hip joint	0.02903	P=0.8692

Table-3 revealed that during the follow-through the obtained value of coefficient of correlation in all kinematics variables was less than the required value at selected level of significance, these selected angular kinematics variables at selected moment have shown insignificant relationship with the performance of subjects.

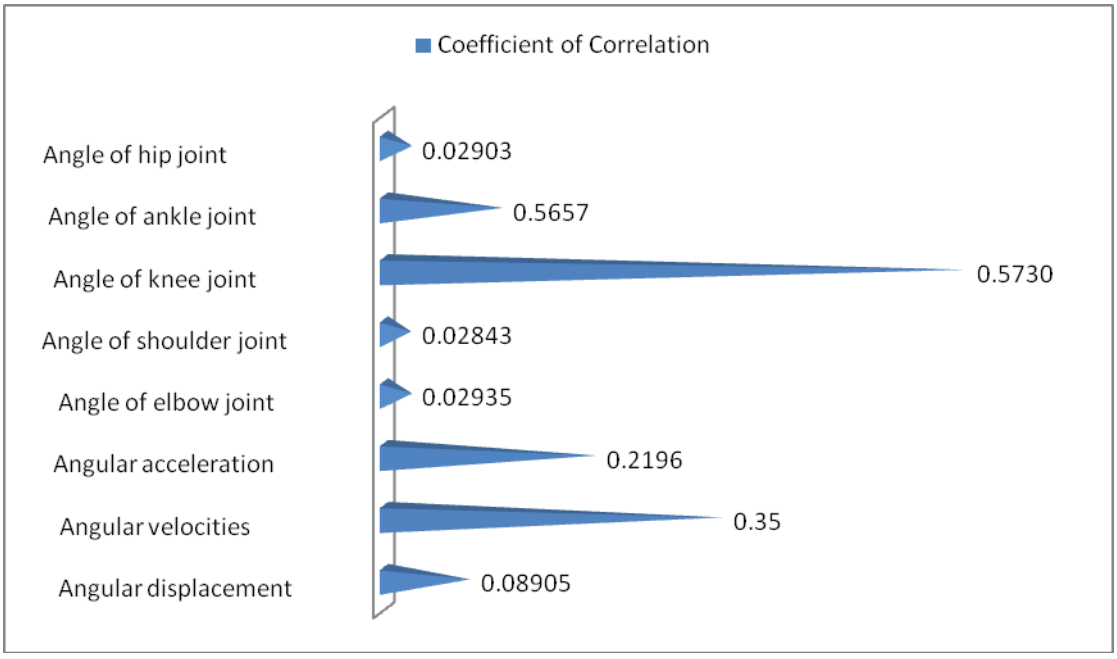

Figure 4: Relationship of Selected Linear and Angular Measurements with Performance of Kicking for Distance in Soccer during Follow-Through

5. Discussion

Soccer is a sport requiring high-intensity, intermittent, non continuous exercise that includes agility, many sprints of different durations, rapid accelerations, jumping, among others [7, 8]. According to these characteristics and physiological demands, researchers started to investigate the effect of different position of soccer players in these physiological aspects [9]. Biomechanical modeling techniques have helped in the understanding of the underlying mechanisms of performance, although their use has been limited. It is concluded that there are still many features of the game of soccer that are amenable to biomechanical treatment, and many opportunities for biomechanics to make a contribution to the science of soccer. The result of this study is supported By K. Masuda, N. Kikuhara , S. Demura , S. Katsuta, K. Yamanaka in their paper titled “Relationship between Muscle Strength in various Isokinetic Movements and Kick Performance among Soccer players” which stated that approach angle showed a significant relationship with knee Flex, hip Extension strength of the supporting leg[10]. E. Manolopoulos, C. Papadopoulos, E. Kellis have also suggested in their paper ”Effects of combined strength and kick coordination training on soccer kick biomechanics in amateur players” that the application of the training programs using soccer-specific strength exercises would be particularly effective in improving of soccer kick performance[11].

6. Conclusions

The angle of knee joint and hip joint significantly influences the performance of kicking for distance in soccer. Training focussing on the development of hip joint and knee joint is recommended.

7. Acknowledgements

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