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The Relationship of Some Kinematic Variables of the Fixed Foot and Body and the Accuracy of Scoring While Performing Penalty by Futsal Players

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Abstract: *There is a difference in terms of the views of coaches and specialists regarding the fixed foot and position of the body. No study has been noted on futsal in which the variables of the kinematics of the fixed foot and body were analyzed. These variables have a significant importance in terms of the angle of fixed foot and body and their direction and distance. They are important in order to be accurate in scoring and specifically in the fixed balls. The objective of the study was to identify the relationship of some kinematic variables of the fixed foot and body to the accuracy of scoring when performing penalty by futsal players. The research participants were the team of the University of Koya for the academic year 2016-2017. The researcher chose the sample by deliberate method and reached 13 players. Each player has played for at least four years, and all players use the right foot, while the the average age of sample is 23.4 years, body mass 67.37 kg, body height 171 cm, and leg length 93.76 cm. The conclusions of the researcher are that the fixed foot as other parts of the body have an effective role during the scoring of a fixed ball in the game of futsal. The direction angle of the fixed foot has an impact on the mechanical axis of the body and is reflected on the accuracy of the scoring in fixed balls in futsal.*

Keywords: *Futsal Player, Kinematic Variables, Scoring.*

Introduction

Football is the most popular sport in the world (Lees, 1998). Futsal is no less important than the football and because of the small size of the futsal field, there are many stops compared to regular football. When reviewing the futsal law, we see two penalties. The first penalty is after the fifth foul (cumulative fouls). All legal fouls reward the opposing team with a penalty kick (10m) and the second penalty is 6m (FIFA Futsal, LAW12). "Most penalty kicks can be researched and subjected to biomechanical analysis" (Barfield et al., 2002; Dorge et al., 2002; Lees and Nolan, 2002; Nunome et al., 2002; Shan and Westerhoff, 2005). As the desired goal (movement analysis) cannot be reached by observation, we must address the technical scientific observation through image analysis and clarify it more accurately. Hull notes that "biomechanical analysis is one of the most important sciences to study the movement of an organism as required by mechanical laws that are appropriate to the movement nature in order to be able to give clear scientific explanations of the performance and nature of the movement" (SGHull, 1995, p.3). The researcher sees that there are many biomechanical variables that can be exploited in order to achieve a specific goal with high precision and specifically in futsal which has a goal measuring of 6 m. "The accuracy of the direction during the kick is measured by the angle between the direction of the kick and the direction required" (Wesson, 1998). This distance is narrow and the player must have a strong muscle sense in terms of placing the fixed foot in the right place in addition to placing the corners of the body because "in the performance of these kicks, all parts of the body (trunk, arms and the fixed foot) of the player are involved in the implementation and not only the foot shooting the ball, but each part of these parts has a certain role in performing the skill smoothly (Jabr, 2012)." However, the preparation of some biomechanical variables is the bridge between them. The accuracy of the scoring and the dynamic performance of the scoring skill in futsal are considered the main factors, which can be defined as the ability to kick the ball into a specific area (Finnoff, 2002).The shooting in a penalty is considered as the last step to score a goal. A goal is a skill which

the outcome of the matches depends on. Therefore, it is more effective if coaches and players are concerned to change the result in favor of their team. It is important to focus on a goal and not only a shoot. Since there are many biomechanical researches that have studied the skill of shooting the penalty, until now there are gaps that can be addressed and studied. Therefore, the importance of this research is to focus on a scientific subject by finding the relationship between some of the biomechanical variables of the fixed foot and body to the accuracy of scoring while performing the penalty by the players of futsal, especially the performance of this penalty in order to make the best achievement. The researcher hopes to participate seriously scientific in achieving the desired benefit and to know the strengths and weaknesses and the extent of the relationship between them. A dynamic analysis of the skill of the penalty (kick) can lead us to the optimal motor performance, which can be guided to upgrade the training and educational process. The objective of this study is to identify the relationship of some kinematic variables of the fixed foot and body to the accuracy of scoring when performing the penalty kick by the futsal players and also to identify the relationship of some kinematic variables of the fixed foot and body between themselves when performing the penalty kick by the futsal players. We have proposed the following hypotheses: 1 - There is a statistically significant relationship between some of the kinematic variables of the fixed foot and body to the accuracy of scoring when performing the penalty kick by futsal players. 2 - There is a statistically significant relationship between some kinematic variables of the fixed foot and body between themselves at performing the penalty kick by futsal players.

Research Methods and Materials

Data Analysis

The research community will be from the futsal team of the University of Koya for the academic year 2016-2017. The researcher chose the sample in a deliberate manner and reached 13 players. Each player has played for at least four years, and all the players use their right foot. The average age of the sample was 23.4 years, body mass 67.37 kg, body height 171 cm and leg length 93.76 cm.

Devices, Tools and Means of Collecting Information:

Three Japanese-made video cameras (Casio-High Speed-Exilim) with 1000-420-210 image/sec speed and kinovea.V8.25 program were used for the analysis of movements and extraction of results, prepared specifically for the analysis of mathematical movements, to adjust the numbers of players and their attempts.

Test Used in the Research (Shehab and A, 2008)

The researcher used the scoring test from the fixed balls on six divisions, which measures the scoring accuracy of the fixed balls on six divisions. The player (tester) shoots 6 balls from a distance of 10 meters on the divisions drawn on the target in sequence from 1-6 and re-sequencing again.

Test conditions: The player is free to use any part of the foot.

Registration: Each player shall be awarded a grade if the ball touches the required partition or its lines.

The player is given zero if the ball does not touch the required division or any of the other divisions or outside, or the ball is rolling on the ground during the scoring process. The total score of the test is 6 degrees..

Figure 1. *shows a goal in the scoring test of fixed balls on six divisions*

Kinematic variables:

The variables selected were: horizontal distance, vertical distance, vertical and horizontal distance result (hypotenuse), angle of the fixed foot direction, hip angle, knee angle and angle of the body inclination, where the fixed foot

variables were measured between the center of the gravity of the ball and the center of the gravity of the fixed foot at the moment of placing the fixed foot.

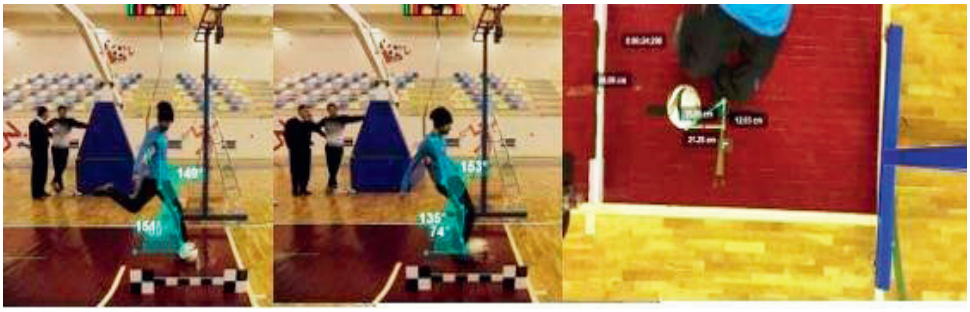

Figure 2. *shows the measurement of* **kinematic** *variables*

Precision Measurement Method:

Accuracy indicator = ideal performance total** (grade) / total of performance time (d / s)

Or accuracy indicator = total of scores / number of time of attempts.

The ideal performance is measured by the output of the performance (degree). The higher the result, the higher the accuracy of the ball, and the time of the ball (from the moment of shooting the ball to the point of arrival of the ball to the ground), through video imaging and analysis..

Figure 3. *shows the measurement of the precision indicator*

***The number of grades the tester gets while performing the penalty*

Procedures for imaging and analysis (main experiment) in order to find time and variables, the researcher used the program (kinovea.V8.25), since this program is dedicated to the analysis of sport movements to extract times, distances and angles..

The Main Test

The researcher conducted the main experiment on the selected sample of the selected players of the futsal team of the University of Koya on Tuesday, 30/2/2016 at 1:00 pm at the enclosed hall of futsal according to the measurements of FIFA and it is the hall of the School of Physical Education. The researcher gave a clear explanation of the test vocabulary before it was started and then gave a suitable period for the players for the purpose of warm-up in order to ensure the accuracy of the performance, and to detect errors and to adjust the degree of convergence of the technical performance of the player. Cameras were based according to the dimensions obtained from the exploratory experiments, therefore, the researcher used 3 (Casio-High Speed-Exilim) Japanese-made cameras with speed 1000-420-210. They also store the video recording of the movement directly into memory. The cameras were mounted on a tripod perpendicular to the midpoint of the player's movement on the right side with a distance of 3.10 meters. The height of the middle of the lens was 1.32 m, while the second camera was fixed to a holder to be above the player shooting the ball with 2.56 meters from the ground. The third camera was on the triangular holder with a distance of 11.90 meters, and the height of the middle of the lens was 1.32 m from the ground to measure the time of the ball for precision indicator. Six attempts were recorded for each player.

Statistical Means

The researcher used the statistical SPSS version 18 for data processing.

Discussion

Table 1. *Shows the computational and standard deviations of some biomechanical variables and accuracy of the fixed foot and body before kicking the ball*

Sequence	Variables	Measruing unit	Stability scoring	
			Maen	S.D
1	Horizontal distance of the foot	cm	27.37	6.82
2	Vertical distance of the foot	cm	9.94	5.02
3	The result of the foot	cm	29.13	6.40
4	Angle of the foot direction	Degree	9.76	4.29
5	Angle of inclination	Degree	70.98	4.93
6	Knee angle	Degree	145.56	12.87
7	Angle of trunk	Degree	151.59	8.28
8	Accuracy scoring	Degree	0.92	0.91

Table 2. *shows the correlation matrix between accuracy with some biomechanical variables of the base foot and the body and with some biomechanical variables between themselves before shooting the ball...*

S	Variables	Horizontal distance of the foot	Sig. (2-tailed)	Vertical distance of the foot	Sig. (2-tailed)	The result of the foot	Sig. (2-tailed)	angle of the foot direction	Sig. (2-tailed)	Angle of inclination	Sig. (2-tailed)	Knee angle	Sig. (2-tailed)	Angle of trunk	Sig. (2-tailed)	Accuracy scoring	Sig. (2-tailed)
1	Horizontal distance of the foot			0.218	0.055	0.750**	0.000	0.052	0.650	0.087	0.447	0.024	0.834	0.085	0.461	0.100	0.385
2	Vertical distance of the foot					0.199	0.081	0.022	0.848	0.219	0.055	0.079	0.494	0.047	0.683	0.017	0.883
3	The result of the foot							0.055	0.632	0.024	0.831	0.043	0.709	0.140	0.221	0.005	0.964
4	angle of the foot direction									0.218	0.055	0.356**	0.001	0.247*	0.029	0.033	0.777
5	Angle of inclination											0.399**	0.000	0.118	0.303	0.236*	0.037
6	Knee angle													0.121	0.292	0.172	0.132
7	Angle of trunk															0.087	0.447
8	Accuracy scoring																

*** Correlation is significant at the 0.01 level (2-tailed)*

** Correlation is significant at the 0.05 level (2-taile*

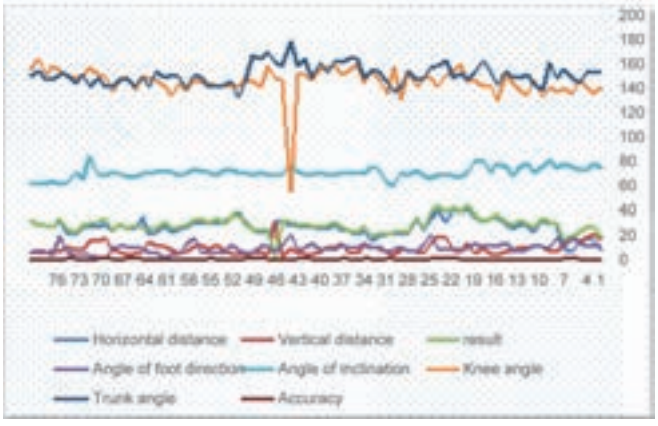

Figure 4. *Results of scoring accuracy with some biomechanical variables of the fixed foot and body before kicking the ball*

Table (2) shows that there is no statistically significant correlation between all the variables of the study with accuracy beyond the variable of the body inclination angle which formed a statistically significant correlation relationship with the value of the correlation (0.236) and the probability value (0.037) When we first come to the reason of the relationship of this variable, we see that this angle depends on the position of the foot of the base so that whenever the body inclination is as far back, the player tries to increase the bending of the knee to the foot of the strike to increase strength and vice versa. As the fixed foot position initially determines the body inclination, the knee angle of the kicking foot is increased and decreased by increasing and reducing the angle of the body inclination. This is what we see as a strong relationship between the angle of the body inclination and the angle of the knee with the value of their correlation (0.399) and a probability value (0.000) and at the end, it determines the accuracy of the strike. The other variables had no relation between themselves and with the accuracy. The researcher attributed this to the lack of interest of the research team members of the fixed foot, which has a mechanical role in the axes and rotation of the direction of the body in addition to the fact that all our players during the training units may not have been instructed to pay attention to this aspect (the base foot) by their coaches. In case of failure to confirm the status of a certain skill in all its aspects, the result is a shortage in the series of this skill. The scoring skill is the first thing where the player is to put the fixed foot to be based and then kicking, therefore practice and correcting mistakes and the establishment of this fixed foot is necessary from the kinematic and kinetic point. Because "while based on the fixed foot. a large part of the kinetic energy acquired by the player in the stage of the rapprochement diverts to potential energy and then converts this potential to kinetic energy during the process of pushing with the base foot in proportion to the nature of performance and help in the scoring process" (Arampatzis, P: 130, 1999). In addition, "scientific training is the best way for the coach to build his players and help them face the potential difficulties in the game and, through training, players can gain experience to solve the problems they face in the game" (Al-Saffar, 1987, p :).

The position of the fixed foot in terms of the horizontal or vertical distance and the angle of its direction has an impact on the accuracy of the scoring and we concluded through our research that there was no relationship between them, "The mechanical benefit of the position of the fixed foot on the left of the ball and a little late gives a mechanical advantage because the player's body will be in the best mechanical position, achieving the least torque to the direction of the line of the descending column on the foot of the base. This will also give the player balance and driving force to the striking foot, which turns to the ball" (Sumaidaie & L, 1987).

Only through the analysis we found that most of the sample put the fixed foot either advanced on the ball or beside it and this is contrary to what Loay Sumaidaie confirms - this can also be one of the reasons for the lack of relationship.

The proximity of the horizontal and vertical dimension of the fixed foot from each other is preferred when the horizontal distance is appropriate, but the vertical distance should be slightly behind the ball according to studies and according to the law of Pythagoras, as well as the result obtained by the researcher which shows that there is a relationship between horizontal distance and the result in a correlation value of (0.750).

The relationship between the angle of the direction of the fixed foot and the angle of the knee and trunk at the value of correlation (0.356, 0.247) indicates that the fixed foot has a role in directing all parts of the body and this is what we mentioned earlier..

Table 3. *Shows the computational and standard deviations of some biomechanical variables and accuracy of the fixed foot and body after kicking the ball*

Sequence	Variables	Measruing unit	Stability scoring	
			Maen	S.D
1	Horizontal distance of the foot	cm	30.57	6.44
2	Vertical distance of the foot	cm	26.18	6.23
3	The result of the foot	cm	40.24	7.39
4	Angle of the foot direction	Degree	9.24	4.61
5	Angle of inclination	Degree	78.10	5.38
6	Knee angle	Degree	138.23	11.75
7	Angle of trunk	Degree	155.04	11.06
8	Accuracy scoring	Degree	0.92	0.91

Table 4. *Shows the correlation matrix between accuracy with some biomechanical variables of the base foot and the body and with some biomechanical variables between themselves after shooting the ball*

S	Variables	Horizontal distance of the foot	Sig. (2-tailed)	Vertical distance of the foot	Sig. (2-tailed)	The result of the foot	Sig. (2-tailed)	angle of the foot direction	Sig. (2-tailed)	Angle of inclination	Sig. (2-tailed)	Knee angle	Sig. (2-tailed)	Angle of trunk	Sig. (2-tailed)	Accuracy scoring	Sig. (2-tailed)
1	Horizontal distance of the foot			0.122	0.286	0.686**	0.000	0.294**	0.000	0.110	0.337	0.097	0.396	0.059	0.605	0.144	0.208
2	Vertical distance of the foot					0.658**	0.000	0.176	1.124	0..202	0.077	0.002	0.983	0.083	0.470	0.238*	0.036
3	The result of the foot							0.121	0.293	0.133	0.244	0.148	0.195	0.125	0.277	0.259*	0.022
4	angle of the foot direction									0.041	0.722	0.171	0.134	0.044	0.702	0.213	0.061
5	Angle of inclination											0.415**	0.000	0.130	0.225	0.182	0.111
6	Knee angle													0.121	0.292	0.143	0.211
7	Angle of trunk															0.063	0.583
8	Accuracy scoring																

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

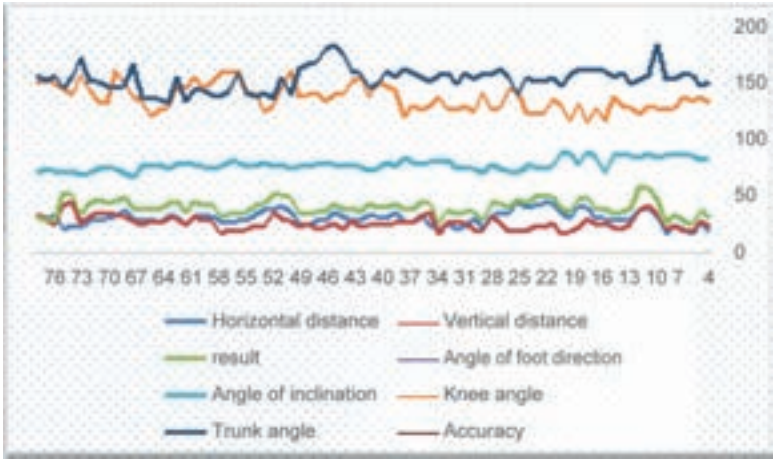

Figure 5. *Results of scoring accuracy with some biomechanical variables of the fixed foot and body after kicking the ball*

Table 4 shows that there is a statistically significant correlation between the two variables. The horizontal distance of the base foot and the vertical distance of the base foot with the mean value of the base foot is 0.86 and 0.658 respectively, and 0.000 and 0.000 respectively. The horizontal and vertical distance is the result of Pythagoras (R2 = AB2 + AC2). This indicates that the player's trunk revolves around the longitudinal axis during ball kicking, ie, a change in the horizontal and vertical distance and in the end in their outcome. The angle of direction of the fixed foot is determined according to the horizontal distance of the fixed foot. Every change in the horizontal distance changes in the angle of the base foot direction, and because of this we see that there is a relation between the horizontal distance variable and the angle of the base foot direction during shooting the ball with a correlation value of 0.294 and a probability of 0.009. In the same table, we see that only the two vertical and total distance variables were related to the accuracy variable with a correlation value 0.238 and 0.289 respectively and the remaining probability 0.036 and 0.059 while shooting the ball. The researcher attributed this to the movement of the kicking foot because of the rotation of the trunk, a change occurs in the angle of the direction of the fixed foot and this affects the angle of the body inclination and the accuracy of the strike because the path of the ball is affected by the change angle of the ball and the angle of the body inclination (a streamlined performance) because "the player's balance, the right motor ali-

gnment of the body parts, and the smooth muscular action at optimal angles have a fundamental role in the success of scoring precision mechanics" (Baumgartner, P: 48. 1995).

In general, the process of accuracy is at the expense of speed. If the player kicks the ball quickly, there will be a little accuracy and vice versa, but in terms of logic, the test should be similar to the game and prefer to cause the player strike at the highest speed because, if the player did not strike quickly during the game, the ball will be caught by the goalkeeper, especially in the narrow area of the goal of the futsal, "because the principle of privacy means containing training and learning on movements similar to the nature of performance in the futsal players' sport activities" (Fisher, p. 43, 1990) (Lamb, p: 4, 1984). Therefore, since the testers kicked the ball quickly and did not follow the position of the body, which is the first and basic basis for the fixed foot, especially for the angle of the fixed food direction which is the mechanical axis of the body. Thus it should be here with a sense of muscle and compatibility between the parts of the body during the performance of the skill because the process of kicking the ball is not limited to the muscles of the kicking foot, but shared between the majority of the muscles of the body. The studies conducted by researchers (James-Morten 1990, Kelly, Reuschlin and Hunspricker 1990, Tant 1990, Morsen and Rural 1986) have identified six characteristics to evaluate the qualitative analysis in kicking the ball by the kicking foot front and have shown these characteristics according to the sequence of appearance in the kick (focus of view, body position, fixed foot position, relay synchronization, collision force, follow-up performance) (Duane V. Kundson, 2010, p. 228-229). Players must be aware that the fixed foot is fitted in a way that suits the static work that happens to the muscles of the fixed foot and in the end it is reflected on the kicking foot..

Conclusions:

1. The fixed foot as other parts of the body have an effective role during the scoring of fixed balls in the game of futsal.
2. The direction angle of the fixed foot has an impact on the mechanical axis of the body and is reflected on the accuracy of the scoring of fixed balls in the game of futsal.
3. The farness and nearness of the fixed foot from the ball have nothing to do with the accuracy of the scoring of fixed balls in the game of futsal.
4. Before kicking the ball, the angle of the body inclination has a strong relationship with the knee angle which is reflected on the accuracy of the scoring in the game of futsal.
5. After the ball is kicked, the vertical side and the result of the fixed foot is closely related to the accuracy of scoring in the game of futsal.
6. The action line of the body inclination angle has to do with the work line of the knee angle and the angle of direction of the fixed foot before and after shooting the ball in the game of futsal.

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