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Kinematic Analysis of Running up and Strike Stages of Overwhelming Strike Skill at Beach Volleyball Game as a Standard to Select the Striker

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Abstract: Kinematics' analysis can explain motor performance through identifying the skill, developing it and selecting the suitable player for it. This will be done by identifying body's parties during the performance through analyzing the movement of the player during the stages of motor performance, The research aims to identify the kinematic prosperities of overwhelming strike skill at 3 meters distance from the netball through, Identifying the variables (distance, speed, angle change) of running up stag, The researcher used the descriptive method using two-dimensional photography with two cameras (SONY 8mm). The research's sample was one player by using kinetic analysis program (Win Analysis).The player has done 10 attempts for this skill and the best one has been chosen and analyzed. Also the skill has been filmed at 3 meters distance. The total time of the skill was 1.36 second, The fastest part of the body was striking hand's joint which reached 13.01m/s at the moment of the strike, The angle of the shoulder at the moment of strike was 77.79 degree.The angle of the elbow at the moment of strike was 162.9 degree, The angle of the wrist at the moment of strike was 177.2 degree.

Key words: Kinesiology % Kinematics % Beach Volleyball % Overwhelming strike Player

INTRODUCTION

Kinematics' Analysis is one of the most important basic principles learned from theories and laws related to the human body's activity which training and learning skills depending on. These principles can explain motor performance through identifying the skill, developing it and selecting the suitable player for it. This will be done by identifying body's parties during the performance through analyzing the movement of the player during the stages of motor performance.

Abd Elmonem *et al*. [1] refers that kinetic system of the human's body is described by several mechanical characteristics. When we apply the mechanical rules on the body's movement, these characteristics should be taken into consideration and the biomechanical variables should be studied. This means that the ideal technique characteristics of any skill or sport movement must be achieved and the suitable use of the mechanical rules reflects the mechanical prosperities of the human's kinetic system.

Beach Volleyball is considered one of the newest sports in the modern era. It characterizes that it can be practiced in the clay in which the sand's deep is 30-40 cm. As there is different between the surface where beach Volleyball player runs up during overwhelming strike and the usual courts, research's problem appears in studying and analyzing the kinematic prosperities of the overwhelming strike skill's player specially in selecting a player who has a different jumping up. Also the overwhelming strike skill is considered one of the effective skills in ending the games according to the analysis of world championships, especially at 3 meters distance due to the increased of the strike angle against bulwark.

The research aims to identify the kinematic prosperities of overwhelming strike skill at 3 meters distance from the netball through:

- Identifying the variables (distance, speed, angle change) of running up stage.
- Identifying the variables (distance, speed, angle change) of strike stage.
- Identifying the total time of overwhelming strike skill at 3 meters distance.

Research Hypotheses: To achieve the research's objective, the following questions should be answered:

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- What is the qualitative value (distance, speed, angle0 change) at the moment of running up?
- What is the qualitative value (distance, speed, angle change) at the moment of striking the ball?
- What is the qualitative values' time (the moment of touching the ball, the movement of striking arms to strike, the moment of joining the foot to run up)?

MATERIALS AND METHODS

The researcher used the descriptive method according to the type of the study by using two-dimensional photography with two cameras (SONY 8mm). The research's sample was one player by using kinetic analysis program (Win Analysis). 19 points of the body were determined as shown in picture no.1. The player has done 10 attempts for this skill and the best one has been chosen and analyzed. Also the skill has been filmed at 3 meters distance. The kinematic variables are extracted according to research's objectives which are:

- The speed of body's parties at the moment of arm's movement backwards (the maximum extent) before the strike.
- The speed of body's parties after arms' movement forwards (at the moment of touching the ball) at the moment of the strike.
- The speed of body's parties at the moment of touching the foot and rising (at the moment of running up).
- The speed of body's parties at the moment of landing the foot on the ground (at the moment of landing).
- The path of body's gravity center of the overwhelming strike during the performance stages around the axis (×-~).
- The total qualitative values of body's gravity center speed of the overwhelming strike during the performance stages.
- The angle change of body's parties of the overwhelming strike skill to some performances.
- The values of some performances' time at the overwhelming strike skill.

RESULTS AND DISCUSSION

Table 1 shows that shoulder's joint speed was 1.52 m/s, while elbow's joint speed was -1.01m/s.The wrist's speed decreased to -3.54m/s and the decreasing increased to the maximum speed of hand's joint reaching to -2.53m/s. Given attention to the low part; pelvis's speed was 3.04m/s, while knee's joint speed was 2.02m/s then foot's speed which was 3.54m/s. The more horizontal distance the player passes to rise then generates more speed, the more performance speed of the striking body' parties. So we find that the speed of striking arms movement to the back reached to the maximum speed before touching the ball with decreasing speed preparing to strike the ball and changing the negative speed to positive one forwards at the second stage. It is noticed that the slowest speed was the foot's speed because all the upper parties of the body work to do the maximum speed.

Table 2 shows that shoulder's joint speed was 2.02 m/s while elbow's joint speed was 9.02 m/s. Wrist's joint speed decreased to 9.11m/s and the maximum speed of hand's joint increased reaching at 13.01m/s. Given attention the lower part, pelvis's speed was (1.05m/s), while knee's joint speed was 7.09m/s then foot's speed which was 9.11m/s.

Table 3 shows that ankle's joint speed was 1.01m/s, while foot's joint speed was 0.00m/s and knee's joint speed was 1.01 m/s. Also pelvis's joint speed was 2.02m/s and shoulder's joint speed was 2.53m/s, then elbow's joint speed which was 2.02m/s. Wrist's joint speed was 3.04m/s reaching to hand joint speed which was 3.02m/s.

Table 4 shows that ankle's joint speed was 1.01m/s, while foot's joint speed was 1.01m/s and knee's joint speed was 3.54 m/s. Also pelvis's joint speed was 2.02m/s and shoulder's joint speed was 1.52m/s, then elbow's joint speed which was 2.53m/s. Wrist's joint speed was 4.56m/s reaching to hand joint which speed reached 2.53m/s.

When we identify the qualitative values of body 'gravity center, we find they were 1.04m on the axis × at the approach stage, while at the running up stage was 1.51m. The speed of movement increased to 2.52m at flying stage then this distance increased at strike stage to 2.70 m. At the moment of ending strike stage and landing the body, the body moved to 3.09m with31 m difference from the previous stage.

Table 6 refers that the speed of body's gravity center was 3.09m/s at approach stage, while at running up stage it was zero. Then it started to increase at flying stage to reach 2.79m/s. At strike stage; it started to decrease reaching to 1.52m/s, while it was 4.05m/s at landing stage.

Table 7 shows that angle change of foot's joint at the moment of leaving the land was 109.7 degree, while knee's joint angle was an obtuse angle by 171.65 degree. Then pelvis's angle was 170.05 degree. We notice the angle change of shoulders, Elbow's, wrist's joints at the moment keeping the striking arms away backwards

Table 1: The speed of body's parties at the moment of arm's movement backwards (the maximum extent) before the strike

Body's parties		Value/Unit
Striking arms	Shoulder	1.52 m/s
	Elbow	- 1.01 m/s
	Wrist	- 3.54 m/s
	Hand	- 2.53m/s
Pelvis		3.04 m/s
Knee		2.02 m/s
Foot		3.54 m/s

Table 2: The speed of body's parties after arms' movement forwards (at the moment of touching the ball) at the moment of the strike

Body's parties		Value/Unit
Striking arms	Shoulder	2.02 m/s
	Elbow	9.02 m/s
	Wrist	9.11 m/s
	Hand	13.01m/s
Pelvis		1.05 m/s
Knee		7.09 m/s
Foot		9.11 m/s

Table 3: The speed of body's parties at the moment of touching the foot and rising (at the moment of running up)

Body's parties		Value/Unit
Striking arms	Ankle	1.01 m/s
	Foot	0.00 m/s
	Knee	1.01 m/s
Pelvis		2.02 m/s
Shoulder		2.53 m/s
Elbow		2.02 m/s
Wrist		3.04 m/s
Hand		3.02 m/s

Table 4: The speed of body's parties at the moment of landing the foot on the ground (at the moment of landing)

Body's parties		Value/Unit
Striking arms	Ankle	1.01 m/s
	Foot	1.01 m/s
	Knee	3.54 m/s
Pelvis		2.02 m/s
Shoulder		1.52 m/s
Elbow		2.53 m/s
Wrist		4.56 m/s
Hand		2.53 m/s

Table 5: The path of body's gravity center of the overwhelming strike during the performance stages around the axis (×-~)

Performance Stages	~	Unit	×	Unit
Approach	0.92	cm	m	1.04
Running up	1.03	m	m	1.51
Flying	1.99	m	m	2.52
Strike	2.13	m	m	2.70
Landing	2.04	m	m	3.09

Table 6: The total qualitative values of body's gravity center speed of the overwhelming strike during the performance stages

Performance Stages	Speed=~
Approach	3.03 m/s
Running up	0.00 m/s
Flying	2.79 m/s
Strike	1.52 m/s
Landing	4.05 m/s

Table 7: The angle change of body's parties of the overwhelming strike skill to some performances

Performance/Body's parties	Angle degree
Angle change of foot's joint at the moment of leaving the land	109.7
Angle change of knee's joint at the moment of leaving the land	171.65
Angle change of pelvis's joint at the moment of leaving the land	171.05
Angle change of shoulder's joint at the moment keeping striking arms away backwards (the maximum extent)	12.87
Angle change of elbow's joint at the moment keeping striking arms away backwards (the maximum extent)	91.24
Angle change of wrist's joint at the moment keeping striking arms away backwards (the maximum extent)	- 176.78
Angle change of shoulder's joint at the moment of striking the ball	70.79
Angle change of elbow's joint at the moment of striking the ball	162.9
Angle change of wrist's joint at the moment of striking the ball	177.2
Angle change of pelvis's joint at the moment of landing	188.0

Table 8: The values of some performances' time at the overwhelming strike skill

Time of some skill performance	Time/second
At the moment of touching the ball	0.98 s
The movement of striking arms at the moment of preparing for the strike	0.82 s
Ah the moment of joining the foot for running up	0.52 s
Total time of the performance	1.36 s

(the maximum extent) were 12.87, 91.24 and -176.78 degrees, respectively. While at the moment of strike were 70.79, 162.9 and 177.2 degrees, respectively. Finally angle change of pelvis's joint at the moment of landing was 188.0 degree.

Table 8 refers to the most important moments, as the total time of performance was 1.36 s. The time of arm's movement graduated to running up 0.8 and 0.5, respectively.

DISCUSSION

Tables 1, 2, 3 and 4 refer to the qualitative speed of shoulder's, elbow's and hand's joints before and at the moment of strike; as the player rotates the trunk in the direction of striking arms in order to increase their speed, then trunk's rotation generates around the longitudinal axis. Hence, the rotation of low part is affected, so that; the player puts his foot at an enough distance to increase its radius of the shorten part by rotating the trunk and achieving the goal of the strike.

Hassan [2] and Jörg [3] refer that player's hand collides with the ball after the great speed of the striking arms in shoulder's, elbow's, wrist's joints precede them. Then the ball moves to the court of the competitor team. The movement of the arms differs according to the running speed and the distance achieved at the approach stage and also to the particular importance of the acquired horizontal speed and turns it to vertical one.

Also, Soubhy and Hamdy [4] clarify that when the arms are pulled down directly, this prevents them to touch the netball. This will be done by rotating the elbow outside paralleling with the shoulder or pulling the arms backwards. Landing should be done from the same place of the running up in order to maintain the balance.

Tables 5 and 6 refer to the movement path of body's gravity center and its speed during performance stages. As body's gravity center is located behind the heels of the foot evenly and the arms extend from the low backwards to the high as possible at the first step to reach perpendicular level on the body at the second step.

Soubhy and Hamdy [4] as well as Abd Elrahaman [5] refer to the important of decreasing body's gravity center during this moment of performing the overwhelming strike skill from its place during standing.

Abd Elmonem *et al*. [1] assure that achieving the main mechanical objective which is that the player knows the biomechanical variables well affecting in the movement through rising speed, the high of body's gravity center and the angle speed of striking arms, trunk, ability, power and so on, leads to rise performance level of the player through the technique and performing this skill automatically and quickly which can be developed through intensive and continuous training.

Table 7 shows the impact of wrist's, elbow's, hand's joints on the angle of strike and shooting the ball which has an important role on the effective of overwhelming strike, what Gerges [6] has assured. He also refers to the importance of wrist's movement which contributes by 73.77 % in the effective on the shooting angle and in drawing the flight path of the ball. Abd Elrahman [7] refers that the ball shoots at the moment of stretching the elbow to be pulled by the wrist which controls on the path of the ball before and after the strike. Rüdiger [8], Akeal and Amer [9], Amer [10] and Algamily [11] show the importance of bending elbow's and wrist's joints primarily to transfer the fast stretching in the joints preparing for striking. From the above mention, it was found that shoulder's joint has the most important and effective role, then wrist and finally the elbow.

Farag [12], Markus and Kolb [13] focus on the importance of the power and the speed of stretching foot after primary bending not more than 120 degree at the angle of knee's joint from the back to be ready to strike after jumping and to achieve the equal reaction to the impetus towards the ball shooting.

Jörg [3] sees that the knee should be bended to give impetus up during the strike. Markus and Kolb [13] found that the players of high levels bend their knees before jumping up and when they begin to stretch their legs, they pull their foot.

Table 8 refers to the total time of the skill and the time of touching the ball. In this table we see also that time is an indicator of the level of the skill, as the time of reaction affects on the time of movement. Strike's time is an indicator of the strength and weakness of the strike and achieving the objective of the skill.

CONCLUSION

- The total time of the skill was 1.36 second.
- The fastest part of the body was striking hand's joint which reached 13.01m/s at the moment of the strike.
- The angle of the shoulder at the moment of strike was 77.79 degree.
- The angle of the elbow at the moment of strike was 162.9 degree.
- The angle of the wrist at the moment of strike was 177.2 degree.

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