Relationship of Selected Kinematics Variables with the Performance of Back Court Spike in Volleyball

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Abstract- The purpose of this study was to examine the relationship of selected kinematics variables with the performance of back court spike in volleyball. The subjects (5 M, age 20 -24 years) who were participated in All India Inter University of Volleyball. Pearson product moment correlation was used to analyze the linear (Height of center of gravity of the body & ball) and angular kinematics (Angles of Shoulder, Elbow, Hip, Knee and Ankle joints) variables at the moment of ball contact. The results have shown that the values of co-efficient of correlation are at right ankle joint (-0.843), left ankle joint (-0.651), right Knee joint (0.879), left knee joint (-0.593), right hip joint (-0.298), left hip joint (-0.081), right elbow joint (0.884), left elbow joint (-0.720), right shoulder joint (-0.560), left shoulder joint (-0.815), Height of C.G. of body (0.112) and height of C.G. of ball (0.497) whereas tabulated value of 3 degree of freedom at .05 level of significance is 0.87. Value of coefficient of correlation in case of the Angle at right Elbow & right Knee joint has shown the significant relationship where as other selected biomechanical variables shown the insignificant relationship at.05 level of significance.

I. Introduction

The game of volleyball is most popular today, not only in India but also in the whole world. For many people volleyball is highly skilled game, which dominates the competitive element for some it is sport for fun and recreation. (Saggar 1994) Every sport activity needs certain movements, procedure to tackle a particular task, which refers to technique. Technique is mechanics or skill. Skill is series of gross movement, fine movements and movements along with posture necessary to perform a required physical task effectively. . They combine the skill into patterns of increasingly greater specificity and complexity. (Wick storm 1977) Jumping events present a unique challenge to the earth bound human being. A challenge to put strength skill and coverage against force of gravity, inertia and momentum of different games and sports. Volleyball is one such game where strength and power dominates and plays an effective role. Because of this volleyball is also known as power volleyball**.** (Philips & Horneck 1979)

Volleyball is no longer thought to be an easy game in which the ball is simply slapped back and forth across the net. Skill in volleyball may be considered as an important part of the specific means necessary for the players to participate successfully in the game. The most spectacular and joyous part of volleyball is spiking or smashing and its contributes to about 44 percent of team's success. Latest strategies insist on all spikers and all defenders. The final aim of a team during a rally is to 'kill' the ball. It is important to remember that the ball must be hit at a minimum height of 2.43 m to clear the net and in match it needs to be even higher in order to pass the blockers. . (Khayambashi 1986)

Spike is the finishing touch to the team's play. It is not designed to win the rally for the team. As a result the spiker has the spot light during the game and every player wants to be a specialist spiker. Unfortunately the physical requirements of top level spikers are more limited than for any other role in volleyball. The players must be tall and have a good vertical jump. (Murugesan 1981)

To identify a movement as an economic one, it is very essential to analyses the movement first. Sometimes, it is very difficult for a human eye to analyze the movement of all the body segments and joints at the same time so, various instruments like still camera, video camera etc. are used to analyze various movements. The best method to analyze or evaluate is called cinematography. This is a quantitative method which is very accurate but at the same time costly and time consuming. The role of cinematography in biomechanical research involved from a simple form of recording motion to a sophisticated means of computer analysis of motor efficiency. Over the years, now techniques in filming and timing having been perfected to aid the research in achieving accurate time measurements of both simple and complex locomotion patterns. (Newton, Aronocher & Abramson 1971)

Kinematics- It is the branch of biomechanics that is concerned with describing the motion of the bodies. It deals with such thing that how far a body moves, how fast it moves and how consistently it moves. (James G.Hay 1973)

Back Court Attack - The back row attacker must jump to hit from beyond the attack line. Contact may be made with the ball in front of the attack line as long as the back court attacker is still in the air or part of the ball is below the top of the net.
Broad jumping is very effective for back row attackers because a broad jump enables them to fly through the air contacting the ball closer to the net. Possessing great volleyball skills for attacking from the back court can often be an effective way to score because…

1. It gives a setter another attacking option.
2. It is often a more difficult hit to block because it's harder to time the jump to block.

Opposing blockers may jump with the front row attackers which may leave more areas open for attacking.

The purpose of this study was to find out the relationship of selected kinematic variables with the performance of back court spike in volleyball.

II. Methodology

Five male volleyball players of Lakshmibai National University of Physical Education participated in the inter-university Competition were the subjects of the study. The age of the subjects was 18-24 years. The subjects were good players and have been practicing the technique of back court spike for quite a considerable time. The subjects were explained about the filming procedure and asked to provide full cooperation during the testing.

The test for performance of the technique of back court spike was conducted outdoors on the Volleyball court of LNUPE, Gwalior. On the word of command "go" the subject passed the ball to the settuper and goes for the spiking technique taking 3 - 5 strides. Photographs were taken for the selected moment only. Height of centre of gravity of player and ball at moment of contact and angles of ankle joint, knee joint, hip joint, shoulder joint and elbow joint were recorded. Each individual was given 3 trials and the best trail was used by the researcher for analysis purpose of this study.

The digital photography was used as a technique for kinematic analysis of back court attack in volleyball. A standard motor driven camera, i.e. Nikon D - 100 was used to obtain photo sequences of selected moment during spiking.

The camera was mounted on a tripod stance at a height of 1.32 m from the ground. The camera was placed perpendicular to the initial line and parallel to the horizontal plane. The filming zone was set at 6.35 m within which the photographs were taken.

Fig. 1 Back Court Spike (Moment Contact)

III. Analysis of the Film

After obtaining the photographs by digital photography which is an important method for analyzing the movements, the stick figures were drawn from the photographs by the help of joining of joints. The centre of gravity of each body segment and the whole body was determined by segmentation method as suggested by James G. Hey (1993). The step-wise analysis was done as follows:

1. The various joints were marked on the photograph as the reference point associated with each segment.
2. Stick figure was obtained by ruling straight line between appropriate reference points. The trunk line was obtained by joining the midpoint of the line between the right and left hip joint to the midpoint of the trunk at the level of suprasternal notch.
3. The length of the each segment was measured and divided into various lengths into appropriate ratio as indicated in table 1. The point of division of each segment line serves as the center of gravity for each segment.

Table – 1:
Location of Center of Gravity of Body Segment

S.No	Segment	C.G. location expressed as percentage of total distance between reference points
1.	Head	46.4% to vertex;53.6% to chin-neck intersect
2.	Trunk	43.8% to suprasternal notch;56.2% to hip axes
3.	Upper arm	49.1%shoulder axes ;50.9% to elbow axes
4.	Fore-arm	41.8% to elbow axes;58.2% to wrist axes
5.	Hand	82% to wrist axes ;18%to knuckle three
6.	Thigh	40% to hip axes ; 60% to knee axes
7.	Calf	41.8% to knee axes;58.2% to ankle axes
8.	Foot	44.9% to heel;55.1% to hip of longest toe

4. Two arbitrary axes (OY & OX) were drawn, one to the left and one below the stick figure.
5. Form was prepared such as that shown in Table 2 and in column 1 entered the weight of the segment taken from Table 2.

Table – 2:
Weight of the Body Segments Relative to the Total Body Weight

S.No	Segment	Relative weight
1.	Head	0.073
2.	Trunk	0.507
3.	Upper arm	0.026
4.	Fore-arm	0.016
5.	Hand	0.007
6.	Thigh	0.103
7.	Calf	0.043
8.	Foot	0.015

6. For each of the segment measured the perpendicular distance from the center of the gravity of the line OY, and entered this in the appropriate place on the form (Table 3, Column 2).
7. To find the moments about OY, the weight of each segment were multiplied by the distance of its center of gravity from the line as shown in column of table.
8. The total sum of moments about OY was found by adding all the moments about OY.
9. A line O'Y' was ruled parallel to OY at the distance of the total sum of moments about OY. The center of gravity of the whole body lies on this line.
10. The above steps were repeated from 5 to 9, taking moment about OX instead of OY. The center of gravity of the subject on his O'X' drawn parallel to OX and at the distance of the total sum of moments about OX. The point of interaction of the two lines i.e. O'Y' and O'X', served as the center of gravity of the subject.

Since the C.G. lies on both O'Y' and O'X' and these two lines have only one point in common (the point where they intersect), it is here that the centre of gravity of the subject is situated.(Appendix G –K)

The height of centre of gravity was obtained by calculating the distance from the court and the centre of gravity of the body of the players (Appendix –M)

The height of centre of gravity of the ball was also obtained by the same way. (Appendix L)

IV. Angular Kinematic Variables

The selected angles of ankle joint, knee joint, hip joint, shoulder joint and elbow joint were obtained by measuring with the help of protector from the stick figures.

V. Analysis of Data

The relationship of selected kinematic variables with the performance of Volleyball Players in Back Court Spike was calculated by using Pearson's product moment correlation and for testing the hypothesis the level of significance was set at .05.

VI. Result

Pearson's product moment correlation was used to find out the relationship of selected biomechanical variables to the performance of male volleyball players in back court spike. The level of significance in order to check the relationship was set at .05.

The score of each independent variable linear and angular biomechanical variable were correlated with performance of subjects in back court spike in volleyball. In order to ascertain the relationship of selected biomechanical variables namely angle of shoulder joint (right & left), elbow joint (right & left), hip joint (right & left), knee joint (right & left), ankle joint (right & left) and height of centre of gravity with the performance of Back Court Spike, the Pearson's product moment correlation was calculated. The values of co-efficient of correlations are presented in Table no. 3.

Table-3:
Relationship of Selected Biomechanical Variables to the Performance of Back Court Spike

(N=5)

S.No.	Variables	Mean	Co-efficient of Correlation 'r'
1.	Angle of right ankle joint(Deg.)	108.4	-0.843
2.	Angle of left ankle joint (Deg.)	120	-0.651
3.	Angle of right Knee joint (Deg.)	153.2	0.879*
4.	Angle of left Knee joint (Deg.)	161.8	-0.593
5.	Angle of right hip joint (Deg.)	167.6	-0.298
6.	Angle of left hip joint (Deg.)	177.4	-0.081
7.	Angle of right elbow joint (Deg.)	152.4	0.884*
8.	Angle of left elbow joint (Deg.)	109.2	-0.720
9.	Angle of right shoulder joint (Deg.)	167.6	-0.560
10.	Angle of left shoulder joint (Deg.)	34.4	-0.815
11.	Height of C.G. of Body (Mtr.)	1.82	0.112
12.	Height of C.G. of Ball (Mtr.)	2.80	0.497

* **signified at 0.05 level.**

Table - 3 reveals that the value of co-efficient of correlation of selected angular kinematics variables at moment of back Court spike were right ankle joint (-0.843), left ankle joint (-0.651), right Knee joint (0.879), left knee joint (-0.593), right hip joint (-0.298), left hip joint (-0.081), right elbow joint (0.884), left elbow joint (-0.720), right shoulder joint (-0.560), left shoulder joint (-0.815), Height of C.G. of body (0.112) and height of C.G. of ball (0.497) whereas tabulated value for 3 degree of freedom at .05 level of significance is 0.87.

VII. Discussion of Findings

As shown in the table 3 that only two variables that is angle at right elbow and right knee joint of subjects, which happen in back court spike of a right handed spiker has exhibited a significant relationship at the selected level of 0.05.
However, other angular kinematic variables ankle joint (left and right), knee joint left, hip joint right and left, shoulder joint right and left, elbow joint left, and height of C.G. of body and height of C.G. of Ball did not show significant relationships.

VIII. Discussion of Hypothesis

The results of the study have shown that only in case of right elbow and knee joint of subjects had shown a significant relationship with the performance in back court spike while other selected biomechanical variables have shown the insignificant relationship with the performance of back court spike.

Therefore, the hypothesis as stated earlier that there is significant relationship between the angles at different joints and height of C.G. with performance in back court spike is accepted in case of right elbow and knee joint of the subjects and rejected in case of other selected variables at the .05 level of significance.

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