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Relationship of selected kinematical variables with performance of counter spiker in volleyball players

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Abstract
The aim of the study to find out the Relationship of selected Kinematical variables with performance of counter Spiker in Volleyball players. In this research total Ten Inter-University level male volleyball players were randomly selected from north zone as subjects for the study. The separate data will collected as for all counter spikers. The subjects were explained about the objective of the study. Age of subjects ranging between 19 to 24 years. For this study six variables selected, these variables are: *(EHa)* horizontal acceleration of elbow joint, vertical velocity of elbow joint, *(EVa)* vertical acceleration of elbow joint, *(SHv)* horizontal velocity of shoulder joint, *(SHa)* horizontal acceleration of shoulder joint, *(SVv)* vertical velocity of shoulder joint and *(SVa)* vertical acceleration of shoulder joint. Motion capture technique was used in this study. The films were analyzed by using standard "quintic coaching v-17 software" approved by Human kinetics. After collection of data Karl Pearson's product moment coefficient correlation statistical technique was used. In order to check the significance, level of significance was set at 0.01.the outcome of the study proved that the significant relationship of all selected Kinematical variables with performance of counter Spiker in Volleyball players.

Keywords: Kinematics, Biomechanics, acceleration and velocity

Introduction
Kinematics is the study of bodies in motion without regard to the causes of the motion. It is concerned with the describing and quantifying both the linear and angular positions of the bodies and their time derivatives. Kinematics is the preferred analytical tool for researchers interested in questions such as, who is faster. What is the range of motion of a joint? How do two motion patterns differ? Kinematic analysis may be an end in itself or an intermediate step that enables subsequent kinetic analysis. The most common method for collecting kinematic data uses an imaging or motion-caption system to record the motion of markers affixed to a moving subject, followed by manual or automatic digitizing to obtain the coordinates of the makers. These coordinates are then processed to obtain the kinematic variables that describe segmental or joint movements. Biomechanists are interested in improving athletes. It is ideal for the analysis of single movements or intervals of exercise lasting up to minutes. The most cost effective method is qualitative analysis, in which the athletes, coach or sport scientist simply view the video together and decide immediately how technique could be improved. The athlete can then attempt any recommended changes and the filmed for a further round analysis.

Biomechanics is of fundamental importance to analyze and evaluate the technique or skill of an athlete with proper application and implementation of applicable mechanical principles for the enhancement of performance in sports and games. Various body angles on ground and in space, centre of gravity of an athlete in specific positions, velocity of the released object, angle of release, height of release etc. play an importance role in the performance, hence, true mastery comes only after serious study of the mechanical principles involved. Sport does not simply involve physical activities but components of physics, mathematics, biology, psychology, sociology and many more. It is actually engineering, which needs regular updated scientific approaches in all the factors.

Statement of the problem
Relationship of selected Kinematical variables with performance of counter Spiker in Volleyball players.

Selection of subjects
Ten Inter-University level male volleyball players were randomly selected from north zone as subjects for the study. The separate data will collected as for all counter spikers. The subjects were undergoing training for a considerable period. Therefore it was ascertained that subjects possess reasonable level of technique. The subjects were explained about the objective of the study. Age of subjects ranging between 19 to 24 years.

Selection of variables
1. *(EHa)* The horizontal acceleration of elbow joint during the course of spiking.
2. *(EVv)* The vertical velocity of elbow joint during the course of spiking.
3. *(EVa)* The vertical acceleration of elbow joint during the course of spiking.
4. *(SHv)* The horizontal velocity of shoulder joint during the course of spiking.
5. *(SHa)* The horizontal acceleration of shoulder joint during the course of spiking.
6. *(SVv)* The vertical velocity of shoulder joint during the course of spiking.
7. *(SVa)* The vertical acceleration of shoulder joint during the course of spiking.

Criterion measure
The criterion measure for this study was the performance of the Spikers. Total ten attempts will be given to each subject and the successful shots will be marked as single score out of ten.

Filming protocol
Motion capture technique was used in this study. To recorded the video of the volleyball counter spiker, while they performing the technique, digital video camera (50 fps) was used by a professional photographer. After obtaining the recorded video, the video was analyzed through Quintic coaching v-17 software approved by Human kinetics. First video was digitized through Quintic coaching v-17 software. After the procedure of digitizing, the video was calibrated. The calibrated video gives us the results through makers, stroboscopic effect technique, stick figures, stopwatch programming, angle manual (horizontal, vertical, draw angles), linear and angular analysis manual etc. with the help of "Quintic coaching v-17 software."

Motion capture technique/Digital videography was used to analysis the kinematic variables of male volleyball counter spiker. Digital video camera Casio EX-FH 100 (50 fps) was used for videography of volleyball counter spiker performance. The performance of the subject was recorded with stroboscopic effect from approach to landing. Digital Video camera was placed 6 meter away at the side of the spikers (lateral axis).

Analysis of film and collection of data
Motion capture technique was used in this study. The films were analyzed
by using standard "quintic coaching v-17 software" approved by Human kinetics. Videos analyzed through strobed photo sequence / stroboscopic effect, stick figure analysis, Quick snap shots with the help of software for analysis of selected variables are presented below:-

Statistical procedure
With regard to purpose of the study Karl Pearson's product moment coefficient correlation statistical technique was calculated between selected kinematical variables with performance of male counter spiker in volleyball. In order to check the significance, level of significance was set at 0.01.

Results

Table 1: Relationship between Horizontal acceleration of elbow joint with performance of counter spiker in volleyball

Trials	Variables	Mean	Standard Deviation	Correlation (r) values
10	Horizontal acceleration of elbow joint	13.74	0.87	0.889
10	Performance	7.10	1.19	

'r' $_{0.05}$(18) =0.468

Table 1 confirmations that the mean value of Horizontal acceleration of elbow joint of counter spiker in volleyball players was 13.74, whereas the standard deviation (SD) of angle of ankle joint of counter spiker in volleyball players was 0.87 respectively. At the time of calculation of relationship between Horizontal acceleration of elbow joint with performance of counter spiker in volleyball players the r value was 0.889. The data does suggest that there is significant relationship between Horizontal acceleration of elbow joint of counter spiker in volleyball players with performance.

Table 2: Relationship between Vertical velocity of elbow joint with performance of counter spiker in volleyball.

Trials	Variables	Mean	Standard Deviation	Correlation (r) Values
10	Vertical velocity of elbow joint	1.52	0.20	0.925
10	Performance	7.10	1.19	

'r' $_{0.05}$(18) =0.468

Table 2 confirmations that the mean value of Vertical velocity of elbow joint of counter spiker in volleyball players was 1.52, whereas the standard deviation (SD) of angle of ankle joint of counter spiker in volleyball players was 0.20 respectively. At the time of calculation of relationship between Vertical velocity of elbow joint with performance of counter spiker in volleyball players the r value was 0.925. The data does suggest that there is significant relationship between Vertical velocity of elbow joint of counter spiker in volleyball players with performance.

Table 3: Relationship between Vertical acceleration of elbow joint with performance of counter spiker in volleyball.

Trials	Variables	Mean	Standard Deviation	Correlation (r) Values
10	Vertical Acceleration of elbow joint	27.74	0.83	0.928
10	Performance	7.10	1.19	

'r' $_{0.05}$(18) =0.468

Table 3 confirmations that the mean value of Vertical Acceleration of elbow joint of counter spiker in volleyball players was 27.74, whereas the standard deviation (SD) of angle of ankle joint of counter spiker in volleyball players was 0.83 respectively. At the time of calculation of relationship between Vertical Acceleration of elbow joint with performance of counter spiker in volleyball players the r value was 0.928. The data does suggest that there is significant relationship between Vertical Acceleration of elbow joint of counter spiker in volleyball players with performance.

Table 4: Relationship between Horizontal velocity of shoulder joint with performance of counter spiker in volleyball.

Trials	Variables	Mean	Standard Deviation	Correlation (r) Values
10	Horizontal velocity of shoulder joint	3.39	0.62	0.698
10	Performance	7.10	1.19	

'r' $_{0.05}$(18) =0.468

Table 4 confirmations that the mean value of Horizontal velocity of shoulder joint of counter spiker in volleyball players was 3.39, whereas the standard deviation (SD) of angle of ankle joint of counter spiker in volleyball players was 0.62 respectively. At the time of calculation of relationship between Horizontal velocity of shoulder joint with performance of counter spiker in volleyball players the r value was 0.698. The data does suggest that there is significant relationship between Horizontal velocity of shoulder joint of counter spiker in volleyball players with performance.

Table 5: Relationship between Horizontal acceleration of shoulder joint with performance of counter spiker in volleyball.

Trials	Variables	Mean	Standard Deviation	Correlation (r) Values
10	Horizontal acceleration of shoulder joint	7.93	0.57	0.928
10	Performance	7.10	1.19	

'r' $_{0.05}$(18) =0.468

Table 5 confirmations that the mean value of Horizontal acceleration of shoulder joint of counter spiker in volleyball players was 7.93, whereas the standard deviation (SD) of angle of ankle joint of counter spiker in volleyball players was 0.57 respectively. At the time of calculation of relationship between Horizontal acceleration of shoulder joint with performance of counter spiker in volleyball players the r value was 0.928. The data does suggest that there is significant relationship between Horizontal acceleration of shoulder joint of counter spiker in volleyball players with performance.

Table 6: Relationship between Vertical velocity of shoulder joint with performance of counter spiker in volleyball.

Trials	Variables	Mean	Standard Deviation	Correlation (r) Values
10	Vertical velocity of shoulder joint	1.70	0.27	0.950
10	Performance	7.10	1.19	

'r' $_{0.05}$(18) =0.468

Table 6 confirmations that the mean value of Vertical velocity of shoulder joint of counter spiker in volleyball players was 1.70, whereas the standard deviation (SD) of angle of ankle joint of counter spiker in volleyball players was 0.27 respectively. At the time of calculation of relationship between Vertical velocity of shoulder joint with performance of counter spiker in volleyball players the r value was 0.950. The data does suggest that there is significant relationship between Vertical velocity of shoulder joint of counter spiker in volleyball players with performance.

Table 7: Relationship between Vertical acceleration of shoulder joint with performance of counter spiker in volleyball.

Trials	Variables	Mean	Standard Deviation	Correlation (r) Values
10	Vertical Acceleration of shoulder joint	4.50	0.31	0.862
10	Performance	7.10	1.19	

'r' $_{0.05}$(18) =0.468

Table 7 displays that the mean value of Vertical acceleration of shoulder joint of counter spiker in volleyball players was 4.50, whereas the standard deviation (SD) of angle of ankle joint of counter spiker in volleyball players was 0.31 respectively. At the time of calculation of relationship between Vertical acceleration of shoulder joint with performance of counter spiker in volleyball players the r value was 0.862. The data does suggest that there is significant relationship between Vertical acceleration of shoulder joint of counter spiker in volleyball players with performance.

Discussion of the findings

Based on the statistical analysis of data following findings were drawn by the researcher:

The result of the study informs that there is significant relationship between Horizontal acceleration of elbow joint, Vertical velocity of elbow joint, Vertical Acceleration of elbow joint, Horizontal velocity of shoulder joint, Horizontal acceleration of shoulder joint of counter spiker, Vertical velocity of shoulder joint and Vertical acceleration of shoulder joint in volleyball players with performance. On the

basis of analysis of the data, investigator found that the earlier study Walter Quispe Marquez, Masanao Masumura, & Michiyoshi Ae (2009) [3] The effects of jumping distance on the landing mechanics after a volleyball spike Sports Biomechanics, Zahalka F Maly T, Mala L, Ejem M and Zawartka M (2017) [4] Kinematic Analysis of Volleyball Attack in the Net Center with Various Types of Take-Off. J Hum Kinet., S. Amritpal and Deol, N.S. (2010) [1]. "Kinematic Analysis of Spikers of Volleyball", *Abstracts - 4th National Conference on Multidisciplinary Approach in Physical Education*, University Patiala and Vaverka F, Jandacka D, Zahradnik D, Uchytil J, Farana R, Supej M and Vodicar J. (2016) [2] Effect of an Arm Swing on Countermovement Vertical Jump Performance in Elite Volleyball Players" supported the present study.

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