

Relationship of Anthropometric Characteristics and Kinematic Variables with Spiking of Volleyball Players

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Abstract

The purpose of the study was to determine the relationship of anthropometric characteristics and kinematics variables with spiking of volleyball players. The subjects were twelve male junior national volleyball players (average height 177.19 cm, weight 64.35 kg, age below 19 years old). All subjects had participated in 39th Junior National Championship for boys and girls held at Shari Dungargarh, Bikaner; Rajasthan (India) from 22-12-2012 to 28-12-2012. 12 volleyball players from Uttar Pradesh representing their states in under-19 national tournament were selected by purposive sampling method. In this study the spiking performance of the subject recorded by subjective judgment criterion. The performance of spike was recorded by the score in the spike which obtained by using three point scales by the three judges. Three spikes were recorded for each volleyball player and the recorded mean of the scores for trial was performance of spiker as there is no established standard test to test the spike. The anthropometric characteristics measured by anthropometry equipments (Rosscraft Innovations Company, Canada). Two High speed video camera with tripod (Sony Model- 3CCD and Casio Exilim EX-F1) used for videography of spike. Silicon coach Pro-7, motion analyzer software powered by Silicon coach Ltd. was used for video analysis. The results show that the value of co-efficient of correlation of selected anthropometric characteristics with off speed spike performance were standing height(0.612), sitting height (0.343), and body weight (0.022), Where tabulated value at 10 degree of freedom at .05 level of significance is 0.553. The value of co-efficient of correlation of selected angular kinematics variables at moment of ball contact in hitting phase spike were right ankle joint (-0.321), right Knee joint (0.564), right hip joint(-0.117), shoulder joint (-0.070), elbow joint (-0.641) and body inclination (-0.335), whereas tabulated value for 10 degree of freedom at .05 level of significance is 0.553. It is suggested that results from this study can provide useful information for coaches to train volleyball players in off speed spike.

Keywords: Kinematic, Anthropometrics Characteristics and Off speed spike

1. Introduction

Today, Volleyball occupies a place among the most popular sport in the world. It's now touted as the second most popular sport in the world. It caters to the highest level competition for players of both sexes of different age groups, providing thrilling and spectacular environment to spectators and above all it enjoys the status of very healthy recreational sports for people of all groups till date. An exciting innovation occurred when the Philippines invented the "spike" which drove the ball hard in to the opponent territory. This spike became an intricate part of this game. To achieve success in volleyball, it is desirable to possess a strong offence, and the main form of attack in the modern game is the smash or 'spike'. So dominant has this aspect of volleyball become universal. The governing body of the sport (FIVB) has recently made more lenient the rules concerning handling errors in defence to try and re-establish a balance between offence and defence introduced libero (British Volleyball Federation, 1990) and blocker can touch two times consequently first during block and second falling the ball next to block which is not counted in three contacts.

1.1 Techniques and Tactics of Volleyball

The spike skill is complex motion and ever more important to decide the outcome of game and became the main tactics to score. The attacks vary according to the type of set and the position of the players. when the ace-spiker and the receiver-attacker attack on high sets they show what young players are taught 3 or 4 step approach, respecting the timing of the set, a take-off, a suspension, hitting the ball and finally landing on the floor to carry on with another action.

In recent years, there is a trend that more teams adopt the technique, tactics and physical performance. The skills like higher attack, powerful jumping-serve, attack from the back row and aggressive blocking are now widely used by volleyball players. All these bring forward greater demand for specific physical fitness and anthropometrics characteristics of volleyball players.

1.1.1 Anthropometric Characteristics in Volleyball Spike:

Anthropometric measurements play an important role in the performance of games and sports in the national or inter-national competitions; there is a very less margin to take the top positions. Physique of an individual helps a lot to achieve better performance and to get refers top positions. Physique refers to the size, the shape and the form of an individual. Anthropometric measurements, physiological variables and psychological traits effects performance by improving fitness, technique and tactics. In the world, coaches have been utilized various methods and approaches in the selection of players, such as performance based, by experience of coaches, use of qualitative and quantitative indices, and scientific testing. Talent identification for players always includes certain anthropometric measurements. Among the anthropometric indices, some of them are highly attributable to heredity (e.g. stature, length and width), but some others are with very low heredity, such as the nutrition indices like body mass.

1.1.2 Kinematics of Spike

The more complex motions executed by humans are the result of individual learning processes and can't be passed on from generation to generation. This is particularly true for sports motions, where biomechanics of sports faces one of its greatest challenges for the future. The attribution of biomechanics in attaining high performance may not be overlooked, since it is the only sciences which help identify the faults of performing technique very precisely. There are basically two methods by which skill can be analyzed. They are qualitative and quantitative. High speed module film for exactness has been used extensively to examine in great details of the movements which occur too fast for the human eye to detect. Kinematic analysis has become a commonly used method in sports which allows us to gain objective basis for a more effective training process. Results of kinematic analysis enable more objective models of optimal movement performance and determination of kinematic barriers of movement performance (Tuma, 2001, Janura and Zahalka, 2004).

One of the factors limiting sport performance in spiking is range of motion in joints. Although game performance in volleyball does not exert extreme demands on flexibility, it is very important to develop optimal range of motion in joints and related functions of individual muscles and muscle groups. A better understanding of movement system functions is one of conditions for cultivation and development of game performance in volleyball.

Previous studies about spike revealed that the take-off commences with the rapid extension of the hips, knees and ankles in conjunction with shoulder flexion. The lower limb action at take-off, and angular velocities for the hip, knee and ankles of significantly related, respectively (left or right was not specified). The spikers reach maximal ankle angular velocity due to a higher centre of mass vertical velocity at take-off by sequencing their lower limb movements correctly. During the flight phase, the movement of the shoulders initiated at take-off is continued past the horizontal, until full flexion is reached. The trunk is hyperextended and the right shoulder is horizontally extended from a position of 90° abduction. The right elbow is flexed (for a right-handed player), while the left elbow is maintained at full extension. The knees are flexed to an angle of approximately 90°. This position has been termed the 'drawn bow' by Oka et al. (1976), who also identified an alternative method of hitting arm movement to reach this position in which the right humerus drops below the horizontal due to adduction and horizontal extension. The first movements in the hitting action are left shoulder adduction and extension, knee extension and leftwards trunk rotation (for a right-handed spiker). The right shoulder is vigorously extended and medially rotated, and the right elbow extends to 180°. The ball is contacted above and just in front of the hitting shoulder, and the right forearm pronates with accompanying wrist flexion to direct the ball. After the ball has been hit, the hitting arm is then further adducted, extended and medially rotated at the shoulder with elbow flexion, to prevent contact with the net. The landing is then made with one or two feet, and the vertical momentum absorbed by the flexion of ankles, knees and hips. (Samson and Roy, 1976).

When spiker jumps for hitting the ball the location of center of gravity play important role on gaining jump height, produce force and speed. The range of motion in joint significantly correlated with various movements on plane and axis. During spiking ,volleyball players swings both arm forward and upward to assist in gaining height, once he has left floor allows one arm to drop down to get maximum reach. The maximum height to which an athlete center of gravity rises determined by velocity and height of center of gravity at take-off (Chen-Fu Huang, Gin-Chang Liu, and Tai-Yen Sheu, 1998). By means of 3D video-graphic method the movement of a volleyball player in blocks (Lehnert, Janura, Stromsik and Vaverka, 2001) and spikes (Zahalka and Suss, 2002) were analyzed. In foreign professional literature Huang, Liu and Sheu (1997) deal with volleyball skills

examined by kinematic analysis. They recorded a take-off with one leg in the spike. Testing of the spike service by means of 3D kinematic analysis was carried by Coleman (2003). Kinematic analysis of a back row attack was examined by Huang, Liu and Sheu (1999).

The power spikes kill lost much of its effectiveness after gaining power and speed because of the emergence of double and triples blocking. This study may evolve the attack tactics from front-row in order to enhance the success of attack to overcome double and triple block. The off speed spike can have an impact on the outcome of a match. Off speed spike is a technique in which the ball can be placed accurately in gaps which are not in the immediate area of the block. It used to place the ball in the center of the back court. In general, studies related to the biomechanical analysis of the volleyball jump spike mainly focus on kinematics variables of general spike. No research has been done on the association of biomechanical and anthropometrics factors of the elite junior national volleyball players of India. Thus, the mechanisms of its implementation have developed whether what is associated with a set of biomechanical variables and anthropometrics characteristics implementing the performance. Hence the present study was undertaken to increase our understanding about the off speed spike. The purpose of the study was to determine the relationship of anthropometric characteristics and kinematics variables with spiking of volleyball players.

2. Methodology

2.1. Source and Selection of Subject

The subjects were twelve male junior national volleyball players (average height 177.19 cm, weight 64.35 kg, age below 19 years old). All subjects had participated in 39th Junior National Championship for boys and girls held at Shari Dungargarh, Bikaner; Rajasthan (India) from 22-12-2012 to 28-12-2012. Twelve (12) volleyball players from Uttarakhnad representing their states in under-19 national tournament were selected by purposive sampling method. All of them had practised volleyball regularly for the last three years and participated in Sub-Junior National Championships. They were considered skilled and their technique was treated as stabilized. The players were informed about the essence of the studies planned, and they as well as their coaches consented to voluntary testing. Participants were provided with information at their level of comprehension about the purpose, methods, demands, risks, inconveniences, discomforts, and possible outcomes of this research. The researcher has obtained approval by the Organising Committee of Competition and Volleyball Federation of India.

2.1.1. Criterion Measure

In this study the spiking performance of the subject recorded by subjective judgment criterion. The performance of spike was recorded by the score in the spike which obtained by using three point scales by the three judges. Three spikes were recorded for each volleyball player and the recorded mean of the scores for trial was performance of spiker as there is no established standard test to test the spike. The anthropometrics characteristics measured by anthropometry equipments (Rosscraft Innovations Company, Canada).

2.1.2. Selection of Variable

Based on literary evidence, correspondence with the expert and scholar's own understanding and keeping the feasibility criterion in mind the research scholar selected the following anthropometrics characteristics and kinematics variables for the study.

(A) Anthropometric Characteristics

- i Standing Height
- ii. Sitting Height
- iii. Body Weight

(B) KINEMATICS VARIABLES:

1. Angular Kinematics

- i. Angle of Ankle Joint (Right)
- ii. Angle of Knee Joint (Right)
- iii. Angle of Hip Joint (Right)
- iv. Angle of Shoulder Joint (Hitting arm)
- v. Angle of Elbow Joint (Hitting arm)
- vi. Body inclination

2.1.3 Procedures of anthropometric measurements

On the day of testing, the researchers met the volleyball players in the morning. Before the measurements, the team officials and researcher explained to the participants the significance of the research and encouraged them to cooperate with the researchers. No warm-up was required.

The anthropometry measurements were executed according to the International Standard for Anthropometrics Assessment (2006) procedures. Each item was measured twice with the assistance of a recorder. If the variation between the two measurements was out of the limit set by ISAK (i.e. >1% in measurements), a third measure was taken. After collection of the anthropometric data as described below, further matched with the official anthropometric data taken by Volleyball federation of India.



Figure-1 Measurement of Body Weight, Standing Height and Sitting Height

2.14 Angular Kinematics Variables Measurements

The procedure of videography technique and analysis of the film with filming protocol has been described as follows:

2.1.6 Procedures of Video graphic Technique:

The Videography was done during 2:30 pm to 6:00 pm on the next day of the anthropometry measurements. After obtaining informed consent, each athlete's spiking mechanics were evaluated on an outdoor volleyball court. A standard volleyball net was arranged in the court at regulation height 2.43 meter. An experienced volleyball setter set the ball for each trial. Subjects started from a self-selected position about 4-5 m from the net, and approached the marked line 1.50m from the net line. Subjects each took several warm-up trials to become acclimated to the environment and to become familiar with the timing and height of the set. For the recorded trials, the participants were instructed to spike the ball with full effort. Each subject had about three minutes rest among three trials in rotations.

Three national coaches as judge, who well acquainted with the spike in volleyball, were requested to judge the best spike on three point scale. Three spikes were recorded for each volleyball player and the recorded mean of the scores for trial was performance of spiker as there is no established test to test the spike. A sequence of the various phases of off speed spike actions is shown below.



Figure-2 Take Off, Flight, Hitting and Landing of Off Speed Spike

2.1.7 Filming Protocol & Analysis of film

The camera was positioned perpendicular to the net in order to capture the sagittal and frontal view of the subject during the spiking performance. Camera-1 was placed perpendicular from the subject at a tripod at a height of 1.57mts from the ground; it was placed perpendicular to the execution line and parallel to horizontal plane at a Displacement of 5.80 mts from the midpoint of the execution line. Camera -2 was placed in front of subject performing the skill at the distance of 10.75 meters and mount at 1.63 meters. The subjects were made to take three trials only. The experimental set up of collecting data is shown in Figures

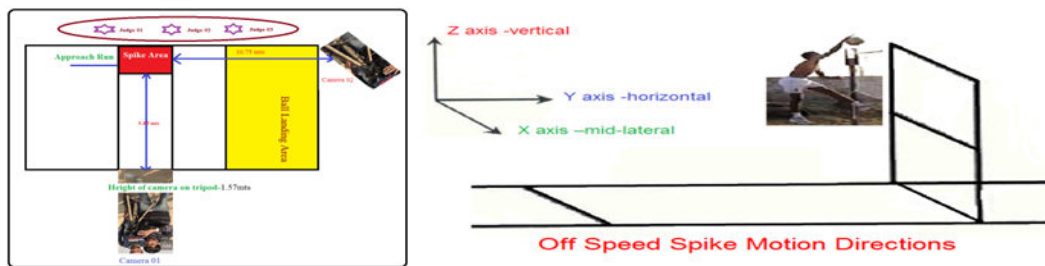


Figure –3 Experimental Setup of the Front-row Spike Motion Direction and Off Speed Spike

2.1.8 Procedure for collecting Angular Kinematic Data

On the basis of the video recording, the scholar marks various angular measurements, with the help of silicon-coach pro-7 motion analysis software.



Figure-4 Measurement of Angle of Various Joints and Body Inclination in Hitting phase

2.1.9 Analysis of Data

The data collected from (12) twelve subjects were analysed by using Pearson's Product Moment Correlation to see the relationship between anthropometric characteristics and performance of volleyball players in spike. The same was applied to see relationship between Kinematic variables and performance of volleyball players in spike. The level of significance was set at .05.

3.Result

In order to ascertain the relationship of selected anthropometrics characteristics namely standing height, sitting height, body weight with the performance of off speed spike, the Pearson's product moment correlation was calculated. The relationship between angular kinematic parameters i.e. angle of ankle joint (right), knee angle joint (right), hip angle joint (right), angle of shoulder joint (hitting arm), angle elbow joint (hitting arm), angle of body inclination at moment of ball contact in hitting phase with the performance of off speed spike also calculated by using Pearson Product Moment Correlations. The values of co-efficient of correlations are presented in Tables.

Table -2 Relationship of Selected Anthropometrics Charecterstics with Off Speed Spike Performance

Sr. No.	Variables	Co-efficient of Correlation 'r'
1	Standing Height	0.612*
2	Sitting Height	0.343
3	Body Weight	0.022

N=12* signified at 0.05 level.

Table -2 reveals that the value of co-efficient of correlation of selected anthropometrics charecterstics with off speed spike performance were standing height(0.612), sitting height (0.343),and body weight(0.022), Where as tabulated value 10 degree of freedom at .05 level of significance is 0.553.

Table -3 Relationship of Selected Angular Kinematics with Off Speed Spike Performance

Sr. No.	Variables	Co-efficient of Correlation 'r'
1	Angle of(Right) Ankle joint (deg)	-0.321
2	Angle of Knee joint (Right)	0.564*
3	Angle of Hip joint (Right)	-0.117
4	Shoulder Joint (Hitting arm)	-0.070
5	Elbow Joint (Hitting arm)	0.641*
6	Body inclination	-0.335

N=12 * signified at 0.05 level.

Table - 3 reveals that the value of co-efficient of correlation of selected angular kinematics variables at moment of ball contact in hitting phase spike were right ankle joint (-0.321), right Knee joint (0.564), right hip joint (-0.117), shoulder joint (-0.070), elbow joint(-0.641) and body inclination (-0.335), whereas tabulated value for 10 degree of freedom at .05 level of significance is 0.553.

4. Discussion of Findings

As for as performance of off speed spike is concerned, being both generally and specifically standing height certainly has great significance association for the successful off speed spike. Results displayed that significant corelation exist between standing height and off speed spike performance at level of 0.05. Attack, block and feint were best performed by players with greater body height. The off speed spike are collinearly interdependent variables which influnced by standing height. During off speed spike, spiker placed the ball softly above the blocker height in vacant zone of opponent court, which need maximam staning height. Arun Singh Rathore, Dharmendra Narwaria, and S. Mukherjee (Dec, 2012) found that volleyball players are taller. Standing height essential for volleyball players in order to give efficient Spike Jump performance. (Sameer Kumar Yadav,Oct,2012). This finding can be attributed to the fact that volleyball elite athletes prerequisite to have high height, due to the nature and the type of the sport.Reach height was the only meaningful sub-height that was significantly correlated with overall ball contact height ($r=0.70$) and appeared to be most sensitive to technique-related differences in performance (Vint, Peter F. and Hinrichs, Richard N.2004).

In case of angular kinamatics that are angle of right elbow joint and right knee joint of subjects has exhibited a significant relationship at the selected level of 0.05. The performance of off speed spike was significantly related to the extension and flexion angle of Right elbow and knee at the moment of ball contact.However, other angular kinematic variables ankle joint (right), hip joint (right) shoulder joint (right) did not show significant relationships. Significant correlation was found only between values of tactical angle delivered by the upper arm, which is in agreement with the results of a volleyball spike study reported by Coleman et al.,(1993).

5. Conclusion

The aim of the study was to found the relationship between anthropometrics charecterstics and kinamatics variables with spiking, but the insights into technique of off speed were not fully realized. the only significant correlations were between standing height and off speed spike performance .The angle of right elbow joint and right knee joint of subjects has exhibited a significant relationship at the selected level of 0.05.The performance

of off speed spike was significantly related to the extension and flexion angle of right elbow and knee at the moment of ball contact.

6. Practical Implication

The findings of the present study may help to the physical education teachers and coaches for better teaching and coaching of off speed spike by knowing contributing factors to the performance of off speed spike. and also help the volleyball players for self-evaluation and better understating in the practice and learning process of off speed spike.

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