Motion Assessment of Volleyball Overhead Serve

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Abstract

Biomechanical principles are applied by scientists in a number of fields in addressing problems related to human health and performance. This study had been taken to biomechanically analyze the technique of Overhead serve in Volley ball. It was hypothesized that there may be significant relationship between the selected kinematical variables with the performance of the volleyball players in overhead serve. Ten male national players of Volleyball were selected. The age of the selected layers were between 20 to 24 years. The study included the kinematical variables namely Ankle Joint (left), Ankle Joint (right), Knee Joint (left), Knee Joint (right), Hip Joint (left), Hip Joint (right), Shoulder Joint (left), Shoulder Joint (right), Elbow Joint (left), Elbow joint (right), Wrist joint (left), Wrist Joint (right), Height of C.G at moment stance and Height of C.G at moment execution for analyzing the technique of overhead serve of volleyball. In the study motion analyzer software motion pro and simi machix is used to asses the selected biomechanical variables. The criterion measure for this study was the performance of selected subjects in overhead serves as assessed by Russell-Lange test of volleyball serve. The product moment correlation (Pearson) was used in order to find out the relationship between selected kinematical variables with the performance of volleyball player's in overhead serve of Volleyball. The results have shown that all the selected kinematical variables had insignificant relationship with the performance of subjects in overhead serve in volleyball.

Keywords: Kinematics, Serve, Center of Gravity, moment of stance and execution

Intoduction

The prime objective of a course of study in sport sciences is to understand the nature and function of human movement in sports, dance, recreational programmes and adopted movement activities. A competent professionalist should be well versed with the knowledge of body movements and subject matter of his/her sport specialized field. Human being by nature is competitive and ambitious for their excellence in all athletic performance. Even, man or nation wants to show their supremacy by challenging other nations to sweat and strive to run fast, jump higher, throw further and exhibit greater strength, endurance and skills in present competitive sports world. This can only be possible through scientific, systematic

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and planned sports training as well as channelizing them in appropriate game and sport by finding the potentialities. Scientific knowledge has revolutionized the standard of performance in sports discipline. Now because the coaches strive to get the optimum performance with minimum expenditure of energy and time, the players and athletes are trained under scientific guidelines.

As we know that for enhancement in game/sport its techniques should be mastered. For improving the techniques or to work upon it, it is very important to analyze it so as to know what are the motor and mechanical variables of the techniques which must be given due attention for improving that particular technique. So that those effective variables could be known this contributes to the effectiveness of the technique. Depending upon those variables contributing effective training could be given to those involved with it. To identify a movement as an economic one, it is very essential to analyze the movement first. Sometimes, it is very difficult for a human eye to analyse all the movements of various body segments and joints at the same time. So, various instruments like still camera, video camera etc are used to analyze various movements. Further the technology moved the analyzation processes to softwares also. This is a quantitative method which is very accurate but at the same time it is vey costly and time consuming. The role of videography and use of motion analysing softwares in biomechanical research is getting enriching day by day. The role of videography or cinematography in biomenical research involved from a simple form of recording motion to a sophisticated means of computer analysis of motor efficiency.

The science of biomechanics is concerned with the forces, which act on a human body and the effects, which these forces produce. Physical educators and coaches work, is concerned with forces and effects. Their ability to teach basic techniques of a sport or physical activities depends very largely on their understanding of scientific principles. Physical Educator, coaches and athletes should turn to biomechanics to provide a sound, scientific basis for the analysis of the techniques used in sports. For many years, the term Kinesiology (literally, the science of movement) was used to describe that body of knowledge concerned with the structure and function of the musculo-skeletal system of the human body. Later the study of the mechanical principles applicable to human movement became widely accepted as an integral part of kinesiology. Kinematics is the geometry of motion, which includes displacement, velocity and acceleration without regard for the forces acting on the body. Kinematics is the branch of biomechanics that is concerned with describing the motion of bodies. Thus kinematics deals with such things as how far a body moves, how fast it moves and how consistently it moves. It is not

concerned at all with what causes a body to move in a way it does. Kinetics is essentially the descriptive geometry of motion with respect to time, ignoring the causes of motion and the concepts of mass, force, momentum and energy. In pure form, kinematics refers to the motion of infinitesimally small mass less particle. However, the kinematics of a rigid body of finite mass may be analyzed if its mass is to be considered at one point. Even a deformal mass, like human body, under some circumstances can be treated as a particle by analyzing the motion of its center of gravity.

Kinematic analyses are important in understanding the mechanisms of athlete's injuries. Kinematics (from Greek *kinein*, to move) is the branch of classical mechanics that describes the motion of objects without consideration of the causes leading to the motion. Biomechanical principles are applied by scientists in a number of fields in addressing problems related to human health and performance. Knowledge of basic biomechanical concepts is also essential for the competent physical education teacher, physical therapist, physician, coach, personal trainer or exercise instructor. An introductory course in biomechanics provides foundational understanding of mechanical principles and how they can be applied in analyzing movements of the human body. The knowledgeable human movement analyst should be able to answer many basic questions related to biomechanics: what are the mechanical principles behind variable resistance exercise machines? What is the safest way to lift a heavy object? Which movement is more/less economical? At what angle should a ball be thrown for maximum distance? From what distance and angle is it best to observe a patient walk down a ramp or a volleyball player execute a service? What strategies can an elderly person or a football lineman employ to maximize stability? 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. In the elite level of competition $1/100^{th}$ of second plays an important role in respect to speed, 1mm plays an important role in respect to distance and height.

Serve

The serve marks the beginning of a rally in volleyball. A player stands behind the baseline and hits the ball, in an attempt to drive it into the opponent's court. His main objective is to make it land inside the court; it is also desirable to set the ball's direction, speed and acceleration so that it becomes difficult for the receiver to handle it properly. A serve is called an "ace" when the ball lands directly onto the court or travels outside after being touched by an opponent.

In contemporary volleyball, many types of serve are employed:

Underhand and Overhand Serve: refers to whether the player strikes the ball

from below, at waist level, or first tosses the ball in the air and then hits it above shoulder level. Underhand serve is considered very easy to receive and is not generally employed in international competitions.

Sky Ball Serve: a specific type of underhand serve, where the ball is hit so high it comes down almost in a straight line. This serve was invented and employed almost exclusively by the Brazilian team in the early 80's. It is now considered outdated.

Line and Cross-Court Serve: refers to whether the balls flies in a straight trajectory parallel to the side lines, or crosses through the court in an angle.

Spin Serve: an overhand serve where the ball gains topspin through wrist snapping.

Floater: an overhand serve where the ball is hit with no spin so that its path becomes unpredictable. Can be administered while jumping or while grounded.

Jump Serve: an overhand serve where the ball is first tossed high in the air, then hit with a strong downward movement of the arm, as in a spike; there is usually much topspin imparted on the ball. This is the most popular serve amongst college and professional teams.

Round-House Serve: the player stands with one shoulder facing the net, tosses the ball high and hits it with a fast circular movement of the arm. Usage of this serve in indoor volleyball is today restricted to a few Asian women's teams.

There are four main components in doing the overhand serve.

1. **The Ball Toss.** Standing in place, take the ball with your weak hand about waist high and hold it in front of your strong arm. The strong arm should be relaxed and straight down. Now practice simply lifting and tossing the ball up to the strong side of your body. The toss should go no higher than five feet over your head. Repeat and repeat until you master the toss. Once you get the toss mastered, mentally envision yourself striking the ball for a successful serve. It is permissable to place your strong hand on top of the ball for a straighter toss is necessary. But for learning the toss, try it without the strong hand holding it.
2. **Arm Swing.** As soon as the ball leaves your tossing hand, lift and draw back your strong arm. This action is very similar to drawing a bow string back in archery. The palm should be facing the floor. As the ball comes down, begin the forward motion with the swinging arm. The ball should be met when the swinging arm is fully extended.
3. **Hand Contact on the Ball.** If you drew a line through the volleyball, the heal of the hand (palm) should make contact slightly under the

line. The extended fingers will slightly contact the ball above the line. Some players want to hit the ball with closed fist for power, although this is wrong, it is permissible for players that are small and weak in strength. Eventually, they will change as they get stronger and more confident.

4. **Foot placement and follow through.** The placement of the lead leg (weak leg) is critical. If the hips open too far, the ball will go downward into or under the net. If the leg swing is too great, it will cause the swinging arm to pull away from contact with the ball. this causes it to go left or right. The lead leg must go straight in the direction of the net. This action helps keep the ball between the antenna's of the net. As the ball is struck and the lead leg goes straight, the back leg (toe) is drug across the court in a follow through. this is important because it helps maintain balance for the skill execution.

This study had been taken to biomechanically analyze the technique of Overhead serve in Volley ball. Sometime, it is very difficult for a human eye to analyze all the movements of various body segments and joints at the same time. So, various instruments like Still Camera, Video Camera, etc are used to analyze the various movements. Further the software is used to assess more specifically the movements. This is a quantitative method which is very accurate but at the same time it is very costly and time consuming.[2,3]. Though considerable numbers of studies have been conducted for the performance enhancement but no such study is done on Indian volleyball before, the researcher made his effort in this direction and attempted to make the understanding of selected variables. It is important to note that many performance get hampered because of faulty biomechanics.

Hypotheses

It is hypothesized that there may be significant relationship between the selected kinematical variables with the performance of the volleyball players in overhead serve.

Procedure and Methodology

Sources of Data

Ten male national players of Volleyball were selected. The age of the selected layers were between 20 to 24 years. The study includes the following selected kinematical variables for analyzing the technique of overhead serve of volleyball-

I. Angular Kinematics

1. Ankle Joint (left)
2. Ankle Joint (right)
3. Knee Joint (left)
4. Knee Joint (right)

5. Hip Joint (left)
6. Hip Joint (right)
7. Shoulder Joint (left)
8. Shoulder Joint (right)
9. Elbow Joint (left)
10. Elbow joint (right)
11. Wrist joint (left)
12. Wrist Joint (right)

II. Linear Kinematics

1. Height of C.G. at moment stance
2. Height of C.G. at moment execution

Criterion Measure

The criterion measure for this study was the performance of the subjects in overhead serves as assessed by Russell-Lange test of volleyball serve.

Video Analysation

Specialized Motion Pro and Simi Machix software were used to analyze the movements of the subjects. Two Digital video cameras were used in order to register the technique of overhead serve.. The sequential photography was also used. A standard motor driven camera i.e. Nikon Model EM., was used to obtain sequences of selected movements during the moment stance and moment execution. From the complete course of the test the subjects were photographed in sagital plane. After obtaining the videography and sequential photography, software analyzation technique was used to measure the entire variables other then the C.G location. For actual results from the used softwares proper calibration was done. An important method for analyzing the height of C.G at selected moments. The stick figures were drawn from the photography by the help of joint-point method as suggested by 'Hay'. The subjects were photographed and videographed in a controlled condition. In Below figures quick snap shot is given while analysis Video of subjects.

Statistical Technique

The product moment correlation (Pearson) was used in order to find out the relationship between selected kinematical variables with the performance of volleyball player's in overhead serve of Volleyball. The level of significance was set at 0.05 level.

Result and Findings

The results of each independent variable of angular and linear kinematic were correlated with the performance of subjects in volleyball serve. Selected moments were stance and execution. The values of correlation of selected angular biomechanical (kinematics) variables i.e. angles of selected joints at selected moments with the performance of subjects in overhead serve are presented in Table 1.

Since the obtained values of coefficient of correlation were less than the required value for o.o5 level of significance, therefore none of the selected angular

Table 1. Relationship of Selected angular kinematic variables with the performance of subjects in overhead serve

S.No	Variables	Coefficient of Correlation	
		Moment Stance	Moment Execution
1.	Ankle Joint (left)	0.380	0.392
2.	Ankle Joint (right)	0.435	0.442
3.	Knee Joint (left)	0.417	0.433
4.	Knee Joint (right)	0.400	0.471
5.	Hip Joint (left)	0.478	0.088
6.	Hip Joint (right)	0.412	0.075
7.	Shoulder Joint (left)	0.234	0.255
8.	Shoulder Joint (right)	0.553	0.546
9.	Elbow Joint (left)	-0.365	-0.193
10.	Elbow joint (right)	-0.531	-0.247
11.	Wrist joint (left)	0.248	0.497
12.	Wrist Joint (right)	0.336	0.411

kinematic variable at selected moments had shown significant relationship with the performance of players in overhead service.

The values of correlation of height of C.G at selected moments with the performance in overhead serve are presented in Table 2.

Since the obtained values of coefficient of correlation were less than the required value for 0.05 level of significance, therefore none of the selected linear kinematic variable at selected moments had shown significant relationship with the performance of players in overhead service.

Conclusion

None of the kinematical variables i.e. Ankle Joint (left), Ankle Joint (right), Knee Joint (left), Knee Joint (right), Hip Joint (left), Hip Joint (right), Shoulder Joint (left), Shoulder Joint (right), Elbow Joint (left), Elbow joint (right), Wrist joint (left), Wrist Joint (right), Height of C.G at moment stance and Height of C.G at moment execution have exhibited the significant relationship

Table 2: Relationship of Selected linear kinematic variables with the performance of subjects in overhead serve

S.No	Variable	Coefficient of Correlation
1	Height of C.G at moment stance	0.488
2	Height of C.G at moment execution	-0.332

with the performance of players in overhead serve. The results have shown that all the selected kinematical variables had insignificant relationship with the performance of subjects in overhead serve in volleyball.

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