# Kinematical Analysis of Overhead Serve in Volleyball by using Motion Analyzing Software

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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 Volleyball. 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 for this study. The age of the selected players was 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 of stance, and Height of C.G. at moment of execution, for analyzing the technique of overhead serve of Volleyball. In the study, motion analyzer software motion pro and simi machix was used to assess 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 players, 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.*

## INTRODUCTION

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

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specialized field. Human being, by nature, is competitive and ambitious for their excellence in all athletic performance. Even, man or a nation wants to show their supremacy by challenging other nations to sweat, 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 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 disciplines. 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 for their contribution to the effectiveness of the technique. Depending upon those variables' contribution 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 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 various movements. Now, the technology has 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 analyzing softwares, in biomechanical research, is getting enriched day by day. The role of videography or cinematography, in biomechanical research, involves 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 Educators, 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 the 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 massless 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.

This study had been taken to biomechanically analyze the technique of overhead serve in Volleyball. 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 various movements. Further, the software is used to assess the movements more specifically. This is a quantitative method which is very accurate; but, at the same time it is very costly and time consuming. Though, considerable numbers of studies have (Beach, 1984; Clark & Clark, 1992) been conducted for the performance enhancement, no such study is done on Indian Volleyball before. The researcher has made an effort in this direction and attempted to make the understanding of selected variables. It is important to note that many performances get hampered because of the faulty biomechanical application.

## HYPOTHESES

It is hypothesized that there may be significant relationship between the selected kinematical variables with the performance of Volleyball players, in Overhead Serve.

## METHODOLOGY

### Sources of Data

Ten male national players of Volleyball were selected. The age of the selected players was 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, with speed of 60 frames per second, 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 than 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 with the help of joint-point method, as suggested by 'Hay'. The subjects were photographed and videographed in a controlled condition.

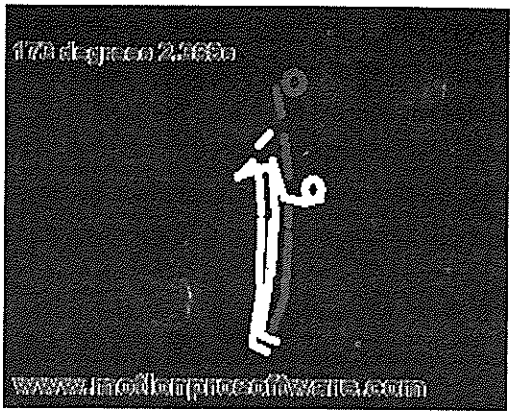

**Fig. 1 : '2 Dimentional' lateral view of subject (moment stance) for analysis of selected kinematical analysis, under motion analysis software.**

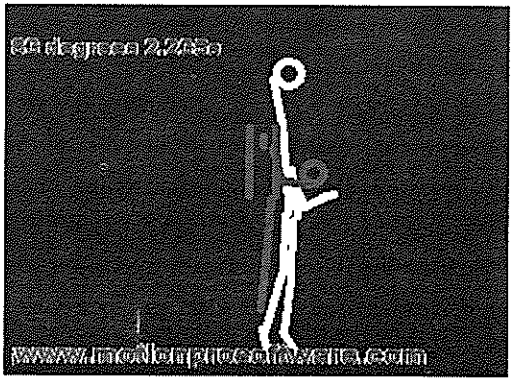

**Fig. 2 : '2 Dimentional' lateral view of subject (moment execution) for analysis of selected kinematical analysis, under motion analysis software.**

## 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 players in overhead serve of Volleyball. The level of significance was set at 0.05 level.

## RESULT & DISCUSSION

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.

**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 |

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 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.

**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 |

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 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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