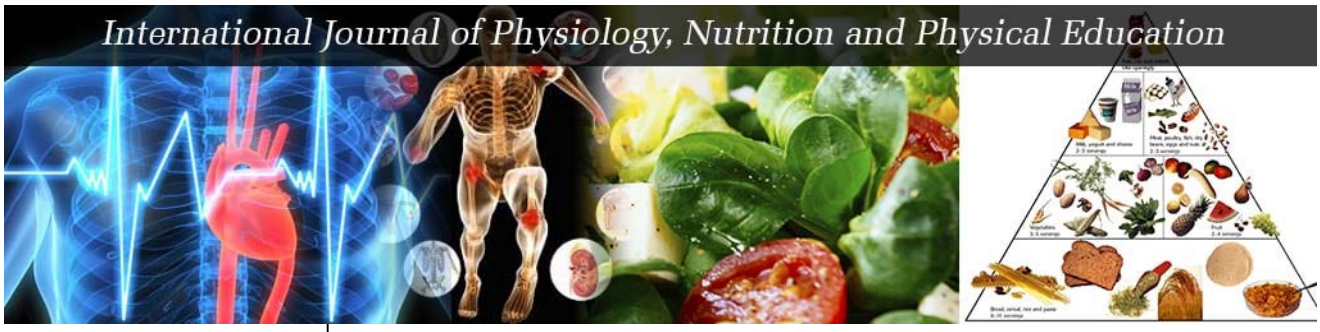

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Ajay Pratap
M. P. Ed. Scholar, Amity University, Uttar Pradesh, India

Dr. Pankaj Pandey
Asst. Prof., Amity University, Uttar Pradesh, India

Correspondence
Ajay Pratap
M. P. Ed. Scholar, Amity University, Uttar Pradesh, India

Kinematic analysis of backhand drive in tennis

Ajay Pratap and Dr. Pankaj Pandey

Abstract
The point to take up this study is to investigate kinematic analysis of backhand drive in tennis. A total of five junior national level tennis players were selected for this study. No statistical analysis was applied since simple subjective analysis (elgon method) was done on the basis of the data obtained from the photographs. Data analyzed through elgon point method and result showed that the subjects who keep the elbow away from the body hit the ball with good linear velocity and also center of gravity falls within the base for maintain the balance

Keywords: Backhand, Tennis, Kinematic, Drive

Introduction
In early era most of the coaches and trainer depend upon the fitness level of the athlete , they only believed in fitness drills and training to enhanced the performance of the players but only the fitness training is not the parameter to enhanced the performance , apart from the technique and fitness other allied factors also influenced athlete's performance. Tennis, initially called lawn tennis and as per the historian record Major Walter who was the British army man invented this game in the year 1873. Tennis is sport which is played on different surfaces like grass, clay, and synthetic. A racket sport needs variety of fitness abilities, techniques, tactics and strategies. The faster responses requires in tennis because ball travels faster around the court. Kinematics is the branch of mechanics which defines the motion of points, bodies and systems of bodies without consideration of the masses of neither those objects nor the forces that may have caused the motion. In sports and games, analysis of motor skills occupies an important role for understanding, interpreting and improving motor skills. Analysis of motor skills is seen as a proficient and scientific process for analyzing the skill performed by an athlete on the basis of principles and laws of mechanics considering the biological limitations of human body. Zhang (2013) He opined that in order to better tennis forehand drive we need to understand technical motion analysis.

Methodology
Selection of subjects: Five male junior national level tennis players have been taken as subjects of the study. The age of the subjects were ranged between 12 to 16 years. The purpose of the study was explained and they were motivated to put their best effort during each attempt.

Selection of kinematic variables
For the present study the following variables were taken.
1. Centre of gravity
2. Angles at various joints
a. Wrist joints
b. Elbow joints
c. c.knee joint
d. ankle joint

Analysis of data: The complete analysis of the variables was carried out with the help of experts in the fields of sports biomechanics. No statistical analysis was applied since simple subjective analysis was done on the basis of the data obtained from the photographs.

ResultandDiscussion

Thekinematicanalysisof backhand drive in respect to subject 1 has been explained as follows

Fig 1: Subject- 1

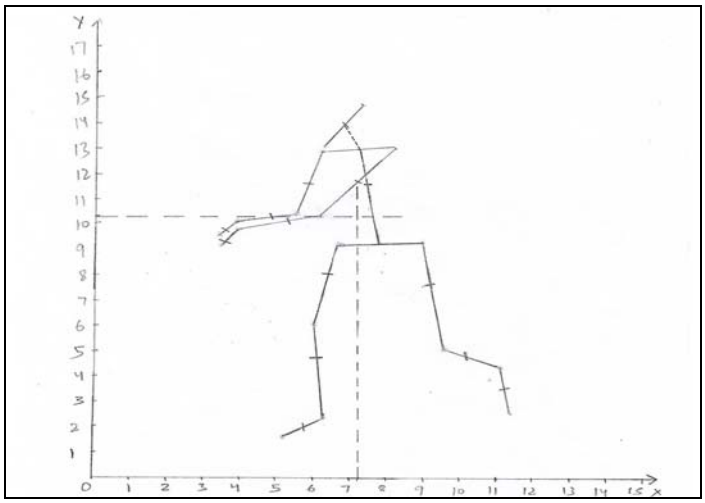

Fig 2: subject-1

Subject 1: Using the X and Y coordinates of 14 segments of the body, the CG was located with the help of segmentation method. The center of gravity has been shown in the elgon in fig. 2 it is clearly visible that CG of the subject lies within the base which reveals that he is properly balanced to execute the drive. From the fig. 2 it clearly visible that when the drive is being executed the subject would gradually move from rear to front leg. However at the time of execution moment that is the moment when the ball contacts with the head of the racquet, the subject has flexed the elbow which shortened the moment arm radius and this will result in increased angular acceleration of arm and he will able to hit the ball with good racquet head speed.

The kinematic analysis of backhand drive in respect to subject 2 has been explained as follows

Fig 3: subject-2

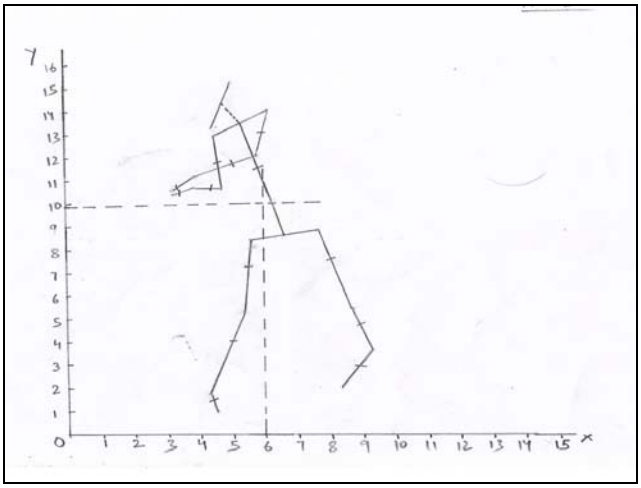

Fig 4: subject-2

Subject 2: The kinematic analysis of subject 2 in respect of the selected biomechanical variables shows that his technique is slightly different from subject one. He transfers his body weight on the right foot so that he can add more power to his backhand drive. His CG falls within the base which shows good balanced position to play the stroke. The contact of the racquet with the ball is far ahead and it should have been made slightly behind so that greater linear velocity has been imparted to the ball.

The kinematic analysis of backhand drive in respect to subject 3 has been explaiend as follows

Fig 5: subject-3

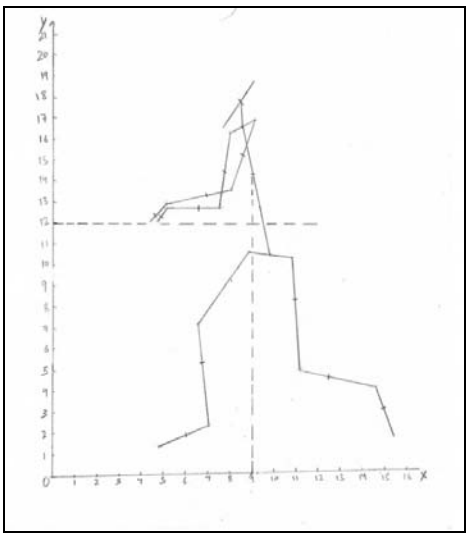

Fig 6: subject-3

Subject 3: From the elgon method it is considered that the overall techniques of subject 3 are fairly good. He had properly balanced to execute the backhand drive because his CG falls within the base. The contact of the racquet head and ball is at the right moment. He is also shifted his body weight on the right foot so that he able to executed more power to his stroke.

The kinematic analysis of backhand drive in respect to subject 4 has been explaiend as follows:

Fig 7: subject-4

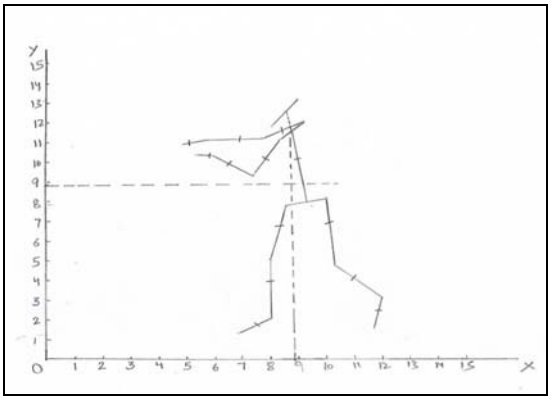

Fig 8: subject-4

Subject 4: The elgon prepared using joint point method and identification of CG using segmentation method shows that the subject 4 CG is within the base which has given him good balance while hitting the backhand drive. His contact with the ball is good because he is hitting the backhand away from his body with which he can place the ball with good linear velocity. He is also coming on toes which give him a good balance so that he can ready for the next shot.

The kinematic analysis of backhand drive in respect to subject 5 has been explaiend as follows:

Fig 9: subject-5

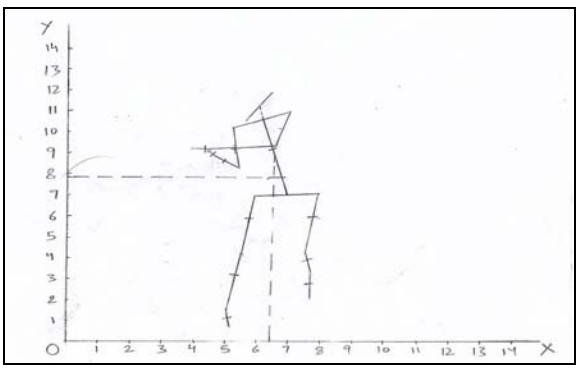

Fig 10: subject-5

Subject 5: Elgon prepared by using joint point method shows that subject 5 elbows are closer to the body and more flexed by which he can't execute more power to the shot. Identification of CG using segmentation method shows that CG is within the base which helps him in getting good balance. He is also uplifting his left toe so that he can easily rotate his trunk to give good direction to the ball.

Table 1: The overall result of the study in tabular form for all the five subjects on "BACK HAND DRIVE" is summarized in this table

S. No	Variables (Unit)	Subjects				
		1	2	3	4	5
1	Angle at left elbow joints (degree)	150	127	115	162	112
2	Angle at right elbow joints (degree)	122	84	102	109	53
3	Angle of Left shoulder joints (degree)	40	42	48	88	40
4	Angle at right shoulder joints (degree)	70	10	32	60	10
5	Angle at hip joint with left leg (degree)	180	180	165	174	148
6	Angle at hip joint with right leg (degree)	146	152	115	149	157
7	Angle at left knee joint (degree)	122	180	102	130	150
8	Angle at right knee joint (degree)	150	160	122	160	180
9	Angle at left ankle joint (degree)	120	110	128	110	169
10	Angle at right ankle joint (degree)	102	130	98	110	155

Conclusion

Within the delimitations of the present study the following conclusions are drawn:

1. Location of position of CG with the help of elgons prepared with help of CG using segmentation method it is clear to be properly balanced while hitting the backhand drive.
2. From the elgons of the players slight variations have been noticed in assuming the proper position while hitting the backhand drive due to variation of height of the incoming ball.
3. Variations were also have been noticed mainly in the elbow joints of the subjects this is because of the point of contact of the ball with respect to the body. More flexion at the elbow joint reveals closer point of contact of the ball and vice versa.
4. Variations were also observed in the knee joint of the subject. It is concluded that more flexion with less angle at knee joint shows that the height of the incoming ball is low. More angle at knee joint revealed more extension of the knee which shows that the height of the incoming ball is slightly higher from the ground.

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