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Relationship of Selected Kinematic Parameters with the Performance of Slice Service in Lawn Tennis

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***Abstract - Aim:** Aim of the present study was to identify the relationships between linear, angular kinematic parameters and slice service performance.*

***Methods:** Five (N=5) male tennis players from Guru Nanak professional tennis academy Chandigarh with Height;176.58±4.52, Weight;72.36±7.26, and Age;22.30±1.52 were chosen for the study.*

***Results:** linear kinematic variable's (Centre of gravity) mean and SD reported was 117.52±10.46, whereas in case of angular kinematic variables, it is evident that Mean was maximum for Shoulder Joint angle (179.60) and minimum for Ankle Joint angle (135.20).*

***Conclusion:** Based on the findings of the current empirical investigation, it is possible to draw the conclusion that a similar study can be carried out with a larger sample size and more experienced tennis players in terms of technical and performance ability*

***Keywords** - linear kinematic parameters, angular kinematic parameters, slice service performance*

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INTRODUCTION

Tennis has been faster and more dynamic throughout time, necessitating more strength, speed, and power to execute faster serves and strokes. The serve is a key stroke in tennis since it is the only one that players can completely control and, if done effectively, can help the serving player win points right away. The most potent and crucial shot in tennis is the serve, which is the only stroke completely under the player's control. The racket speed is raised near impact after the toss-up as the power is transferred from the bottom to the upper portion of the body via a whole-body movement chain (Kibler, 2009).The serve is biomechanically split into three phases: the preparation phase, the acceleration phase, and the follow-through phase (Kovacs M).For a tennis serve to be effective, energy must be generated and moved through these three stages.Serving with a knee bend of more than 10 degrees has been shown to enhance serve speed by 15 mph and reduce upper limb kinematics by around 25% (Elliott B, 2003).

In a tennis serve, the kinematic chain begins with plantar flexion of the feet and ends with the racquet to explain the proximal-to-distal motion produced by the body parts. The speed summation principle is a crucial performance result connected to the kinematic chain (Kibler WB, 2001).The service speed and winning points percentage have been found to be highly correlated. According to (Fett, 2017) and (Kramer, 2017), the most accurate on-court indicator of a player's performance is their maximum service speed.

(Caroline martin, 2012)studied about "Professional tennis players' serve: correlation between segmental angular momentums and ball velocity" and determined Significant association between mean angular momentum of the trunk and ball velocity about the transverse and anteroposterior axes for the MEF (instant of maximal elbow flexion)–RLP (instant when the racket reached its lowest point),

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RLP–MER (instant of maximal external rotation of the shoulder), and MER–BI (ball impact) phases.

Availability of literature regarding relationship between linear and angular kinematics with slice service in tennis was found to be scarce, whereas technique of slice service is predicted to be dependant of joint angles as well as centre of gravity during contact of ball and racquet by the researcher. Therefore, the purposes of this study were: (1) to identify the relationships between linear kinematics and slice service performance; (2) to identify the relationships between angular kinematics and slice service performance. Tennis players may be able to improve their serve performance by following the training and coaching recommendations provided by an understanding of these relationships..

METHODS

Participants

Five (N=5) male tennis players from Guru Nanak professional tennis academy Chandigarh with Height;176.58±4.52, Weight;72.36±7.26, and Age;22.30±1.52 were chosen for the study.

Kinematic Parameters assessment

Selected linear kinematic parameters (Height of center of gravity) and angular kinematic parameters(shoulder joint, Elbow joint, Hip joint, knee joint, Ankle joint) of dominant side were assessed in the standardized tennis court. All study subjects participated in a familiarization session that was held the day before the test. Each subject was instructed to stretch all significant muscles involved in the slice service movement pattern for at least 15 minutes prior to the testing. Following a warm-up, subjects were instructed to slice serve. Performance of slice service in tennis was assessed on the basis of Hewitt service test. Each subject was given ten trials for service placement test. However, if a subject gets zero point for any service, he is given extra trail for completion of the test. Execution of the slice serve was supervised by a competent coach or tennis specialist. There was a 30-second recuperation period in between each trial. For kinematic assessment an average value of 10 trails in which maximum and minimum score of for a single trail were 6 and 1 respectively.

Filming protocol

A high speed Canon Legria HF S10 camcorder was used to record the slice serve performance for the kinematical data, operating at 1/2000 with a frame rate of 120 frames per second. The players' dominant side was located at a distance of 6 metres from the camcorder, which was mounted at a height of 1.45 metres above the surface of court. Video clips were taken during the middle 50% of the execution of the movements during slice service. To reduce inaccuracy, reflective indicators were also applied to the joints, and references were introduced both vertically and horizontally. Using the kinovea software, the recorded video footages were downloaded, cut, and altered. The same analysis programme was used for digitization, smoothing, and analysis as well.

Statistical analysis

IBM SPSS version 20 was used for all statistical analyses (IBM, New York, USA). The descriptive statistics (mean and standard deviations) are presented. For computing relationship between selected kinematic parameters and slice service performance, pearson's correlation was used at 0.05 level of significance.

RESULTS

In order to analyze the relationship of selected linear and angular kinematic variables with slice service performance at moment contact, Product moment correlation was employed and description of Mean, SD for selected variables in presented in table1.

Table 1: Mean and Standard Deviation of Linear and Angular Kinematic Variables of Slice Service Performance at the Moment Contact

Variables	Mean	SD	N
Slice service performance	36.40	6.98	5
Centre of Gravity	117.52	10.46	
Shoulder Joint Angle	179.60	2.60	
Elbow joint Angle	167.00	8.00	
Hip Joint Angle	157.00	9.69	
Knee Joint Angle	171.00	7.68	
Ankle Joint Angle	135.20	5.93	

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From table 1, In case of selected linear kinematic variable's (Centre of gravity) mean and SD reported was 117.52±10.46, whereas in case of angular kinematic variables, It is evident that Mean was maximum for Shoulder Joint angle (179.60) and minimum for Ankle Joint angle (135.20). SD was maximum and minimum for Hip Joint angle (9.69) and Shoulder Joint angle (2.60) respectively. Mean and SD for slice service performance was 36.40±6.98 for tennis players.

Table 2: Relationship between selected Kinematic Parameters and Slice service performance at moment contact

	Center of Gravity	Angleof Shoulder Joint	Angle ofElbow Joint	Angle ofHip Joint	Angleof Knee Joint	Angle ofAnkle Joint
Slice service performance	0.683	0.066	-0.528	0.347	-0.811	-0.304
N	5	5	5	5	5	5

*Correlation is significant at the 0.05 level (2-tailed).

From table 2, It is evident that none of the variable among selected kinematic parameter had shownsignificant correlation with slice service performance at moment contact at 0.05 level.

DISCUSSION

The present study had dual objectives (1) to identify the relationships between linear kinematics and slice service performance; (2) to identify the relationships between angular kinematics and slice service performance.In present study, It was hypothesised that there would be a significant relationship between linear and angular kinematic parameters with slice service performance.But the results of the study indicated absence of significant relationship between linear kinematic parameters and slice service performance as well as angular kinematic parameters and slice service performance. Hence null hypothesis was failed to be rejected and the potential reason for insignificant differences might be due to players intermediate level oftechnical proficiency and playing level which had affected slice service performance in terms of scores obtained in 10 trails as the mean score was 36.40±6.98 which was an average performance as the possibility for highest score by the players in 10 trails could have been 60, provided each trail had been executed perfectly.

CONCLUSION

Based on the findings of the current empirical investigation, it is possible to draw the conclusion that a similar study can be carried out with a larger sample size and more experienced tennis players in terms of technical and performance ability.

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