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Kinematical Analysis of Forehand and Backhand Smash in Badminton

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Abstract:

In badminton, it demands excellent physical fitness and good motor coordination for the development of sophisticated racquet movement. This study aims at identifying the difference of forehand and back hand smash performed by elite male badminton players during North-Zone intervarsity at A.M.U, Aligarh 2009-2010. The parameters to study were focused on upper arm, forearm and wrist segments. Silicon Coach Pro-7 motion analysis software and two legria Canon SF-10 cameras system were used to record and analyze the performance of the subjects. Six male participants served as the subjects. Results of the study shows that there is no significant differences exist between forehand and back hand smash in badminton player as flight angle, shoulder angle, elbow angle and angular velocity of wrist joint. Whereas significance differences exist between forehand and back hand smash in badminton players as shuttle velocity, contact height, racket angle, wrist angle, angular velocity of shoulder joint and elbow joints. Appropriate coaching cues are devised to assist coaches and players in assessing and improving performance.

Keywords: badminton, biomechanics, power strokes, joint actions

1. Introduction:

The beginnings of Badminton can be traced to mid-18th century British India, where it was created by British military officers stationed there.Early photographs show Englishmen adding a net to the traditional English game of battledore and shuttlecock. Being particularly popular in the British garrison town Poona (now Pune), the game also came to be known as *Poona*. Initially, balls of wool referred as ball badminton were preferred by the upper classes in windy or wet conditions, but ultimately the shuttlecock

stuck. This game was taken by retired officers back to England where it developed and rules were set out.The badminton skills are divided into two types, the forehand grip and the backhand grip. Previous studies focused onthe description of forehand strokes of Badminton players, such as, Poole, 1970; Adrian, 1971; and Gowitzke, 1979, theyused 2D model to describe the smash strokes. Tang, et al, 1995 who used 3D model to measure the rotation of theforearm and the wrist, Tsai, et al, 1996, compared the smash and the jump smash of elite players with 3D model. Thepurpose of this study was to analyze the kinematics variables of the elite badminton players in North-Zone Intervarsity 2009-2010 at Aligarh Muslim University, Aligarh when they were performing the forehand and the backhand smashes.

2. Methodology:

2.1 The Subjects:

06 male North-Zone inter-varsity badminton players were used as subjects. Their age, height, and body mass are 21.33±1.67yrs, 1.68±0.07 m, and 64.26±8.37 kg, respectively (mean ± SD). A successful trial forhand and back hand smash was that the subject would hit the shuttle traveling down the line through the opposite court, and landed to the location that no more than 80 cm from the side line.All the selected players have readily agreed and volunteered to act as subject for the study during North-Zone intervarsity 2009-2010 at A.M.U Aligarh.A t-test and the Pearson product moment correlation were used to test the selected variables at .05 significant levels.

2.2 Videography Techniques

The video graphic technique was further organized in to two sections. These are:

(i) Video Graphic Equipments and Location

(ii) Subject and Trail Identification

2.2.1VediographicEquipments and Location

The subject's drop shot and cut shot motion were recorded using LegariaCanon SF-06, 8.1 Mp video camera in a field setting operating at a nominal frame rate of 50 Hz and with a shutter speed of 1/2000 s *and at 60fps* camera were set up 06 m away from the subject in a field setting. The camera was set-up on a rigid tripod and secured to the floor in the location.

The camera was positioned perpendicular to the sagittal plane and parallel to the mediolateral axis (camera optical axes perpendicular on the sigittal plane) as their drop and cut shot arm giving approximately a 90^{o} between their respective optical axes. The camera was also elevated to 95 cms and tilted down in order to get the image of the subject as large as possible while that all points of interested remained totally within

2.2.2 Subject and trail Identifications

To identification the subject in the video graph, each subject was given with a numbers. as to distinguish in the data recorded. For identification purposes of a best performance, the trails were viewed on the computer system and exarter on the subject (thrower) demarketed the trail for the data acquisition.

2.3 Data reduction:

After video recording sessions were over, the video recording was loaded in to the researcher's personal computer (PC) for trail identification. The identified trails were played with the help of Silicon Coach Pro-7 software to make separate clips of each badminton player. The separate clips were then opened on to the Silicon Coach Pro-7 software. The software has provision to analyze the angles, displacement, time, speed, acceleration and number of frames as in the feature.

3. Result:-

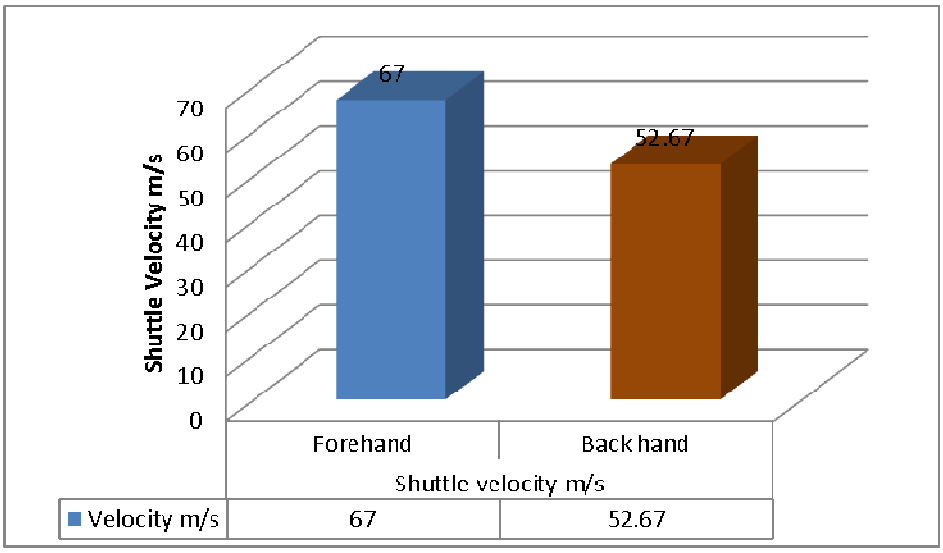
The duration time of contact in the forehand smash (0.004 sec) was as long as the time of the contact time in the backhand smash. The initial velocity of the forehand smash was 67.00 m/s, the initial velocity of the backhand smash was 52.57 m/s. The variables of forehand smash and backhand smash during contact are shown in table 1 and graph 1, 2 and 3 as followed.

Table: 1 kinematics differences between forehand and backhand smash of badminton players.

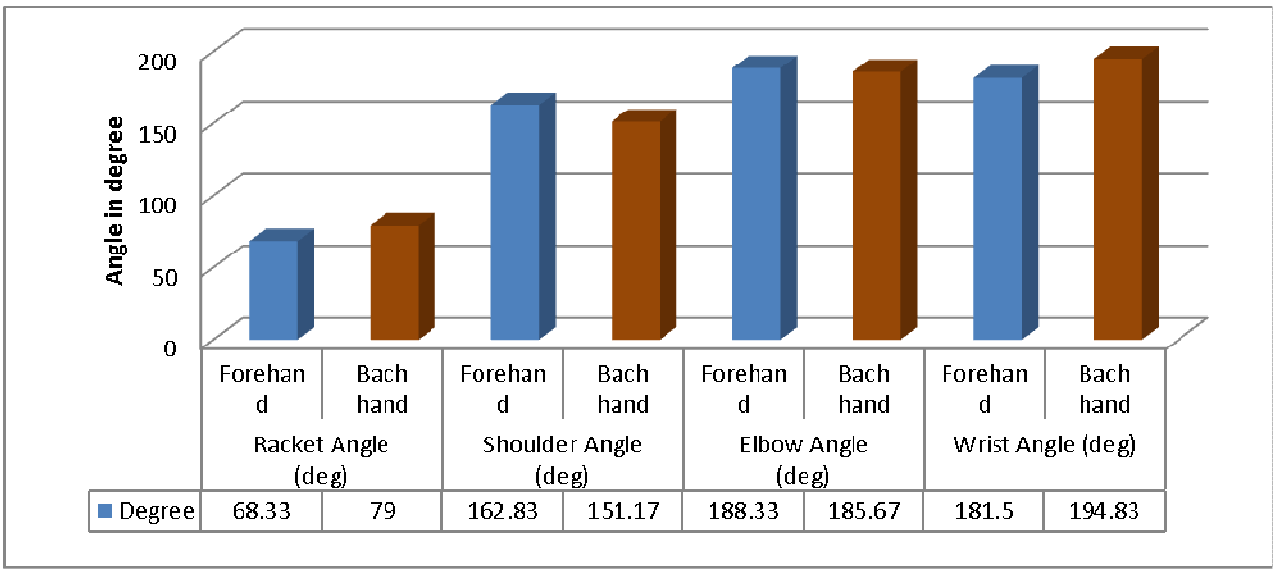
Variable	Group	Numbers	Mean	S.D	't' value
Shuttle velocity (m/s)	**FH**	06	67.00	6.32	4.52*
	BH	06	52.67	4.50	
Flight Angle (deg)	**FH**	06	3.83	0.75	0.00
	BH	06	3.83	0.41	
Contact Height(m)	**FH**	06	2.39	0.08	3.75*
	BH	06	2.24	0.06	
Racket Angle (deg)	**FH**	06	68.33	5.21	3.59*
	BH	06	79.00	5.10	
Shoulder Angle (deg)	**FH**	06	162.83	11.69	2.25
	BH	06	151.17	5.04	
Elbow Angle (deg)	**FH**	06	188.33	8.55	0.62
	BH	06	185.67	6.09	
Wrist Angle (deg)	**FH**	06	181.50	9.35	3.15*
	BH	06	194.83	4.45	
Angular Velocity of shoulder joint (deg/s)	**FH**	06	605.50	71.11	12.94*
	BH	06	229.33	3.56	
Angular Velocity of elbow joint (deg/s)	**FH**	06	728.17	8.77	7.39*
	BH	06	872.00	46.85	
Angular Velocity of wrist joint (deg/s)	**FH**	06	1718.50	254.81	3.01
	BH	06	1393.70	72.00	

*significant difference level at(0.05)FH= Forehand smash BH=Backhand smash

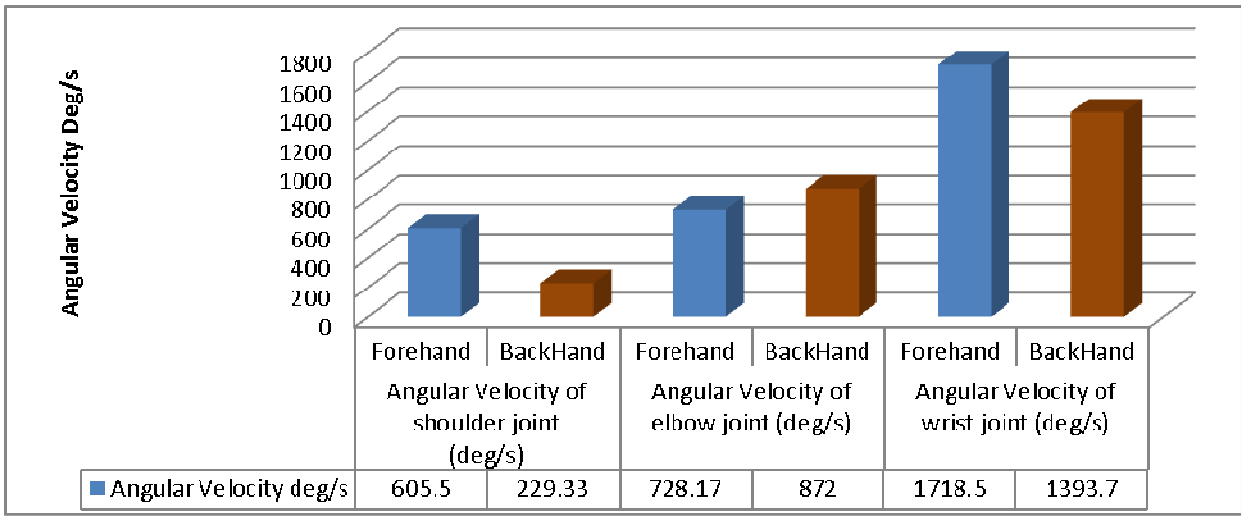
Table't' at (0.05) =2.78



Graph 1. The Shuttle Velocity of the forehand and backhand smash.



Graph 2. The Angle of the segments during performed forehand and backhand smash.



Graph 3. The angular velocity of the segments during performed forehand and backhand smash.

Table-1shows that there is no significant differences exist between forehand and back hand smash in badminton player as flight angle, shoulder angle, elbow angle and angular velocity of wrist joint. Whereas significance differences exist between forehand and back hand smash in badminton players as shuttle velocity, contact height, racket angle, wrist angle, angular velocity of shoulder joint and elbow joints.

Table: 2 Relationship between different kinematics of forehand and back hand smash.

Variable	CONHFH	CONHBH	WANVFH	WANVBH
SVFH	0.66	-0.05	0.93**	0.18
SVBH	0.51	0.22	0.75	0.11

**significant difference level at (0.01)

SVFH= Shuttle velocity forehand smash SVBH= Shuttle velocity backhand smash

CONHBH= Contact height forehand smash CONHBH= Contact height backhand smash

WANVFH= wrist angular velocity forehand smash WANVBH= wrist angular velocity backhand smash

4. Discussion / Conclusions

The results of the study showed that the forehand smash was significantly greater as compare to backhand smash in the initial shuttlevelocity and the contact height of the shuttle. There was a positive correlation between shuttle velocity and the wrist angular velocityin the backhand smash and highly correlation between shuttle velocity and wrist angular velocity in the forehand smash. And there was a negative correlation between the shuttle velocity of forehand smash and contact height in backhand smash. This is followed by accelerating the racquet forward and upward principally by medially rotating the shoulder, and pronating the radio-ulnar joints (Gowitzke and Waddell, 1977, 1979). In addition, it should be noted that use of a flexed elbow during the shoulder rotation portion of the stroke, maximizes the contribution of the shoulder action to the stroke. As well, a marked angle between the racquet and the forearm maximizes the contributions of radio-ulnar pronation. The angular velocity pattern at the contact of the forehand smash and the backhand smash were similar shoulder greater than elbow and elbow greater than wrist .it obeyed the role of the kinetic chain.

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