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Analysis of Arm Movement in Badminton of ForehandLong and Short Service

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Abstract

The Badminton, in respect to shuttle velocity, is one of the fastest racket sports along with Long Tennis. The ability to respond quickly and effectively to a constant changing environment is a key factor to successful performance in addition service plays a vital role in winning a point. Thus, the study was proposed to analyse arm movements of six male university players of long and short services. The data was collected during competition situation. The biomechanical variables and segmental variables of upper extremities were- shuttle velocity, shuttle height at contact, shuttle attaining maximum height, shuttle angle, wrist angle, elbow angle and shoulder angle. The mean age, body height and body weight were reported as (20.83±1.72) years, (167.13±7.06) cm and (59.00±3.68) kg respectively. Canon Legria HF S10 Comcorders operating at 60 Hz was used to record the movement. The identified clips were analyzed with the help of "Silicon Coach Pro7" motion analysis software. The result of study revealed that there were significant differences between forehand long and short serve in elbow angle, shuttle height at contact and shuttle attaining maximum height at 0.05 level of significance.

Key-Words: Biomechanical, Segmental, Forehand, Long Service, Short Service, Shuttle Velocity.

1. Introduction:

The beginning of Badminton can be traced to mid 19th century British India, where, it was played by British military officers. Being popular in the British Garrison town Poona, it is also being known as Poonai. But ultimately the game was taken by retired officer back to England where it was developed and rules were set. Badminton is one of the most popular racket sports in the world. The Badminton is one of the fastest racket sports in accordance with shuttle velocity along with Long Tennis and Basketball (Kollath, 1996; Tsai & Chang, 1998). The ability to respond quickly and effectively to a constant changing environment is a key factor of successful performance. The badminton encompass various skills- long service, short service, drop shot, overhead smash forehand smash, backhand smash, etc. To start the game, most commonly used skills are long serve and short serve and to an extend determines the control of the game. Although, badminton is foremost racket sports, even then, there is still scanty of scientific research in comparison to other sports such as swimming, soccer and athletics.

The previous studies revealed that there are relatively few scientific investigations on the execution of badminton forehand and backhand. However, some studies have been done on smash (Poole, 1970; Tang 1995; Tsai 1998), drop shot (Tsai 2001) and power stroke (Gowitzke 1986, 1991 and 1991). Along with these studies, there were few descriptive studies focused on arm movement during forehand smash (Elliott, 1995; 1996; Springing, 1994; Tang, 1995). They have analyzed movements using Direct Linear Transformation (DLT) on images recorded by high speed cameras. They concluded that pronation of the radio-ulna joint were the most significant with the largest range and the shortest time among the three rotations of the upper limb. They revealed that the shuttlecock velocities were significantly higher for the elite players and flight trajectory of shuttlecock in smashes were significantly steeper for the elite players.

The main purpose of this study is to identify the key contribution of upper extremity- wrist, elbow and shoulder angle to the speed of the shuttlecock in badminton forehand services. In order to identify the contribution of arm movement in badminton long and short serve must be systematically observed and described. The rotation of the upper and lower arm and its role to the speed of the racket and the shuttlecock must be accurately quantified.

Therefore, the present study will be beneficial for the sports scientists, badminton coaches and players to study the applied mechanics and their effect involved in the forehand and backhand services. This will add knowledge and information to enhance the performance of players in badminton.

2. Methodology:

The subject selected for the present study was six male Badminton players from final match of‘North Zone Intervarsity Badminton Tournament’, organized at Aligarh Muslim University, Aligarh in 2010. The mean age, body height and body weight were reported as 20.83 years (±1.72), cm (167.14±7.06) and kg (59.0±3.68) respectively. All subjects in the study were right handed badminton players. They were healthy and don’t had any injury reported within the last year. For the acquisition of kinematical data, each subject’s one successful forehand long and short service motion were recorded and selected for this study using Canon Legaria HF-S10, 8.1 mp (mega-pixel) video cameras in a field setting operating at a nominal frame rate of 60 Hz and with a shutter speed of 1/2000 s and at 120fps. The camera was set-up on a rigid tripod and secured to the floor in the location at a distance of 8 meter from the point of service position of forehand long and short service. The cameraswere positioned perpendicular to the sagittal plane and parallel to the mediolateral axis (camera optical axes perpendicular on the sigittal plane) as their forehand long and short service arm giving approximately a 90^o between their respective optical axes. The cameras were 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 within one frame. The recorded video footages were downloaded, slashed and edited by using the downloaded version of STHVCD55 software. Digitization, smoothing and analysis of biomechanical variables and segmental anglesusing the ‘Silicon Coach Pro7’ motion analysis software.

The kinematic variables selected were identified as the- shuttle velocity (SV), shuttle height at contact (SHC), shuttle attaining maximum height (SMH), shuttle angle (SA), wrist angle (WA), elbow angle (EA), shoulder angle (SA) and number of frames were analysed with the help of the software. The numeral data of the variables were acquired by digitizing video data with the help of software (Silicon coach pro 7). The mean and standard deviation were computed for different variables of both forehand long and short services. The independent't-test' was used to determine the difference between the selected variables of forehand long and short services, further the level of significance was set at 0.05 significant level. All statistical procedures were conducted using the SPSS 16.0 software at 0.05 level of confidant.

3. Result:

The results highlight the differences in movement pattern between the forehand long and short services. There were significant differences between forehand long and short services in relation to elbow angle, shuttle height at contact and shuttle attaining maximum height at 0.05 level of significance. The wrist angle of short service has higher mean value than long service (215>213), but there is high variation in forehand short service than long service.

Table-I

The Mean, Standard Deviation and Calculated t of Biomechanical variables and Segmental angle of forehand long and short service.

Variables	Groups	Mean	Mean difference	SD	Calculated 't'
WA (deg.)	Short Serve	215°		9.17	0.17
	Long Serve	213°	2	17.69	
EA (deg.)	Short Serve	133.67°		6.81	3.25*
	Long Serve	148°	14.33	3.46	
SA(deg.)	Short Serve	41°		17	0.48
	Long Serve	46.33°	5.33	9.29	
SV (m/s)	Short Serve	41.11		25.03	1.59
	Long Serve	69.32	28.21	17.71	
SHA (deg.)	Short Serve	46°		15.62	0.55
	Long Serve	51°	5	2.65	
SHC(m)	Short Serve	1.14		0.05	10.01*
	Long Serve	0.79	0.35	0.04	
SMH(m)	Short Serve	2.19	1.96	0.09	15.06*
	Long Serve	4.15		0.21	

*significant difference level at(0.05)

Table 't' at (0.05) =2.78

WA = Wrist angle, EA = Elbow angle, SA = Shoulder angle, SV = Shuttle velocity, SHA = Shuttle angle. SHC= Shuttle Height at Contact, SMH= Shuttle attaining Maximum Height.

On the other hand, the result outcome revealed that there is no significant difference between forehand long and short service to wrist angle, shoulder angle, shuttle velocity and shuttle angle. The mean value of all variables of forehand long service is higher than short service except wrist angle and shuttle height at contact. The mean of both groups (long and short services) in relation to wrist angle is nearly same. But, table-I revealed that there is great variation in all variables. Forehand long serve has more variation than short serve in relation to wrist angle and shuttle attaining maximum height and forehand short serve has more variation than long serve in relation to elbow angle, shoulder angle, shuttle velocity, shuttle angle and shuttle height at contact.

4. Discussion:

The present study aimed to determine the individual contribution of arm movement in upper extremities- wrist, elbow and shoulder angle with the kinematic variables- shuttle velocity, shuttle angle, shuttle height at contact and shuttle attaining maximum height during the execution of forehand long and short services in badminton. The result showed that there were significant differences between long and short service in elbow angle, shuttle height at contact and shuttle attaining maximum height. The result corresponds slightly with the study of Kuei et al (2002). They analyzed the performance of three backhand overhead strokes- smash, clear and drop. The selected kinematic variables were shuttle velocity, flying angle, contact height and racket angle along with various segmental angle and angular velocities. According to Townend- it may be due to use of more arm muscles (Biceps and Triceps) and shoulder muscles (Deltoid and LattismusDorsi).

The result of present study also supports the study of Chien-Lu Tsai et al. Their study of biomechanical analyse of EMG activity between smash and drop shot of selected biomechanical variables: shuttle velocity, shuttle angle and time of contact along with segmental angles of extremity and angular velocity. The study revealed significant difference between the smash and drop shorts in elbow angle. It may be due to changes in response time by hitting the ball (shuttle) earlier or later in service can produce changes in elbow angle. Shim et al. (2005) also found response time during live movement or performance was significantly faster than ball projected from a machine. In contrast, no significant difference were evident in wrist angle, shoulder angle, shuttle velocity and shuttle angle variables in both groups.

5. Conclusion:

Considering the scope the limitations and the result of the study, concludingling we can say that the all joints (wrist, elbow and shoulder) angles have an important role to performed different types of service (forehand long and short service) in badminton. The elbow joints angles were found to be significantly influence the shuttle velocity at both forehand long and short service. The joints angles were found to significantly influence the shuttle velocity at forehand long and short service in badminton. The shuttle angle and shuttle maximum height during service were found significant mean difference between forehand long and short service. On the basis of result obtained, it is concluded that there were significant differences between forehand long and short services in relation to elbow angle, shuttle height at contact and shuttle attaining maximum height.

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