KINEMATICAL ANALYSIS OF TWO DIFFERENT FOREHAND BADMINTON DROP SHOTS TECHNIQUES

Wei-Cheng Liao, Kuang-Min Pan, Yi-Chang Hsueh, Chien-Lu Tsai
Department of P. E., National Taiwan Normal University, Taipei, Taiwan

The purpose of this study was to compare the kinematics variables between badminton forehand regular and reverse slice drop shots. The participants were eight elite male players. Eight Vicon Motion T20s System cameras (300Hz) were used to record the 3D kinematic data, which were computed by Visual 3D software. All the variables were tested by Wilcoxon rank analysis of variance nonparametric statistical test with the significant level at α = .05. The results showed that there was significant difference between the two forehand drop shots in the racket pan angle. The strategy of two drop shots seems different. That might because the reverse slice drop was with greater shoulder abduction movement than the regular drop shot. The players performed reverse slice drop shot might because that the abduction movement was similar with the smash.

KEY WORDS: biomechanics, reverse, slice, overhead.

INTRODUCTION: Badminton is very popular in the world especially in the Asia. Among all the badminton skills, the forehand overhead stroke(figure 1) is the classical technique of the badminton and it is more agressive than other strokes. The badminton forehand overhead technique can be devided into several techniques, such as the clear, the smash and the drop shot. The players should carry out the different techniques to control the displacement route of the opponent's. The motive of the drop shot is to flap the shuttle downward just across the net and make the opponent to move more distance forward to the net and become passive in the game. The previous studies had mentioned the different forehand overhead strokes. Such as, Poole (1970), Adrian (1971), and Gowitzke (1979), they used 2D model to describe the smash strokes. Tang, Abe, Katoh, and Ae (1995) they used 3D model to measure the rotation of the forearm and the wrist. Tsai, Huang & Jyh (1997), Tsai, Huang, Lin & Chang (2000), Tsai, Lin, Huang, Chang & Cheng (2001) compared the drop shot with the smash and the clear of the elite players with 3D model. Tsai, Hsueh, Pan, Chang & Yu (2008) had compared the differnent forehand strok of elite female players. The studies showed that the initial velocity of drop shot was from 25~29m/s for the male, 22m/s for the female. The drop shot can be devided into two types, the regular and the reverse slice drop shots. The form of the reverse slice drop shot is different from the regular drop shot with more radial movement as the coaches and the players thought. The purpose of this study was to compare the kinematics variables between badminton forehand regular drop shot and reverse slice drop shots. The variables were including shuttle velocity, racket angle, shuttle flight angle, contact height,movement duration time and the angular variables of upper limbs.

Preparation Cock Contact Follow through

Figure 1: The movement of drop shot

METHODS: Eight right handed male elite badminton players in Taiwan (ages: 24 ± 4 years; height: 176 ± 8 cm; weight: 74 ± 8 kg) served as the subjects. We were interested in the motions were from the phase of preparation while the center of gravity (COG) went down to the lowest position to the point of making contact with the shuttle. Eight Vicon motion analysis system T-20 cameras (Vicon, Oxford, UK, 300Hz) were used to record the 3D kinematics data. There were 54 passive markers were stick on each participant and the racket (47 points on the body, 6 points on the racket frame and 1 point on the shuttle). The figure 2 shows the experimental setup of this study. The participants were standing on the center of the court to prepare to hit the shuttle that served over the net from the opposite court by an elite badminton player. They performed the regular and the reverse slice drop shots in the action area as in the figure of the experimental setup. The landing area (200cm × 80cm) of the drop shot is shown as in the figure 2. The 3D kinematics data as in the figure 3, including the initial shuttle velocity, the initial shuttle flight angle, racket angle at the contact, the contact height, the angle and the angular velocities of the upper limbs were calculated by VICON Nexus 1.8 system and the Visual 3D soft ware. The Wilcoxon matched-pairs signed-rank nonparametric statistical test was used to compare two different drop shot movement variables by using the SPSS 20.0 software at α = .05 significant level.

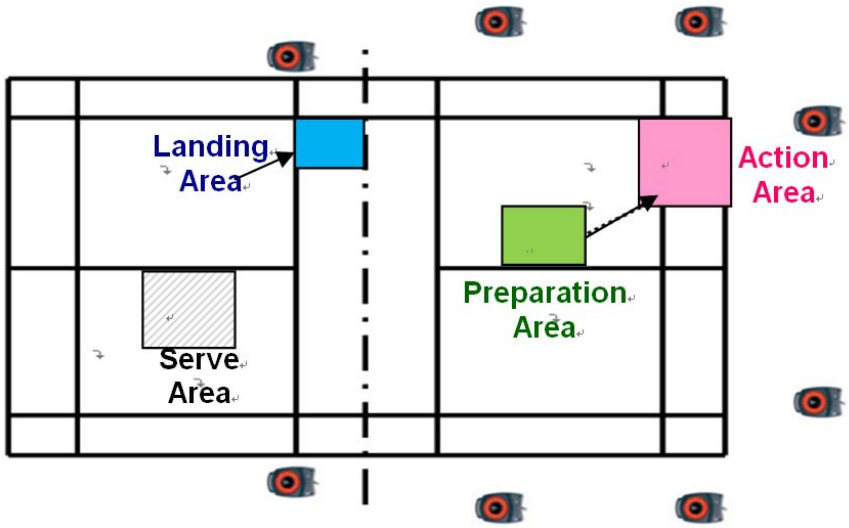

Figure 2: The Schematic of the Experimental Setup

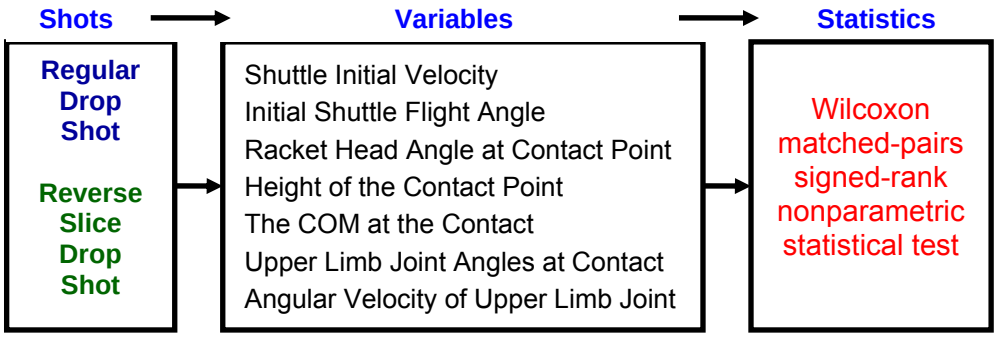

Figure 3: The structure of the study

RESULTS: Table 1 shows the linear and the angular kinematical data of the regular and the reverse slice drop shots. There were no significant differences between the regular and the reverse slice drop shots in most of the kinematics variables, except the racket pan angle of two drop shots. The racket pan angle of the reverse slice drop shot is face more outward than the regular drop shot.

Table 1 Kinematics variables comparison between regular and reverse slice drop shots

Variables	Movements	Average ± SD	Wilconxon test
Shuttle Initial Velocity (m/s)	Regular Drop Shot	30.61 ± 5.24	
	Reverse Slice Drop Shot	26.01 ± 2.57	
Racket Head Velocity (m/s)	Regular Drop Shot	21.62 ± 5.88	
	Reverse Slice Drop Shot	23.07 ± 2.42	
Shuttle Initial Flight Angle (deg)	Regular Drop Shot	-2.41 ± 4.26	
	Reverse Slice Drop Shot	-1.60 ± 4.23	
Downward Swing Duration Time (s)	Regular Drop Shot	0.31 ± 0.05	
	Reverse Slice Drop Shot	0.31 ± 0.03	
Upward Swing Duration Time (s)	Regular Drop Shot	0.14 ± 0.02	
	Reverse Slice Drop Shot	0.15 ± 0.02	
Racket Head Tilt Angle (deg)	Regular Drop Shot	89.92 ± 9.97	
	Reverse Slice Drop Shot	92.15 ± 4.63	
Racket Head Pan Angle (deg)	Regular Drop Shot	4.02 ± 3.62	*
	Reverse Slice Drop Shot	14.93 ± 6.05	
Contact Height (Body Height)	Regular Drop Shot	1.37 ± 0.04	
	Reverse Slice Drop Shot	1.38 ± 0.05	
Wrist Flexion (+)	Regular Drop Shot	-18.18 ± 11.57	
(deg) Extension (−)	Reverse Slice Drop Shot	-20.24 ± 12.01	
Wrist Ulnar Flex. (+)	Regular Drop Shot	-24.43 ± 14.07	
(deg) Radial Flex. (−)	Reverse Slice Drop Shot	-34.83 ± 11.10	
Shoulder Adduction (+)	Regular Drop Shot	-339.73 ± 128.65	
(deg/s) Abduction (−)	Reverse Slice Drop Shot	-624.04 ± 212.15	
Elbow Flexion (+)	Regular Drop Shot	-328.11 ± 154.62	
(deg/s) Extension (−)	Reverse Slice Drop Shot	-261.35 ± 109.03	
Forearm Pronation (+)	Regular Drop Shot	195.08 ± 96.95	
(deg/s) Supernation. (−)	Reverse Slice Drop Shot	224.39 ± 111.22	
Wrist Flexion (+)	Regular Drop Shot	134.98 ± 159.96	
(deg/s) Extension (−)	Reverse Slice Drop Shot	95.46 ± 30.90	
Wrist Ulnar Flex. (+)	Regular Drop Shot	323.62 ± 263.56	
(deg/s) Radial Flex. (−)	Reverse Slice Drop Shot	125.85 ± 122.31	
Upper Trunk Rotation (deg/s)	Regular Drop Shot	213.17 ± 132.45	
	Reverse Slice Drop Shot	177.23 ± 77.97	
Lower Trunk Rotation (deg/s)	Regular Drop Shot	58.96 ± 31.44	
	Reverse Slice Drop Shot	100.35 ± 46.88	

$p < .05$

DISCUSSION: From the results in table 1, the average initial shuttle velocity of the regular drop shot was 30.61m/s and the reverse slice drop shot was 26.01 m/s, there was no significant difference between two drop shots initial velocities. The racket head velocity of the regular drop shot was 21.62m/s and the reverse slice drop shot was 23.07m/s. The shuttlecock initial velocity of the drop shots were similar with the previous studies such as Tsai, Huang, Lin & Chang (2000) and Tsai, Lin, Huang, Chang & Cheng (2001). There was no significant difference in the racket head velocities at contact between two drop shot movements. Table 1 shows the shuttle initial flight angle of two drop shots were the same and both flight downward. The duration time of the down swing and upward swing were both the same. The racket tilt angle of the regular drop shot was a little downward though the reverse slice drop shot was a little face upward at the contact point. The racket pan angle of the reverse slice drop shot was significant greater than the regular drop shot. That meant the

racket pan angle of the reverse slice drop shot was face more outward than the regular drop shot. The contact height between two drop shots was similar. The angular variables on upper limbs and trunk rotation variables were shown as in the table 1, there were no significant differences between two drop shots. We found the outward racket pan angle of the reverse slice drop shot might come from the pronation movement of the forearm. We supposed that the reverse slice drop shot should be acted with more wrist radial movement than the regular drop shot. But unspected, the movement of the reverse slice drop shot was similar with the regular drop shot in the kinematics variales.Though there was no significant difference in the racket head and shuttle initial velocity between two drop shots. The reverse slice drop shot was with more racket velocity but performed less shuttle velocity. That might because the reverse slice drop was performing more inward racket movement than the regular drop shot, since the shoulder abduction angular velocity in reverse slice was almost double amount than the regular drop shot. The reasons that the badminton players should perform reverse slice drop shot at the right rear court might because the abduction movement was similar with the smash.

CONCLUSION: The results showed that there was significant difference between the two forehand drop shots in the racket pan angle. That might come from the froearm pronation movement. The strategy to perform two drop shots seems different. That might because the reverse slice drop was with more shoulder abduction movement than the regular drop shot. The players performed reverse slice drop shot might because that the abduction movement was similar with the smash. The further studies should monitor the kinetics and the EMG signal between the different drop shots and compare the biomechanical variables among two drop shots and the smash technique.

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