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Flat serve success in the relationship to the serve toss and racket-ball impact of competitive and hobby tennis players: A case study

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Abstract

The flat serve is characterized by its speed. When successfully executed, the serving player can gain a direct point from the serve or an advantageous situation for the following rally. The aim is to investigate the relationship of ball toss to the success rate of the flat serve of tennis players. We observed 2 hobby and 8 competitive tennis players who served 40 flat serves. They were videotaped on a high-speed camera (200Hz) from a side view. Based on the 2D kinematic analysis, we evaluated the racket-ball contact of the serves: 1) in (good serves) 2) into the net 3) fault-long 4) fault-wide. Hobby players contacted the balls 13 cm lower and reached 43 kph slower serve compared to competitive players. In addition, the toss variability was bigger for the hobby players. Toss training is very important for players, especially in relation to their own coordination for hitting, so it is important to pay a lot of attention to the toss and its practice.

Keywords: Kinematic analysis, first serve, movement skills, game performance.

INTRODUCTION

Every point in tennis starts with the serve, which makes the serve one of the most important strokes in tennis. If the first serve is successful, the tennis player can reach a service winner or put him/herself in a favourable situation for the rest of the rally. If the reverse is true and the serve is of poor quality, the player may find him/herself in the role of defending player and lose the advantage of the serving.

The serve is one of the key strokes during a match and is also the most frequent stroke in tennis singles, accounting for 45% (French Open) to 60% (Wimbledon) of the total number of strokes in a match [1,2]. The efficiency of the first serve varies between 63-75% depending on the court surface, with the men's serve being more efficient due to its higher speed [3]. The first serve is far more dangerous for the receiving player as it is considerably more forceful than the second serve. Due to its higher speed, the receiver has much less time to make a good return. Ideally, a player should play at least 70% of successful first serves [4]. The flat serve is one type of the first serve characterized by the lowest spin rate of the ball. This allows the ball to reach the maximum possible speed, unlike the second serve where the spin is used to control the ball [5].

Learning a good and quality toss is very important because that determines the quality of the subsequent serve. Therefore, the player should fully concentrate on the toss and be in control of it because even the slightest inaccuracy can affect the whole serve. Although Crespo and Miley [6] recommend using the same toss for all types of serves for the reason that the opponent will not be able to anticipate the direction or serve type, Carboch and Pribylova [7] point out that this doesn't happen often. They report that player's toss the ball differently on kick serves than on flat serve. The same is true for the direction of the second serve. However, elite players sometimes deliberately toss the ball deceptively to confuse their opponents [5,8]. According to Scholl [9], it is essential to learn a good and accurate toss because it is a prerequisite for a successful serve. The first serve in success rate at the elite level is around 60% [3]. There are several types of serves with different execution techniques [6,10-12]. In addition, intermediate players do not achieve the same quality of serve as competitive players. The aim of this study is to investigate the relationship between the toss and racket-ball contact on the success of flat serve and the difference between competitive and hobby tennis players.

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METHODOLOGY

Participants

This is a case study where we observed 2 male hobby tennis players and 8 male competitive players. The hobby players playing right-handed were 180 cm tall and weighed 66 and 75 kg, respectively. Both had only played competitive team tennis between the ages of 12 and 13, but have not played competitive tennis since then and play tennis occasionally (4 times a month). Competitive right-handed tennis players had a mean age of 25.1±5.4; height of 183.4±5.9 cm; weight of 79.1±9.9 kg; and a national ranking in the men's category of 439±255. They have been playing tennis since they were 5-8 years old. These competitive players regularly play tennis several times a week while also engaging in coaching activities.

Measures and procedures

The measurements were carried out on an indoor tennis court. After being briefed on what would be required of the players, i.e. to play the first 40 flat serves at the highest possible speed into a pre-defined area, they proceeded to a standard warm-up including hitting and serving [13]. The participant hit 40 (4 sets of 10) flat serves from the deuce court, which was aimed at the "T-line", which is the junction of the centre service line and the service line. For clarity, the entire area was demarcated by small cones that were placed at a distance of 1.5 m from the centre service line (Figure 1). The player always started his serve from the same position, i.e. there was a mark located on the baseline 1 m from the centre service mark, so that the toe of the player's front foot was always placed in the same place. The player made 10 serves each time, followed by a two-minute rest break.

A Basler GeniCam piA640- 210gc high-speed camera with a frame rate of 200 Hz was used. This camera was positioned in the baseline extension at a distance of 2.5 m behind the sideline and at a height of 150 cm. Before each measurement, a calibration procedure was made. A Stalker Pro II radar was used to measure the serve speed, which was placed two meters behind the baseline directly on the other court end near the centre serve mark.

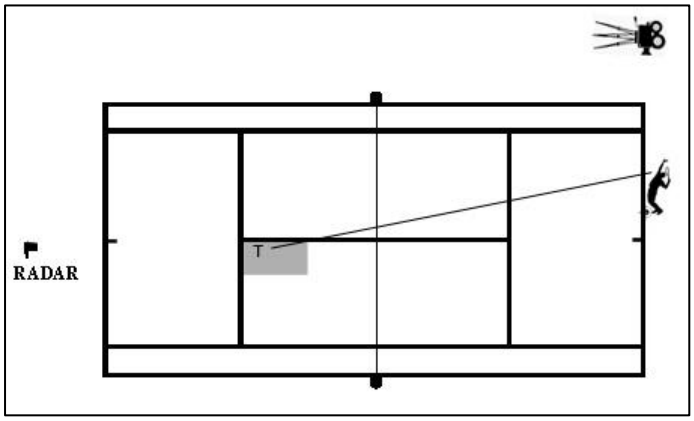

Figure 1: Experiment set-up

Data analysis

Played serves were categorized into 1) Fault-net serve 2) In (good serve) 3) Fault-long 4) Fault-wide. The video recordings were analyzed in Dartfish 10 software. The recordings were evaluated using 2D analysis. The origin of the two-dimensional global coordinate system was translated to the position of the front foot toe and the origin was determined prior to each subject's serve to account for possible shifts in foot placement [13-15]. The X-axis represents the horizontal distance of the racket-ball contact from the baseline toward the net. The vertical Y-axis represents the height of the racket-ball contact. The measured data were processed using basic descriptive characteristics such as mean and standard deviation.

RESULTS

Recreational players hit balls 13.2 cm lower than competitive players, which can be considered an important value (Figure 2). Furthermore, we can see there is a wider range and greater variability of their tosses compared to the competitive players, both in toss height and in distance from the baseline, as shown by the higher standard deviation in Tables 1 and 2. These tables also show the results of the racket-ball contact for each player.

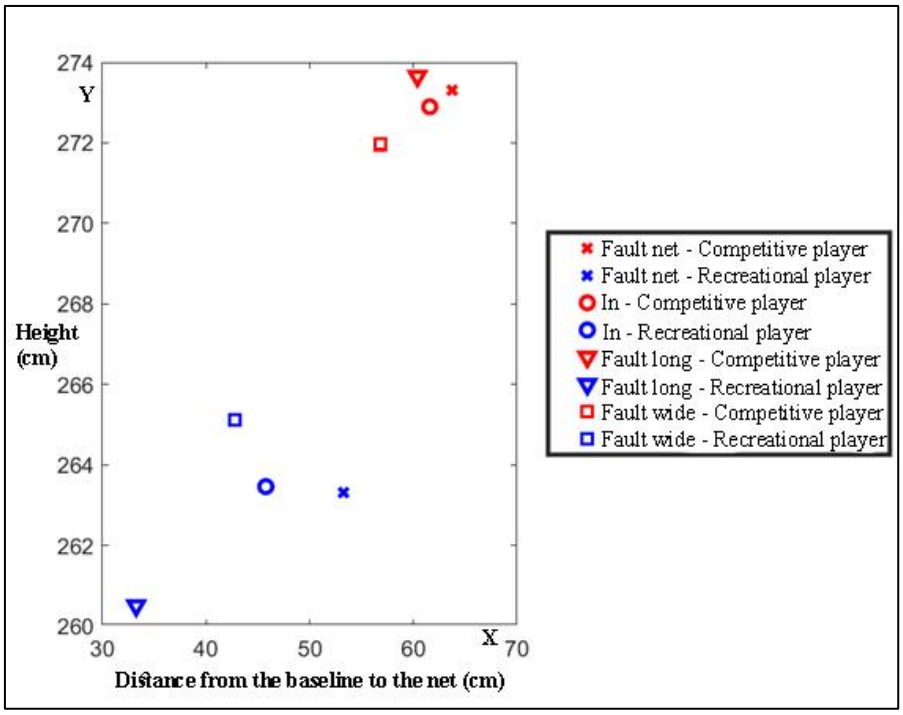

Figure 2: Racket-ball contacts of the hobby and competitive players

Table 1: Racket-ball contact point of hobby players in succesful and unsuccesful serves.

		Fault net [cm]		In [cm]		Fault long [cm]		Fault wide [cm]		Serve speed
		X	Y	X	Y	X	Y	X	Y	Km/h
Hobby player 1	Mean	28,1	267,7	24,1	266,6	0	262	22,5	265,8	142,3
	SD	11,2	3,3	13,2	3,6	0	0	13,3	2,1	6,3
Hobby player 2	Mean	78,4	258,9	67,5	260,4	66,5	259	63	264,5	127,4
	SD	14,5	5	12,4	2,9	6,4	7,1	2,8	0,7	4,4
Overall mean		53,3	263,3	45,8	263,5	33,3	260,5	42,8	265,2	134,9
SD		35,6	6,2	30,7	4,4	47	2,1	28,6	0,9	7,45

Table 2: Racket-ball contact point of competitive players in succesful and unsuccesful serves.

		Fault net [cm]		In [cm]		Fault long [cm]		Fault wide [cm]		Serve speed
		X	**Y**	**X**	**Y**	**X**	**Y**	**X**	**Y**	**Km/h**
Competitive player 1	Mean	60,1	281,7	69,4	283,6	61,8	282,0	64,7	283,7	187,7
	SD	13,5	2,4	5,5	3,9	14,9	2,5	7,5	3,7	4,7
Competitive player 2	Mean	70,1	266,4	71,2	266,2	73,4	266,8	65,0	266,3	180,7
	SD	6,9	2,9	9,7	3,0	10,9	5,3	16,5	5,7	6,3
Competitive player 3	Mean	64,9	289,2	58,7	285,4	63,4	284,6	51,4	286,2	183,5
	SD	12,8	2,8	8,9	8,8	6,8	3,2	12,0	5,6	8,7
Competitive player 4	Mean	60,0	279,0	58,8	278,9	57,8	279,7	57,7	275,8	186,4
	SD	0,0	0,0	8,1	3,5	9,1	3,0	12,1	6,1	6,8
Competitive player 5	Mean	69,6	277,1	50,9	278,5	40,4	285,8	52,3	274,7	160,5
	SD	20,4	5,9	24,0	6,0	27,2	7,0	32,6	6,5	6,7
Competitive player 6	Mean	76,8	267,8	71,1	267,8	70,4	266,8	61,0	264,0	171,0
	SD	5,8	2,5	6,5	3,4	4,6	4,1	0,0	0,0	6,0
Competitive player 7	Mean	56,3	274,2	54,5	271,6	59,0	274,5	48,9	274,1	186,3
	SD	8,8	4,2	7,7	4,5	2,8	4,9	12,0	6,8	6,8
Competitive player 8	Mean	51,8	250,9	58,2	251,1	56,9	249,1	54,0	251,0	156,7
	SD	9,5	4,1	5,4	4,3	10,0	3,1	8,5	0,0	3,8
Overall mean		**63,7**	**273,3**	**61,6**	**272,9**	**60,4**	**273,7**	**56,9**	**272,0**	**176,6**
SD		**8,2**	**11,7**	**7,9**	**11,2**	**10,0**	**12,4**	**6,2**	**11,4**	**11,5**

DISCUSSION

The aim was to investigate the relationship between the toss and racket-ball contact on the success of flat serve and the difference between competitive and hobby tennis players. In the case of recreational players, it is quite evident that their serve did not reach the same quality as that of competitive players. Their serve toss had much more variance in both the horizontal and vertical planes. Even the serve speed of the recreational players was 43 km/h lower compared to the competitive players. These differences may have been due to poorer serving techniques. The technical skills of competitive players reach different qualities than those of recreational players, who usually learn the technique often on their own and thus their serve does not reach the same quality as when a player learns for several years under the guidance of an experienced coach.

We have shown that the ball toss is variable. This was also concluded by [16] who argue that adult individuals are able, depending on how they toss the ball, to coordinate e.g. racket angle, and shoulder rotation to hit the ball in the best possible position. On the contrary, according to their results, younger players cannot do this, which is supported by our results of recreational players with inadequate experience. Serving is a very complicated skill [17], in the sense that the player has many motion options to execute the serve, and the error rate of the serve is not caused only by the toss itself but can be caused by multiple factors, such as the angle of the racket in hitting the ball. They further state that the skill of perception-action, where tennis players can respond to different tosses by being able to compensate for their inaccuracies or their variance through movement adaptation. The success of the serve is closely connected to the perception-action skill - linking the server's movements in the relation to the toss [18].Serving style can be very individual. Whiteside et al. [19] did not observe differences in the movement kinematics of successful and unsuccessful serves. According to these authors, a fault serve does not have a single source of biomechanical error. This can only be estimated for serves played into the net, which is characterized by a projection angle of the ball hit that is well below the horizontal plane. Thus, we can assume that the ideal position of the ball for hitting it may increase the success rate of the serve and the further away this point of hitting is, the more correction must occur, which may affect the success rate in certain cases. Therefore, the serve is not "pre-programmable" and visual feedback is a key informant for the spatiotemporal regulation of the serve. Hence, even if the toss is not completely consistent, the

player can adjust his action (movements) based on visual information to hit a successful serve [20].

This research was limited by T-line serve placement as only one direction to was observed. However, tennis players also use two other directions, wide and body serve. There are other types of the first serve, but we focused only on the flat serve in this study. Furthermore, players served only from the deuce court only and not from the ad court. Lastly, it is important to mention that the research involved competitive players and only a small number of recreational players. All of these limitations would be good to incorporate in a future study.

CONCLUSION

We have shown a kinematic analysis of the toss and racket-ball contact point in the relation to the success rate of the flat serve in tennis between recreational and competitive players. As this is a case study and the results are based on observations of only 2 recreational players, we approach the findings with caution and cannot generalize them. However, they did show some differences in the players' skills. The serve toss and the racket-ball contact point are somewhat related to the success of the serve, but they are not the only cause of fault serves. Toss training itself is very important for players, especially in relation to their own movement coordination for serving, so it is important to pay considerable attention to the serve toss in training sessions.

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Conflicts of Interest

The author reports no conflicts of interest in this work.

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