THE DIFFERENCES IN THE BALL SPEED AND THE SPIN RATE DEPENDING ON THE RESULTS OF A TENNIS SERVE

Ryogo Kashiwagi*, Shuhei Okamura*, Shinya Iwanaga*, Shunsuke Murakami, Koki Numata, Hiroo Takahashi

Graduate School, National Institute of Fitness and Sports in Kanoya*
National Institute of Fitness and Sports in Kanoya

*Email: m197001@sky.nifs-k.ac.jp
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Abstract

In tennis, the service is the only shot that a player can give himself without being influenced by his opponent, and it is said to be the most powerful and essential shot in the game to win the game (Kovacs and Ellenbecker, 2011). In this study, we will investigate the difference in speed and spin rate in services when a service is entered, when it is not entered, and when an ace is taken. Fourteen three-set singles matches of 20 participants in the ATP Challenger tournament were included in the analysis. The speed and spin rate was measured using the Trackman. The analysis included 1343 1st service balls. We compared the speed and spin rate for each IN, FAULT and ACE in the 1st service using one-way ANOVA. The speed of the 1st service, IN was significantly slower than that of FAULT and ACE. The spin rate of the 1st serve, IN had significantly more revolutions than the FAULT and ACE. The results of this study showed that the service was faster and lower spin rate when ACE was taken. However, it was found that the faster the speed of the service and the lower the spin rate, the higher the rate of FAULT. These considerations suggest that it is important to decide whether to take risks or play it safe, depending on the game situation at the time.

Keywords: tennis, serve, ball speed, spin rate

Introduction

In tennis, the service is the only shot that a player can release himself without being influenced by his opponent, and it is said to be the most powerful and important shot that can be used to gain the upper hand in a game (Kovacs and Ellenbecker, 2011). Mecheri et al. (2016) show that in ATP tournaments, the faster the speed of service, the higher the rate of point acquisition. These considerations suggest that speed of service is important for winning a match. In terms of spin rate, Goodwill et al. (2007) reported that the maximum service speed was 4300 rpm in seven men's players competing in the Davis Cup. Muramatsu et al. (2010) measured the spin rate of the ball by using a high-speed camera to capture the services of eight male players ranked in the top 50 in the world at an international tennis tournament, and found that the spin rate of the 1st service was between 1,000 and 3,500 rpm, and that the 2nd service was between 3,000 and 5,000 rpm. Thus, although more and more studies have measured tennis players' spin rate, due to the limitations of the measurement method, it has not been possible to determine how players use different spin rate during actual matches. Recently, however, the Trackman Tennis Radar (Trackman. Inc), a device that can easily measure the spin rate of a hit ball in tennis, has been developed. Murakami et al. (2016) verified the accuracy of the speed and spin rate of a trackman. They reported that the measurement accuracy was comparable to that of a previously used high-speed camera. This Trackman is used to measure the speed and spin rate of services throughout the match, and to find out how the speed and spin rate of services differ when a service enters when it does not enter and when a service ace is taken. The purpose of this study is to investigate the difference in speed and spin rate between IN, FAULT and ACE in an actual tennis match.

Methods

Fourteen men's singles matches of 20 participants in an ATP Challenger tournament were included in the analysis. The wind condition during the tournament was relatively low. The speed and spin rate was measured using the Trackman. The Trackman was placed on both sides of the tennis court or behind one side of the court, and the distance from the centerline of the tennis court to the Trackman was measured and calibrated. Trackman calibration is completed by measuring the distance from the centerline to the Trackman using an infrared laser and having the Trackman recognize this distance. The match video was filmed from behind the tennis court using a coaching cam (SONY) as well as the Trackman. The distinction between IN, FAULT and ACE was made based on the filmed video. When a service entered the service box, it was set to IN, when a service did not enter the service box (including both NET and OUT) it was set to FAULT, and when the server acquired a point without the returner touching the ball it was set to ACE. LET was excluded from the analysis. The analysis included 1343 1st service balls. SPSS was used to analyze the data. One-way ANOVA was used to test for IN, FAULT and ACE. The significance level is less than 5%. We categorized the service speed in steps of 10 km/h each with reference to Macheri et al. (2016). The spin rate was classified in steps of 500 rpm. A crosstabulation table was created based on the categorized data, and the $\chi 2$ test was used to analyze the bias of the point acquisition rate. If the results of the $\chi 2$ test were significant, a residual analysis was performed to determine which cells contributed to the significance.

Table1. World ranking and age of the players at the time of data acquisition

PLAYER	WORLD RANKING	AGE
A	356	28
B	587	24
C	148	29
D	149	30
E	513	27
F	244	19
G	191	24
H	185	23
I	144	24
J	233	23
K	266	19
L	186	32
M	205	33
N	176	29
O	240	31
P	178	27
Q	301	22
R	170	20
S	174	27
T	521	27
	258 ± 130	26.0 ± 4.0

Results

We compared the speed and spin rate for each IN, FAULT and ACE in the 1st service using one-way ANOVA (Table 1). The speed of the 1st service IN was significantly slower than that of FAULT and ACE. In terms of spin rate, the 1st service IN had significantly more spin rate than the FAULT and ACE (Tab.2).

Table2. Result of Speed and spin rate for the 1st service

	IN	FAULT	ACE
Speed(km/h)	180.7 ± 13.8	183.2 ± 12.9	187.2 ± 12.7
Spin rate(rpm)	2330 ± 824	2141 ± 813	2070 ± 900

A $\chi 2$ test for the IN rate at each speed in the 1st service showed that the bias in the point acquisition rate was significant ($\chi 2(5) = 12.320$, $p<0.05$, Cramer's V = 0.096), so a residuals analysis was performed for each speed. The results showed that the IN rates were significantly higher in the 0-160 (km/h) and 160-170 (km/h) range and significantly lower in the 180-190 (km/h) range.

Table3. Relationship between IN rate and speed in 1st service

	IN	FAULT	Total	IN RATE(%)	Distribution(%)
Total	874	469	1343	65.1	100.0
～160	63	22	85	74.1	6.3
160-170	126	45	171	73.7*	12.7
170-180	225	123	348	64.7	25.9
180-190	233	152	385	60.5*	28.7
190-200	155	87	242	64.0	18.0
200～	72	40	112	64.3	8.3

*p<0.05

A $\chi 2$ test for the IN rate at each spin rate in the 1st service showed that the bias in the point acquisition rate was significant ($\chi 2(4) = 9.198$, $0.05<p<0.10$, Cramer's V = 0.083), so we performed a residuals analysis between each spin rate. The results showed that the IN rate was significantly lower in the 0-1500 (rpm) range and significantly higher in the 3000-4000 (rpm) range.

Table4. Relationship between IN rate and spin rate in 1st service

	IN	MISS	Total	%	Distribution
Total	874	469	1343	65.1	100.0
～1500	171	117	288	59.4*	21.4
1500-2000	185	111	296	62.5	22.0
2000-2500	184	85	269	68.4	20.0
2500-3000	156	80	236	66.1	17.6
3000～	178	76	254	70.1	18.9

*p<0.05

Discussion

This study was conducted on players ranked 258±130 in the world who participated in the ATP Challenger Tournament. Therefore, it shows the service tendencies of players at the level of the ATP Challenger tournaments. In the 1st service, the service at FAULT was significantly faster and had lower spin rate than that at IN. Similarly, the speed and the number of revolutions were significantly higher and lower for the service during ACE than during IN(Tab2). This suggests that services with higher speeds and fewer revolutions are

more likely to take ACE, but also have a higher risk of becoming a FAULT. This suggests that it is necessary to consider whether to take a risk and speed up the speed of the service or to increase the number of rotations by emphasizing probability, depending on the situation in the match. The relationship between the speed of the service and the IN rate was examined by dividing the speed of the service into several stages, and the results showed that the faster the speed of the service, the lower the IN rate. The relationship between the spin rate of the service and the IN rate was examined by dividing the spin rate of the service into several stages, and the results showed that the higher the spin rate of the service, the higher the IN rate. These facts suggest that hitting fast services with high probability is not an easy task even for a professional tennis player. The results of this study show the tendency of services of players at the level of participation in the ATP Challenger Tournament. The results of this study can be used as an indicator of the speed and spin rate of the service of professional players, which can be used for coaching and as a target value for service.

Conclusion

In this study, we investigated the differences in the speed and rotation of services in tennis depending on the results of the services. The results showed that the services that take ACE were faster and had lower spin rate, but the benefits that became FAULT were quicker and had fewer revolutions as well.

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