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THE TOSS OF THE PROFESSIONAL AND THE COMPETITIVE TENNIS PLAYER: SERVING FROM THE AD-COURT

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ABSTRACT

We compared the serve toss of different types of serve when tennis players served from the ad-court. They used different spin on the ball and various ball placements in the opponent's service box. Our aim was to compare the toss in different types of serve between a competitive (local tournament) player and a professional player, from the point of view of the receiving player, when they served from the ad-court. One professional and one competitive tennis player (both right handed) were observed while serving different types of serve to various locations of the opponent's service box. We used a high-speed camera, which was placed opposite to the server in the position of a receiving player. The results showed that the players do not use the same toss for each type of serve. The professional player had a bigger range of racket-ball contact point on horizontal axis (32 cm) of the various types of first serves, compared to the competitive player (only 24 cm). The toss of the kick serve had similar characteristics between both players (the racket-ball contact point was observed to be mostly to the right, from the view of receiver). Neither the professional nor the competitive player showed a stable profile of toss. In some cases, the receiving players could anticipate the type of the serve from the server's toss.

Keywords: tennis; anticipation; visual perception; receiving player

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INTRODUCTION

Every rally in tennis begins with a serve. If the server misses the first serve (makes a fault) he or she can hit the second serve. If he/she misses the second serve too, it is a double fault and he/she loses a point. The serve is one of the most difficult strokes in tennis and has already been described (e.g. Abrams et al., 2011; Carboch et al., 2014; Chow et al., 2003; Cross, 2011; Sakurai et al., 2013). The serve motion starts with the ball toss, which

is crucial for the whole stroke. The players need to toss the ball with stability, and need to control the toss. Gilet et al. (2009) say the serve and the return are the strokes that most affect the results of tennis matches, even on clay courts (the slowest surface). The ball speed after the serve can often reach over 200 kph in professional tournaments. This means that the receiving player has to react very quickly. Even though the ball decelerates on the way to the receiver, the ball travels to him/her in 0.5–1.2 s, depending on the serve quality, ball spin and surface (Dunlop, 2000; Kleinöder, 1997).

Vaverka (2010) compared serve speed between genders in professional tennis. He reported that male tennis players reach an average speed of 184 kph in the first serve and 149 kph in the second serve. Female tennis players reach an average speed of 155 kph in the first serve and 132 kph in the second serve. The Australian Open winner in the men's tournament in 2015 served an average 190 kph on the first serve and 158 kph on the second serve (Australian Open, 2015). Crespo and Miley (2002) say that women have less muscle mass, relatively narrow shoulders, wider hips and shorter legs than men. For women, that means less favorable biomechanical conditions for many physical activities compared to men, on which depends the total force that can be developed (Crespo & Miley, 2002). Male competitive tennis players are expected not to be so physically fit and prepared as professional players and therefore competitive players can't develop such force and serve speed as the professionals.

Players can serve various types of serve, i.e. a flat serve (no or minimum spin on the ball), a slice serve (side spin) or kick serve (topspin) (Crespo & Miley, 2002). According to Cross (2011), when a player serves the kick serve (KS) a side spin is also generated together with the topspin. The KS is relatively slower, but the ball bounces very quickly and very high. The KS is usually served to the opponent's backhand. The flat serve (FS) is about the highest speed. The ball trajectory during the slice serve (SS) is curved. The ball turns to the side, from right to left (in the case of right-handed server). The second serve is slower because players use more spin to control the ball. Players need to achieve high efficiency of the second serve, too.

The receiving players need 0.2 s to estimate the ball trajectory (Crespo & Miley, 2002). After that, they have a very short time for movement to return the ball. However, the receiving player can gain more time if he anticipates correctly. Experienced players focus their vision on the opponent's shoulder-racket area (Singer et al., 1996). Crespo and Miley (2002) say that advanced players should use the same toss for every type of serve to hide their intentions.

In a similar previous study, Carboch (2015) examined professional and amateur players, when they served from the deuce court. He found individual style differences in toss execution between the players, and also found toss differences among serve types (only some types of serves had similar toss trajectory – and both players did not use the same toss for each type of serve).

The aim in this study is to compare the toss in different types of serve between a competitive (local tournament player) and a professional player from the point of view of the receiving player, when they served from the ad-court.

METHODS

In this case study we observed one competitive and one professional tennis player. The competitive player was a club level player. He was 23 years old, right-handed and ranked 136 in the Czech Republic (national ranking). At the time of measuring his weight was 73 kg and he was 181 cm tall. The professional player was regularly playing ITF (International Tennis Federation) and ATP (Association of Tennis Professionals) Challenger events. He was 27 years old, right-handed and his ATP ranking was 296. He was 184 cm tall and his weight was 76 kg at the time of measuring.

After finishing a standard match warm-up, the participants were told to serve with maximum effort, exactly the same way as in a match. Every serve was made from the same place. The participants served from the ad-court. There was a mark on the court, which was a starting position for each trial, placed on the baseline 1 m to the left of the center service mark. The participant started every serve from this mark by touching this mark with the tip of his front leg. First, he served a FS wide (FSW) – which means in the direction of the side line of the service box on the receiver's end of the court. After 3 successful trials, he served a FS to "T" (FST). "T" or "T-line" is the junction of the center service line and service line (figure 1). Next, the participant served a second serve wide (2W), followed by a second serve to T (2T), followed by the KS wide and SS to T. The KS and SS were served as a type of first serve. The target area was 1 m wide 3 m long. It corresponded to the zones where players normally place the serve (wide and T). In total, the participant reached 18 successful serves from the ad-court. The action was recorded by a high-speed camera (Basler GenICam piA640-210gc) with a frequency of 200 Hz. The location of the high-speed camera was at the point where the receiver stands on the opposite end of the court. The camera was placed 1 m behind the baseline, 0.5 m from the side line for singles towards the center of the court and at the height of 1.6 m, so that we could see the server's action. The serve speed was measured by radar (Stalker Pro II), which was placed next to the high-speed camera.

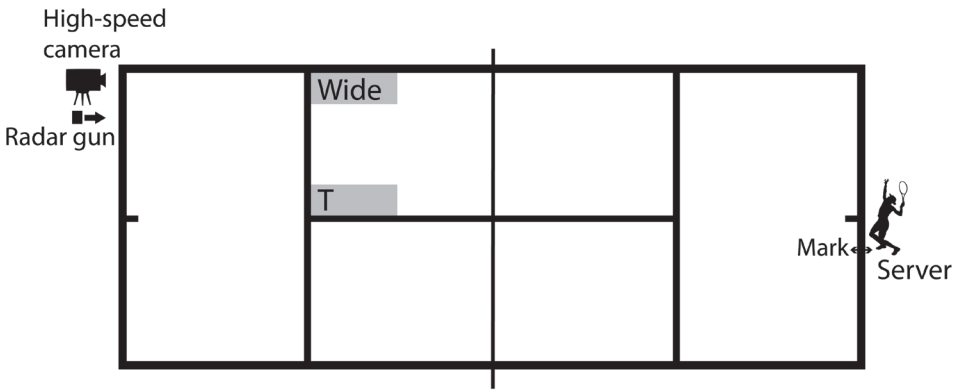

Figure 1. Experiment set-up

The records were analyzed using 2D analysis. Cartesian coordinate system was defined prior to each trial to prevent foot displacement, even though players started their motion from the same place. Horizontal axis X and vertical axis Y were used from the point of view of the receiving player (figure 2). Point 0 of these axes was set at tip of the server's front leg. Using software *Dartfish 7*, we analyzed the ball toss 1) at the ball release point from the server's hand; 2) at the highest point of toss; 3) at the point of the racket-ball contact. We have two players with different height (181 and 184 cm), which we have to take into account in observed variables. The data were analyzed using descriptive statistics.

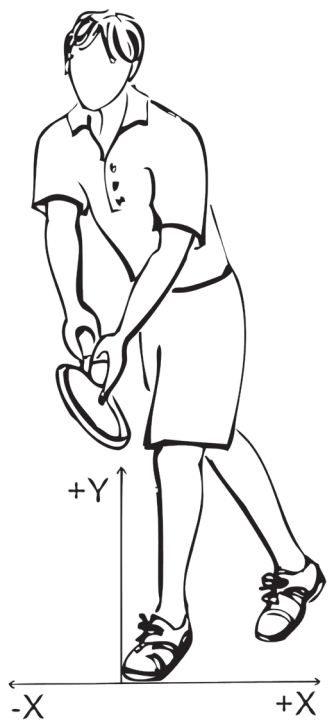

Figure 2. Orientation of global coordinate system

RESULTS

Altogether, we analyzed 18 serves of the professional and 18 serves of the competitive player. We evaluated 6 types of serve (6 × 3). Mean values and standard deviation of all observed variables from 3 successful trials for each type of the serve are shown in table 1. Both players had very similar ball release point for their own serves. Inter-individual comparison, the competitive player released the ball on the average 21 cm higher compared to the professional. The competitive player used a higher toss (mean height 396 cm), which was 39 cm more than the professional. However, the professional contacted the ball with his racket 7 cm higher, i.e. at the mean height of 286 cm. The mean of the competitive player's serve speed was 16 kph lower compared to the professional player.

Table 1. Mean values of all observed variables

	Type of serve	Ball release		Toss maximum		Racket-ball contact		Serve speed (km/h)	Speed difference
		(cm)		(cm)		(cm)			
		X	Y	X	Y	X	Y		
Competitive player	FSW	–28.7 ± 2.1	195.0 ± 1.2	12.7 ± 6.7	376.7 ± 4.9	26.0 ± 7.2	268.3 ± 2.9	178.7 ± 2.5	–10.7
	FST	–32.0 ± 3.0	195.0 ± 0.6	12.7 ± 11.0	391.3 ± 9.1	43.0 ± 13.0	279.3 ± 2.3	172.7 ± 3.5	–16.7
	2W	–31.0 ± 2.0	191.3 ± 4.0	17.0 ± 5.2	400.3 ± 9.5	37.3 ± 8.3	280.0 ± 5.2	148.7 ± 2.3	–8.3
	2T	–31.0 ± 6.2	193.7 ± 1.2	21.7 ± 9.2	403.0 ± 8.2	53.0 ± 14.2	281.0 ± 8.0	127.7 ± 5.5	–32.3
	SS	–30.7 ± 2.5	193.7 ± 1.5	11.3 ± 2.5	401.7 ± 5.1	36.3 ± 8.1	283.0 ± 4.0	156.3 ± 4.9	–18.7
	KS	–29.7 ± 2.5	195.3 ± 6.5	24.0 ± 7.2	407.7 ± 4.9	49.7 ± 7.2	283.0 ± 2.6	132.0 ± 3.0	–8.0
Professional	FSW	5.3 ± 1.5	175.0 ± 2.6	18.7 ± 5.0	357.7 ± 9.0	20.3 ± 7.0	286.0 ± 5.6	189.3 ± 2.1	10.7
player	FST	7.7 ± 0.6	170.7 ± 3.8	16.0 ± 5.6	365.3 ± 4.5	14.3 ± 7.0	284.0 ± 1.7	189.3 ± 3.8	16.7
	2W	7.7 ± 2.5	171.3 ± 1.5	26.3 ± 6.7	362.0 ± 3.6	32.7 ± 6.8	284.7 ± 1.5	157.0 ± 4.1	8.3
	2T	6.3 ± 2.1	171.0 ± 2.6	24.7 ± 3.2	364.0 ± 8.2	30.7 ± 2.1	285.0 ± 2.0	160.0 ± 9.2	32.3
	SS	5.0 ± 2.6	173.0 ± 4.4	24.3 ± 7.6	367.7 ± 3.1	30.3 ± 11.2	284.7 ± 1.2	175.0 ± 9.2	18.7
	KS	6.3 ± 0.6	174.7 ± 1.5	33.7 ± 3.5	364.3 ± 2.1	46.7 ± 7.1	282.0 ± 4.0	140.0 ± 10.0	8.0

The competitive player's release point was recorded much more to left, from the receiver's point of view (about 24 cm). The ball motion during the toss of the first serves is shown in figure 3. We can see differences between the participants and between types of first serves. The toss trajectories are different. The KS racket-ball contact point was mostly to the right from all serves by both players. The same happened during the FS (wide and T), but to the left side. Although both players had very similar ball release point for all types of serves, the racket-ball contact point differed on the horizontal X-axis. Surprisingly, the professional had a range on this axis of 32 cm (between FST and KS); and the competitive player only 24 cm (between FSW and KS).

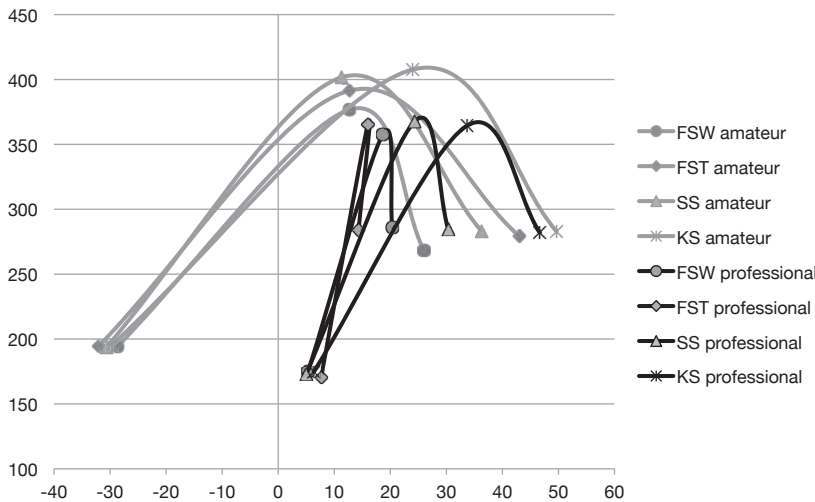

Figure 3. Serve toss comparison among different types of the first serves

The toss trajectories of the second serves are shown in figure 4. The ball release point of the competitive player is more to the left (individual style difference). As with the first serves, the competitive player contacted the ball lower. Also here, the competitive player used a higher toss. The competitive player had the second serves' racket-ball contact point 4 cm lower. The contact points on the X axis of the professional 2T and 2W are almost the same (2 cm difference). However, the competitive player has the racket-ball contact point of 2T 16 cm to the right than his 2W. That means, there is no chance of anticipating the direction of the second serves of the professional player. On the other hand, the second serve toss of competitive player provides some cues for anticipation.

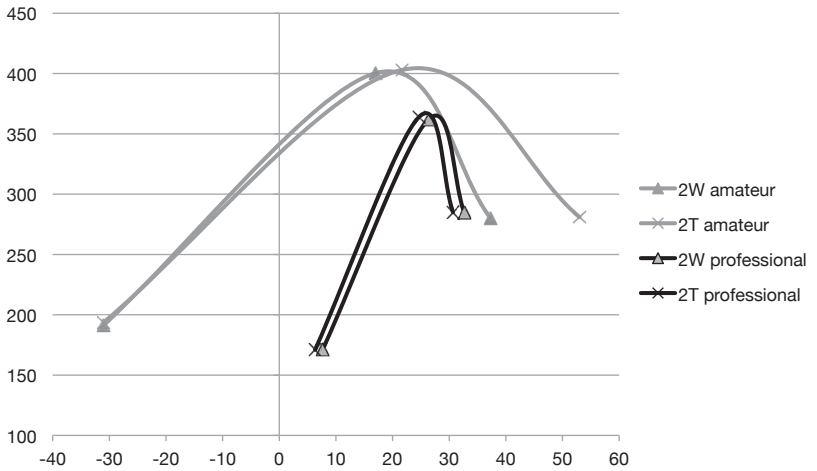

Figure 4. Serve toss comparison between directions of second serves

Interesting results were found on the horizontal X axis. The ball moves during toss (shift on X axis from the ball release point to the racket-ball contact) within different serve types (table 2). Both players had high values when they served the KS. This table also shows that the competitive player had a different style of serve toss execution.

Table 2. Horizontal ball movement between ball release and racquet-ball contact point

Type of serve	Competitive	Professional
FSW	–55	–15
FST	–75	–7
2W	–68	–25
2T	–84	–24
SS	–67	–25
KS	–79	–40

DISCUSSION

The aim of this study was to compare the toss of different types of serves between the competitive and the professional player from the point of view of the receiving player. Even though Crespo and Miley (2002) suggest that players should use the same toss for every serve to hide their intention. We observed this during the second serves of the professional. The professional player had lower variance of the flat serves racket-ball contact point (FST and FST) −6 cm (X) / 2 cm (Y). Otherwise the toss for the first serves varies widely between the players.

We presented some differences in toss execution. Carboch and Süss (2015) showed toss differences between the KS and the SS. They examined 10 players and found that

the racket-ball contact point of KS was 27 cm more to the right compared to SS when the players served from the ad-court. This supports the results for both players in our study (16 cm for the professional or 13 cm for the competitive player). Reid et al. (2011) observed 6 professional players (average ATP ranking 1539). They found no toss differences between FSW and FST; and between 2T and 2W (only 2 cm differences on the horizontal axis at the racket-ball contact point). We reached the same results only for the second serves of the professional (2T and 2W – 2 cm difference) or FSW and FST (6 cm difference). There are some contradictory results, as Reid et al. (2011) say that the players use the same toss. However, Carboch and Süss (2015) suggest that players do not use the same toss, even though both studies examined different type of serves. Surprisingly, our study suggests that observed players do not use the same toss for each type of serve (with the exception of the second serves and flat serves of the professional). However, similar findings were reported in a case study (Carboch, 2015), when the players served from the deuce court.

If we compare both players, we can see similar characteristics of the ball toss in some types of serves. For example, the KS toss trajectory was similar, and the racket-ball contact was mostly to the right from all the serves. However, we could observe individual differences in their own style of serve. The competitive player released the ball much more to the left. This is because of biomechanical factors and individual serve technique. This serving technique determines the serve execution, including the toss. The professional player reached a higher speed than the competitive player in all observed types of serves. The professional had similar average speed of all serves, like top professional tennis players, as shown by Vaverka (2010).

There were some limitations in this case study. We observed only two directions of serves – T and wide. Players may also serve into the middle of the service box – in the "body" direction of an opponent. Future research should include more participants in order to generalize the research.

CONCLUSION

We found differences in toss execution between the professional and the competitive player. The professional player used the same toss when he served FST and FSW; or 2T and 2W as well. There were differences in serve execution between serve types. The professional player varied more in serve toss execution (bigger range at racket-ball contact point of first serve), but not in the toss of the second serve. However, this study suggests that professional and competitive player did not use the same toss for each type of serve, since we could mostly see differences on the horizontal X axis. This means that receiving players can anticipate from the server's toss in some cases. Hence, tennis coaches should be more aware of this problem.

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