Original Article

Rally pace and match characteristics of male and female tennis matches at the Australian Open 2017

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ABSTRACT

Tennis players hit very fast shots during matches and the opponent needs to hit the ball back within a limited time. The aim of this paper is to analyse the rally pace characteristics and the frequency of rally shots in the men's and women's matches at the Australian Open 2017. We analysed male (n=7) and female (n=23) matches at Australian Open 2017. We compared the (1) point duration; (2) number of rally shots; (3) time between the points; (4) rally pace; and (5) work to rest ratio. In spite of some small differences between the men's and women's matches, such as work to rest ratio (men 1:3,63±0,38; women 1:4,05±0,73), point duration (men 5,93±0,67 s; women 5,44±1,11 s) and rally shots number (men 4,85±0,48; women 4,47±0,72), none of these differences were significant. Both genders played at the same rally pace (while the ball is in the play), which was 1.2 s (mean ball flight time between the opponents). About 60 % of rallies were finished within the first four shots of the rally. Our findings could help coaches to utilize the practice sessions prior to the Australian Open tournament. **Keywords:** Performance analyses; Gender differences; Men; Women.

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INTRODUCTION

There are differences between the genders in on-court performance in tennis, but both men and women need to react very quickly on an incoming ball. Players try to hit the ball as fast as possible to hit a winner or to provide the opponent with as little time as possible. The ball flight duration from the server to receiver is between 0.5–1.2 s depending on the serve quality and type, its initial velocity and spin and the court surface (Dunlop, 2000; Kleinöder, 2001). However, men reach much higher serve speeds compared to women (Chow et al. 2003, Crespo & Miley, 2002; Elliott et al. 2013; Reid et al., 2016).

Male and female differences of tennis players (such as different anatomical, physiological or psychological characteristics) are published (e.g. Chow et al. 2003; Ong, 2017; Mavvidis et al., 2008; Paces et al., 2016; Reid et al., 2016). These differences can have a direct impact on the game performance in tennis matches (Crespo & Miley 2002). According to Reid et al. (2016) the biggest difference between the genders in tennis is in regard to serve speed, running speed and court coverage. On the other hand, there are some similarities such as forehand-backhand ratio or mean shot contact height (Reid et al., 2016). Weber et al. (2010) say that more than 50 % points in men's and women's matches are decided within the first 4 shots of the rally. In addition, women deliver more serve returns in play (Reid et al., 2016), which can be caused by a lower serve speed. Filipcic et al. (2011) suggest that various match records may provide valuable information for scientists, coaches and players.

Weber et al. (2010) reported 33.1 s and Schönborn (1999) 25.6 s in the time between points in men's and 19.4 s in women's matches. Until 2017 the Grand-slam rules allowed 20 s between the points (ITF, 2017); however this was changed to 25 s from 2018 (ITF, 2018). In tennis, a work to rest ratio is 1:2-1:5 depending on the court surface (Christmass et al., 1998; Fernandez et al., 2006; Kovacs, 2004; O'Donoghue & Ingram, 2001; Reid & Duffield, 2014; Smekal et al., 2001). Intermittent load is typical for tennis including repeatable high intensity movements and rest. Various match characteristics were examined in the past (e.g. Carboch, 2017; Filipcic et al., 2011; Reid et al., 2016), such as serve and return efficiency, return points won, game or match duration. Morante & Brotherhood (2005) found a time difference in point duration between the male and female tennis players at Wimbledon 2005 and the Australian Open 2005. They showed the mean point duration was at the Australian Open 6.4 s in men's and 7.0 s in women's matches. During this time, the player performs high intensity acyclic and cyclic movements (Crespo & Miley, 2002; Fernandez et al., 2006), however Reid et al (2016) argue, that men play in higher pace.

The purpose of this study is to examine the rally pace during whole point, i.e. how quickly the ball travels between the opposing players, in other words, how much time the player has since the opponent hits the ball in the whole rally and during whole match. To the authors' knowledge, the rally pace from this view has never been analysed before, except for the serve-return duration (Dunlop, 2000; Kleinöder, 2001). The aim is to analyse the rally pace characteristics and the frequency of rally shots between the men's and women's matches at the Australian Open 2017.

MATERIAL AND METHODS

Participants

We analysed 7 men's and 23 women's matches at the Australian Open 2017. In 7 men's matches we observed total 1738 points. In these matches professional tennis players n = 12 (mean 28.0±4.9 years) and had a mean ATP ranking of 45.0±35.7. Two matches consisted of 3 sets and five matches consisted of 5 sets. Four of the matches were first round matches, two semi-finals and finals. In 23 women's matches, we

analysed 2926 points. Professional tennis players n = 27 (26.8± 4.5 years) in these matches had a mean WTA ranking of 47.9±50.3. We observed 2 first round matches, 3 second round matches, 5 third round matches, 6 fourth round matches, 4 quarterfinals, 2 semi-finals and final. Eighteen matches consisted of 2 sets and five matches consisted of 3 sets. This study was approved by the Ethics Committee at the Faculty of Physical Education and Sport, Charles University.

Procedures

The match recordings were obtained from television or internet broadcasts. The quality of the video was found appropriate for the analyses. A spreadsheet with all the observed variables was prepared in advance for each match. The variables were: (1) Point duration – the measurement of this variable started by striking the ball by the server (in case of 1st serve fault the measurement started by striking the ball by the 2nd serve) till the point was finished. The point was finished in following cases – when the ball was out (touched the court outside the lines or hit the permanent fixture); the ball ended up in the net; when the ball bounced for the second time. (2) Number of rally shots – every stroke (racket-ball contact) was considered as a shot excluding the occasions when the ball just touched the racket frame and continued behind the striking player (this was not considered as a shot). (3) Time between the points – the time was measured when the previous point was finished to the racket-ball contact by the following first serve. The time was measured only during the games themselves (from the end of the first point of each game until the last point of the game). This variable was not measured during changeovers and after the end of the game or during tie-breaks (delays in ball delivery to opposite court end). The time between the points was not measured in following unusual situations which would delay the expected pace: racket change, medical time out, discussion or argument the umpire, use of hawk-eye, unusual crowd behaviour delaying the game. (4) Rally pace – point duration divided by rally shots. (5) Work to rest ratio (point duration/time between the points). Data were excluded from the sample when a player made a double fault (time between the points was not excluded); when the ball became invisible (e.g. landed in the stands) or when the rally started during a commercial break.

Each match was observed twice. Point duration and rally shots were observed during the first observation. The time between the points was observed during the second observation. The time was measured using a stopwatch. After every point, the video-recording was stopped and the evaluator marked the measured variables into the spreadsheet. In unclear situations, the video-recording was paused or reviewed.

Data analyses

All the matches were analysed by two evaluators. The evaluators had a one-hour practice session for data observation and measurement before they started the match analyses. The inter-rater reliability (ICC) was in all the observed variables ≥ 0.94. The intra-rater reliability reached in all the observed variables ≥ 0.97 (evaluator 1) and ≥ 0.96 (evaluator 2). Firstly, we calculated the means of each variable from every single match. Using SPSS 15.0, data were analysed using descriptive statistics and independent sample t-tests. Effect sizes (Cohen's *d*) were calculated and can be interpreted as small (0.20 to 0.49), moderate (0.50 to 0.79), and large ($d \geq 0.80$) (Cohen, 1988). After the analyses of all matches, we conducted the same analyses but only from the data of first two sets of the match to avoid possible fatigue effect of long matches (Ferrauti et al., 2001; Kovacs, 2006; Martins et al. 2016; Myers et al., 1999; Ojala & Häkkinen, 2013; Reid & Duffield, 2014) due to different match format of genders (i.e. best of 3 of 5 sets).

RESULTS

Independent sample t-test did not show any significant difference between men's and women's matches in any of the observed variables (table 1). Cohen *d* showed moderate effect in case of rally shots, point duration

and work/rest ratio between the genders. Overall, women's rally pace was faster than the men's pace, but not significantly, and Cohen *d* showed only a small effect.

Table 1. Genders comparison of all observed variables (whole matches)

	Rally shots	Point duration (s)	Time between points (s)	Rally pace (s)	Work to rest ratio
	M ± SD	M ± SD	M ± SD	M ± SD	M ± SD
Men	4.85±0.48	5.93±0.67	21.46±2.88	1.22±0.03	1:3.63±0.38
Women	4.47±0.72	5.44±1.11	21.25±1.97	1.21±0.06	1:4.05±0.73
Mean Difference	0.39	0.49	0.21	0.01	-0.43
p	0.20	0.28	0.82	0.48	0.15
Cohen *d*	0.63	0.54	0.09	0.27	0.72

Table 2 shows the descriptive statistics of the first two sets of the analysis. Similarly to previous results of the whole match, the independent sample t-tests did not show any significance between the genders in observed variables. Cohen *d* showed only a moderate effect in work to rest ratio between the genders. Notably, the mean men's rally pace was 0.02 s faster compared to the whole match results.

Table 2. Genders comparison of all observed variables in the first two sets of the match

	Rally shots	Point duration (s)	Time between points (s)	Rally pace (s)	Work to rest ratio
	M ± SD	M ± SD	M ± SD	M ± SD	M ± SD
Men	4.71±0.34	5.66±0.47	21.05±2.88	1.20±0.01	1:3.72±0.40
Women	4.46±0.70	5.40±1.04	21.18±1.90	1.21±0.05	1:4.06±0.69
Mean Difference	0.25	0.27	-0.21	-0.01	-0.35
p	0.37	0.52	0.90	0.87	0.15
Cohen *d*	0.45	0.32	-0.05	-0.28	-0.60

The frequency of rally shot (figure 1) was similar for the two genders. In the whole match, the rally was finished within the first four shots in 59 % (men) and in 62 % (women) cases; within 5-8 shots the rally was finished in 27 % (men) and 27% (women) cases; and within 9 and more shots the rally was finished in 14 % (men) and 11 % (women) cases. In the first two sets it is even more equal for the two genders, i.e. the rally was finished within the first four shots in 62 % and within 5-8 shots in 26 % or 27% respectively.

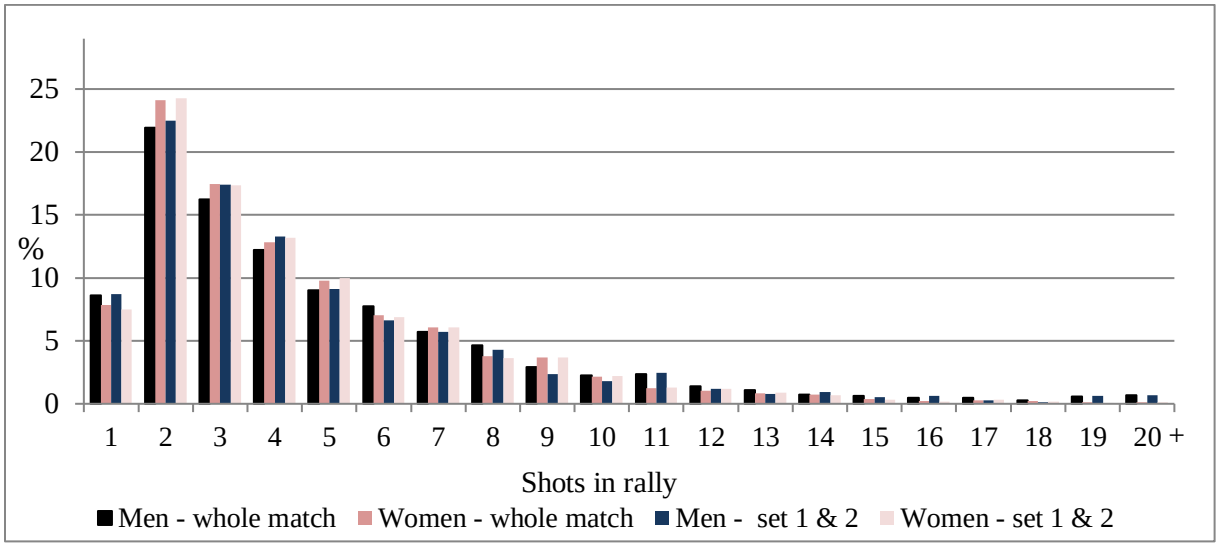

Figure 1. Frequency analyses of rally shots in men's and women's matches

DISCUSSION

The aim was to analyse the rally pace characteristics and the frequency of rally shots between the men's and women's matches at the Australian Open 2017. The rally pace (duration of the ball delivery from the opponent, in other words how much time the player has to hit the ball after the opponent's stroke) was very similar in men's and women's matches and the differences in all the other variables were not significant.

Remarkably, the overall rally pace was faster in women's matches (by only 0.01 s and not significant). Therefore we suggest that men and women played in the same rally pace at this tournament. This contradicts with Reid et al. (2016) who reported that male play in higher pace compared to women as men reach significantly higher movement speed and cover more meters on the court. This can be supported by Morante & Brotherhood (2005), who say that men reach higher stroke frequency per minute due to their different style of play. Reid et al. (2016) also say that men and women tennis players have comparable ball speed of serve return, but men reach higher ball speed of serve and ground strokes. The groundstroke speed difference and non-contrasted rally pace could be attributed to the distance which the ball travels, i.e. women can play closer to each other. Nevertheless, Reid et al. (2016) found that men hit more ground strokes inside of the baseline compared to women. However, in the first two sets comparison, the men reached 0.01 s faster rally pace compared to women. In spite of that, we still suggest both genders played in the same rally pace. The overall (slower) rally pace by men could be explained by men's fatigue.

Muscle fatigue is present in long matches and can affect a player's performance (Martin et al., 2016). Previously, it was evidenced that fatigue negatively influences the overall performance, e.g. biomechanical forces, ball speed, motion flexibility, or decreases metabolism and physiological processes (Escamilla et al., 2007; Kovacs, 2006; Martins et al. 2016; Murray et al., 2001; Myers et al., 1999). On the other hand, Gescheit, et al. (2015) argue that fatigue does not affect the stroke speed in consecutive long matches, but decreases the total movement in explosive tasks of lower limbs such as sprinting and jumping. Also fatigue from a previous match can affect the movement and performance (Ojala & Häkkinen, 2013; Reid & Duffield, 2014). Ferrauti et al. (2001) say that decrement of running can result in an inaccurate (late) stroke preparation. The player needs to expand sideways during the hitting phase leading to a lower stroke speed (loss of power). This can also change the stroke intention (instead of hitting a winner to avoid the error) (Ferrauti et al., 2001).

However, Reid & Duffield (2014) say that the fatiguing effect on the players' movement and their shot result is still unclear. Of course, the rally pace can be affected by these factors. Morante & Brotherhood (2005) reported that the mean men's match duration was 40 minutes longer at the Australian Open. Therefore, fatigue could be present more in men's matches. Men play best of 5 sets (in our study 5 out of 7 matches played all 5 sets) compared to women's best of 3 sets. Possible fatigue may explain why the mean men's rally pace was slower in the match compared to women; and why the mean men's rally pace was faster during the first two sets.

The point duration at the Australian Open, which is 0.5 s longer in men's matches, has become shorter over the last 13 years (Morante & Brotherhood, 2005). Compared to their study, the point duration was 0.5 s shorter in men's and 1.6 s in women's matches respectively. This could suggest that tennis is becoming faster and more aggressive especially in women's matches compared to the past. The point duration can be affected by weather conditions. The Australian Open in well known for hot weather conditions. It was found that extremely hot weather (>30°C) makes the point duration significantly shorter and prolongs the time between points compared to colder conditions (Périard et al., 2013). Therefore, using a resting interval between the points is important.

The time between the points was limited to 20 s by rules at grand-slam tournaments (ITF, 2017). Even though both male and female players often exceed the allowed time based on our results, they obviously try to take as much time as possible. Reid et al., (2016) specifies the characteristics of ground strokes between the sexes. Male players have a faster serve, their ground strokes are faster, flatter (lower above the net) and male players hit the ball inside the court more often. As the mean number of shot is larger with men, this may be explained by the movement difference between the genders. Men reach higher speeds and have more power; therefore they can reach more incoming balls. Both genders finished the point by 4 strokes in about 60 % cases and 4 to 8 strokes in 27 % cases, similarly to men at the French Open 2009 (women 54%), but not to the French Open 2008 (the point was finished within the first four shots in about 50 % cases, both genders) (Schönborn, 2012; Weber et al., 2010). This may be explained by different court surface characteristics or due to the development of a more aggressive playing style. The work to rest ratio in our study is similar to that found in previously published studies (Kovacs, 2004; Reid & Duffield, 2014). Together with the mentioned rally pace, this information can help the coaches to utilize the practice sessions.

The study was limited by the sample size of male's matches. However, we observed a large number of points and we believe these results can provide useful information for the coaches. The rally pace can be affected by various factors, such as the individual playing style of opposing players, their tactics and strategy, by weather conditions and fatigue etc. Also a different ball brand and court surface can affect the rally pace, number of shots, the work to rest ratio and other match characteristics, but these hypotheses need to be confirmed. The next studies could examine the rally pace and work to rest ratio on other court surfaces, during different weather conditions, e.g. hot, cold, or examine the fatigue effect, trying to assess the typical characteristics of each tournament to help utilize the training specifications prior to each Grand-slam tournament. It is very likely that similar results could be obtained from another tournament played on the same surface.

CONCLUSION

This study found that the rally pace (while the ball is in play) was the same both in men's and women's matches at the Australian Open 2017. The players, both men and women, have mean time of 1.2 s to reach a ball hit by the opponent. Other match characteristics were also not different between the genders. The point

was finished within the first 4 shots in about 60 % cases in both genders. These pieces of information could help coaches to utilize the practice sessions prior to the tournament.

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