Original Article

doi: 10.16926/par.2019.07.06

Match Characteristics and Rally Pace of Male Tennis Matches in Three Grand Slam Tournaments

Jan Carboch[ACD], Jakub Siman[B], Michal Sklenarik[AB], Matej Blau[B]

Department of Sport Games, Faculty of Physical Education and Sport, Charles University, Prague, Czech Republic

Authors' Contribution: A – Study Design, B – Data Collection, C – Statistical Analysis, D – Manuscript Preparation, E – Funds Collection

Abstract

Introduction: A tennis player has a very limited time to hit an incoming ball; however, the ball delivery time is affected by playing on different surfaces. Consequently, the playing surface can affect also other match characteristics as players can reach more incoming balls or can move on the court with different intensity (cover more distance). *Aim of Study:* The aim is to analyze the rally pace characteristics and the frequency of rally shots in men's matches in the Australian Open, French Open and Wimbledon in 2017. *Material and Methods:* We analyzed 24 male matches in the Australian Open, French Open and Wimbledon in 2017. Analysis of variance including post-hoc tests and Cohen *d* were used to compare the point duration, number of rally shots, time between the points, rally pace and work to rest ratio among these tournaments. *Results:* The rally pace (mean ball flight time between the opponents) was the fastest in the Australian Open (1.22 s) and was significantly faster (p=0.003) compared to the French Open (1.35 s). The rally pace in the Wimbledon reached 1.27 s and Cohen *d* showed large effect between the rally pace in the Wimbledon and French Open or moderate effect between the Australian Open and Wimbledon. There were other differences among the tournaments, but the lowest number of rally shots (4.07), point duration (5.30 s) and time between points (18.82 s) was reached in the Wimbledon. More than 50 % of all points were finished within the first four shots (most in the Wimbledon – 66%). *Conclusion:* These findings show and endorse the impact of surface differences on the game performance in professional tennis and can be used to shape specific training sessions on different surfaces.

Keywords: intensity, performance analysis, professional tennis, surface, tennis court

Address for correspondence: Jan Carboch - Department of Sport Games, Faculty of Physical Education and Sport, Charles University, Prague, Czech Republic, email: carby@post.cz

Recevied: 29.12.2018; Accepted: 31.12.2018; Published online: 6.03.2019

Cite this article as: Carboch J, Siman J, Sklenarik M, Blau M. Match Characteristics and Rally Pace of Male Tennis Matches in Three Grand Slam Tournaments. Physical Activity Review 2019; 7: 49-56. doi: 10.16926/par.2019.07.06

INTRODUCTION

There are differences among various court surfaces in tennis, but on any of these surfaces players 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 as little time as possible forcing him to make an error. 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 [1,2]. The four Grand Slam tournaments (Australian Open, French Open, Wimbledon and US Open) are played on different surfaces.

The International Tennis Federation (ITF) classifies the surfaces according to the court pace rating (measures the effect of ball-surface interaction) and the surfaces are consequently categorized as slow, medium-slow, medium, medium-fast and fast [3]. The clay courts (French Open) are generally known and classified as slow courts as the ball has slow and high bounce providing the receiver with the opportunity of returning more serves than on faster surfaces [4]. Also the players are able to slide on the clay court and they do so quite often while reaching the ball or stopping their movement. The players can move very intensively on hard courts (Australian Open, US Open) as they have the biggest adhesion while running and changing the movement direction on these courts. The match on hard court is characterized by high intensity efforts as the tennis players cover a greater distance accelerating, with more pacing and higher speeds [5]. Playing on the grass surface (the Wimbledon) can be different as the ball usually has a very low bounce which reduces the time to return the ball and it is hard to change the direction of moving player or to stop his running movement on the grass as the player can slip very easily. Male and female players cover the smallest distance per point in the Wimbledon and male players cover the biggest distance in the French Open [6,7]. Differences in the playing style and strategy are not only between the opponents but also in different surfaces. Different serving and returning strategy can be used on these surfaces as well as the different ball height above the net and ball spin [8]. On the other hand, Cui et al. [7] suggest that match tactics among court surfaces became less different as players try to adopt aggressive strategy on all surfaces. Various match characteristics were examined in the past such as serve and return efficiency, return points won, game or match duration, number of rally shots [9–11].

Carboch [9] compared all four Grand Slam tournaments in 2016 and reported that the lowest number of winners was in the US Open and the most return games won was in the US Open and French Open. The most aces from all the Grand Slams were reported in the Wimbledon as well as the most games per sets, but the most points per game are played in the French Open [6,9,12,13]. Even in the French Open more than 50 % points in male matches are decided within the first 4 shots of the point [14]. It was suggested that various match records may provide valuable information for researchers, coaches and players [11].

Intermittent load is typical for tennis including repeatable high intensity movements and rest [8, 15]. Previous studies reported 33.1 s between the points in the French Open 2009 men's semifinals and final matches or 21.5 s between the points in males matches in the Australian Open 2016 [14,16]. Till 2017, the Grand Slam rules allowed 20 s between the points [17]; however this was changed to 25 s from 2018 and is unified with the ATP circuit tournaments [18, 19]. The mean point duration reached in the Australian Open 6.4 s in male matches and 5.2 s in the Wimbledon or 8.3 s in the French Open [20, 21]. During this time, the player performs high intensity acyclic and cyclic movements [8,22]. In tennis, a work to rest ratio is 1:2-1:5 depending on the court surface [22–26]. Reid et al. [11] compared match characteristics of male and female players and reported that men play in higher pace. The purpose of this study is to examine the rally pace during the 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 on different Grand Slam surfaces. The rally pace in female matches in the Australian Open was significantly faster (1.16 s) in the late stage of the tournament compared to the early stage (1.23 s) [27]. The aim is to analyze the rally pace characteristics and the frequency of rally shots in men's matches in the Australian Open, French Open and Wimbledon in 2017.

MATERIAL AND METHODS

Participants

Altogether we analyzed 24 men's matches in the Australian Open (AO), French Open (FO) and Wimbledon (W) in 2017. We observed total 1738 points in 7 men's matches in the AO 2017. In these matches the players (n = 12) had a mean ATP ranking of 45.0 ± 35.7 and age 28.0 ± 4.9 years. Four of the matches were first round matches, two semi-finals and finals. In the FO 2017 we observed 1337 points in 10 men's matches. The players (n = 19) had a mean ATP ranking 37.5 ± 54.5 and age 28.5 ± 3.5 years. We analyzed one first round match, three second round matches, three third round matches, one fourth round match, one quarterfinal, one semi-final and a final one. In the W we analyzed 1778 points in 7 men's matches. The players (n = 12) had a mean ATP ranking 45.1 ± 38.1 and age 29.0 ± 5.3 years. Four of the matches were first round matches, two semi-finals and finals. 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 behavior 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 number of rally shots were analyzed during the first observation. The time between the points was measured 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.

Statistical analyses

All matches were analysed by three evaluators. The evaluators had 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 ≥ 0.92. The intra-rater reliability (ICC) reached in all the observed variables ≥ 0.97 (evaluator 1), ≥ 0.96 (evaluator 2) and ≥ 0.96 (evaluator 3). Firstly, we calculated the means of each variable from every single match. Using SPSS 15.0, data were analysed using descriptive statistics and analysis of variance. Post-hoc tests (Tukey) were calculated to assess the difference among the three Grand Slam tournaments. 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 ($d \geq 0.80$) [28].

RESULTS

Descriptive statistics of all variables are shown in the table 1. A one-way between subjects ANOVA was conducted to compare the effect of the Grand Slam tournament (surface) on the rally shots number $F(2, 21) = 5.155$, $p = 0.015$. A Tukey post-hoc test revealed that the number of shots was statistically significantly lower between the FO and W ($p = 0.012$). There was no statistically significant difference between the AO and FO; or the AO and W respectively. Further, Cohen *d* showed large effect between the number of rally shots in the AO and FO; or the AO and W (Table 2). ANOVA showed a statistically significant difference between groups in the point duration $F(2, 21) = 5.315$, $p = 0.014$. A Tukey post-hoc test revealed that the point duration was significantly lower between the FO and W ($p = 0.012$). Cohen *d* showed large effect between the AO and FO; or the FO and W. Another statistical difference between the groups was revealed in the time between points $F(2, 21) = 5.931$, $p = 0.009$. Post-hoc comparisons indicated longer time between the points in the FO than in the W ($p = 0.007$). We observed large effect size between the AO and W; or the FO and W.

A one-way between subjects ANOVA compared the effect of the Grand Slam tournament on the rally pace $F(2, 21) = 7.553$, $p = 0.003$. Post-hoc test showed significant difference between the rally pace in the AO and FO ($p = 0.003$). However Cohen *d* revealed large effect between the AO and FO; the FO and W; and moderate effect between the AO and W. ANOVA and post-hoc test did not show any significance in the work/rest ratio in these three tournaments, but Cohen *d* showed large effect between the AO and FO; and moderate effect between the FO and W.

Frequency analysis of rally shots number showed that the most points were finished within the first three shots in the W (Figure 1). The frequency of 4 rally shots was similar among observed Grand Slams. The point was finished within the first four shots in 59 % cases (AO), 53 % (FO) and 66 % (W); within 5–8 shots in 27 % cases (AO), 31 % (FO) and 24 % (W); within 9-12 shots in 9 % cases (AO), 11 % (FO) and 8 % (W); and within 13 and more shots in 5 % cases (AO), 6 % (FO) and 21 % (W).

Table 1. Comparison of observed variables among the Australian Open, French Open and Wimbledon

	Australian Open			French Open			Wimbledon		
	M±SD	95 % CI Lower	95 % CI Upper	M±SD	95 % CI Lower	95 % CI Upper	M±SD	95 % CI Lower	95 % CI Upper
Rally shots [quantity]	4.85±0.48	4.41	5.30	5.18±0.83*	4.59	5.77	4.07±0.71*	3.42	4.72
Point duration [s]	5.93±0.67	5.31	6.55	6.93±1.19*	6.08	7.79	5.30±1.10*	4.29	6.32
Time between points [s]	21.46±2.88	18.80	24.13	22.39±1.90**	21.03	23.74	18.82±1.49**	17.44	20.19
Rally pace [s]	1.22±0.03##	1.19	1.25	1.34±0.04##	1.31	1.37	1.27±0.09	1.19	1.36
Work/rest ratio	1:3.63±0.38	3.27	3.98	1:3.29±0.46	2.97	3.62	1:3.69±0.87	2.88	4.49

Significantly different French Open vs. Wimbledon ($p < 0.05$)*; ($p < 0.01$)**; Significantly different Australian Open vs. French Open ($p < 0.01$) ##

Table 2. Effect sizes of observed variables among the tournaments - Cohen *d*

	AO vs. FO	AO vs. W	FO vs. W
Rally shots	0.49	1.32	1.44
Point duration	1.04	-0.69	-1.42
Time between points	0.38	-1.15	-2.09
Rally pace	3.39	0.75	-1.01
Work/rest ratio	0.80	0.09	0.58

AO – Australian Open, FO – French Open, W – Wimbledon

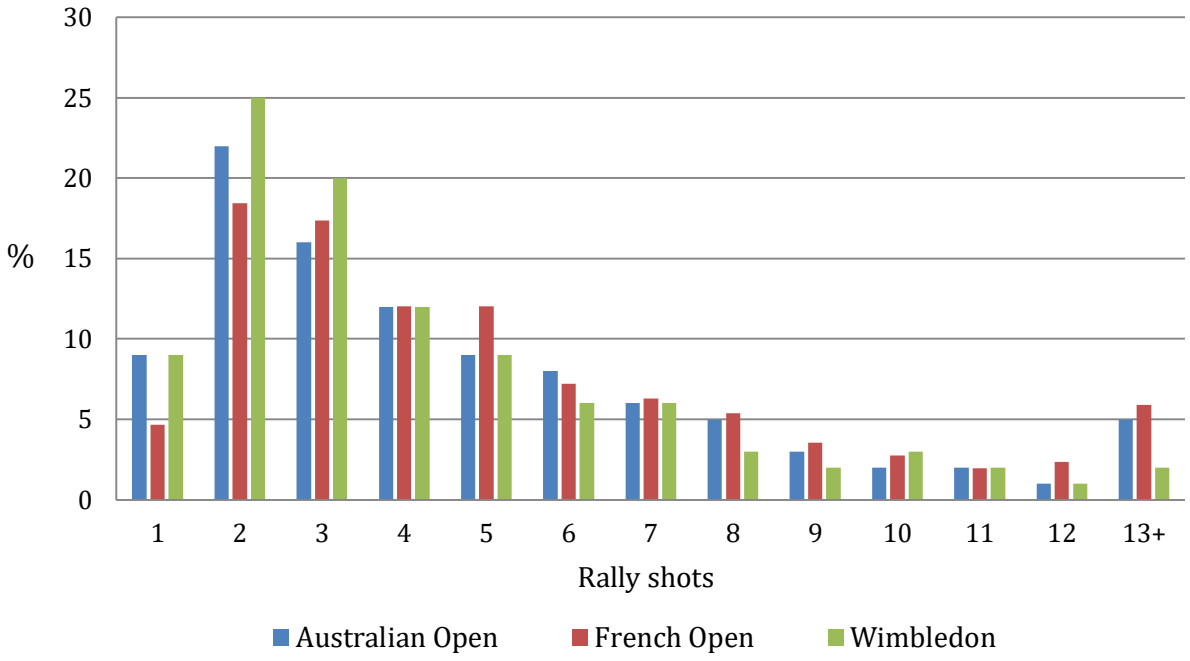

Figure 1. Frequency of rally shots.

DISCUSSION

The aim was to analyze the rally pace characteristics and the frequency of rally shots in men's matches in the AO, FO and W in 2017. The point was finished within the first 4 shots in more than 50 % cases in all the observed tournaments, meaning each player hit the ball no more than twice. The rally pace was significantly different between the AO and FO. The rally shots number, point duration and time between points were also significantly different between the FO and W. However, the effect sizes indicated large effect among the Grand Slams even in more cases as apparent above.

Remarkably, the rally pace was the fastest in the AO. This could be explained by the hard surface which affects the on-court movement. The movement can reach the highest intensity efforts as the tennis players cover a greater distance accelerating, with more pacing and higher speeds [5]. They can even change their direction quickly while running and cover more distance on court. This can allow the players to reach the ball on time (earlier than on less adhesive surfaces like clay or grass) and hit the ball in an optimal position. If the player is lately positioned for his stroke, the player needs to expand sideway during hitting phase leading to lower stroke speed (loss of power) and this can also change his stroke intention (instead of hitting a winner to avoid the error) [29]. This can affect the rally pace and can explain why players hit more rally shots sometimes. On the other hand the faster surface it is, the less time for the player to hit the incoming ball. This could be seen in the W as there is also a low ball bounce present on the grass surface decreasing the ball flight time. The grass surface is less adhesive, which can make the court movement difficult and therefore not to allow the player to hit the ball in an optimal position (late) and the players cover the least distance in the W from all the Grand Slams [7]. The low ball bounce is usually below the net height which forces the player to hit the ball with different ball trajectory. The ball needs to fly up above the net first and needs to be controlled by the spin to bounce onto the opponents court (not to be too long) or the ball needs to be hit with lower speed. This could be why the rally pace in the W is slower compared to the AO. However, in the W final the player played in faster pace 1.13 s [30]. This may be attributed to better skills of the players or to their offensive strategy. The rally pace in the FO is to no surprise to be the slowest, due to decrement of ball speed at the ball impact and its high ball bounce. This allows reaching more balls as the players can have more time for that. Men hit more ground strokes inside of the baseline compared to women on hard surface [11], but especially on clay some players can play more behind

the baseline or use shots higher above the net, which both can increase the ball flight duration. Even though the results were statistically significant only between the FO and W, the effect sizes showed large effect (AO vs. FO; FO vs. W) or moderate effect (AO vs. W). Due to the Cohen *d* results and reasons mentioned above we suggest these rally pace differences among the three Grand Slams are practically significant.

The rules allowed 20 s between the points in 2017 [17]. The only Grand Slam which was within this limit was the W. This limit was exceeded in the AO and FO, but still was within the ATP rules (not applied in the Grand Slam tournaments) [19]. Kolbinger et al. [16] support our finding in the AO by reporting identical time between the points. The longer time between the points in the AO and FO can be attributed to several factors. Players can move with higher intensity in the AO and FO; or the point duration and number of rally shots is higher. Both factors can cause the players need to rest more between the points. Also the umpires may not enforce this rule as they issue very low number of time violations [16]. However since 2018 the time limit between the points was changed to 25 s in the Grand Slams. The point duration was the longest in the FO as the players are able to reach more incoming balls and hit the most rally shots there. Also the service has the lowest efficiency in the FO and the players can return the serve more easily compared to other Grand Slams [9]. The work/rest ratio was very similar to previous studies [23–25] and was similar among the three Grand Slams, as the point duration seemed to correlate with the time between the points.

The most rally shots were played in the FO as the surface allows the players to reach the most incoming balls. Points were finished within the first 4 four shots of the rally in 53 % in the FO. Similar results were previously reported in the FO [14]. However, in the Wimbledon it was 66 % of all points, which can be explained by surface difference, by different players' strategy on this surface or both. Notably, in the final match the points were finished within the first 4 shots in 78 % [30] (each player played 2 shots or fewer during the point). This suggests the importance of these first two rally shots. Therefore various servers' combinations like serve and 2nd shot should be perfectly controlled by servers.

The authors are aware that this study had some limitations. 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 and researchers. The match characteristics can be affected by various factors, such as the playing style of players, their tactics and strategy against different opponents or on different surfaces, by weather conditions, fatigue or mental state etc. Also a different ball brand can affect various match characteristics. Further studies could examine the rally pace and match characteristics of female or junior players, trying to assess the typical characteristics of each Grand Slam tournament to help utilize the training designs prior to the specific tournament. It is very likely that similar results could be obtained from other tournaments played on the same surface.

CONCLUSION

The match characteristics vary among the AO, FO and W. The rally pace was the fastest in the AO and slowest in the FO. The lowest number of shots, point duration and time between points was reached in the W. More than 50 % of points were finished within the first four shots of the rally, in the W 66 % respectively. These results provide insight into tactical and conditional disposition in professional tennis, which can be used to improve the game performance. The findings inform and endorse the impact of surface differences on the game performance in tennis. These pieces of information can set objective criteria for future research and can be used to shape a specific training on different surfaces prior the tournaments.

ACKNOWLEDGMENTS

This study was written within the Programme of the institutional support for science at Charles University Progress, No. Q41 *Biological aspects of the investigation of human movement*. The authors report no conflicts of interest.

REFERENCES

1. Dunlop JI. Characterizing the service bouncing using a speed gun. In: Haake SJ. Coe A. editors. Tennis Science & Technology. Oxford: Blackwell Science; 2000. p. 183-190.
2. Kleinoder H. The return of serve. ITF coaching & sport science review. 2011;2:5-6.
3. International tennis federation.court pace [internet]. Technical ITF; 2018 [cited 2018 sep 27]. Available from: https://www.itftennis.com/technical/courts/court-testing/court-pace.aspx
4. Martin C, Prioux J. The Effect of Playing Surfaces on Performance in Tennis. In: Hong Y. editor. Routledge Handbook of Ergonomics in Sport and Exercise. Abingdon: Routledge; 2013.
5. Galé-Ansodi C, Castellano J, Usabiaga O. Effects of different surfaces in time-motion characteristics in youth elite tennis players. International Journal of Performance Analysis in Sport. 2016;16(3):860-870. doi: 10.1080/24748668.2016.11868934
6. Cui Y, Gómez MA, Gonçalves B, Sampaio J. Performance profiles of professional female tennis players in grand slams. PLoS ONE. 2018;13(7):e0200591. doi.org/10.1371/journal. pone.0200591
7. Cui Y, Gomez MA, Goncalves B, Liu H, Sampaio J. Effects of experience and relative quality in tennis match performance during four Grand Slams. International Journal of Performance Analysis in Sport. 2017;17(5):1-19. doi: 10.1080/24748668.2017.1399325
8. Crespo M, Miley D. Advanced coaches manual. London: ITF; 1998.
9. Carboch J. Comparison of game characteristics of male and female tennis players at grand-slam tournaments in 2016. Trends in Sport Sciences. 2017; 24(4):151-155. doi: 10.23829/TSS.2017.24.4-2
10. Filipcic A, Caks KK, Filipcic T. A comparison of selected match characteristics of female tennis players. Kinesiologia Slovenica. 2011;17(2):14-24.
11. Reid M, Morgan S, Whiteside D. Matchplay characteristics of Grand Slam tennis: implications for training and conditioning. J Sports Sci. 2016;34(19):1791-1798. doi: 10.1080/02640414.2016.1139161
12. Cross R, Pollard G. Grand Slam men's singles tennis 1991-2009 Serve speeds and other related data. ITF Coaching and Sport Science Review. 2009;16(49):8-10.
13. Filipcic T, Filipcic A, Berendijas T. Comparison of game characteristics of male and female tennis players at Roland Garros 2005. Acta Universitatis Palackianae Gymnica. 2008;38(3):21-28.
14. Weber K, Exler T, Marx A, Pley C, Röbbel S, Schäffkes C. Schnellere Aufschläge, kürzere Ballwechsel und höherer Zeitdruck für Grundschläge in der Tennis-Weltspitze. Leistungssport. 2010;40(5):36-42. German.
15. Fernandez J, Mendez-Villanueva A, Pluim BM. Intensity of tennis match play. Br J Sports Med. 2006;40(5):387-391.
16. Kolbinger O, Grossmann S, Lames M. A closer look at the prevalence of time rule violations and the inter-point time in men's Grand Slam tennis. Journal of Sports Analytics. 2018; Preprint:1-10. doi: 10.3233/JSA-180277
17. International Tennis Federation. 2017 Official Grand Slam Rule Book. London: Grand Slam Board; 2017.
18. International Tennis Federation. 2018 Official Grand Slam Rule Book. London: Grand Slam Board; 2018.
19. Association of Tennis Professionals. The 2017 ATP official rulebook. Ponte Vedra Beach, FL: ATP Tour Inc.; 2017.
20. Morante S, Brotherhood J. Match Characteristics of Professional Singles Tennis. Medicine & Science in Tennis. 2005;12-13.
21. Schornborn R. Advanced Techniques for Competitive Tennis. Aachen: Meyer&Meyer Sport; 1999.
22. Fernandez J, Mendez-Villanueva A, Pluim, BM. Intensity of tennis match play. Br J Sports Med. 2006;40(5):387-391.
23. Kovacs MS. Applied physiology of tennis performance. Br J Sports Med. 2006;40(50),381-386.
24. O'Donoghue P, Ingram B. A notation analysis of elite tennis strategy. J Sports Sci. 2001;19(2):107-115.
25. Reid M, Duffield R. The development of fatigue during match-play tennis. Br J Sports Med. 2014;48: i7-i11. doi.org/10.1136/bjsports-2013-093196
26. Smekal G, Duvillard SP, Rihacek C, Pokan R, Hofmann P, Baron R, et al. A physiological profile of tennis match play. Med Sci Sports Exerc. 2001;33:999-1005.
27. Carboch J, Placha K. Development of rally pace and other match characteristics in women's matches in the Australian Open 2017. Journal of Physical Education and Sport. 2018;18(supplement issue 2):1079-1083. doi.org/10.14198/jhse.2018.134.03
28. Cohen, J. Statistical power analysis for the behavioral sciences.2nd ed. Hillsdale (NJ): Lawrence Earlbaum Associates; 1988.
29. Ferrauti A, Pluim B, Weber K. The effect of recovery duration on running speed and stroke quality during intermittent training drills in elite tennis players. J Sports Sci. 2001;19:235-42.

30. Siman J. Tempo hry v tenise na Wimbledonu 2017 [unpublished bachelor thesis]. Prague, Czechia: Charles University; 2018. [in Czech]