

ORIGINAL SCIENTIFIC PAPER

Match and Game Performance Variables in Elite and Junior Men Singles Tennis Players

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Abstract

Junior players although easier approachable in terms of running tests and measurements, are less studied and examined particularly in such popular field of sports science as Performance Analysis. Most of the studies are focusing on elite athletes, whereas juniors are left without attention. This does not help them to successfully progress from junior to senior division. The aim of this study was to investigate the difference of the game structure between Elite Level (EL) and Junior Level (JL) single tennis players. A total of 14 matches were analyzed including semi-finals and finals of International tennis tournaments. The game structure variables selected for this study included match duration (MD), game (set) duration (SD), rallies per game (set) (RPS), shots per rally (SPR), rally length (RL), rest time between rallies (RT), ball in play in seconds (BLs) and ball in play in percentage (BP%). Independent Sample T-test and Mann-Whitney test depending on the normality of data distribution were used for the comparison of game variables between Elite Level and Junior Level. Number of rallies, rest time between rallies, ball in play in percentage, and match duration were tested using Independent Sample T-test. Mann-Whitney test was used for comparing set duration, ball in play in seconds, rally length and shots per rally. There were statistically significant differences among the two categories in number of rallies, ball in play in percentage, ball in play in seconds and rally length (all at $p < 0.05$).

Keywords: tennis, performance analysis, elite players, junior players

Introduction

Although tennis is not dominant in Asian countries like it is in Europe, there are several athletes who have achieved elite level of performance. For example, Kei Nishikori from Japan is one of the best Asian male tennis players who have reached the final in a Grand Slam – U.S Open 2014 (Puri, 2014). Although Nishikori was not showing any outstanding results while at junior level, after 18 and above he has won 12 singles titles.

Among the areas of tennis dedicated research, particularly in junior division, traditionally more attention is paid to the development of motor qualities (Smajic, Barasic, Javorac, Cokorilo, & Tomic, 2014, Smajic et al., 2015), some attention is paid to tactical and psychological issues (Milenkovic, 2007), some to technical issues (Tajul, Fatemah, & Radzani, 2016),

with still less attention paid to performance analysis and match and game structure variables (Donoghue & Ingram, 2001; Filipic, Caks, & Filipic, 2011). Researchers typically tend to analyze tennis players' performance through analyzing the traditional set of markers provided by of the major ATP professional performance analysts (Kovalchik & Reid, 2017).

The use of video analysis and video-based technology has become one of the favorite methods to analyze performance by sport biomechanics and performance analysis. By recording a video, an important event during performance can be quantified and analyzed in a consistent and reliable manner (Hughes & Barlett, 2002). A video is also recognized as an appropriate medium for obtaining qualitative information about performance such as enhanced feedback using replays,



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real time three-dimensional simulations or superposition of vector graphic. It also can be further used for individual notational analysis and game statistics in remote locations (Liebmann et al., 2002).

As stated by Hughes and Behan (2007), national ranked or elite players used far more complex tactics in their matches compared to other standard athletes or juniors due their superior fitness and technical ability. Technical evaluation is inter-dependent as it depends on technical strength and weakness of players to make a tactical decision. In addition, analysis of technical deficiencies and strengths in players is important for coaches to improve performance (Hughes & Behan 2007).

Once the player enters the elite level, skills and quality of the player increase due to physiological factors, experience and practices that had been mastered as compared to junior players. Thus, video that will be analyzed may help coaches and junior players to reach or master the skill by seeing the playing pattern with technical and tactical strategy. There were very limited studies attempted in tennis with ones particularly related to comparison of international level players in elite and junior divisions. Therefore, in this study an analysis towards game structure may provide some information for further use by coaches and players in order to increase performance especially in Asian countries. As stated by Loh and Krasilshchikov (2015), very limited studies were attempted in racket sports particularly comparing world elite and junior elite players.

A study by Loh and Krasilshchikov (2015) in table tennis stated that lower-level players take longer duration of the game. This may be due to elite players being more experienced and more skillful thus the time taken to finish one set or game is less compared to junior player. By doing a mistake while serving in tennis match will make duration of the game longer. Usually, professional group or elite players made less mistakes compared to junior. This is pointed out by Hazuan et al. (2011) who showed professional group served significantly less faults than under-16 players and under-12 players.

In comparing elite and junior level of tennis players, Hazuan, Reid and Whipp (2011) compared six different indicators in performance analysis, independently of gender in professional players and high-performance players under 16 and under 12. The results showed, male professionals served more aces than the under 16 and under 12 and female professional players. The study also indicated professionals serving significantly fewer double faults, winning a significantly greater percentage of points on first serve and winning significantly more points on second serve return compared to players of U-16 and U-12 groups.

Coaches are spending most of the time teaching effective technique and tactics but there is no guideline which playing patterns are the most suitable. In addition, the coaches also face the challenges to determine which skill and movement pattern fits players within their skill and capacity level.

Thus, this study will attempt helping the coaches and trainers by providing quantitative data on match performance structure of tennis players of Elite level and junior level. The data that will be obtained may help juniors to improve and ease their transition into elite players.

Study objective was to determine and quantify game structure of men's singles tennis players in elite and junior categories and to determine the differences in the game struc-

ture between elite men's single tennis players and youth men's players.

Methods

Sampling

Recorded videos of international matches were collected throughout the years of 2016-2017 and the videos analyzed for both junior and elite players. Only matches from semi-finals and finals were selected for further analysis. Inclusion criteria for the video match were collected on male single tennis championships. Total number of the matches analyzed was 14 (7 from junior and 7 from elite level) with total 41 games eventually into statistical analysis. Total number of sets analyzed were 16 and 25 respectively for Juniors and Elite category.

Procedures

Type of research design in this study was quantitative analysis focused on game structure of tennis players. The data collected through video recording was consequently analyzed in post-match mode by using Elite Sport Analysis-Focus-X2 PRO. This software allows the user to create code window performance indicators analyzed. In addition, this software enables video to view the record of variables or actions that user is interested through using Category Set. Category Set is created by the users themselves based on their variables of interest.

Then the data of the variables were extracted from matrix and transferred into spreadsheet in Microsoft Excel 2010. From Microsoft Excel, the game structure, match and game variables for each match were calculated.

Nine game structure variables were selected for this study including match duration (s), game duration (s), rallies per set (number), shots per rally (number), rally duration (s), rest time between rallies (s), ball in play (s), ball in play (%) and unforced errors (number). Since the research did not involve physical participation of athletes, ethical clearance was not required.

Statistical analysis

Data collected was analyzed using Statistical Package for the Social Science (SPSS) version 24.0. The result of variables for each match were exported from spreadsheet in Microsoft Excel to SPSS for analysis.

The mean and standard deviations were shown as descriptive statistics for variables of game structure for both groups: Elite group and Junior group. Normality of distribution was determined through Shapiro – Wilk Test. If the data was normally distributed independent t-test was used for game structure variables to compare between both groups. In adverse, variables not normally distributed were analyzed using Man-Whitney test.

Results

Game Structure in Elite Level Players

For Elite Level, the mean for match duration was 5027.14 ± 2222.50 s or equivalent of 83.79 ± 37.04 minutes (min) whereas mean for set duration was 1515.12 ± 486.45 s or equivalent to 25.25 ± 8.11 min, 48.08 ± 10.68 number of rallies per game, 6.10 ± 4.51 shots per rally, ball in play of 339.34 ± 142.47 s or equivalent to 5.66 ± 2.37 min or 22.79% (SD=6.36) of game duration per game, rally length of 6.76 ± 7.28 and rest time between rallies of 1524.56 ± 393.50 s or equivalent to 25.41 ± 6.56 min. The results are presented in Table 1.

Table 1. Mean, Standard Deviation (SD), Median, Interquartile Range (IQR), Minimum (min) and Maximum (max) of game structure variables in Elite Level

Variable	Mean	SD	Median	IQR	Min	Max
MATCH ^a						
Match duration (s)	5027.14	2222.50	5772.0	3962	2347.00	7893
GAME ^b						
Set duration	1515.12	486.45	1402.00	722.5	805.00	2940
Number of rallies per game	48.08	10.68	47.00	13.50	31	75
Shots per rally ^c	6.10	4.51	5.0	5	1	37
Ball in play (s)	339.34	142.47	289	173.5	157	847
Ball in play (%)	22.79	6.36	22.00	12.20	12.20	31.17
Rally length (s) ^d	6.76	7.28	4.00	7	0.50	65
Rest time per rallies (s)	1524.56	393.50	1466	691.50	952	2332

Note; ^a Number of matches, n= 7; ^b Number of games, n= 25 ^c Number of rallies analyzed, n =1137; ^d Number of rallies analyzed, n=1139

Game Structure in Junior Level Players

For Junior Level, the mean for match duration was 3209.14±996.394 s or equivalent to 53.48±16.61 minutes (min) whereas mean for set duration was 1400.88±415.11s or equivalent to 23.35±6.92 min, 61±17.97 number of rallies per

game, 6.14±4.37 shots per rally, ball in play of 466.18±188.70 s or equivalent to 7.8±min or 3.14 % (SD=6.36) of game duration per game, rally length of 7.58±7.66 and rest time between rallies of 1445.06±610.94 s or equivalent to 24.1±10.18 min. The results are presented in Table 2.

Table 2. Mean, Standard Deviation (SD), Median, Interquartile Range (IQR), Minimum (min) and Maximum (max) of game structure variables in Junior Level

Variable	Mean	SD	Median	IQR	Min	Max
MATCH ^a						
Match duration (s)	3209.14	996.394	2772.00	1095	2037	5021
GAME ^b						
Set duration	1400.88	415.11	1401.00	746.50	748	197448
Number of rallies per game	61.00	17.97	54.50	31.50	37	100
Shots per rally ^c	6.14	4.37	5.0	5.0	2	34
Ball in play (s)	466.18	188.70	455.50	274.25	251	936
Ball in play (%)	33.38	8.76	31.57	13.40	20.67	51.10
Rally length (s) ^d	7.58	7.66	5.0	8.0	1	63
Rest time per rallies (s)	1445.06	610.94	1482.5	869.75	184	2228

Note; ^a Number of matches, n= 7; ^b Number of games, n= 16 ^c Number of rallies analyzed, n =976; ^d Number of rallies analyzed, n=976

Comparison of Game Structure between Elite and Junior Level Players

Shapiro-Wilk test was used for sample size (n) less than 2000 which is when the p value ≥0.05 showed that null hypothesis of normally distributed data accepted. If P value <0.05, null hypothesis of normality data is rejected. Test for variable which is normally distributed will be tested with Independent t- test

where the mean and standard deviation (SD) were compared. Whereas for variables not normally distributed data will be tested using Mann Whitney where the median and interquartile range (IQR) were compared. There was homogeneity of variance as assessed by Levene's Test for equality of variances.

Results presented in Table 3 show that mean and standard

Table 3. Comparison of the Variables in Elite and Junior level

Variables	Elite	Junior	Mean differences (95%CI)	t(df)	p
	M (SD)	M (SD)			
Match Duration (s)	5027.14 (2222.50)	3209.14 (996.40)	1818 (-187.78, 3823.78)	1.95 (12)	0.07
Game Variables					
Number of rallies per set (number)	48.0 (10.68)	61 (17.97)	12.92 (-21.95, -23.24)	-2.89 (39)	0.006*
Rest time between rally (s)	1524.56 (393.50)	1445.06 (610.94)	79.50 (-236.10, 395.98)	0.51 (39)	0.61
Ball in play (%)	22.79 (6.36)	33.38 (8.76)	10.60 (-15.37, -5.82)	-4.486 (39)	0.001*

Note: *p<0.05, **p<0.01, ***p<0.001

deviation are tested for variables in Elite Level and Junior Level categories, respectively. There were mean significant differences in number of rallies per set ($p=0.006$) and ball in play % ($p=0.001$) between Elite Level and Junior Level, when tested using Independent T-test. Whereas for variables of match duration (s) ($p=0.07$) and ball in play (s) ($p=0.61$) were no statistically significant differences between Elite Level and Junior Level which is p value more than ($p>0.05$). Mean for number of rallies per set and ball in play % were significantly higher in Junior Level than Elite Level. Mean for match duration (s) and rest time between rallies(s) were not significantly higher in Elite Level compared to Junior Level.

Results presented in Table 4 show median and standard inter-quartile range for tested variables in Elite Level and Junior Level categories, respectively. There were median significant differences of ball in play (s) ($p=0.01$) and rally length (s) ($p=0.001$) between Elite Level and Junior Level, when tested using Mann-Whitney test. Median of ball in play (s) and rally length (s) were significantly higher in Junior Level compared to Elite Level. Variables of set duration (s) ($p=0.487$) and shot per rally (s) ($p=0.6$) were not median statistically significant differences between Elite Level and Junior Level. Median of set duration is not significant which is slightly higher in Elite Level compared to Junior Level while median of shot per rally (s) is same for both categories.

Table 4. Comparison of median and Interquartile Range (IQR) of the Variables in Elite and Junior Level

Variables	Elite Median (IQR)	Junior Median (IQR)	Z statistic	p
Set Duration (s)	1402 (722.5)	1401 (746.5)	-0.695	0.487
Ball in play (s)	289 (173.50)	455.5 (274.25)	-2.51	0.01*
Rally Length (s)	4.00 (7)	5.0 (8.0)	-3.448	0.001*
Shot per Rally (number)	5.00 (5)	5.0(5.0)	-0.585	0.6

Note: * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Discussion

There were no statistically significant differences between match duration of Elite Level and Junior Level in this study. These results might be caused by the rest time between rally is not much different with 1524.56 ± 393.50 s or equivalent to 25.41 ± 6.56 min and of 1445.06 ± 610.94 s or equivalent to 24.1 ± 10.18 min for Elite Level and Junior Level, respectively. Based on Fernandez, Villanueva and Pluim (2006), recovery periods are controlled by ITF rules which is rest time between points is 20s, 90s between changeovers and 120 second between sets.

Apparently, in this study Elite players are likely having longer duration 5027.14 ± 2222.50 s or equivalent to 83.79 ± 37.04 minutes than Junior Level 3209.14 ± 996.394 s or equivalent to 53.48 ± 16.61 minute. This is more likely games played by Elite level are longer with the average games played per match being 3.32 while for the Junior level it was 2.3.

Players at Elite level show no significantly longer game duration compared with players at Junior level. In present study, shots per rally between levels were not much different with Elite (6.10 ± 4.51) and Junior (6.14 ± 4.37) which possibly influence game duration not significantly different in the present study either.

Based on Fernandez et al. (2007), increased number of shots per rally in male single tennis in matches with longer duration will require higher physiological response. Longer duration of the set may demand greater cardiovascular fitness and psychological strength especially when the games are tied up to 13 games. It is recommended for the players to win 6 games which is 2 point ahead from the opponent straightly thus time to exhaustion and requirement of high energy can decrease.

There was a significant difference between number of rallies per game between Elite and Junior Level which is higher in Juniors than in Elite Level with a mean difference of 12.92 (95% CI of mean difference: (-21.95, -23.24), which in turn elevates the physiological demands to the performance in tennis (Johnson & Hugh, 2005).

Based on previous study Leong and Krasilshchikov (2016),

showed there was no significant differences in rallies per game between Elite 35.1 ± 5.1 and Youth Level 37.7 ± 3.6 badminton players. Current study results showed that Youth Level play more rallies per game compared to Elite Level.

In the present study, there was no statistical difference of shots per rally between Elite players and Junior Players. One of the factors may be due serve point which players win within one shot in a rally which is ace serve. There are about over 50% (50.8%) of all rally demanded players to execute between 1 and 2 strokes in a game (Fernandez, Villanueva, Garcia, & Terrados, 2007).

Based to the past study, there were significantly higher physiological responses in matches with longer rally duration and increased strokes per rally in male singles (Fernandez et al., 2007). Average shot per rally in Junior tennis players had an average 5.45 ± 0.22 strokes per rally (Luque, Cabello, Raquel, & Garatachea, 2011). In present study, an average was 6.14 ± 4.37 stroke per rally in Junior level which is not similar with past study.

When comparing between levels Junior players showed greater average rally duration as compared to Elite players (Luque et al., 2011). Thus, increased rally length may lead to higher number of shots per rally in the game. Further, higher quality players play more shots per rally and play less rallies per game as compared to lower quality players (Leong & Krasilshchikov, 2016).

There was a significant difference when comparing ball in play(s) in Elite Level and Junior Level in this present study with the median real playing time 7 min (IQR = 4.6) for Junior level and 4.8 min (IQR= 2.89) in Elite Level. Juniors' ball in play was higher compared to Elite Level possibly due to the rally length difference. The fact that rally length in the game is significant can be related to these findings whereby the total real play time increases due to longer duration of the game. Length of the rally may lead to more shots per rally in the game (Luque et al., 2011). Luque et al. (2011) showed that real play time in young tennis players was 34 min in male players and 30 min in female players.

Present study showed significantly higher percentage of ball in play for Junior Level ($33.38 \pm 6.36\%$) compared to Elite Level ($22.79 \pm 8.76\%$) with mean differences 10.60. In regard to percentage of real play time among Junior Tennis players (Luque et al., 2011) reported that male tennis players had a real play time of $31.06 \pm 3.20\%$ of the game duration which looks similar in this study.

Percentage ball in play may be affected by rally length of the game. When the rally length is longer in the real playing game thus percentage increase. This can be related to the result from the present study namely significantly different rally length. Elite players show less total ball in play compared to junior due to time it takes to win the game is shorter when compared to Juniors.

Junior players seem to play longer duration as they are less skillful compared to Elite players due to stroke speed, open angle, and the power of the players. Junior level played 5 stroke per rally in 9s whereas Elite Level played 5-6 stroke in 6s (Luque et al., 2011). Hence the number of strokes is similar, but the length of the rally is different. Thus, we can assume that Elite Level played short rallies, but similar stroke number compared to Juniors who played longer duration rallies with same shots number.

The result in rest time between rallies show no significant difference between Elite and Junior players. The reason why

because the rest between set, interchanges and game are fixed based on ITF rules. Based on ITF rule tennis rest time not more than 20s between point and not more than 90 s between games may be one of the reason present study are not significant.

Rest time between the rallies in Elite Level by comparing mean 25.40s was not significantly longer than mean of Junior Level which was 24.1s. In comparing with junior players, the results showed that match activity of top junior female tennis players consisted of short bouts (1–8 s) of rallies and short recovery periods (11–20 s) (Fernandez et al., 2007) with our present study showing the rest intervals between the rallies at slightly higher values.

As a conclusion from this study, there were significant differences in the game structure between tennis players in Elite Level and Junior Level. Junior Level associated with higher number of rallies per set, ball in play (%), ball in play (s), and longer rally length compared to Elite Level. Significant differences between these variables were inter-dependent from each other which perhaps contributed to such result.

Practically speaking, junior players can use the information from this study to get themselves prepared while transitioning into Elite Level. Modified training based on this study results may help players to modify their skills, improve their fitness and familiarize themselves in playing longer set and match durations.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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