

# The relationship between the incidence of winners/errors and the time spent in different areas of the court in elite tennis

RAFAEL MARTÍNEZ-GALLEGO<sup>1</sup> , JOSÉ F. GUZMÁN<sup>1</sup>, NIC JAMES<sup>2</sup>, JESÚS RAMÓN-LLIN<sup>1</sup>, MIGUEL CRESPO<sup>3</sup>, GORAN VUCKOVIC<sup>4</sup>

<sup>1</sup> Faculty of Physical Activity and Sport Sciences, University of Valencia, Spain

<sup>2</sup> Sport Institute, University of Middlesex, London, England

<sup>3</sup> International Tennis Federation, London, England

<sup>4</sup> Faculty of Sport, University of Ljubljana, Ljubljana, Slovenia

## ABSTRACT

Martínez-Gallego R, Guzmán JF, James N, Ramon-Llin J, Crespo M, Vuckovic G. The relationship between the incidence of winners/errors and the time spent in different areas of the court in elite tennis. *J. Hum. Sport Exerc.* Vol. 8, No. Proc3, pp. S601-S607, 2013. Winners and errors have been two of the most studied performance indicators in tennis, contributing to the prediction of match outcome and definition of the playing style of the players. Furthermore, the position occupied by the player on the court has also been shown to be a good indicator of both the final result and style of play. The aim of this study was to examine whether there were differences between game winners and losers in terms of number of winners and errors, and if there were differences in them according to the player's position. 8 matches of the 2011 ATP tournament 500 Valencia were recorded and analysed using SAGIT, a computer vision tracking system that allowed both players' movements to be tracked automatically. The software was programmed to divide each half of the court into offensive and defensive zones. The data were divided in games (N = 188) for analysis purposes and the outcomes of the rallies were classified as winners, forced and unforced errors. The proportionate frequency of unforced errors for losers was higher than winners, and the proportionate frequency of winners and opponent's forced errors was higher for winners than for losers. The time spent of winners in the offensive zone correlated with the percentage of winners and opponent's forced errors, while for the losers time spent in the offensive zone correlated with the percentage of unforced errors. These results suggest that when game winners are in offensive zone they take advantage to hit more winners or force opponent's error. On the contrary when game losers are in offensive zone, they commit more unforced errors. Future investigations should consider shots played in each zone separately. **Key words:** MOTION ANALYSIS, TACTICS, WINNERS, LOSERS.

---

 **Corresponding author.** Faculty of Physical Activity and Sport Sciences, University of Valencia, Spain. C/ Gascó Oliag nº3, CP 46010. Valencia. Phone number: +34699389602.  
E-mail: ramargal@hotmail.com  
Performance Analysis Workshop, 2 - 5 April 2013, Alicante, Spain  
JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202  
© Faculty of Education. University of Alicante  
doi:10.4100/jhse.2013.8.Proc3.05

## INTRODUCTION

Tennis is a dynamic and complex game in which players repeatedly make decisions regarding positioning and shot selection (O'Donoghue & Ingram, 2001). Notational analysis allows these dynamic and complex situations to be measured objectively, in a consistent and reliable manner, so that critical events can be quantified during tennis competition (Gillet & Stein, 2009; Hughes & Barlett, 2007). Performance indicators provide data, and statistical analysis of them allow to identify tactical solutions and player's individual strategies which help us to understand the tennis' characteristics and the reasons that contribute to a better performance (Filipic et al., 2009; Katić et al., 2011).

There are a large number of studies that have considered winners and errors as performance indicators to predict tennis match outcome and the playing style of the players (Djurovic et al., 2009; Filipic et al., 2009; Hughes & Clarke, 1995; Katić et al., 2011). Hughes & Clarke (1995) using one of the first graphical user interface to enter match data analyzed the surface strategies at both Wimbledon and the Australian Open finding that errors, rather than winners, were the main cause of rallies ending at both tournaments.

More recently, Katic et al. (2011) assessed the correlation among various tennis performance indicators and match outcomes at Wimbledon and Roland Garros tournaments. Study results showed the winners to be more aggressive than losers in the total sample, having a higher percentage of points achieved to the opponent's service, and more winners and breaks. In Wimbledon, like the total sample, winners executed more aces and winners. Nevertheless, there were no statistically significant differences in unforced errors between winners and losers in Roland Garros. Comparing winners and loser of two tournaments, winners at Roland Garros committed a greater number of unforced errors.

Filipic et al. (2009) analyzed characteristics of male and female tennis players at Roland Garros and differences between winners and losers. There were differences between winners and losers in the number of unforced errors in both genders, losers making more unforced errors than winners. Results regarding the number of winners showed differences between male and female winners and losers, achieving winners a greater number of winners than losers.

Analyzing different variables and the latent factor of a tennis match, Djurovic et al. (2009) identified five structures such as: match successfulness, first serve significance, serve speed, net play and playing errors. The fifth factor, playing errors, was defined as unforced and double-fault errors. They found that won matches were characterized by a lower number of double-fault and unforced errors than lost matches.

Previous movement analysis studies have shown how the surface influences the strategy in elite tennis players, providing positional and temporal information as well as distributions shots frequency and rallies outcome situations (Hughes & Clarke, 1995). Other studies have focused in players' movement patterns, analyzing displacements and feet movements' sequences and repetitions (Richers, 1995).

Lately, Martínez-Gallego et al. (In press) analyzed movement characteristics of elite tennis players in relation to the direction of groundstrokes and establish whether there were differences between winners and losers. To perform it, each half of the court was divided into offensive and defensive zones, results showing that losers moved quicker, spent more time in the defensive zones and less in the offensive zones. Results suggested that game winners tended to dominate losers forcing them to exhibit behaviors typically associated with a defensive strategy.

The relationship between time spent in offensive and defensive zones and the winners/errors proportion could help us to better understand players' strategies and their efficiency in the game. Thus, the aim of this study was to examine whether there were differences between game winners and losers in terms of number of winners and errors, and if there were differences in them according to player's position.

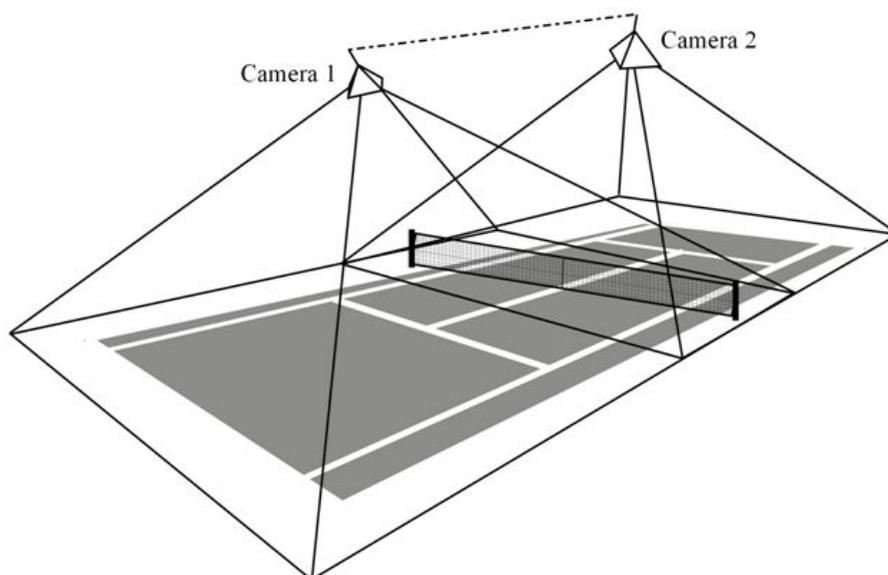
## MATERIAL AND METHODS

### *Sample of matches and participants*

8 matches were recorded at the ATP tournament 500 Valencia in 2011, containing 11 professional players (age  $24.8 \pm 2.9$ ) ranked between 5 and 113 on the ATP ranking list during the tournament. A university ethics committee granted ethical approval and informed written consent was obtained from the organizing committee of the tournament.

### *Measures*

During the competition all matches were recorded with two IP cameras (Bosch Dinion IP 455, Germany) that were attached to the ceiling above the court with each one covering half of the court (Figure 1). The cameras were then connected to a laptop (located outside the court) to save all video footage in mpeg-4 format.



**Figure 1.** Camera locations and video image captured

The final digital images had a resolution of 384 x 288 pixels at 25 frames per second to avoid video interlacing problems. A flash from a digital camera was used to synchronize the two video footages prior to each match.

### *Procedures*

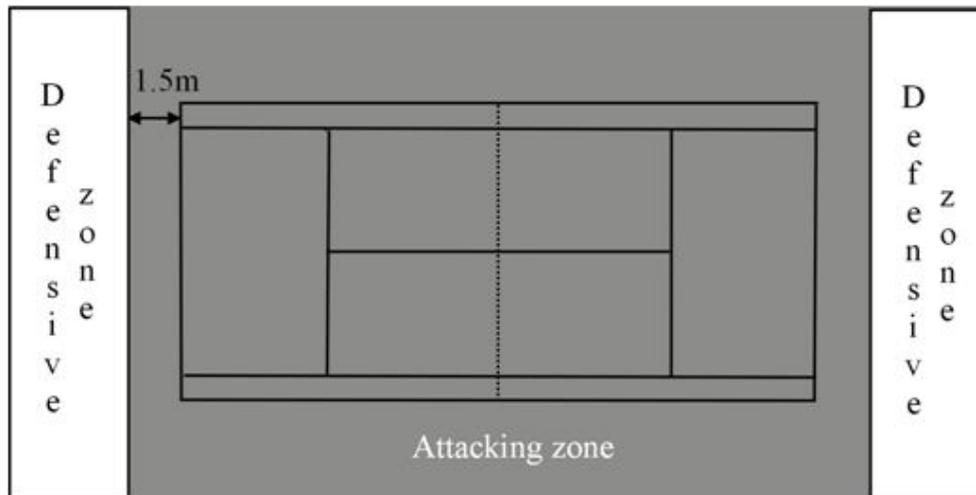
Digital images were processed by the SAGIT tracking system that allowed both players' movements to be tracked automatically, albeit with operator supervision, using a computer vision method (Perš et al., 2002; Vučković et al., 2010). This procedure involved several stages including calibrating the system to the empty court, a tracking phase and manual notation of players' activity (stroke type, stroke outcome and start and end of rallies). This activity information was added such that both the movement and event data were synchronized, and hence could be assessed in relation to each other when exported into spreadsheet

format. Specific data of interest e.g. positions of players during a particular activity type (Perš et al., 2005) were identified through a combination of SQL statements in Microsoft Access (Microsoft, Redmond, USA) and data sorting techniques in Microsoft Excel.

### Analysis

All matches were divided into games for analysis, 188 games in total, to see if this would differentiate performance between winners and losers of games. This meant that players could be classified as losers (game losers) even if they subsequently won the match (since match outcome was not used as a measure).

The software was programmed to divide each half of the court into offensive (OZ) and defensive zones (DZ) (Figure 2). The OZ comprised the whole court area from 1.5 m behind the baseline to the net, and the DZ the whole court area behind the OZ (Martinez-Gallego et al., In press). By separating the court in this manner by the software, information regarding players' motion in each zone was collected. All zone specific information was calculated as a proportion of total time (ball in play (active) and ball not in play (passive)). All outcome shots (rally continue, winner, unforced error, forced error) were manually added using the frame-by-frame playback facility in the software. For analysis purposes, the rallies outcomes were classified in unforced errors (UE), when the rally outcome was an error caused by a wrong tactical decision or execution by the player, and in opponent's forced errors and winners (OFE/W), when the rally outcome was caused by a forcing shot that could not be returned or reached by the opponent. Only ground strokes, excluding serves returns, were analyzed for the purpose of this study. Additionally, the reliability of two separate observations was calculated to guarantee the quality of the observation, obtaining a kappa index of 0.89.

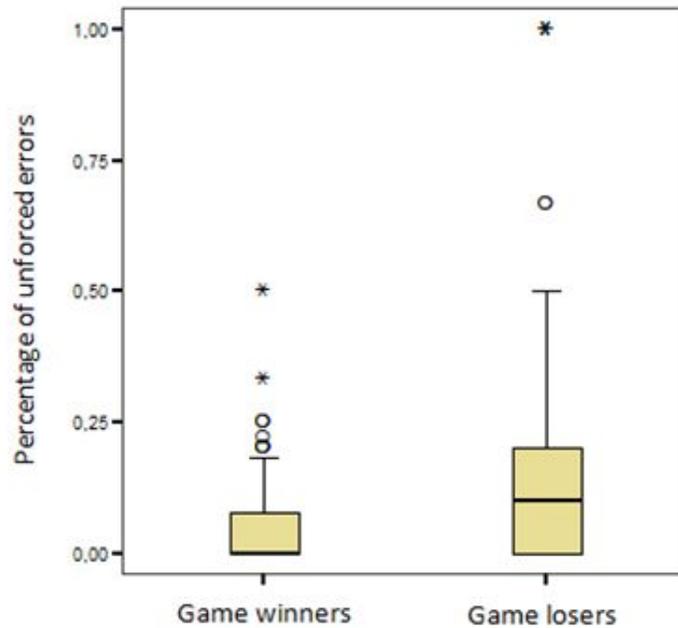


**Figure 2.** Offensive and defensive zones

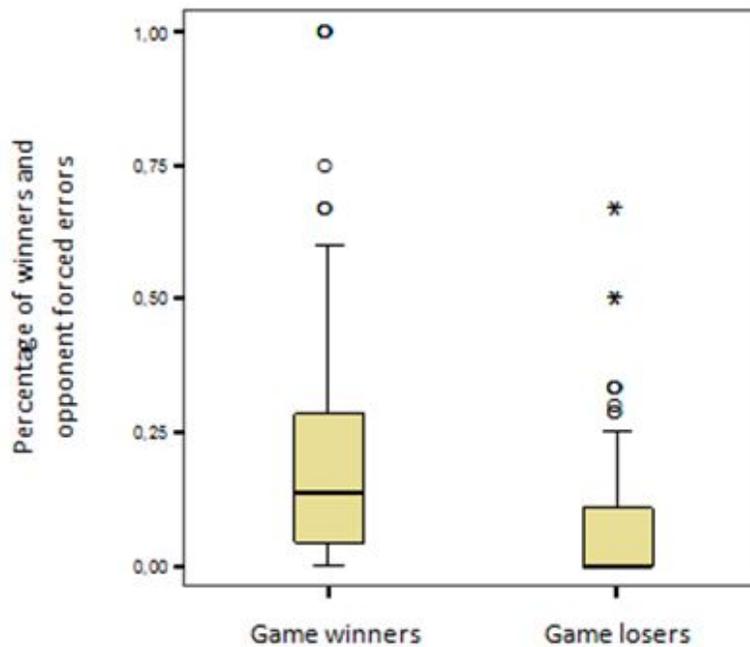
All data were exported from SAGIT software to Microsoft Excel and SPSS v.18 for analysis. All data were examined for normality (Kolmogorov-Smirnov) and with some departures from normality, multiple outliers and large differences in variance noted, non-parametric tests and descriptive statistics were used. Wilcoxon signed ranks tests were used to test for differences between game winners and losers. Spearman's rho was used to assess correlations between variables.

## RESULTS

Unsurprisingly the proportionate frequency of unforced errors for losers was higher (median=10%) than winners (median=0%;  $z=6.72$ ,  $p<0.001$ ) (Figure 3). In the same way the proportionate frequency of winners and forced errors of the opponent was higher for winners (median=14%) than for losers (median=0%;  $z=6.45$ ,  $p<0.001$ ) (Figure 4).



**Figure 3.** Percentage of unforced errors by game winners and losers.



**Figure 4.** Percentage of winners and opponent's forced errors by game winners and losers.

The time spent by winners in offensive zone correlated with the percentage of winners and forced errors from the opponent moderately ( $r = 0.33$ ) while for the losers time spent in the offensive zone correlated with the percentage of unforced errors, although it was weaker ( $r = .15$ ).

## DISCUSSION

Unsurprisingly, the results of this study showed that game losers committed more unforced errors than game winners, which is consistent with some previous studies that analyzed matches played on clay courts (Filipic et al., 2009) and matches played on grass courts (Katić et al., 2011). However the results obtained by Katić et al. (2011) to matches played on clay courts, didn't show differences between match winners and match losers in terms of unforced errors committed.

In tennis, the main cause of rallies ending are unforced errors (Brody, 2006). Therefore according with this assertion, it seems obvious that if game winners win more points than game losers, their number of unforced errors probably will be lower, justifying this way the results obtained in this study.

On the other hand, and as expected, game winners achieved more winners and opponent's forced errors than game losers. This finding was congruent with results provided by Filipic et al. (2009) and Katić et al. (2011) who found that match winners whatever surface, achieved a greater number of winners than match losers. A previous study with the same sample demonstrated how game winners tend to dominate losers, forcing them to exhibit behaviours typically associated with a defensive strategy (Martínez-Gallego et al., In press) which explains that game winners are willing to achieve more winners or force the opponent into errors.

Moreover, with respect to the results related to the positions in the court, it has been shown that game winners tend to spend more time in offensive zones than game losers (Martínez-Gallego et al., 2013). These facts suggest that when players are in offensive zone they are in a better position, but performance result is not always the same. The results obtained showed that when game winners are in offensive zone they take advantage of this better position to strike the ball more effectively and consequently, hit more winners or force opponent's error. On the contrary, when game losers are in offensive zone, they commit more unforced errors, losing their options to win the point or force their opponent's errors.

This study suggests that may be interesting to relate player's position on the court with winners and errors in order to improve the understanding of successful performance, hereby future investigations should consider shots played in each zone.

## CONCLUSIONS

This study gives detailed information about the relationship between winners and errors and time spent by tennis players in different areas of the court. Results showed that game losers committed a higher percentage of unforced errors than game winners, and these ones achieved a greater percentage of winners and opponent's forced errors. Furthermore, it has been shown how game winners hit more winners or force opponent into errors when they were in the offensive zone, and in the opposite, game losers committed more unforced errors when they were in offensive zone.

## REFERENCES

1. BRODY H. Unforced errors and error reduction in tennis. *Brit J Sport Med.* 2006; 40(5): 397-400.
2. DJUROVIC N, LOZOVINA V, PAVICIC L. Evaluation of Tennis Match Data-New Acquisition Model. *J Hum Kinet.* 2009; 21(-1): 15-21.
3. FILIPCIC T, FILIPCIC A, BERENDIJAS T. Comparison of game characteristics of male and female tennis players at Roland Garros 2005. *Acta Univ Palacki Olomuc Gymn.* 2009; 38(3): 21-28.
4. GILLET E, LEROY D, THOUVARECQ R, STEIN JF. A Notational Analysis of Elite Tennis Serve and Serve-Return Strategies. *J Strength Cond Res.* 2009; 23(2): 532-539.
5. HUGHES M, BARLETT R. What is performance analysis? In M. Hugues (Eds.), *Basics of Performance Analysis*. Cardiff: Centre for Performance Analysis, UWIC. 2007
6. HUGHES M, CLARKE S. Surface effect on patterns of play of elite tennis players. In T. Reilly, M. Hughes, & A. Lees (Eds.), *Science and Racket Sports* (pp. 272-278). London: E. and F. N. Spon. 1995
7. KATIĆ R, MILAT S, ZAGORAC N, DJUROVIĆ N. Impact of Game Elements on Tennis Match Outcome in Wimbledon and Roland Garros 2009. *Collegium Antropol.* 2011; 35(2): 341-346.
8. MARTÍNEZ-GALLEGO R, GUZMÁN JF, JAMES N, PERS J, RAMÓN-LLIN J, VUCKOVIC G. Movement Characteristics of Elite Tennis Players on Hard Courts with Respect to the Direction of Ground Strokes. *Journal of Sports Science and Medicine*; 2013; 12: 275–281.
9. O'DONOGHUE P, INGRAM B. A notational analysis of elite tennis strategy. *J Sport Sci.* 2001; 19(2): 107-115.
10. PERŠ J, KOVAČIČ S, VUČKOVIĆ G. Analysis and pattern detection on large amounts of annotated sport motion data using standard SQL. In S. Lončarić, H. Babić, & M. Bellanger (Eds.), *Proceedings of the 4th International Symposium on Image and Signal Processing and Analysis* (pp. 339-344). 2005
11. RICHERS TA. Time–motion analysis of the energy systems in elite and competitive singles tennis. *J Hum Movement Stud.* 1995; 28: 73-86.
12. VUČKOVIĆ G, PERŠ J, JAMES N, HUGHES M. Tactical use of the T area in squash by players of differing standard. *J Sport Sci.* 2009; 27(8): 863-871.