

## Serve analyses of elite European table tennis matches

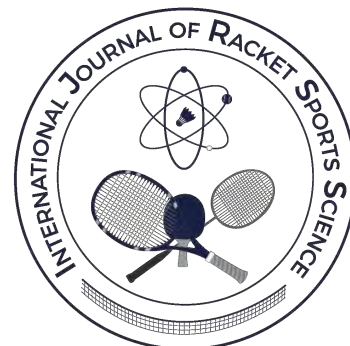
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### Abstract

The purpose of this study was to analyze the serve activities of elite European table tennis players. Twenty matches (78 games, 1466 points) of semifinal and final German League and Europe TOP 16 in men's (in the top 30 of ETTU Rank list) were analyzed. Differences in serving activities (type, stroke type, outcome and placement) were analyzed according results outcome of match, game, point, phase of the game and type of games.

Results showed that forehand short serve prevailed (76.9%) instead other types of serve, mostly placed in the middle of the table on the opponent's backhand side. Percentage of point won directly with serve was 11.6%, points won with 3<sup>rd</sup> stroke - 22.4% and points won with 5<sup>th</sup> stroke after serve (10.9%). Lost points after serve mostly were after 3<sup>rd</sup> stroke (25.0%) and after 5<sup>th</sup> stroke (22.4%) and serve errors were noted in 1.5% of all analyzed points. In the 3<sup>rd</sup> phase of the game serve points were won mostly with 3<sup>rd</sup> and 5<sup>th</sup> stroke instead previous phases of the game.

Results of Pearson's chi-squared test showed an association between match outcomes and serve type and outcome, serve type and outcome considering phase of the game and different type of games with serve type, outcome and placing zones.

Keywords: *Activity Analyses, Notational Analyses, Player Performance*

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## Introduction

Table tennis is a complex sport with a large number of different types of strokes, which become even more specialized or individualized by the type of execution, the intensity, and the tactical goal (Tepper, 2003). However, the serve in table tennis affects the whole rally. The serve in table tennis is the strokes that puts the ball in play and is often referred to as one of the most important strokes in the game, influencing one's scoring or losing tendency. In general, players should take maximum advantage of a service in order to score and this is regarded as the most important challenge for them (Molodzoff, 2008; Geske & Muller, 2010).

High performance table tennis requires observation and measurement to improve knowledge of performance, application of new knowledge to enhance performance (Hughes, Cooper, & Nevill, 2004), so collecting data of strategy and tactics is important, and can help coaches and players to better understand and prepare a strategy for the match (O'Donoghue, 2004; Padulo et al., 2016).

Serve activities already were reported as important indicators of performance in high-ranking table tennis players (Djokic, 2002a, 2002b, 2003; Katsikadelis, Pilianidis, & Mantzouranis, 2013; Zhang, Liu, Hu, & Liu, 2013; Malagoli Lanzoni, Di Michele, & Merni, 2014; Tamaki, Yoshida, & Yamada, 2017; Fuchs et al., 2018; Zhang, Zhou, & Yang, 2018).

Previous research has shown that 80% of rallies in the table tennis matches ends at the fifth stroke, and even if the rally continues, one player is usually in a winning position at that same stroke (McAfee, 2009). Besides, a more recent study confirmed that rallies become shorter (Leite et al., 2017; Djokic, Munivrana, & Levajac, 2016a, 2016b). The application of the most recent service rules as well as the use of new rubbers and plastic balls seem to decrease the efficacy of serve resulting in the shortening of the match (Djokic et al., 2019).

Considering all this as well as the serve impact on the game, there is strong need for permanent analyses and monitoring.

The aim of this study was to analyze the serve activities of elite European table tennis players.

## Material and methods

### Data sample

Twenty matches (78 games, 1435 points) of semifinal and final German League (season 2018/19 and Europe TOP 16 (2018) in men's competition were analyzed. All players were in the top 30 of ETTU Rank list.

### Variables

Performance indicators measured to provide information about the serve activities were:

Serve type:

- 1) FSHOSE - Forehand short serve (serve that, if allowed, ball would bounce twice on the far side of the table).
- 2) FLONSE - Forehand long serve (serve, with the second bounce off the table)
- 3) BSHOSE - Backhand short serve
- 4) BLONSE - Backhand long serve

Serve outcome:

- 5) SERDIR - Serve direct point
- 6) SER3WN - Serve point won after 3<sup>rd</sup> stroke
- 7) SER5WN - Serve point won after 5<sup>th</sup> stroke
- 8) SER7WN - Serve point won after 7<sup>th</sup> stroke
- 9) SER3LS - Serve lost point after 3<sup>rd</sup> stroke
- 10) SER5LS - Serve lost point after 5<sup>th</sup> stroke
- 11) SERROR - Serve error

Serve placement (Djokic, 2002b):

- 12) SOUTFH - Outside forehand zone
- 13) SMIDFH - Middle forehand zone
- 14) SMIDBH - Middle backhand zone
- 15) SOUTBH - Outside backhand zone

	SOUTFH
	SMIDFH
	SMIDFH
	SOUTBH

Figure 1. Serve placement zones

Differences in serving activities (type, outcome and placement) were analyzed according to the final results outcome of match, game and point. Also, we considered 3 score periods (phases) in game: from 0 to 4 points as the first phase (e.g. till 4:3), from 5 to 8 the second phase (e.g. from 5:4) and 8 to 11 the third phase (e.g. from 8:5) of the game with the aim to see does the serve activities differ in different part of the game. At the end, according to the game result we analyzed serve activities in three type of games: balanced (2 difference points (e.g. 11:9, 12:10), N = 464), unbalanced (3-5 difference points (e.g. 11:6-11:8), N = 826) and very unbalanced (6 and more difference points (e.g. 11:0-11:5), N = 174).

### Procedure

Data were collected by videos of matches available on the official DTTB and ITTF website. The video material allowed the observers during the video analysis to clearly see the players, the table, and the playing area, which allowed a reliable verification of all events during the match. The observer analysed video of the matches in real speed, but in case of certain inconsistencies, they were re-wound and seen in slow motion (0.2 X). Kinovea, a free 2D motion analysis software (player) under GPLv2 license was used. All the data were registered in the specially prepared templates for the analysis of every match (by hand on paper), in which all the analysed variables were coded and after that, the data were input to a Microsoft Excel spreadsheet.

### Reliability

In order to ensure a quality of reliability (O'Donoghue & Mayes, 2013), the matches were evaluated by means of intra- and inter-observers. For this research, two expert table tennis coaches were engaged for the role of observers. The intra- and inter-observer reliability is based on the analysis and re-analysis of 20 games randomly selected. Krippendorff's Alpha was calculated to assess data collection reliability (Krippendorff, 2004). The intra-observer reliability analysis showed an Alpha value of 0.995. Inter-observer reliability was assessed reanalysing all the matches by the second analyst.

### Statistical analyses

Descriptive statistical parameters (frequencies and percentages) were calculated for all analyzed samples with a consideration of result outcome (winners/losers). A Pearson's chi-square test of independence was performed to examine the relation between serve activities and winning matches, with a level of significance of ( $\alpha = 0.05$ ). All the data were analyzed using SPSS 20.0 (IBM Corporation, USA).

### Results

Results showed that short forehand serve is the most used kind of service. Complete results of analyses of serve type are shown in Table 1.

Table 1.

*Results of analysis of serve type of all sample and according result outcome (winners/losers)*

	ALL SAMPLE		WINNERS		LOSERS	
	Frequency	%	Frequency	%	Frequency	%
FSHOSE	1126	76.9	584	80.3	542	74.8
FLONSE	254	17.3	102	14.4	152	20.3
BSHOSE	62	4.2	32	4.6	30	4.5
BLONSE	4	0.3	2	0.7	2	0.4

Based on the results of chi-square test we can state that there was a significant association between winning the match and serve type  $X^2(2, N=1466) = 11.685, p < 0.20$ .

The serve outcome in analyzed matches showed that most points were won with the 3<sup>rd</sup> ball after serving

and directly with serve, while most often points were lost after 3<sup>rd</sup> and 5<sup>th</sup> stroke. Results of analyses of serve outcome are shown in Table 2.

Table 2.

*Results of analysis of serve outcome of all sample and according result outcome (winners/losers)*

		ALL SAMPLE		WINNERS		LOSERS	
		Frequency	%	Frequency	%	Frequency	%
Won points	SERDIR	170	11.6	94	12.9	76	10.3
	SER3WN	328	22.4	170	23.3	158	21.5
	SER5WN	160	10.9	92	12.6	68	9.2
	SER7WN	90	6.1	60	8.2	30	4.1
	Total	748	51.1	416	57.1	332	45.1
Lost points	SER3LS	366	25.0	176	24.1	190	25.8
	SER5LS	328	22.4	126	17.3	202	27.4
	SERROR	22	1.5	10	1.4	12	1.6
	Total	716	48.9	312	42.9	404	54.9

Table 3.

*Results of analysis of serve placement of all sample and according result outcome (winners/losers)*

	ALL SAMPLE		WINNERS		LOSERS	
	Frequency	%	Frequency	%	Frequency	%
SOUTFH	186	12.8	104	14.4	82	11.3
SMIDFH	306	21.1	140	19.4	166	22.9
SMIDBH	730	50.4	354	49.3	376	51.8
SOUTBH	224	15.5	122	16.9	102	14.0

Based on the results of chi-square test we can state the that there was a significant association between winning the match and serve outcome,  $X^2(2, N=1466) = 34.229, p < .000$ .

Most of the points after serve were finished after 3-5 stroke, and winners has a better percentage of winning points on serve directly and after 3<sup>rd</sup> and 5<sup>th</sup> stroke.

The most used zone on the opponent's side of the table where serve were placed was middle, more in

backhand side. Results of analyses of serve placement are shown in Table 3.

There was no significant association between winning the match and serve placement.

Analyzing serve activities and outcome instead of the phase of the game, it is noted that in last phase most points were won with 3<sup>rd</sup> and 5<sup>th</sup> stroke. Besides, involving the backhand serve was noted in 2<sup>nd</sup> and 3<sup>rd</sup> phase (Table 4).

Table 4.

*Results of analysis of serve type and outcome in different phases of the match of all sample*

		1 <sup>st</sup> PHASE	2 <sup>nd</sup> PHASE	3 <sup>rd</sup> PHASE
Serve type	FSHOSE	79.9	73.9	77.5
	FLONSE	17.6	19.9	16.3
	BSHOSE	2.5	5.8	5.7
	BLONSE	0.0	0.4	0.5
	Total	100.0	100.0	100.0
Won points %	SERDIR	10.5	13.5	10.6
	SER3WN	21.0	21.0	25.8
	SER5WN	10.5	9.0	13.8
	SER7WN	4.4	7.0	6.9
Lost points %	SER3LS	27.0	24.0	24.0
	SER5LS	25.0	24.0	17.5
	SERROR	1.6	1.5	1.4
	Total	100.0	100.0	100.0

Table 5.

*Results of analysis of serve activities for won/lost points*

		WON POINTS		LOST POINTS	
		Frequency	%	Frequency	%
Serve type	FSHOSE	584	78.1	542	77.8
	FLONSE	130	17.3	124	17.3
	BSHOSE	32	4.3	30	4.2
	BLONSE	2	0.3	2	0.7
	Total	748	100.0	698	100.0
Won points	SERDIR	170	22.8		
	SER3WN	328	44.0		
	SER5WN	158	21.2		
	SER7WN	90	12.0		
Lost points	SER3LS			366	51.1
	SER5LS			328	45.7
	SERROR			22	3.2
	Total	746	100.0	716	100.0
Serve placement	SOUTFH	90	12.0	96	13.7
	SMIDFH	148	19.8	158	22.7
	SMIDBH	396	52.9	334	47.7
	SOUTBH	114	15.3	110	15.9
	Total	1494	100.0	1414	100.0

There was a significant association between phase of the game and serve type,  $X^2(2, N=1464) =$

$16.669, p < .034$ ) and serve outcome  $X^2(2, N=1464) = 22.591, p < .031$ )

The analyses of all won and lost points were done from the aspects of serve type, outcome, placement and type. Results of analyses are shown in Table 5.

Won points are mostly in the 3<sup>rd</sup> rally (44.0%) and 5<sup>th</sup> rally (21.2%), while lost in the 3<sup>rd</sup> (51.0%) and 5<sup>th</sup> (45.7%).

Considering type of game, we analyzed differences in serve activities between balanced and unbalanced games (very unbalanced were excluded because they didn't represent real game situation considering

result. There was noted a significant association between serve type,  $X^2(2, N=1290) = 12,588, p < .013$ , serve outcome,  $X^2(2, N=1290) = 14,794, p < .022$  and serve placement,  $X^2(2, N=1290) = 81,362, p < .000$ ). In balanced games players used more backhand serves, more points were won in 3<sup>rd</sup> stroke, fewer lost after 3<sup>rd</sup> stroke and serves were placed more in middle zones (especially forehand) compared to unbalanced games. All results are shown in Table 6.

Table 6.

*Results of analysis of serve activities for different type of game*

		Balanced		Unbalanced		Very unbalanced	
		Frequency	%	Frequency	%	Frequency	%
Serve type	FSHOSE	346	74.4	634	76.9	146	83.9
	FLONSE	80	18.7	154	18.9	20	11.5
	BSHOSE	32	6.9	24	2.9	6	3.4
	BLONSE			2	1.3	2	1.1
	Total	458	100.0	814	100.0	174	100.0
Won points	SERDIR	62	13.3	96	11.6	12	6.9
	SER3WN	112	24.0	158	19.1	58	33.3
	SER5WN	56	12.1	78	9.4	26	14.9
	SER7WN	28	6.1	54	6.5	8	4.6
Lost points	SER3LS	96	20.6	236	28.6	34	19.5
	SER5LS	100	21.5	192	23.2	36	20.7
	SERROR	10	2.4	12	1.5		
	Total	464	100.0	826	100.0	174	100.0
Serve placement	SOUTFH	54	11.9	112	13.7	20	11.5
	SMIDFH	162	34.8	118	15.6	26	14.9
	SMIDBH	194	41.9	434	52.5	102	58.6
	SOUTBH	48	11.4	150	18.2	26	14.9
	Total	458	100.0	814	100.0	174	100.0

## Discussion

The objective of the research was to analyze serve activities in elite European players. .

Regarding the serve type, the forehand short serve was dominant (around 80%) and as in some previous research there was a significant difference in the use of the forehand short serve in favour of the winners (Djokic, 2003).

Winners are better at performing short serves than losers. Most points were won (and finished) in the 3<sup>rd</sup> ball and the rate of points won directly with serves is high – 11.6%, but still lower than before changes of the serve rules were applied – 14.3% (Djokic, 2003). The same results were found also in a recent study of Djokic et al. (2019).

There was a significant association between winning the match and serve outcome with point directly won with the serve and the winning point – after 5<sup>th</sup> and 7<sup>th</sup> ball. Zhang et al. (2013) indicated a

correlation between technique effectiveness and competition performance based exactly on these activities, which illustrates a difference between winners and losers.

In this study, percentage of won serve for the winners was 57.1%, and is in relation with previous researches of the best European players (53.1 – 61.6%) and best world players (59.3%) (Djokic, Munivrana, & Levajac, 2016a, 2016b, 2017).

The most used zone on the opponent's side of the table where the serve were placed was middle, but more towards the backhand side, so players' placement decisions are more or less the same as before (Djokic, 2003).

Analyzing serve type and outcome instead of the phase of the game, we found that as the game goes on in the second and third phases players start performing backhand serves as an alternative serve (because neither player hadn't use a backhand serve in first phase of game). In the third phase, points were more often won with 3<sup>rd</sup> or 5<sup>th</sup> stroke, so, in this phase the server must have a high level of concentration on quality realization in short rallies.

A significant association between phase of the match and serve type was noticed, in fact, that the backhand, serve was in use in the 2<sup>nd</sup> and 3<sup>rd</sup> phase (not in 1<sup>st</sup> phase), probably as a choice by players to change something in the game. In addition, in the last phase, all players were trying to play a short serve in which game points usually were decided after 5<sup>th</sup> stroke.

Most of the points after the serve were won on the 3<sup>rd</sup> and 5<sup>th</sup> stroke (65.2%), which is higher than that reported in some previous research reported in European Championships (46.5%) and World Championships final (50%) (Djokic, Munivrana, & Levajac, 2016a, 2016b).

In balanced games, the backhand short serve was more frequently used, probably as a player's attempt to change something and disturb the receiving opponent. Furthermore, in such matches there were more points won directly with the serve, and points won with 3<sup>rd</sup> stroke rather than in unbalanced ones. Accordingly, even if several table tennis rules intentionally reduced the advantage of the server

(Djokic et al., 2019), the players do have the ability to make multiple types of services with identical motions, and so the service still has an important impact on a rally.

## Conclusions

The results of the present study indicate that the quality of serve activities is an important differentiator between winners and losers in table tennis. The results of this research can be useful for coaches and players with regard to the identification of important aspects of serve activities, in order to design better training sessions. In addition, the findings can be seen as an advertisement for a particular model of performance analysis indicating a need for continuous systematic match observation in this sport.

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