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Reception-Attack Transition in Volleyball: Analysis of Spike Effectiveness

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Abstract

The aim of this study was to assess the effectiveness of the front receiver's spike according to their participation in the reception-attack transition and the team's rotation, in addition to the interaction between the two. The sample was drawn from 29 matches played between 2012 and 2016 by top-level men's national teams. The variables studied were: the rotation of the receiving team, the existence of reception-attack transition and spike performance. In the data analysis, mean, standard deviation and effectiveness were described, and Pearson's chi-squared and ordinal regression models were used to determine the influence of transition, team rotation and setter position on spike performance. The significance level was set at p = .05. The results showed an improved spike performance by the front receiver when they did not transition and the setter was in the back position, especially in the RT1 and RT5 rotations. Improved spike performance was also found when the transition was made by a front setter, compared to a back setter. The worst spike performance occurred when there was transition and the team was in RT6. In conclusion, the spike performance of the front receiver is affected by the interaction between transition and team rotation in K1; either when studying the rotations individually, or comprehensively according to the position of the setter.

Keywords: effectiveness, high performance, K1, performance, receiver, spiker.

Introduction

In volleyball, as in all team sports, there are continuous defence-attack and attack-defence transitions. In sports where space is not shared, given the existence of a net, and where possession is limited by a certain number of contacts, the speed with which the transition is made can become a determining factor in performance. Specifically, in volleyball, possession time is limited to the three permitted contacts. The aim is to control the ball in the first contact (defensive phase), in order to be able to develop the offensive phase in the following contacts (Eom and Schutz, 1992).

The technical actions that are performed throughout rallies are grouped within the different game complexes, which are defined according to the offensive action they are trying to achieve (Hileno et al., 2020). Complex 1 (K1) is played starting with the service reception and continues with the set and attack. The same authors state that, occurring after the serve and in the initial part of each rally, it is the most repeated complex during the game, and its execution is considered the main indicator of success in men's mid and high-level teams (Ugrinowitsch et al., 2014).

One of the parameters that determines K1 transition is the time available to move from the defensive to the offensive phase. This depends, among other things, on the player's readiness to attack (Ugrinowitsch et al., 2014), which is conditioned by previous actions and the distance to the attack end zone (Kitsiou et al., 2020). This aspect is especially relevant to players in the front receiver position, given the double responsibility of receiving and joining the attack (Lima et al., 2021), as their readiness may be reduced or even cancelled out (Paulo et al., 2016); this interferes with the setter's choice of attacker (Marcelino et al., 2014).

Moreover, teams playing with only one setter exhibit six different formations: three with the front setter and three with the back setter (Palao et al., 2005), an aspect that may also influence the transition.

Therefore, the following objective was set: to assess the effectiveness of the front receiver's spike according to their participation in the reception-attack transition and the team's rotation, as well as according to the interaction between the two.

Methodology
Materials and methods

Participants

The sample for this study consisted of 29 top-level competitive matches played between 2012 and 2016 in men's World Cup (W.C.), Olympic Games (O.G.) and World League (W.L.) finals. Non-probability convenience sampling was used. The matches were chosen on the basis of the following criteria:

1. It comprises part of the final stages of one of the following men's competitions played in the 2012-2016 Olympic cycle: O.G. 2012; W.L. 2013, 2014, 2015 and 2016; World Championships 2014 (W.C.); World Cup 2015.
2. The match can be found online in full.
3. The image quality was equal to or higher than 720p.
4. The recording viewpoint was predominantly lateral.

Ethical considerations

This study was approved by the Research Ethics Committee of the European University under reference CIPI/18/181.

Observation design and criteria

The observational design used is found in the nomothetic, punctual and multidimensional quadrant. And the observation criteria, in the corresponding categorisation system (Anguera et al., 2011):

- Transition from reception to spike (TR) - Transition Yes (TRY): the same receiver receives and spikes; Transition No (TRN): the receiver that spikes has not received the serve.
- Team rotation in K1 (RT) - The 6 rotations in the game were considered, numbered from 1 to 6 (RT1, RT2, RT3, RT4, RT5 and RT6), according to the position of the setter (Silva et al., 2016).
- Subsequently, the rotations were grouped according to Position of the Setter (SP) - Front Setter (FSP): group RT2, RT3 and RT4; Back Setter (BSP): group RT1, RT5 and RT6.

- Spike performance (SP) - A 6-category scale was used to categorise this variable, adapted from the FIVB Statistical System designated by the World Coaching Commission in 1979, and based on that proposed by Coleman et al. (1969) and the Schall statistical system (Palao et al., 2009) - Spike error (PSE) (0): the ball goes out, does not go over the net, or the referee considers that the spiker has committed a foul. Bad spike (PBS) (1): the spike is brought under control by the defending team, and they are able to recover the game with all attacking options. It is also considered PBS if the shot is blocked and remains in play in the attacker's court and the support is not able to set up another spike. Poor spike (PPS) (2): the spike is brought under control by the defending team, and they are able to recover the game with all attacking options, but with difficulty performing early on. Average spike (PAS) (3): the spike is brought under control by the defending team, and they are not able to recover the game early on. It will also be considered PAS when the attacker plays against the block and their support allows another shot to be set up. Good spike (PGS) (4): the spike is defended by the opposing team without the possibility of an attack being made (in volleyball this is called "free-ball"). Precise Spike (PPS) (5): the ball bounces in the opponent's court; it rebounds the block and the defending team cannot continue the game (in volleyball this is called "block-out"); or the referee considers that a player of the defending team has committed a foul during the defence.

Subsequently, the strike performance variable was grouped into two: low effective performance (LEP) groups: PSE, PBS and PPS; high effective performance (HEP) groups: PAS, PGS and PPS.

Both groupings were designed to meet the conditions necessary for further analysis.

Procedure

The actions were recorded by a single certified observer with more than 5 years' experience in volleyball performance analysis and team management. Observation criteria were established according to a handbook, including possible borderline cases. In order to estimate the quality of the data, a second expert observer with the same qualifications as the first was trained. Both the intra-observer agreement analysis ($\varkappa \geq .928$) and the inter-observer analysis ($\varkappa \geq .915$) reached quasi-perfect levels of agreement on all variables assessed.

For the calculation of PEKI, the Percentage of Effectiveness formula (Coleman et al., 1969) adapted to the 6-category system described was used:

$$\%\ Ef = \frac{(5(N^oA5\text{-}N^oA0)+4(N^oA4)+3(N^oA3)+2(N^oA2)+1(N^oA1))}{5(N^oA\ totals)} \times 100$$

Wherein: *Ef* is Effectiveness, Nº A5 is the number of spikes with a rating of 5, Nº A4 is the number of spikes with a rating of 4, and so on.

Similarly, the arithmetic mean of effectiveness was calculated based on the values given to each of the categories, divided by the total number of actions.

LINCE software, specifically designed for the recording of observational data in sport (Gabin et al., 2012), was used to record the data.

Statistical analysis

Frequency, percentage, mean and standard deviation were used to report the results. Intra and inter-observer agreement was checked with Cohen's Kappa. Firstly, to describe the spike effectiveness, the Mann-Whitney U and Kruskal Wallis H-tests were used due to the violation of parametric assumptions. Cohen's *d* was also calculated from these statistics to report the effect size. 4 proportional odds ordinal regression models were then used to determine the relationship between the criterion variable SP and the predictor variables RT, SP and TR: bivariate model, multivariate model, factor model and interaction model. In all analyses, compliance with the proportionality hypothesis was analysed and the likelihood ratio was used to compare the accuracy of the models and to analyse the impact of each variable. In addition, Odds Ratios and 95% confidence intervals were calculated to interpret the effect of the variables. To assess the variance explained by the models, the Nagelkerke Pseudo r^2 test was carried out. The significance level was set at $p < .05$. Statistical analysis was carried out with IBM SPSS (version 21.0 for Windows; SPSS Inc., Chicago, IL, USA).

Results

A total of 3,687 spike actions were recorded in K1, of which 1,284 were carried out by the front receiver.

In table 1, the frequency and percentage of team spikes in each rotation and according to the position of the setter can be observed (53.78% BSP; 46.22% FSP), in addition to the frequency and percentage of spikes by the front receiver in each rotation and again according to the position of the setter (32.02% BSP; 38.09% FSP).

Of the 1,284 spike actions by players in front receiver positions, only 366 resulted in TRY. The remaining actions (*n* = 918) resulted in TRN, as the receiving pass was made by a player other than the subsequent spiker.

In table 2, the frequency, mean values and standard deviation values of the effectiveness, in addition to the percentage of effectiveness of the front receiver with all data aggregated can be observed. No significant differences in SP according to RT SP and TR were obtained.

Table 1
Total frequency of spikes per rotation.

RT	*n*	% RT	*n* BR spikes	% BR spikes
RT2	558	15.13%	227	40.68%
RT3	563	15.27%	226	40.14%
RT4	583	15.81%	196	33.62%
RT1	623	16.90%	195	31.30%
RT5	638	17.30%	201	31.50%
RT6	722	19.58%	239	33.10%
BSP	1,983	53.78%	635	32.02%
FSP	1,704	46.22%	649	38.09%

Acronyms: RT = Team rotation in KI; *n* = Frequency; BR = Back receiver; RT2 = Rotation with the setter in 2; RT3 = Rotation with the setter in 3; RT4 = Rotation with the setter in 4; RT1 = Rotation with the setter in 1; RT5 = Rotation with the setter in 5; RT6 = Rotation with the setter in 6; BS = Back setter; FS = Front setter.

Table 2
Frequency, Mean and Standard Deviation of SP according to RT and TR.

	n	%Ef	$\overline{X}$ ± Sd	CI95%	*d*	*p*
RT2	227	54.36%	3.42 ± 1.85	3.18; 3.66	.079	.22
RT3	226	49.29%	3.26 ± 1.9	3.01; 3.51		
RT4	196	45.40%	3.21 ± 1.97	2.94; 3.49		
RT1	195	47.48%	3.27 ± 1.92	3; 3.54		
RT5	201	53.63%	3.45 ± 1.83	3.2; 3.71		
RT6	239	36.90%	3.02 ± 2	2.76; 3.27		
BSP	635	45.44%	3.23 ± 1.93	3.08; 3.38	.036	.462
FSP	649	49.89%	3.3 ± 1.9	3.16; 3.45		
TRN	918	50.22%	3.33 ± 1.88	3.21; 3.46	.089	.091
TRY	366	41.36%	3.11 ± 1.99	2.9; 3.31		

Acronyms: RT = Team rotation in KI; *n* = Frequency %Ef = Percentage of Effectiveness; $\overline{X}$ = Mean; Sd = Standard deviation; CI95% = Confidence Interval 95%; RT2 = Rotation with the setter in 2; RT3 = Rotation with the setter in 3; RT4 = Rotation with the setter in 4; RT1 = Rotation with the setter in 1; RT5 = Rotation with the setter in 5; RT6 = Rotation with the setter in 6; BS = Back setter; FS = Front setter; TRN = Transition no; TRY = Transition yes.

Table 3
Frequency, Mean and Standard Deviation of SP according to RT and TR.

RT	TRN						TRY						*d* TR	*p* TR
	n	%Ef	X̄ ± Sd	CI95%	*d*	*p*	*n*	%Ef	X̄ ± Sd	CI95%	*d*	*p*		
RT2	156	55.26%	3.44 ± 1.81	3.15; 3.72	.138	.096	71	52.39%	3.39 ± 1.95	2.93; 3.86	.152	.215	.019	.877
RT3	174	50.11%	3.28 ± 1.88	3; 3.56			52	46.54%	3.19 ± 2	2.64; 3.75			.022	.862
RT4	128	41.88%	3.11 ± 1.99	2.76; 3.46			68	52.06%	3.41 ± 1.93	2.95; 3.88			.145	.283
RT1	134	55.22%	3.47 ± 1.84	3.16; 3.78			61	30.49%	2.84 ± 2.04	2.31; 3.36			.282	.038
RT5	144	60.42%	3.65 ± 1.76	3.36; 3.94			57	36.49%	2.96 ± 1.92	2.46; 3.47			.334	.012
RT6	182	40.11%	3.1 ± 1.98	2.82; 3.39			57	26.67%	2.74 ± 2.08	2.18; 3.29			.133	.284
BSP	460	50.86%	3.38 ± 1.88	3.21; 3.55	.049	.433	175	31.20%	2.85 ± 2	2.55; 3.14	.256	.011	.233	.002
FSP	458	49.56%	3.29 ± 1.89	3.11; 3.46			191	50.66%	3.35 ± 1.95	3.07; 3.62			.047	.527

Acronyms: RT = Team rotation in KI; *n* = Frequency; %Ef = Percentage of Effectiveness; X̄ = Mean; Sd = Standard deviation; CI95% = Confidence Interval 95%; RT2 = Rotation with the setter in 2; RT3 = Rotation with the setter in 3; RT4 = Rotation with the setter in 4; RT1 = Rotation with the setter in 1; RT5 = Rotation with the setter in 5; RT6 = Rotation with the setter in 6; BS = Back setter; FS = Front setter. TR = Transition; TRN = Transition no; TRS =Transition yes.

Table 3 shows the frequency results, the mean and standard deviation of the effectiveness and the percentage of effectiveness segregated according to the existence or not of transition. No significant differences were observed in the spike effectiveness according to rotation in cases of TRN (p = .096), or in cases of TRY (p = .215). Additionally, no significant differences in effectiveness according to SP were observed in cases of TRN (p = .433), but such differences were observed in cases of TRY (p = .011), where higher performance was achieved with FSP. Finally, greater effectiveness was observed in RT1 (p = .038), RT5 (p = .012) and in BSP (p = .002) in cases of TRN, compared to in cases of TRY.

In order to interpret the differences found in a multivariate context and to be able to assess possible interactions between RT and TR (predictor variables), ordinal regressions were generated. In these, SP was the criterion variable.

Table 4 shows the results of ordinal regressions assessing the relationship between SP and RT and TR.

In the bivariate models, no significant relationships were observed between SP and RT (X^2_5 = 6.99; p = .222; r^2 = .006); nor between SP and TR (X^2_1 = 2.89; p = .089; r^2 = .002). However, small increases in attack performance were observed in RT2 (OR = 0.37; CI95% = 0.04; 0.71) and RT5 (OR = 0.4; CI95% = 0.06; 0.75), compared to RT6. The multivariate model slightly improved the estimates, but was not significant either (X^2_6 = 10.34; p = .111; r^2 = .008). The factor model improved the estimates, and was significant (X^2_{11} = 19,89; p = .047; r^2 = .016), it was therefore decided that the interaction between RT and TR should be studied to facilitate the interpretation of the results. This interaction suggests the importance of the TR in spike effectiveness in some rotations. In particular, improved SP was achieved in TRN*RT1 (OR = 0.68; CI95% = 0.11; 1.24), TRN*RT2 (OR = 0.61; CI95% = 0.06; 1.15), TRN*RT5 (OR = 0.85; CI95% = 0.29; 1.41), TRS*RT2 (OR = 0.64; CI95% = 0.01; 1.28) and in TRS*RT4 (OR = 0.65; CI95% = 0.01; 1.3), compared to TRS*RT6 in each case.

Table 4
Spike performance of front receiver in K1(SP), according to the transition (TR) and team rotation in KI (RT).

		Bivariate model		Multivariate model		Factor model		Interaction model	
	n (%)	OR (CI95%)	*p*	OR (CI95%)	*p*	OR (CI95%)	*p*	OR (CI95%)	*p*
Transition									
TRN	918 (72)	0.19 (-0.03; 0.41)	.086	0.21 (-0.01; 0.43)	.064	0.31 (-0.22; 0.85)	.251		
TRY	366 (29)	ref.		ref.		ref.			
Rotation									
RT1	195 (15)	0.25 (-0.1; 0.59)	.162	0.26 (-0.08; 0.61)	.136	0.08 (-0.57; 0.72)	.82		
RT2	227 (18)	0.37 (0.04; 0.71)	.027	0.39 (0.06; 0.72)	.022	0.64 (0.01; 1.28)	.048		
RT3	226 (18)	0.24 (-0.09; 0.57)	.158	0.24 (-0.1; 0.57)	.162	0.45 (-0.24; 1.13)	.199		
RT4	196 (15)	0.21 (-0.14; 0.55)	.237	0.23 (-0.11; 0.58)	.188	0.65 (0.01; 1.3)	.046		
RT5	201 (16)	0.4 (0.06; 0.75)	.022	0.41 (0.07; 0.76)	.019	0.16 (-0.5; 0.82)	.632		
RT6	239 (19)	ref.		ref.		ref.			
Transition * rotation									
TRN*RT1	134 (10)					0.29 (-0.48; 1.06)	.461	0.68 (0.11; 1.24)	.018
TRN*RT2	156 (12)					-0.35 (-1.1; 0.4)	.358	0.61 (0.06; 1.15)	.031
TRN*RT3	174 (14)					-0.27 (-1.05; 0.51)	.496	0.49 (-0.05; 1.03)	.076
TRN*RT4	128 (10)					-0.62 (-1.38; 0.14)	.109	0.34 (-0.22; 0.9)	.231
TRN*RT5	144 (11)					0.38 (-0.4; 1.15)	.342	0.85 (0.29; 1.41)	.003
TRN*RT6	182 (14)					ref.		0.31 (-0.22; 0.85)	.251
TRY*RT1	61 (5)					ref.		0.08 (-0.57; 0.72)	.820
TRY*RT2	71 (6)					ref.		0.64 (0.01; 1.28)	.048
TRY*RT3	52 (4)					ref.		0.45 (-0.24; 1.13)	.199
TRY*RT4	68 (5)					ref.		0.65 (0.01; 1.3)	.046
TRY*RT5	57 (4)					ref.		0.16 (-0.5; 0.82)	.632
TRY*RT6	57 (4)					ref.		ref.	

Acronyms: *n* = Number of recordings in the category; OR = Odds Ratios; *p* = significance value (< .05); TR = Reception-spike transition; TRN = Transition No; TRY = Transition Yes; RT = Team rotation in KI; RT1 = Rotation 1, RT2 = Rotation 2; RT3 = Rotation 3; RT4 = Rotation 4; RT5 = Rotation 5; RT5 = Rotation 5; RT6 = Rotation 6; ref. = Reference category.

Table 5
Spike performance of front receiver in K1(SP), according to setter position (SP) and the existence of a transition (TR).

		Bivariate model		Multivariate model		Factor model		Interaction model	
	n (%)	OR (CI95%)	*p*	OR (CI95%)	*p*	OR (CI95%)	*p*	OR (CI95%)	*p*
TR									
TRN	918 (72)	0.19 (-0.03; 0.41)	.084	0.2 (-0.03; 0.42)	.084	-0.1 (-0.42; 0.21)	.515		
TRY	366 (29)	ref.		ref.		ref.			
SP									
BSP	635 (49)	-0.08 (-0.28; 0.13)	.462	-0.08 (-0.28; 0.12)	.448	-0.51 (-0.89; -0.14)	.007		
FSP	649 (51)	ref.		ref.		ref.			
SP, grouped* TR									
BSP*TRN	460 (36)					0.6 (0.16; 1.05)	.008	-0.01 (-0.32; 0.3)	.949
BSP*TRY	175 (14)					ref.		-0.51 (-0.89; -0.14)	.007
FSP*TRN	458 (36)					ref.		-0.1 (-0.42; 0.21)	.515
FSP*TRY	191 (15)					ref.		ref.	

Acronyms: *n* = Number of recordings in the category; OR = Odds Ratios; *p* = significance value (< .05); TR = Reception-spike transition; TRN = Transition No; TRY = Transition Yes; RT = Team rotation in KI; RT1 = Rotation 1, RT2 = Rotation 2; RT3 = Rotation 3; RT4 = Rotation 4; RT5 = Rotation 5; RT6 = Rotation 6; RT6 = Rotation 6; ref. = Reference category. SP = Setter position; BSP = Back setter position; FSP = Front setter position; SP = Spike performance.

Finally, table 5 presents the results of the ordinal regressions assessing the relationship between SP and SP and TR. In the bivariate models, no significant relationships were observed between SP and SP ($X^2_1 = 0.54$; $p = .462$; $r^2 < .001$); nor between SP and TR ($X^2_1 = 2.89$; $p = .089$; $r^2 = .002$). A significant multivariate model was also not found ($X^2_2 = 3.47$; $p = .176$; $r^2 = .003$). But, again, when evaluating the factor model, a significant relationship was observed between SP and the interaction position of the setter x transition ($X^2_3 = 10.53$; $p = .015$; $r^2 = .009$), again indicating the importance of TR in SP in some specific rotations of the game. The in-depth study of interactions showed worse SP in cases of BSP*TRY (OR = -0.51; CI95% = -0.89; -0.14), compared to cases of FSP*TRY.

Discussion

This study compares the effectiveness of front receivers' spikes, according to their participation or lack thereof in the reception-attack transition, and according to the team's rotation, in addition to the interaction between the two.

Spike efficiency is the strongest predictor of K1 performance (Marelić et al., 2004). Spikes must be adapted to the different interactions that occur in each of the six rotations (López et al., 2022), understanding each of the rotations as differentiated contexts at the beginning of K1 (Palao et al., 2005).

However, when analysing the effectiveness of the front receivers' spikes, no significant differences were observed according to rotation. These results coincide with those provided by other research that analysed K1 spike performance in men's volleyball, although without differentiating the role of the spiker (Laios and Kountouris, 2011; Palao et al., 2005). Similarly, no significant differences were obtained in the performance of the front receiver's spike, according to the front or back position of the setter, although in women's volleyball and in lower categories differences have been found in the overall spike performance depending on the position of the setter (Đurković et al., 2008; Palao et al., 2005). It appears that the greater effectiveness of back receiver's spikes in men's categories (Mesquita and César, 2007) and the improved effectiveness of this type of spike as the level of the team increases, allows a greater balance in attacking performance to be achieved between the different rotations; especially among the top-ranked high-level men's teams (Silva et al., 2016).

In the course of the K1 sequence, there is a chaining of two actions of maximum motor difficulty: reception and spike. Although Rentero et al. (2015) found no difference in reception performance according to the receiver, they did find that the greater the libero's participation in reception, the better the team's ranking in the men's final in the Olympic Games of 2008. This would support the idea that the libero helps to better develop attacking systems by avoiding cases of transition for spikers.

Different studies carried out at men's high-level have found that front receivers' reception-attack transition can reduce spike effectiveness in K1 (Afonso et al., 2012; Grgantov et al., 2018; Paulo et al., 2016; Valhondo et al., 2018). In addition to the coordination difficulty of linking the two actions, the transition can generate a time deficit for the receiver's incorporation into the attack. On many occasions, the player is forced to receive the ball in unbalanced positions or even as they are falling. Consequently, there is a percentage of actions in which reception can generate a previous muscle fatigue that decreases ability to jump in the spike (Maraboli et al., 2016); and can even prevent the receiving player from joining the KI attack system (Marcelino et al., 2014). This leads to the emergence of a type of serve that seeks to interfere with the reception-attack transition, to reduce the performance of the attacking receiver and to limit the possible attacking combinations (Kitsiou et al., 2020). But not all serves directed at a receiver who has to make the transition interfere with their attack, perhaps only serves directed at certain areas of the court do. Thus, it appears that difficulty increases when reception involves moving the attacker to a position far away from the net (Afonso et al., 2012; Grgantov et al., 2018; Kitsiou et al., 2020); too close to it, or within the spike zone (Hurst et al., 2016).

In the current study, differences close to 9% were obtained in relation to the percentage of spike effectiveness according to transition, although this did not reach statistical significance. It appears that team game models are searching for solutions to the reception-spike transition problem, and one of them is to shorten the transition spatially, as Paulo et al. (2016) describe, observing a tendency for the front receiver to move closer to the net, reducing their responsibility in the receiving system. Other solutions are: the introduction of the opposing player into the system by generating lines of 4 receivers, especially in the case of very powerful serves (Ciuffarella et al., 2013); or designing attacking systems in which the distribution of the setter avoids a player who is in a bad position after receiving the serve being chosen (Barzouka, 2018; Marcelino et al., 2014). This study also considers that the superior level of training of high-level receivers allows them to reduce the potential negative impact of transition on their spike performance.

However, when relating the transition to the position of the setter and spike performance, a 19.4% lower effectiveness was found when the spike occurred with transition and the setter at the back, compared to when the setter was at the front. On the other hand, a 19.6% higher effectiveness was found when spiking with a back setter and without transition, in relation to spikes carried out with transition (table 3).

The interaction of transition with team rotation resulted in significant changes in spike performance and effectiveness: with greater effectiveness when there was no transition in RT1 and RT5; and with greater spike performance in actions performed without transition in RT1, RT2 and RT5, and with transition in RT2 and RT4 in relation to actions performed with transition in RT6.

The higher frequency of directing sets to zone 4 has been associated with both excellent receptions that generate quick sets (Barzouka, 2018) and poor receptions or difficult sets made outside the ideal set zone (Barzouka, 2018; Grgantov et al., 2018); and allowing the opponent to form more frequent, well-structured two- or three-player blocks (Araújo et al., 2011). With a front setter, the attacking system has one less setter on the front line, which increases the percentage of sets directed to the front receivers (FSP): 38%; BSP: 32%). Therefore, the fact that a greater spike effectiveness with transition and front setters was obtained, as in RT2 and RT4, may be related to the fact that a higher percentage of sets started from better quality receptions. However, the improved performance of the transition with front setters is partly contradictory to the findings of Araújo et al. (2011), who report a better block structuring with a higher number of triple blocks against the front receiver, when the setter is a front setter.

With a back setter, the front receiver shares the front line of attack with the centre and the opposing attacker, and with the latter being a spiking specialist, setters may tend to direct more sets to opposing players once they have received the front receivers, which prevents the transition. And they may also direct more sets to the front receivers creating more transitions from more difficult situations, especially when reception is close to their spike zone and it is difficult to send a set to other players.

In relation to the greater effectiveness of the front receiver-spiker in RT1 and RT5 without transition compared to with transition, in addition to re-considering the argument already set out in the previous paragraph, the fact that RT1 is the only rotation in which the front receiver normally receives in zone 1 and strikes throughout zone 2 must also be taken into consideration. Therefore, it is not their usual striking zone, and the transition could be less practised than the one executed in zone 4, which is their usual attacking zone. In addition, zone 2 is closer to the ideal set zone (zone 2-3) than zone 4, which decreases the ball's time in the air and may further limit the time available for transition for the back receiver. López et al. (2022), using a high-level male sample, found a higher than expected serving frequency in RT1 in zone 1 and in RT5 in zone 5, with the possible aim of making the transition more difficult for the front receiving attacker. Furthermore, in the same study it was found that in RT6 significantly more serves occurred in zone 1 and in the areas close to the setter than in the left half of the court (zone 6-5). Nonetheless, reception performance in zone 5 was lower. According to the authors, this could be related to a possible imbalance of the receiving structure in RT6 by overloading the line of receivers towards zone 1, which forces the front receiver to move away from the spike zone (zone 4), which would result in the lower spike performance when the transition occurs in RT6.

Conclusions

The spike performance of the front receiver is affected by the interaction between transition and team rotation in K1; either when studying the rotations individually, or according to the position of the front or back setter. In particular, it appears that the spiker's performance decreases when transition occurs and the setter is at the back.

As practical considerations, the results suggest the need to expand the libero's zone of intervention in receiving systems, in order to free the front receivers from that responsibility as much as possible. This solution is considered to be more applicable to women's volleyball, as it can be used especially in the case of serves executed at a slower speed. This release would allow the attacking receivers to make a quicker transition without prior contact with the ball during the reception. This increase in the spatial responsibility of the libero may lead to the need for faster and broader liberos. Furthermore, although volleyball can be approached and analysed as a set of isolated actions, due to the dynamics of the game itself, it is essential that chained actions, where the player maintains effectiveness in each one, are part of training. And taking into account the influence of the rotation and the position of the setter found in this study, it is considered relevant that the reception-attack transition is also integrated into training in the different rotations, understood as differentiated initial situations.

It would be interesting in future research to carry out the same study in women's volleyball, and in training stages.

As a limitation of this study, it is possible that the tendencies of some teams may have masked those of others, which is why it is considered relevant to study the opponents individually, assessing how the transition affects the spike performance in each of the rotations.

References

Afonso, J., Esteves, F., Araújo, R., Thomas, L., & Mesquita, I. (2012). Tactical determinants of setting zone in elite men's volleyball. *Journal of Sports Science and Medicine*, *11*(1), 64–70.

Anguera, M. T., Blanco, A., Hernández, A., & Losada, J. L. (2011). Diseños observacionales: ajuste y aplicación. *Cuadernos de Psicología del Deporte*, *11*(2), 63–76. Recuperado a partir de https://revistas.um.es/cpd/article/view/133241

Araújo, R., Castro, J., Marcelino, R., & Mesquita, I. R. (2011). Relationship between the Opponent Block and the Hitter in Elite Male Volleyball. *Journal of Quantitative Analysis in Sports*, *6*(4). https://doi.org/10.2202/1559-0410.1216

Barzouka, K. (2018). Comparison and assessment of the setting zone choices by elite male and female volleyball setters in relation to the reception quality. *Journal of Physical Education and Sport*, *18*(5), 2014–2021. https://doi.org/10.7752/jpes.2018.s5299

Ciuffarella, A., Russo, L., Masedu, F., Valenti, M., Izzo, R. E., & De Angelis, M. (2013). Notational Analysis of the Volleyball Serve. *Timisoara Physical Education and Rehabilitation Journal*, *6*(11), 29–35. https://doi.org/10.2478/tperj-2013-0013

Coleman, J. E., Neville, B., & Gordon, B. (1969). A statistical system for volleyball and its use in Chicago Women's Assn. *International Volleyball Review*, *17*, 72–73.

Đurković, T., Marelić, N., & Rešetar, T. (2008). Influence of the position of players in rotation on differences between winning and loosing teams in volleyball. *International Journal of Performance Analysis in Sport*, *8*(2), 8–15. https://doi.org/10.1080/24748668.2008.11868431

Eom, H. J., & Schutz, R. W. (1992). Transition Play in Team Performance of Volleyball: A Log-Linear Analysis. *Research Quarterly for Exercise and Sport*, *63*(3), 261–269. https://doi.org/10.1080/02701367.1992.10608741

Gabin, B., Camerino, O., Anguera, M. T., & Castañer, M. (2012). *Lince: multiplatform sport analysis software.* (pp. 4692-4694.). Procedia - Social and Behavioral Sciences. https://doi.org/10.1016/j.sbspro.2012.06.320

Grgantov, Z., Jelaska, I., & Šuker, D. (2018). Intra and interzone differences of attack and counterattack efficiency in elite male volleyball. *Journal of Human Kinetics*, *65*(1), 205–212. https://doi.org/10.2478/hukin-2018-0028

Hileno, R., Arasanz, M., & García-de-Alcaraz, A. (2020). The Sequencing of Game Complexes in Women's Volleyball. *Frontiers in Psychology*, *11*(739), 1–7. https://doi.org/10.3389/fpsyg.2020.00739

Hurst, M., Loureiro, M., Valongo, B., Laporta, L., Nikolaidis, P. T., & Afonso, J. (2016). Systemic mapping of high-level women's volleyball using social network analysis: The case of serve (K0), side-out (KI), side-out transition (KII) and transition (KIII). *International Journal of Performance Analysis in Sport*, *16*(2), 695–710. https://doi.org/10.1080/24748668.2016.11868917

Kitsiou, A., Sotiropoulos, K., Drikos, S., Barzouka, K., & Malousaris, G. (2020). Tendencies of the volleyball serving skill with respect to the serve type across genders. *Journal of Physical Education and Sport*, *20*(2), 564–570. https://doi.org/10.7752/jpes.2020.02083

Laios, A., & Kountouris, P. (2011). Receiving and serving team efficiency in Volleyball in relation to team rotation. *International Journal of Performance Analysis in Sport*, *11*(3), 553–561. https://doi.org/10.1080/24748668.2011.11868573

Lima, R. F., Caleiro, F., & Clemente, F. M. (2021). Variations of technical actions among playing positions in male high level volleyball. *Trends in Sport Sciences*, *28*(2), 153–158. https://doi.org/10.23829/TSS.2021.28.2-9

López, E., Diez-Vega, I., & Molina, J. J. (2022). Reception and performance in high level male volleyball: A relational study. *Journal of Human Sport and Exercise*, *17*(2), 1–15. https://doi.org/10.14198/jhse.2022.172.16

Maraboli, P., Garrido, A., Hernández, C., Guerra, S., & González, S. (2016). Jump height increase in university voleyball players. *Apunts Educación Física y Deportes, 126*, 64–71. https://doi.org/10.5672/apunts.2014-0983.es.(2016/4).126.07

Marcelino, R., Afonso, J., Moraes, J. C., & Mesquita, I. (2014). Determinants of attack players in high-level men's volleyball. *Kinesiology*, *46*(2), 234–241.

Marelić, N., Rešetar, T., & Janković, V. (2004). Discriminant analysis of the sets won and the sets lost by one team in a1 italian volleyball league - a case study. *Kinesiology*, *36*(1), 75–82. https://hrcak.srce.hr/4223

Mesquita, I., & César, B. (2007). Characterisation of the opposite player's attack from the opposition block characteristics. An applied study in the Athens Olympic games in female volleyball teams. *International Journal of Performance Analysis in Sport*, *7*(2), 13–27. https://doi.org/10.1080/24748668.2007.11868393

Palao, J. M., Manzanares, P., & Ortega, E. (2009). Techniques used and efficacy of volleyball skills in relation to gender. *International Journal of Performance Analysis in Sport*, *9*, 281–293. https://doi.org/10.1080/24748668.2009.11868484

Palao, J. M., Santos, J. A., & Ureña, A. (2005). The effect of the setter´s position on the spike in volleyball. *Journal of Human Movement Studies*, *48*(1), 25–40.

Paulo, A., Zaal, F. T. J. M., Fonseca, S., & Araújo, D. (2016). Predicting Volleyball Serve-Reception. *Frontiers in Psychology*, *7*(1694), 1–9. https://doi.org/10.3389/fpsyg.2016.01694

Rentero, L., João, P. V., & Moreno, M. P. (2015). Analysis of the líbero's influence in different match phases in volleyball. *Revista Internacional de Medicina y Ciencias de La Actividad Fisica y Del Deporte*, *15*(60), 739–756. https://doi.org/10.15366/rimcafd2015.60.008

Silva, M., Sattler, T., Lacerda, D., & João, P. V. (2016). Match analysis according to the performance of team rotations in volleyball. *International Journal of Performance Analysis in Sport*, *16*, 1076–1086. https://doi.org/10.1080/24748668.2016.11868949

Ugrinowitsch, H., Lage, G. M., Dos Santos-Naves, S. P., Dutra, L. N., Carvalho, M. F. S. P., Ugrinowitsch, A. A. C., & Benda, R. N. (2014). Transition I efficiency and victory in volleyball matches. *Motriz. Revista de Educacao Fisica*, *20*(1), 42–46. https://doi.org/10.1590/S1980-65742014000100006

Valhondo, A., Fernandez-Echeverria, C., Gonzalez-Silva, J., Claver, F., & Moreno, M. P. (2018). Variables that Predict Serve Efficacy in Elite Men's Volleyball with Different Quality of Opposition Sets. *Journal of Human Kinetics*, *61*(1), 167–177. https://doi.org/10.1515/hukin-2017-0119

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