Original Article

Brazilian men's volleyball: analysis of attacks carried out from the attack zone

AUGUSTO CÉZAR RODRIGUES ROCHA[1], HERBERT UGRINOWITSCH[2], AURO BARREIROS
FREIRE[3,4], HENRIQUE DE OLIVEIRA CASTRO[5], GIBSON MOREIRA PRAÇA[2], BRENO FERREIRA DE
BRITTO EVANGELISTA[5], GUSTAVO DE CONTI TEIXEIRA COSTA[1]
[1] Cognição e Ação Lab, Universidade Federal de Goiás, BRASIL
[2] EEFFTO, Universidade Federal de Minas Gerais, BRASIL
[3] Faculdade de Educação Física, Centro Universitário Uma, BRASIL
[4] Faculdade de Educação Física, Pontifícia da Universidade Católica de Minas Gerais, BRASIL
[5] Faculdade de Educação física, Centro Universitário Estácio de Brasília, BRASIL.
[5] Minas Tênis Clube, BRASIL

Abstract:
The present study aims to analyze the predictive factors of the effects of attacks carried out from the attack zone. The sample consisted of the observation of 8,059 attack actions of the Brazilian men's Super League in 2014–2015. The variables analyzed were reception effect, attack tempo, and attack effect. The results showed that excellent reception, first attack tempo and powerful attacks increase the chance of scoring; defense of attack increases the chances of occurring after moderate reception but reduces them after first attack tempo and powerful attacks; attack blocked increases the chance of occurring after the powerful diagonal attack. In conclusion, in contemporary volleyball, the effect of the reception should be high to allow all options of attack to score, even attack with speed and attack with power, when the attack is performed from the attack zone.
Keywords: volleyball, game analysis, attack effect, predictive factors..

Introduction

Match analysis is not recent (Eom & Schutz, 1982; Hughes & Bartlett, 2002) and allows for an understanding of which aspects of a game influence sport performance (Barreira & Silva, 2016; Clemente et al., 2016). In volleyball, numerous articles have analyzed the association between game skills and the attack effect on the side-out (Mesquita et al., 2013; Costa et al., 2016, 2017a; Silva et al., 2016a). Specifically, studies have investigated how volleyball reception, setting and attack (Mesquita et al., 2013), reception effect (Mesquita et al., 2013; Costa et al., 2016), attack tempo (Afonso et al., 2010; Costa et al., 2016) and attack type (Costa et al., 2010; Costa et al., 2016) influence the attack effect.

Although the studies show an association between the game skills, only a few factors were considered predictive of the attack in the side-out process. Recent studies have found that the excellent receptions that allow the organized attack with all the options of attack (Marcelino et al., 2014), fast settings in first and second tempo (Mesquita et al., 2013; Garcia-de-Alcaraz, Ortega, & Palao, 2015) and powerful attacks in parallel and diagonal (Costa et al., 2017b; Conti et al., 2018) are predictive factors of the attack effect. However, studies that sought to understand the attack effect according to the place it was performed (Stutzig et al., 2015; Silva et al., 2016b) or the attacker's position (Peiró et al., 2016; Costa et al., 2017b; Conti et al., 2018) have demonstrated divergences in relation to the predictive factors of the attack, suggesting that situational constraints and front or back row attacks must be taken into account when analyzing volleyball games (Paulo, Davids, & Araújo, 2017; Ramos et al., 2017).

In this context, although most attacks in men's volleyball occur from the attack zone (Costa et al., 2016), we did not find studies that analyzed the predictive factors according to the situational constraints of the game. Thus, the present study aims to analyze the predictive factors of the attack effect performed from the attack zone.

Material & Methods
Sample
The sample was composed of the observation of 8,059 actions of attack during the Men's 2014–2015 Superliga Championship. This sample is relevant because Brazilian men's volleyball is internationally ranked among the top three national teams (www.fivb.org), and most of the players participate in this championship. This sample gives high generalization power to understand what occurs in world volleyball.
Variables
Effect of reception. The instrument proposed by Maia and Mesquita (2006) was adapted to evaluate the quality of reception in the following order:
Reception of excellent quality (A). Reception that allows for organized attack with all possibilities of

attack.

Reception of moderate quality (B). Reception that allows for organized attack, although not all the attackers were available for attack; more specifically, reduces the chances of first attack tempo.

Reception of low quality (C). Reception that does not allow for organized attack, evincing the location of the attack distribution.

Attack tempo. According to Afonso et al. (2010), attack tempo is categorized as:

First attack tempo. The attacker jumps during or immediately after setting, and a step may occur after the setting;

Second attack tempo. The attacker takes two or three steps after setting;

Third attack tempo. The attacker waits for the ball to reach the peak of the upward trajectory, and only then starts the attack.

Attack type. To analyze the type of attack, an adaptation of the instrument proposed by Costa et al. (2011) was adopted, as follows:

Powerful attack in the parallel (APP). Attack performed in downward trajectory, parallel to the sideline with maximum power.

Powerful attack in the diagonal (APD). Attack performed on downward trajectory, diagonally to the sideline with maximum power.

Placed attack. Attack performed with the ball contact executed at the bottom.

Attack effect: the instrument proposed by Marcelino, Mesquita and Sampaio (2011) was used, classifying the attack effect as:

Error. The attacker fails in the attack, striking the ball into the net, out of bounds or performing some infraction to the regulations.

Block. Attacker fails in attack due to opponent block, resulting in opponent's point.

Continuity. The attack action does not result in a final action and allows game continuity.

Point. The attack results in a direct point as the ball touches the opponent's field or is deflected by blocking off the court.

Data Collection Procedure

All games were recorded with the camera positioned 7–9 meters behind the court bottom line and approximately three meters high to get a better viewing of the video scenes. The observers were two physical education teachers with at least five years of experience in the specific function. Before the video analyses, the reliability was calculated, and 20% of the samples were re-analyzed, exceeding the reference value of 10% (Tabachnick & Fidell, 2013). Cohen's Kappa values for inter- and intra-observer reliability, respectively, were reception effect = 0.98 and 0.96, attack tempo = 0.90 and 0.92, attack type = 1.00 and 1.00, attack effect = 1.00 and 1.00. Thus, the reliability values were above the reference value of 0.75 adopted in the area (Fleiss, 2003).

Statistical Procedures

A descriptive analysis was performed followed by a multinomial logistic analysis, observing the relation of the independent with the dependent variables one by one. In this context, the attack effect was considered as the dependent variable and the effect of reception, attack tempo and attack type were independent variables. The error type I adopted was 5% ($p \leq 0.05$), and data analyses were run with SPSS software version 20.0.

Results

Descriptive analysis (Table 1) showed that most of the attack points occurred after reception A (54.6%), first attack tempo (55.4%), and powerful attack in the diagonal (60.2%).

Table 1 - Descriptive analysis of the game skills concerning the attack effect.

Game Procedures	Attack effect	Total				
	Point	Continuity	Block	Error		
Effect of Reception	Reception A	Ocurred	4847	1429	1121	662	8059
		% Effect of reception	60.1%	17.7%	13.9%	8.2%	100.0%
		% Attack effect	54.6%	43.4%	39.2%	42.7%	48.6%
	Reception B	Ocurred	3188	1432	1273	658	6551
		% Effect of reception	48.7%	21.9%	19.4%	10.0%	100.0%
		% Attack effect	35.9%	43.5%	44.5%	42.5%	39.5%
	Reception C	Ocurred	837	432	467	230	1966
		% Effect of reception	42.6%	22.0%	23.8%	11.7%	100.0%
		% Attack effect	9.4%	13.1%	16.3%	14.8%	11.9%
Attack tempo	1st attack tempo	Ocurred	4918	1323	1131	647	8019
		% Attack tempo	61.3%	16.5%	14.1%	8.1%	100.0%
		% Attack effect	55.4%	40.2%	39.5%	41.7%	48.4%
	2nd attack tempo	Ocurred	2381	1046	873	484	4784
		% Attack tempo	49.8%	21.9%	18.2%	10.1%	100.0%
		% Attack effect	26.8%	31.8%	30.5%	31.2%	28.9%

2442--

JPES ®   www.efsupit.ro

	3rd attack tempo	Ocurred	1573	924	857	419	3773
		% Attack tempo	41.7%	24.5%	22.7%	11.1%	100.0%
		% Attack effect	17.7%	28.1%	30.0%	27.0%	22.8%
Attack type	APP	Ocurred	3068	982	1046	599	5695
		% Attack type	53.9%	17.2%	18.4%	10.5%	100.0%
		% Attack effect	34.6%	29.8%	36.6%	38.6%	34.4%
	APD	Ocurred	5345	1633	1587	801	9366
		% Attack type	57.1%	17.4%	16.9%	8.6%	100.0%
		% Attack effect	60.2%	49.6%	55.5%	51.7%	56.5%
	Placed Attack	Ocurred	459	678	228	150	1515
		% Attack type	30.3%	44.8%	15.0%	9.9%	100.0%
		% Attack effect	5.2%	20.6%	8.0%	9.7%	9.1%

The analysis of the predictive factors of the attack effect demonstrated to be statistically significant ($x2 = 725,699$; $p < 0.00001$), as shown in Table 2. It is observed that reception A increases the chances of occurrence of the point of attack by 1.5 times, first attack tempo increases the chance of the attack point 1.7 times, and powerful attack approximately doubles the chance of the attack point occurring. The defense of the attack increases 1.2 times after reception B and reduces the chances of occurring after the first attack tempo (adds ratio adjusted [ORA]: 0.83) and the powerful attacks (ORA: 0.36 and 0.45, respectively parallel and diagonal). Attack blocking increases the chance of occurring after the powerful diagonal attack by 1.2 times.

Table 2 - Predictive factors of the attack effect carried out in the attack zone

Attack effect	OR Brute	p Brute	OR Adjusted	p Adjusted	95% Confidence Interval for Exp(B)		
					Lower limit	Upper limit	
Point	Reception A	2.012	<0.001	1.502	<0.000*	1.242	1.817
	Reception B	1.331	0.001	1.038	0.685	0.865	1.246
	Reception C [b]						
	1st attack tempo	2.025	<0.001	1.737	<0.000*	1.490	2.024
	2nd attack tempo	1.310	<0.001	1.132	0.125	0.966	1.326
	3rd attack tempo [b]						
	APP	1.674	<0.001	1.760	<0.000*	1.434	2.161
	APD	2.181	<0.001	2.182	<0.000*	1.787	2.664
	Placed Attack [b]						
Continuity	Reception A	1.149	0.140	1.230	0.053	0.997	1.517
	Reception B	1.159	0.118	1.256	<0.025*	1.029	1.533
	Reception C [b]						
	1st attack tempo	0.927	0.320	0.839	0.040*	0.709	.992
	2nd attack tempo	0.980	0.802	0.915	0.313	0.770	1.087
	3rd attack tempo [b]						
	APP	0.363	<0.001	0.360	<0.000*	0.294	.442
	APD	0.451	<0.001	0.450	<0.000*	0.370	.548
	Placed Attack [b]						
Block	Reception A	0.834	0.054	0.890	0.277	0.721	1.098
	Reception B	0.953	0.606	1.006	0.955	0.825	1.226
	Reception C [b]						
	1st attack tempo	0.855	0.042	0.888	0.175	0.749	1.054
	2nd attack tempo	0.882	0.126	0.928	0.402	0.779	1.105
	3rd attack tempo [b]						
	APP	1.148	0.235	1.132	0.290	0.900	1.424
	APD	1.303	0.020	1.297	0.022*	1.038	1.621
	Placed Attack [b]						

[a] The reference category for the dependent variable is the attack error; [b] The reference category for the independent variable; * difference for $p < 0.05$.

AUGUSTO CÉZAR RODRIGUES ROCHA, HERBERT UGRINOWITSCH, AURO BARREIROS FREIRE,
HENRIQUE DE OLIVEIRA CASTRO, GIBSON MOREIRA PRAÇA, BRENO FERREIRA DE BRITTO
EVANGELISTA, GUSTAVO DE CONTI TEIXEIRA COSTA

Dicussion

The present study aimed to analyze the predictive factors of the attack effect performed from the attack zone. The descriptive analysis showed that most of the points of attack occur after good reception and faster and powerful attacks. The most recurrent effect of point of attack (Mesquita et al., 2013; Costa et al., 2016; Silva et al., 2016a) was after receptions allowing the organized attack (Costa et al., 2011; Costa et al., 2017b), as other studies have also demonstrated. However, the results disagree with some studies about the attack tempo, since they indicate the second attack tempo as the most used in the conquest of the point of attack (Palao, Santos, & Ureña, 2007; Costa et al., 2017b; Conti et al., 2018). The contradictory results may be because previous studies analyzed all the attacks, i.e., from both the defense zone and the attack zone, and we analyzed only attacks performed in the attack zone.

The predictive factors of the attack showed the point of attack to be more likely to occur after excellent reception; defense is more likely to occur after moderate reception and less likely to occur after first attack tempo and powerful attacks, and the block is more likely to occur after the powerful diagonal attack. These results are partially similar to previous studies which showed the first and second attack tempo as predictive factors of the attack point, and that the powerful attacks reduce the possibilities of defense (Castro, Souza, & Mesquita, 2011; Nikos & Elissavet, 2011; Stutzig et al., 2015; Costa et al., 2017b). The block analysis is partially in agreement with the study of Conti et al. (2018), which showed the block the powerful attack in the parallel and diagonal as a predictive factor of the sucess of attack. This difference is probably because the aforementioned study refers to the attack of the opposing player from both zones, attack and defense. Based on the high deterministic nature of volleyball actions and game configurations, it is possible to identify and quantify tactical and technical performance patterns according to the interaction between the actions providing adaptations in the attack and defense systems (Mesquita et al., 2013). Thus, the strong diagonal attack increases the chances of the block. It is probably justified by the higher occurrence of this type of attack, resulting in greater predictability in the type of attack and better blocking system structuring.

Conclusions

Based on the results, the present study shows that contemporary men's volleyball requires a high reception effect allowing the organization of the attack and involving all options of attack, such as the first attack tempo and powerful attack, to win the point. More specifically, our results suggest that this formation becomes necessary when the attack is carried out from the zone of attack. It was also observed that moderate receptions increase the chances of defense, and the second attack tempo is not able to predict the point of attack.

In this context, we may suggest as practical implications that training should be directed to high efficacies in game procedures, such as reception, while the attacks placed should be avoided, i.e., the attacker must take the risk of making mistakes in powerful attacks. For future investigations, we suggest analyzing the procedures of the game according to its match status and in different categories.

Conflicts of interest - There isn't a conflicts of interest.

References:

Afonso, J., Mesquita, I., Marcelino, R., Silva, J. (2010). Analysis of the setter's tactical action in high performance women's volleyball. Kinesiology, 42(1), pp. 82-89.

Barreira, J., Silva, C. E. (2016). National teams in Women's Soccer World Cup from 1991 to 2015: participation. performance and competitiveness. Journal of Physical Education and Sport. 16(3), pp. 795-799.

Castro, J., Souza, A., Mesquita, I. (2011). Attack efficacy in volleyball: Elite male teams. Perceptual and Motor Skills. 113(2). pp. 395-408.

Clemente, F. M., Martins, F. M. L., Mendes, R. S., Silva, F. (2016). Social network measures to match analysis in soccer: A survey. Journal of Physical Education and Sport. 16(3). pp. 823-830.

Conti, G., Freire, A., Evangelista, B. Pedrosa, G., Ugrinowitsch, H., Castro, H. (2018). Brazilian high level men's volleyball: characterization of the attack performed by the opposite player. Kinesiology, 50(2), pp.10-17.

Costa, G. C., Castro, H. O., Evangelista, B. F., Malheiros. L. M., Greco. P. J. Ugrinowitsc, H. (2017b). Predicting factors of zone 4 attack in volleyball. Perceptual and Motor Skill. 124(3): 621-633.

Costa, G., Ferreira, N., Junqueira, G., Afonso, J., Mesquita, I. (2011). Determinants of attack tactics in youth male elite volleyball. International Journal of Performance Analysis in Sport, 11(1), 96-104.

Costa, G., Mesquita, I., Greco, P. J., Ferreira, N., Moraes, J. C. (2010). Relação saque. recepção e ataque no voleibol juvenil masculino. Motriz Revista da Educação Física, 17(1), pp. 11-18.

Costa, G.D.C.T., Ceccato, J.S., Oliveira, A. S., Evangelista, B.F.B., Castro, H.O., Ugrinowitsch, U. (2016). Men's volleyball hight level: association between game actions on the side-out. Journal of Physical Education, 27(1), e-2755.

Costa, G.D.C.T., Maia, M. P., Rocha, A. C. R., Martins, L. R., Gemente, F. R. F., Campos, M. H., Milistetd, M., Freire, A. B. (2017a). Association between effect of reception and game procedures in high-level Brazilian volleyball: The case of the women's "Superliga" champion team. Brazilian Journal of

----

Kinanthropometry and Human Performance, 19(6), pp. 663-675.

Eom, H. J., Schutz, N. R, (1992). Statistical analysis of Volleyball team performance. Research Quarterly for Exercises and Sport, 63(1), pp. 11-18.

Fleiss, J. (2003). Statistical methods for rates and proportions. 3rd ed. Wiley-Interscience.

García-de-Alcaraz, A., Ortega, E., Palao, J. M. (2015). Effect of age group on male volleyball players' technical-tactical performance profile for the spike. International Journal of Performance Analysis in Sport, 15(2), pp.668-686.

Hughes, M., Bartlett, R. M. (2002). The use of performance indicators in performance analysis. Journal of Sports Science, (20), pp. 739-754.

Maia, N., Mesquita, I. (2006). Estudo das zonas e eficácia da recepção em função do jogador recebedor no voleibol sênior feminino. Revista Brasileira de Educação Física e Esporte, 20(4), 257-70.

Marcelino, R., Mesquita, I., Sampaio, J. Effects of quality of opposition and match status on technical and tactical performances in elite volleyball. Journal of Sports Sciences, 29(7), 733-41.

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

Mesquita, I., Palao, J. M., Marcelino, R., Afonso, J. (2013). Performance analysis in indoor volleyball and beach volleyball. In: McGarry T. O'Donoghue P. Sampaio J. editors. Routledge Handbook of Sports Performance Analysis. pp.367-79.

Nikos, B., Elissavet, N.M (2011). Setter's performance and attack tempo as determinants of attack efficacy in Olympic level male volleyball teams. International Journal of Performance Analysis in Sport, 11(3), pp.535-544.

Palao, J.M., Santos, J.A., Ureña, A. (2007). Effect of the manner of spike execution on spike performance in volleyball. International Journal of Performance Analysis of Sport, 7(2), pp.126-138.

Paulo, A., Davids, K., Araújo, D. (2017). Co-adaptation of ball reception to the serve constrains outcomes in elite competitive volleyball. International Journal of Sports Science & Coaching. 13(2), pp. 253-261.

Peiró, M.S., Parra, M., León, J., Fradua, L., Benitez, J.M., Ureña, A. Relationship between middle hitter and setter's position and its influence on the attack zone in elite men's volleyball. International Journal of Performance Analysis in Sport. 16(2), pp.523-538.

Ramos, A., Coutinho, P., Silva, P., Davids, K., Guimarães, E., Mesquita, I. (2017). Entropy measures reveal collective tactical behaviours in volleyball teams: how variability and regularity in game actions influence competitive rankings and match status. International Journal of Performance Analysis in Sport. 17(6), pp.848-862.

Silva, M., Marcelino, R., Lacerda, D., João, P, (2016a). Match analysis in volleyball: a systematic review. Monten Journal of Sports Science and Medicine, 5(1), pp.35-46.

Silva, M., Sattler, T., Lacerda, D., João, P. V. (2016b). Match analysis according to the performance of team rotations in Volleyball. International Journal of Performance Analysis in Sport, 16(3), pp.1076-1086.

Stutzig, N., Zimmermann, B., Busch, D., Siebert, T. (2015). Analysis of game variables to predict scoring and performance levels in elite men's volleyball. International Journal of Performance Analysis in Sport. 15(3), pp.816-829.

Tabachnick, B., Fidell, L. (2013). Using multivariate statistics. 6th ed. Boston: Allyn & Bacon.

--2445

JPES ®   www.efsupit.ro