RICYDE. Revista Internacional de Ciencias del Deporte
doi: 10.5232/ricyde
Rev. Int. cienc. deporte

RICYDE. Revista Internacional de Ciencias del Deporte
Volume XVII - Year XVII
Pages: 56-68 - ISSN: 1885-3137
Issue 63 - January 2021

https://doi.org/10.5232/ricyde2021.06305

Effect of serve on reception and side-out performance in relation to ball´s contact with the net and type of serve, in high level male volleyball

Efecto del saque en el rendimiento de la recepción y en el complejo I en función del contacto del balón con la red y el tipo de saque, en voleibol masculino de alto nivel

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Abstract

The contact of the serve's ball with the net in volleyball generates uncertainty in the receivers, due to the change in trajectory and speed that occurs. The objective of this study was to determine the influence of the serve contact with the net on the performance of the receiving team, on male teams of the highest international level. A total of 4,227 actions of reception or side-out corresponding to 29 matches were analysed, of which only 275 contacted the net (5.42%). Reception performance was higher in the power jump serves that contacted with the net ($p<0.001$). However, the effect of contact with the net on floating serves did not have a significant impact. The final performance of the side-out did not make a significant impact neither. In conclusion, the contact of the ball with the net affects the reception performance in the highest international men's volleyball teams.

Key words: Sport analysis; evaluation; team sport; service; reception.

Resumen

El contacto del balón de saque con la red en voleibol genera incertidumbre en los receptores debido a la variación en la trayectoria y velocidad que se produce en el saque. El objetivo de este estudio fue determinar la influencia del contacto del saque con la red en el rendimiento del equipo receptor, en equipos masculinos de máximo nivel internacional. Se analizaron 4.227 acciones de recepción o KI pertenecientes a 29 partidos, de las que únicamente 275 contactaron con la red (5,42%). El rendimiento en recepción fue superior en los saques en salto con rosca que contactaron con la red ($p<0,001$). Sin embargo, el efecto del contacto con la red en los saques flotantes no tuvo un impacto significativo. El rendimiento final del KI tampoco obtuvo un impacto significativo. En conclusión, el contacto del balón con la red afecta al rendimiento de la recepción en equipos de voleibol masculinos de máximo nivel internacional.

Palabras clave: Análisis deportivo; evaluación; deporte de equipo; saque; recepción.

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Received: February 22, 2020; Accepted: October 18, 2020

Introduction

In volleyball each point starts with a serve action, which the opposing team tries to answer through the side-out (KI). KI involves a phase of the game consisting of reception, set and spike. It has been shown that the service's reception in volleyball is conditioned by different aspects, such as the receiver's positioning and movement, the speed and trajectory of the ball, as well as the serve technique (Paulo et al., 2018; Quiroga et al., 2012). Since the regulatory change made in 2000 (FIVB 2015) by the International Volleyball Federation (FIVB), volleyball has become the only divided court sport that allows the continuity of the game when, during a service action, the ball touches the net (rule 10.2). However, the effect that the touch of the ball with the net has on the performance of a team's reception has not yet been studied. Perhaps the lack of studies is due to its low frequency.

Because of the contact of the ball with the net, the individual technical actions and the collective reception structures need to be adapted to the uncertainty caused by the possible changes in trajectory and speed of the serve. According to Conejero, Claver, Fernández-Echeverría, González-Silva and Moreno (2017), the high levels of uncertainty in collective sports demand a selective level of attention that makes possible the perception, processing and optimal decision making. This ability to observe the trajectory of the ball, analysis of the situation and fast decision-making is especially relevant in volleyball, due to the high speed of the ball and the inability to retain it (Salles et al., 2017). Therefore, the contact of the ball with the net can provoke in the receivers an increase of this uncertainty, and thus an increase in difficulty in hitting.

Being volleyball a sport of a sequential nature in which the actions are repeated cyclically (Palao, Santos, and Ureña 2004; Stutzig et al., 2015), the accuracy of the reception conditions the spiking possibilities of successive actions (Afonso, Esteves, Araújo, Thomas, & Mesquita, 2012; Costa, Afonso, Barbosa, Coutinho, & Mesquita, 2014; Costa et al., 2016; Papadimitriou, Pashali, Sermaki, Mellas, & Papas, 2004), and therefore, is related to attack performance (Bergeles, Barzouka, & Nikolaidou, 2009; Costa et al., 2017; João, Mesquita, Sampaio, & Moutinho, 2006; Rodriguez-Ruiz et al., 2011). It has been shown that the quality of the reception is a good predictor of the team's success (Paulo et al., 2016; Zetou et al., 2007).

In order to evaluate the performance in volleyball, different tools have been used. These have evolved since the collection of information about the actions that were considered most relevant during the game (Marcelino, Mesquita, & Sampaio, 2011). Among the most used tools, FIVB's statistical system stands out. It is based on the system proposed by Coleman, Neville and Gordon (1969) being used by different researchers to analyze the game (Conejero et al., 2017; Quiroga et al., 2012). The FIVB statistical system is based on the assignment of a numerical value, on a scale of four or five values, which allows evaluating different game actions' output. The lowest value would be a point-against action. By contrast, the highest values consider success in ending actions (serve, spike and blocking), or an action with high precision in the actions of game continuity (reception, defense and set). In this way, performance in volleyball is assessed, becoming an important source of information for both coaches and players and which supports the effectiveness of the training and decision-making processes (Eom and Schutz 1992; Peña et al., 2013; Stutzig et al., 2015).

Considering that volleyball is the only sport in which the contact of the ball with the net during the service is allowed, that this contact modifies the trajectory and velocity of the ball (disturbing both reception and attacking moves), and the knowledge of the effects on KI's performance during competition is far from being extensive; the present study aims to identify the influence of the contact of the ball with the net and the type of serve, on the performance of the reception and the strategic KI of the high-performance male volleyball teams.

The hypothesis of this study is the existence of an association between the ball's net contact, and the reception and KI's performance, and this association is influenced by the type of serve.

Materials and Methods

Within the observational methodology developed to carry out the present study, a system of categories that met the requirements of mutual exclusivity and completeness was designed (Anguera, 1991). This allowed the registration of all the observed cases. In line with Blanco, Losada and Anguera (2003), a specific observation scheme was made, with a nomothetic criterion and a multidimensional response level.

Sample

The sample of the study consisted of 4,227 actions of reception, from the analysis of 29 masculine world-high-performance matches. The analyzed matches correspond to the final phases of the Olympic Games (O.G.), the World Cup (W.C.) and the World League (W.L.) played between 2012 and 2016. Non-probability sampling for convenience was used.

Matches were selected according to the following criteria:

1. Be part of the final phases of one of the main international male competitions played in the Olympic Cycle 2012-2016: O.G. 2012, W.L. 2013, 2014, 2015 & 2016, World Championship 2014 (W.CH.), W.C. 2015.

2. That the complete match was available online.

3. That the image quality was equal to or greater than 720 p.

4. That the perspective of the field was predominantly lateral.

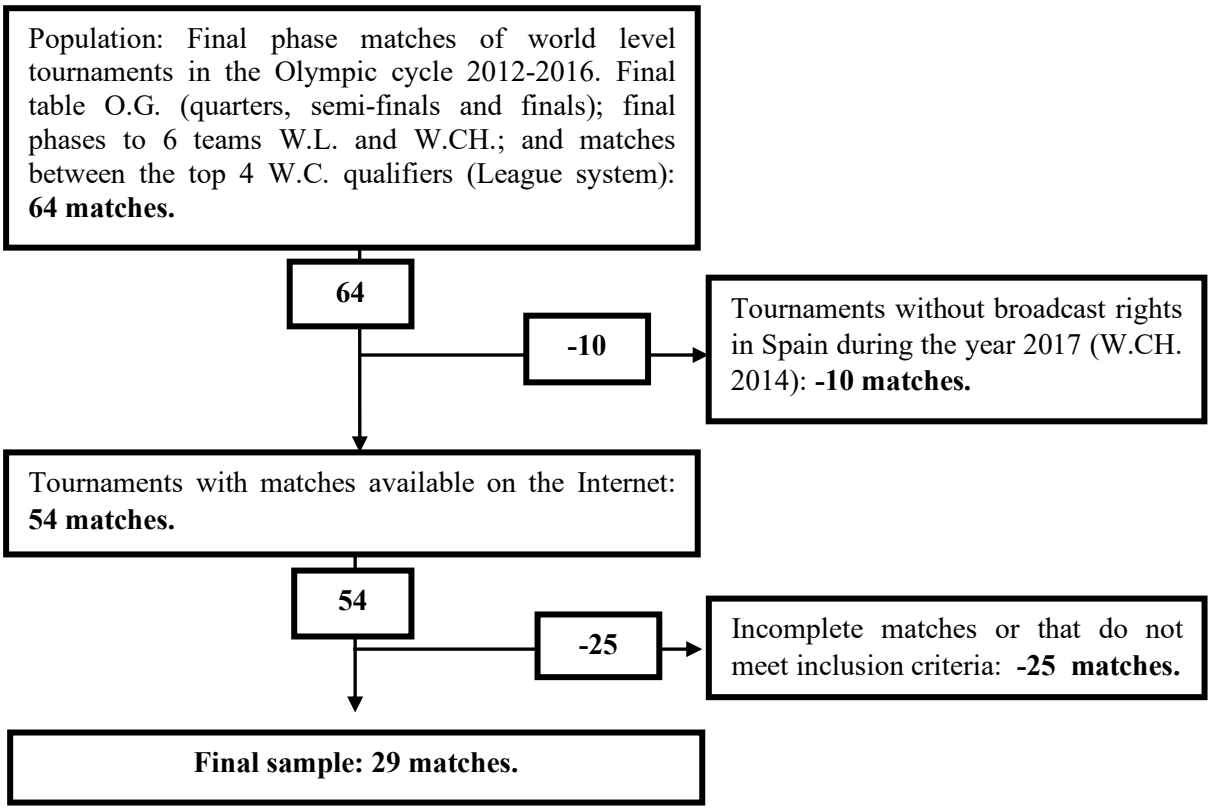

Figure 1. Matches of study sample.

Variables, approach and procedure

In the present study, four variables were analyzed, each one defined by its corresponding system of categories:

- The type of serve (TS) allowed classifying serves into two different categories:
  - Jump power serve (JPS): strike the ball in the air after a jump, making it spin over its own stem.
  - Jump float serve (JFS): strike the ball in the air after a jump. The ball holds in the air without flipping on its axis.
- Contact of the serve with the net (CN):
  - Ball strikes net (BSN): the ball overcomes the net after striking on it.
  - Ball doesn't strike net (BDSN): the ball overcomes the net without striking on it.
- Reception performance (RP), adapting of the 4 FIVB statistical system values (Díaz, 1997), into 5 values:
  - Reception error (RER): which corresponds to the category of error reception of the FIVB system. The serve achieves either an ace or a reception error.
  - Reception Bad (RBA): which corresponds to the category of bad reception of the FIVB system. The reception quality does not allow to elaborate a sequence with setting and spike, returning a free-ball.

  - Reception Regular (RRE): which corresponds to the category of good reception of the FIVB system. The reception quality does not allow setting firsts times.
  - Reception Good (RGO): the quality of the reception allows setting first times with risk.
  - Reception Excellent (REX): the quality of the reception allows to play any type of setting.

- Performance of KI (KP), adapting of the 5 FIVB statistical system values for the attack (Díaz, 1997) into 6 values:
  - KI Error (KIE): the team in situation of K1, receives a point, either due to a reception error, setting error, or other type of error.
  - KI Bad (KIB): the ball sent to the opposite side is controlled by the defending team, allowing to play any type of setting.
  - KI Deficient (KID): the ball sent to the opposite side is controlled by the defending team, allowing setting first times with risk.
  - KI Regular (KIR): the ball sent to the opposite side is controlled by the defending team, not allowing a game reconstruction with firsts times.
  - KI Good (KIG): the ball is contacted by the opposite team, not managing a spike attack move.
  - KI Point (KIP): the ball sent to the opposite side becomes a point.

The observation of the studio was made by a single observer. The observer was a top-level national and international level II coach, with experience in team management and performance assessment. A match was visualized by joining criteria and establishing a manual of atypical cases, whose eventualities were incorporated into the categorization process. After completing the registration of actions, the observation of the first match was repeated in order to evaluate and confirm intra-observer reliability. A second expert observer was trained and analyzed a match independently, with the intention of checking and ensuring the inter-observer agreement. This second expert has the same qualifications as the first expert. Our first analyses showed an almost perfect agreement in the intra-observer ($\kappa \geq .921$) and the inter-observer concordance ($\kappa \geq .849$).

The data was recorded by means of the LINCE sport observation and analysis software (Gabin et al., 2012).

Data analysis

First, the reliability of data coding was assessed, analyzing the degree of intra- and inter-observer agreement through Cohen's Kappa test. According to Landis and Koch (1977), it was considered almost perfect (.81-1), high (.61-.8), moderate (.41-.6), low (.21-.4) or very low (<.2).

Frequencies and percentages were used to report the descriptive results of the sample.

To determine the influence of the contact of the ball with the net on the performance of the reception and the KI, chi-square analysis was used, adjusting post-hoc comparisons with Bonferroni correction. To report the magnitude of the relationship, Cramer's V was used (V<0,3 low effect, V<0,5 medium effect, V>0,5 high effect). To grasp the relationship, Haberman's corrected residues were used. These residues have been considered when they have exceeded the level of ±1.96 as an absolute value and that implies their significative condition (Haberman, 1978).

Statistical processing was carried out with IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY (IBM Corp. 2012). The level of significance was set at p = .05 in all hypothesis contrasts.

Results

Table 1 shows the distribution of analyzed actions. From the initial sample of 5,104 serves, 5 serves were missing, 864 failed and 4,235 had continuity. Taking into account that 8 reception performances' values were missing, a total of 4,227 actions were used.

Table 1. Distribution of the service actions evaluated.

	Power jump serve (n=3479)	Float jump serve (n=1620)	Other (n=5)	Total (n=5104)
Service missing	1 (<.1)	1 (.1)	3 (60)	5 (.1)
Service errors				
Ball does not cross the net	320 (9.2)	58 (3.6)	1 (20)	379 (7.4)
Ball contacts the net and goes out	9 (.3)	1 (.1)	0	10 (.2)
Ball no-contacts the net and goes out	414 (11.9)	61 (3.8)	0	475 (9.3)
Service with continuity				
Ball contacts the net	247 (7.1)	30 (1.9)	0	277 (5.4)
Ball no-contacts the net	2488 (71.5)	1469 (90.7)	1 (20)	3958 (77.5)

Results are expressed as frequency (percentage).

A significant relationship was found between the type of service and the contact of the ball with the net ($\chi^2(1)=77.11$, p<.001; V=.136), being more frequent net contact in the power jump serves (9 %) than in float jump serves (2 %).

Table 2 presents results about the relationship between the performance of reception with the contact of the ball with the net, aggregated and segregated by type of service. A significant increase in excellent performance and a decrease in regular performance was found when the ball contacted the net (p=.002). Analyzing the results separately according to the type of serve, it is observed that this behavior occurs in power jump serves (p<.001), but not in float jump serves (p=0,318).

Table 2. Distribution of the reception performance according to the contact vs. no-contact of the ball with the net.

	Ball contacts the net			Ball no-contacts the net					
	n (%)	AR	CR	N (%)	AR	CR	χ^2	p	V
Power jump serve							34.38	<.001*	.112
Reception Error	17 (6.9)	-1.3	-1.4	240 (9.6)	.4	1.4			
Reception Bad	19 (7.8)	-1.5	-1.7	281 (11.3)	.5	1.7			
Reception Regular	50 (20.4)*	-3.0	-3.7	795 (32.0)*	.9	3.7			
Reception Good	89 (36.3)	1.5	1.9	755 (30.4)	-.5	-1.9			
Reception Excellent	70 (28.6)*	4.0	4.7	414 (16.7)*	-1.3	-4.7			
Float jump serve							4.71	.318	.056
Reception Error	2 (6.7)	1.1	1.1	45 (3.1)	-.2	-1.1			
Reception Bad	2 (6.7)	-.3	-.3	118 (8.0)	.0	.3			
Reception Regular	3 (10)	-1.2	-1.4	294 (20.0)	.2	1.4			
Reception Good	10 (33.3)	-.5	-.6	569 (38.8)	.1	.6			
Reception Excellent	13 (43.3)	1.3	1.6	441 (30.1)	-.2	-1.6			
Total							17.07	.002*	.064
Reception Error	19 (6.9)	-.2	-.2	285 (7.2)	.0	.2			
Reception Bad	21 (7.6)	-1.2	-1.3	399 (10.1)	.3	1.3			
Reception Regular	53 (19.3)*	-2.5	-3.0	1089 (27.5)*	.7	3.0			
Reception Good	99 (36.0)	.7	.8	1324 (33.5)	-.2	-.8			
Reception Excellent	83 (30.2)*	2.8	3.3	855 (21.7)*	-.7	-3.3			

Results are expressed as frequency (percentage). *Significant differences in distribution ($p<0.05$)

Table 3 shows results about the relationship between the performance of KI and the contact of the ball with the net, aggregated and segregated by type of service. No significant relationships were found in total, power or float jump serves ($p>.05$).

Table 3. Distribution of the KI performance according to the contact vs. no-contact of the ball with the net.

	Ball contacts the net			Ball no-contacts the net					
	n (%)	AR	CR	n (%)	AR	CR	χ^2	p	V
Power jump serve							10.6	.060	.062
KI Error	51 (20.7)	-1.4	-1.7	637 (25.6)	.4	1.7			
KI Bad	11 (4.5)	-1.7	-1.8	190 (7.6)	.5	1.8			
KI Deficient	22 (8.9)	.8	.9	184 (7.4)	-.3	-.9			
KI Regular	28 (11.4)	-.9	-1.0	337 (13.6)	.3	1.0			
KI Good	13 (5.3)	.2	.2	124 (5.0)	-.1	-.2			
KI Perfect	121 (49.2)	1.9	2.6	1012 (40.7)	-.6	-2.6			
Float jump serve							4.65	.460	.056
KI Error	4 (13.3)	-.6	-.7	271 (18.5)	.1	.7			
KI Bad	3 (10.0)	.9	.9	89 (6.1)	-.1	-.9			
KI Deficient	1 (3.3)	-.8	-.8	103 (7.0)	.1	.8			
KI Regular	6 (20.0)	1.1	1.2	221 (15.1)	-.2	-1.2			
KI Good	1 (3.3)	-1.2	-1.3	77 (98.7)	.2	1.3			
KI Perfect	15 (50.0)	.1	.2	706 (48.1)	.0	-.2			
Total							5.36	.374	.036
KI Error	55 (19.9)	-1.0	-1.2	908 (23.0)	.3	1.2			
KI Bad	14 (5.1)	-1.2	-1.3	279 (7.1)	.3	1.3			
KI Deficient	23 (8.3)	.6	.7	287 (7.3)	-.2	-.7			
KI Regular	34 (12.3)	-.6	-.7	558 (14.1)	.2	.7			
KI Good	14 (5.1)	-.3	-.3	201 (5.1)	.1	.3			
KI Perfect	136 (49.3)	1.4	1.9	1718 (43.5)	-.4	-1.9			

Results are expressed as frequency (percentage).

Discussion

The results of this study show that the JPS serves are four times more likely to touch the net and pass to the opposite side than the JFS. This may be due to the higher level of risk assumed in the execution of the JPS serves, which may reduce the accuracy and safety of the serve (Ureña et al., 2001; Marcelino, Mesquita, & Afonso 2008). In fact, the error percentage between both types of serves is around 15% according to different authors (Callejón, 2006; Ciuffarella et al., 2013; Moras et al., 2008; Stamm, Stamm, Vantsi, & Jairus, 2016). The highest level of risk of JPS is determined by the higher power with which they are executed, generating speeds around 82 km/h in JPS, compared to 43 km/h in JFS (Moras et al., 2008). Another factor that may explain the greater number of contacts of the JPS with the net is the serve's hitting height, which according to Mackenzie, Kortegaard, Levangie and Barro (2012) is lower in the JFS and allows to maintain a greater control over the ball.

The present article studies the serves separately, due to the type of serve influences on the performance of reception. Different authors have previously reported that JFS generates higher reception performance, (Afonso et al., 2012; Callejón & Hernández, 2009; Ciuffarella et al., 2013; Marcelino et al., 2011; Valhondo, Fernandez-Echeverria, Gonzalez-Silva, Claver, & Moreno, 2018; Yiannis & Panagiotis, 2005), despite the fact that this technique of service often incorporates erratic flights, hindering the identification of trajectories and the action of the receiver (Deprá and Brenzikofer 2004; Mackenzie et al., 2012).

Regarding the contact of the ball with the net, the results show an improvement in the performance of the reception, especially in the JPSs. Receiving JPS after contacting the net, significantly increases excellent receptions and reduces regular receptions. At the descriptive level there is a tendency to decrease low or medium quality receptions (RER, RBA, RRE), increasing high quality receptions (RGO, REX). Although some authors, such as Moras et al. (2008), did not find direct relationship between the increase in the speed of serve and the effectiveness of reception, it seems that speed can be a key factor. The lower speed of the JFS, as well as the decrease in speed suffered by the JPS when touching the net, allow the receiver to have more time to execute the motor response. Benerink, Bootsma and Zaal (2015) analyzed the response's times of the receivers, computing the average time in 0.69 s. in the JPS and in 1.04 s. in the JFS. In this same study, authors pointed out the inability of the receivers to move the body adopting a stable position when the serves were produced at high speed, forcing to intercept the serve with their bodies in an unstable situation or still in motion due to the temporary deficit. Therefore, the decrease in the speed of the serve when contacting the ball with the net seems to have more influence on the reception's performance than the possible difficulty derived from the perception and response to the change of the trajectory produced by the serve after touching the net.

On the contrary, in the JFS it was not demonstrated an improvement in reception performance when the ball touched the net. This could be because the speed of the ball does not have as much repercussion in the JFS, since the speed is lower (Moras et al., 2008). It is also possible that the positive effect of the contact of the ball with the net in the JPS doesn't have any effect on the JFS, given the fact that the latter falls with little speed and very close to the net, hampering the reception.

Regarding the performance of KI, the results do not show changes when the ball touches the net. Although volleyball is a sequential sport, in which the previous actions condition the performance of the subsequent ones, as different authors have described previously (Costa et al., 2016; Patsiaouras, Charitonidis, Moustakidis, & Kokaridas, 2009; Rodriguez-Ruiz et al., 2011), in this case the improvement of reception performance before touching the net, does not cause a performance improvement in KI. This may be due to the ability of high-level setters, to transform low-quality receptions into good settings (Castro et al., 2011; Marcellin et al., 2014; Patsiaouras et al., 2010). Or perhaps the size of the effect may not be strong enough, to reflect a change in KI performance.

Some concerns must be considered when interpreting the results of this work. This is the first study that analyzes the influence that the serve's contact with the net has on high-performance volleyball male teams. This fact is an important strength and novelty in the analysis of the game. Other notable strengths are the homogeneity and the highest competitive level belonging during an Olympic cicle. As possible limitations of this study, some actions analyzed have low representation, as demonstrated by the small sample obtained for the present study (5.42%), and the speed and the hitting height of the serve in the possible influence on the net contact have not been measured.

It is possible that the motor actions and decision making of the expert players could be decisive and differentiated from those of the non-expert players. These results can be used to establish behavioral reference's models to apply in the training and learning categories of volleyball, seeking the best individual and collective action guidelines of the reception systems for this purpose. Simulation of situations in which the serve touches the net could be positive in the stages of player formation, asking the players to react by advancing the center of gravity generating an imbalance forward, and even taking a small leap forward with both feet

simultaneously approaching the net. In addition, the results of this study may be taken as a reference for other net divided sports, in which the regulatory option of allowing the net serve contact has been raised. Future literature could analyze how the net serve contact affects the individual technique and the players' movements and structure in the reception at different competitive levels, assessing the possible participation of auxiliary receiving players when the serve occurs with falling parables closest to the net. Another possible line of investigation could focus on how the ball's trajectory affects its own rotation and the MAGNUS effect when the ball touches the net.

In conclusion, the contact of the ball with the net influences the performance of the reception of the male volleyball teams of the highest competitive level. The contact of the serve with the net, especially in the spin serve, increases the performance of the receiving team.

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