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Original Article

Tendencies of the volleyball serving skill with respect to the serve type across genders

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Abstract:
The purpose of this study was to investigate the areas from which the serves performed by elite volleyball players were carried out, the zones into where they were directed and their performance in respect to the serve type used per gender. A three-member group of coaches assessed the serve actions of male (M) and female (F) elite players from 20 volleyball games (M=10, F=10) of National Teams competing in the final phase of the World League 2018. The analyzed variables comprised the serve type, the area from which the serve was carried out (SA), the serve direction and the serve performance which was assessed based on a 5-level tactical rating scale (Eom & Schutz, 1992). Results showed thatmen mainly preferred the power jump serve (PJS) while women the float jump serve (FJS). Both genders irrespective of the serve type used chose mainly the SA behind zone 1 (SA1) for the execution of their serves. However, men used the SA behind zone 5 (SA5) for the execution of their FJS more frequently compared to women who preferred the SA1 for the execution of both the PJS and the FJS as well. Women directed the PJS into the central part of the court and the FJS into zone 5 more frequently than men. On the other hand, men directed the PJS into zone 5, the FJS into zones 7 and 8 and made more mistakes than women. Moreover, they presented a higher proportion of PJS which directed into zone 5 and evaluated as very good compared to women. In addition, irrespective of the serve type used men made more errors than women who created more often ideal conditions for the opponent setter to organize the game.
Key Words: serving area, serve direction, serve performance

Introduction

In volleyball,the serve is the action of hitting the ball with the arm and directing it over the net into the opponent's court by the server placed in the serve zone (Coejero Suarez, Claver Rabaz, Fernandez-Echeverria, Gil-Arias, & Perla Moreno, 2017) and most of its types are determined through the athlete's posture before he/she hits the ball(Depra, Brenzikofer, Goes, & Barros, 1998). As the first offensive actionthrough which a point can be scored(Raiola, Parisi, Giugno, & Di Tore, 2013; Quiroga, et al., 2012; Moras, et al., 2008)or to prevent the opponent to construct the attack (Claver, Jimenez, Gil, Moreno, & Moreno, 2013)it seems to have a purpose-determined nature and may be decisive in a team's performance for male (Drikos, Kountouris, Laios, & Laios, 2009; Zetou, Tsigilis, Moustakidis, & Komninakidou, 2006) and female teams(Drikos, Angelonidis, & Sobonis, 2018). Moreover, it is the only action of the game preceded by a period of 8 seconds from the first referee's signal for serve(F.I.V.B., 2012)during which the player has the chance to decide the serve-type, the trajectory of the ball and how much strength he/she will exert on it(Garcia-Tormo, Vaquera Jimenez, & Morante Rabago, 2015; Stamm, Stamm, Torilo, Thompson, & Jairus, 2016). Five different types of serve are classified depending on the technique used when carrying out: a) the powerful jump serve (implies ball rotation), b) the placed jump serve (similar to the previous one but with much less strength), c) the sharp-fast jump float serve, d) the placed jump float serve and e) the float serve without jumping (Costa, Afonso, Brant, & Mesquita, 2012).

However, in the internationallevel volleyball, the frequency of using each one of the above-mentioned serve types seems to be different. During28 games of the 2008-09 Men's World Championship, only 3.3% of the serves which were carried out were float serves without jump(Ciuffarella, Russo, Masedu, Valenti, & De Angelis, 2013). On the other hand, 26.9% of the total serves were jump float and 69.9% of them were power jump serves. The latter seemed to be used more often than the other serve types even though they showed relatively higher failure rates and point-to-error ratio(Garcia de Alcaraz, Ortega, & Palao, 2015). This preference may be since most of the successful jump serves were effective in increasing the difficulty of the opponent team reception, eliminating the possibility of a positive team attack (Ciuffarella et al., 2013). Concerning the women,

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it was found that their main serve-type choice was the float serve (48.6%) while the rest of their serve-type choices were in a hierarchical order, the power jump serve and the jump float serve. Additionally, it is shown that the serve type was significantly related to the in-game role of the server (Quiroga, et al., 2010).

The aforementioned are in accordance with the study of Palao, Manzanares, Ortega (2009) who found that during the 15th Mediterranean Games women used mostly the float serve while men used the power jump serves. Taking into consideration the above, it seems that distinguished differences exist between genders in the use of the serve types. Besides, it is notable that even youth female volleyball teams used float serve more frequently in comparison with the other serve types(Costa et al., 2012). On the contrary, youth male volleyball is characterized by a higher occurrence of powerful jump serves (Costa et al., 2012). Apart from the gender preference for the type of serve used, a crucial factor that mainly concerns the tactics and is related to the individual characteristics and the subsequent actions of the players, is the area from which the serve is carried out (Quiroga et al., 2012). In women, the dominant serve area was found to be the SA1which was chosen mainly by the setters, the opposites and most of the receivers-attackers (56.2%). The SA5 was chosen mainly by the middle-attacker(Maia & Mesquita, 2006). As far as men are concerned, it was found that the area from which the vast majority of their serves were carried out was SA1 while the serve type they opted for was the power jump serve. The next serve area in a hierarchical order was SA5 while the serve type used was mainly the jump float (Stamm et al., 2016). At the high-level volleyball, one of the most important components in serve efficacy is the area where the serve is aimed to (Quiroga et al., 2012).

Research studies indicated that a serve aimed near to the sidelines and baseline (Moreno, Garcia de Alcaraz, Moreno, Molina, & Santos, 2007), increased the likelihood of the reception not going to an acceptable zone for the setting (Alfonso, Esteves, Araujo, Thomas, & Mesquita, 2012). According to Ciuffarella et al. (2013) the areas where most of the serves were aimed, were hierarchically the zones 6, 7, 5, 1 and 8 (by 32.1%, 14.4%, 14.3%, 13.8% and by 13.7%, respectively). Taking all the above into consideration as well as the evolution of volleyball, it is a common belief that the knowledge of the differences that distinguish male and female players would be a useful tool for the coaches so that they can improve the effectiveness of the technical and tactical skills of their team and help them to analyze and assess serve execution as well as serve performance in each gender of competition.Therefore, the purpose of this study was to analyze the technical-tactical performance profile of the serve through the investigation of the areas from which the serves performed by elite volleyball players were carried out, the zones into where they were directed and their performance in respect to the serve type used per gender.

Materials and Methods

Procedure

A three-member group of experienced coaches assessed 3507 serves that were carried out by male and female volleyball players (M=1658, F=1849) during 20 volleyball games (M=10, F=10) of National Teams competing in the final phase of World League 2018. Intra-rater and inter-rater reliability coefficients were found to be r=0.983 and r=0.984, respectively, indicating very high consistency in the assessment procedure.

The analyzed variables comprised the serve type, the gender area from which the serve was carried out, the serve direction and the degree of the serve performance. For the evaluation of the serve type, the proposal of Callejon Lirola (2006) was adopted. As such, three categories were established: a) the jump spin power serve (implies ball rotation, PJS), b) the jump float serve (without ball rotation, FJS), c) the overhead float serve (without ball rotation and jumping, FS) d. The serving area, defined as the area from which the serve is carried out, covers a 9-metre wide space located behind the baseline of the court and as an extension to the side-lines, differentiates three areas of origin: a) the serving area 1 (SA1, behind zone 1), b) the serving area 6 (SA6, behind zone 6) and c) the serving area 5 (SA5, behind zone 5), as proposed by Fernandez-Echeverria, Gil, Moreno, Claver, Moreno (2015). For the evaluation of the serve direction, the defensive court was divided into 10 zones as proposed by Ciuffarella et al. (2013).

However, data analysis did not include any serves that were assessed with performance score 0 (zone 10; 507 actions), since the ball was not directed into the court. For the evaluation of the grade of the quality of the serve performance (SQG), the coaches were asked to observe and categorize the serve quality according to the 5-level tactical rating scale proposed by Eom and Schutz (1992), which quantifies the effectiveness of skill performance within a range of points from 0 to 4.

Statistical Analysis

The test of independence for the categorical variables “gender” and “serve area” for each one of the 3 levels of the variable “serve type” was carried out using the Chi-square test (X^2) and Fisher’s exact test (implemented with the statistical package SPSS v. 17). Following the overall independence test, we tested the difference in proportions between men and women, within each level of the “serve zone” variable for each one of the 3 levels of the variable “serve type” (test of proportion differences based on the normal distribution) using the statistical package Statgraphics Plus v. 5.1. The same procedure was followed for the variables: “gender” and “serve direction”, “gender” and “serve performance”.

Results

Serving area choices of elite male and female players in relation to the serve types

Men carried out 1658 serve actions, in total. Of these, 75.4% were PJS, 24.4% were FJS and only 0.2% was FS. Irrespective of the serve type used, 56.6% of the total serves were carried out from the SA1, 29% from the SA5 and 14.5% from the SA6. On the other hand, women carried out 1849 serve actions, in total. Of these, 93.3% were FJS, 4.9% were PJS and only 1.8% were FS. Irrespective of the serve type used, 48.4% of the total serves were carried out from the SA1, 46.6% from the SA5 and 5% from the SA6. The statistical analysis showed a significant relation (p-value <0.05, X^2 Test) between genders and serve areas in each one of the 3 levels of the variable "serve type"(Table 1).Moreover, after testing the difference in proportions of the serve area between genders, within each level of the "serve type" variable it was found thatwomen carried out a statistically significantly higher proportion of both PJS and FJS from SA1 (p value=0.05 and pvalue<0.001, respectively) compared to men (78% vs 68.3% and 47.7% vs 20.2%, respectively) while the latter carried out higher proportion of FJS from SA5 (p value<0.001) compared to females (72.3% vs 46.9%, respectively),

In total, irrespective of the "serve type" used, men carried out a statistically significantly higher proportion (p value<0.001) of serves from SA1 and SA6 compared to women (56.6% vs 48.4% and 14.5% vs 5%, respectively) while the latter carried out a higher proportion from SA5 (p value<0.001) compared to their male counterparts (46.6% vs 29%, respectively).

Table 1. Serving area choices of elite male and female players in relation to the serve type.

Serve type	Gender	Serving area			X^2
		1	5	6	Value
		% (N)	% (N)	% (N)	Sig.
PJS	Men	68.3% (854)	14.9% (186)	16.8% (210)	19.228
	Women	78% (71)	22% (20)	0.0% (0)	0.001
	Z	-1.93	-1.81	-	
	P	0.05	0.07	-	
FJS	Men	20.2% (82)	72.3% (293)	7.4% (30)	101.585
	Women	47.7% (823)	46.9% (809)	5.4% (93)	0.001
	Z	-10.1	9.21	1.55	
	P≤	0.000	0.001	ns	
FS	Men	66.7% (2)	33.3% (1)	0.0% (0)	23.294
	Women	0.0% (0)	100% (33)	0.0% (0)	0.001
	Z	-	1.19	-0.14	
	P	-	ns	ns	
Sum	Men	56.6% (938)	29% (480)	14.5% (240)	
	Women	48.4% (894)	46.6% (862)	5% (93)	
	Z	4.85	-10.7	9.58	
	P≤	0.001	0.001	0.001	

Men: N= 1658 (100%), Women: N= 1849 (100%)

Serve direction zones of elite male and female players in relation to the serve type.

The analysis of the data did not include any serves that were assessed with performance score 0 (zone 10; 507 actions) since the ball was not directed into the court. As a consequence, men carried out 1337 serve actions while women 1663, in total.

The statistical analysis showed a significant relation (pvalue <0.05, Fisher's Exact Test) between genders and serve direction zones in the two of the three levels of the variable "serve type"(PJS, FJS; Table 2). Moreover, it showed that both genders directed the highest proportion of PJS into zone 6 (Men: 40.3%, Women: 33.8%).

However, after testing the difference in proportions of the serve direction zone between genders, within each level of the "serve type" variable it was found males directed a statistically significantly higher proportion of PJS into zone 5 (p value=0.03) and lower into zone 8 (p value<0.001) compared to females (26.4% vs 14.9%, and 3.8% vs 13.5%, respectively).

With regard to FJS,both genders directed the highest proportion of serves into zone 7 (Men: 33.2%, Women: 35%). However, males directed a statistically significantly higher proportion of FJS into zones 9 and 8 (p value=0.003 and pvalue=0.001) compared to females (17.7% vs 11.9%, and 23.2% vs 16.1%, respectively). In total, irrespective of the "serve type" used, men directed a statistically significantly higher proportion of serves

into zones 1 and 5 (p value<0.001) compared to women (14.8% and 21.8% vs 7.5% and 15.1%, respectively) while the latter directed higher proportion into zones 9, 8 and 7 (p value<0.001) compared to their male counterparts (12%, 15.9 and 33.6 vs 8.3%, 9.3% and 11.9%, respectively).

Table 2.Serve direction zones percentage (%) of elite male and female players in relation to the serve type.

ST	R		Serve direction 1	2	3	4	5	6	7	8	9	Fisher's Exact Test Value Sig.
PJS	M	%	18.8	0.5	0.9	0.6	26.4	40.3	3.8	3.8	4.8	22.181
		N	182	5	9	6	256	390	37	37	46	
	W	%	18.9	0.0	2.7	0.0	14.9	33.8	8.1	13.5	8.1	0.003
		N	14	0	2	0	11	25	6	10	6	
	Z		-0.02	-	-1.5	-	2.18	1.1	-1.8	-3.88	-1.25	
	P≤		ns	-	ns	-	0.03	ns	0.07	0.001	ns	
FJS	M	%	4.4	0.3	0.0	1.1	9.5	10.6	33.2	23.2	17.7	30.927
		N	16	1	0	4	35	39	122	85	65	
	W	%	6.9	0.1	0.5	0.6	15.2	13.7	35	16.1	11.9	0.001
		N	107	2	8	10	237	213	545	251	186	
	Z		-1.78	0.93	-	1.04	-2.82	-1.58	-0.065	3.22	2.97	
	P≤		0.08	ns	-	ns	0.005	ns	ns	0.001	0.003	
FS	M	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	6.904
		N	0	0	0	0	0	0	0	2	0	
	W	%	13.3	0.0	0.0	3.3	10	13.3	23.3	13.3	23.3	0.165
		N	4	0	0	1	3	4	7	4	7	
	Z		-	-	-	-0.78	-	-	-	-0.13	-	
	P		-	-	-	-	-	-	-	ns	-	
Sum	M	%	14.8	0.4	0.7	0.75	21.8	32.1	11.9	9.3	8.3	
		N	198	6	9	10	291	429	159	124	111	
	W	%	7.5	0.1	0.6	0.7	15.1	14.6	33.6	15.9	12	
		N	125	2	10	11	251	242	558	265	199	
	Z		6.41	1.69	0.34	0.0	4.74	11.4	-13.8	-5.35	-3.31	
	P≤		0.001	ns	ns	ns	0.001	0.001	0.001	0.001	0.001	

ST: Serve type,GDR: Gender, M: Men (N= 1337), W: Women (N= 1663)

Serve performance of elite male and female players in relation to the serve type.

The analysis of the data included 3507 serve actions in total. Of these, 1658 serves were carried out by the men and 1849 by the women.

The statistical analysis showed a significant relation (p-value <0.05, X^2 Test) between genders and serve performance in one (PJS) of the 3 levels of the variable "serve type" (Table **3**). Moreover, after testing the difference in proportions of the serve performance between genders, within each level of the "serve type" variable it was found that men carried out a higher proportion of PJS which were evaluated with the SQG3 (p value=0.009) compared to women (20% vs 8.8%, respectively).

The latter carried out a higher proportion of PJS which were evaluated with the SQG2 (p value=0.07) compared to men (40.7% vs 31.6%, respectively). In total, irrespective of the serve type used, men carried out higher proportion of serves which were evaluated with the SQG0 (p value<0.001) compared to women (19.4% vs 10.1%, respectively) while the latter carried out a higher proportion of serves which were evaluated with the SQG1 and SQG2 (p value<0.001 and p value=0.004, respectively) compared to their male counterparts (27% vs 21.2% and 37.5% vs 32.8%, respectively).

Table 3.Serve performance of elite male and female players in relation to the serve type.

Servetype	Gender	Serve quality grade					X^2
		0	1	2	3	4	Value
		% (N)	% (N)	% (N)	% (N)	% (N)	Sig.
PJS	Men	22.6 (282)	18.3 (229)	31.6 (395)	20 (250)	7.4 (93)	10.726
	Women	18.7 (17)	19.8 (18)	40.7(37)	8.8 (8)	12.1 (11)	0.03
	Z	0.86	-0.36	-1.79	2.61	-1.62	
	P	ns	ns	0.07	0.009	ns	
FJS	Men	9.4 (38)	30.1 (122)	36.8 (149)	19.8 (80)	4 (16)	1.915
	Women	9.6 (166)	27.6 (476)	37.1 (640)	20.5 (353)	5.2 (90)	0.751
	Z	-0.12	1.01	-0.11	-0.31	-0.99	
	P	ns	ns	ns	ns	ns	
FS	Men	33.3 (1)	33.3 (1)	0.0 (0)	33.3 (1)	0.0 (0)	5.661*
	Women	9.1 (3)	15.2 (5)	51.5 (17)	21.2 (7)	3 (1)	0.209
	Z	1.28	0.8	-	0.48	-	
	P	ns	ns	-	ns	-	
Sum	Men	19.4 (321)	21.2 (352)	32.8 (544)	20 (332)	6.6 (109)	
	Women	10.1 (186)	27 (499)	37.5 (694)	19.9 (368)	5.5 (102)	
	Z	7.81	-3.99	-2.91	0.07	1.37	
	P≤	0.001	0.001	0.004	ns	ns	

* Fisher's Exact Test value, Serve quality grade: (0: error, 1: moderate, 2: good, 3: very good, 4: excellent), Men: N= 1658 (100%), Women: N= 1849 (100%).

Discussion

The purpose of this study was to investigate the areas from which the serves performed by elite volleyball players were carried out, the zones into where they were directed and their performance in respect to the serve type used per gender. Regarding the serving areas, the analysis of the data showed that irrespective of the serve type used the men carried out a higher proportion of serves from the SA1 and SA6 and lower proportion from the SA5 in comparison with their women counterparts. This may be because men were carried out the highest proportion of their serve actions (56.5%) from the SA1 while the women used for their serves almost equally the SA1 and the SA5 (48.4% and 44.8%, respectively). Besides, the above seem to be partially in line with the results of recent studies who found that almost 50% of the men's serves were carried out from the SA1 (Stamm et al. 2016) while only a minor percentage of the women's serves was executed from the SA6 (Quiroga et al. 2012). Taking into account the serve type used by the players, the current study showed that women carried out a higher proportion of PJS and FJS from SA1 and lower from SA5 compared to men. A possible explanation could rely on the fact that men carried out their serves from all the serve areas in a more balanced manner than women. Indeed, although the 56.5% of their serves werecarried out from the SA1 the rest of them were executed from the SA6 (15%) and the SA5 (28.9%) confirming the results of previous studies (Stamm et al. 2016). On the other hand, women used for their serve actions mainly the SA1 (48.4%) and the SA5 (44.8%) while only a minor percentage of their serves (5%) was carried out from the SA6. As regards to the serve direction in respect of the serve type used per gender, the results showed that the dominant zone into which both men and women directed their PJS and FJS were the zones 6 and 7, respectively.

This may be since most of the men's serves were PJS (72.4%) which due to the height of the net and the distance from the execution point were mainly directed to the central back part of the court (Ciuffarella et al. 2013) i.e., zone 6. In conjunction with the above, another possible explanation could rely on the intention of both genders to avoid the libero or/and the risk of failure which is higher after the time-outs and at the end of the set especially when the score is balanced(Marcelino, Sampaio, & Mesquita, 2012). On the other hand, the FJS which are considered tactical serves with an intermediate risk of failure (Garcia-Tormo, Vaquera Jimenez, & Morante Rabago, 2015) was mainly directed to zone 7 possibly because of both genders' intention to harden the reception and then the attack of the opponent receiver-attacker of the offensive zone. More specifically the current study showed that when executing PJS the men directed their serves into the left-back part of the opponent courtmore frequently compared to their women counterparts who aimed more frequently at the middle part of the court i.e., zone 8. This may be due to the difference of the net height between genders (men: 2.43, women: 2.24) which in the case of the men favors the direction of their serves into the back part of the court or even to their intention to increase the frequency of not permitting the opposite team to attack as well as to achieve direct points or free-balls (Valhondo, Fernandez-Echeverria, Gonzalez-Silva, Claver, & Moreno, 2018). On the other hand, this study

found that when executing FJS, the women directed their serves into the left-back part of the opponent court (i.e., zone 5) more frequently compared to men. However, this may be due to the difference in the number of observations in favor of women (1559 vs 367) or to their intention to harden the attack of the opposing team since after the reception the receiver attacker of the offensive zone should cover a longer distance in order take part in her team offence.

On the contrary, men directed their FJS into the zones 7 and 8 more frequently in comparison to women possibly because they tried to harden the attack combinations of the middle and the receiver attacker of the offensive and/or the defensive zone as well. Besides, it is shown that under excellent setting conditions male setters distribute their settings in a balanced manner, taking advantage of not only the entire length of the net but also all the attacking possibilities of their team. As a consequence, a remarkable percentage of their setting actions is found to carry out to the middle of the net and position 6(Barzouka, 2018; Sotiropoulos, Barzouka, Tsavdaroglou, & Malousaris, 2019). Concerning the serve performance in respect of its type, it was found that the majority of the serves that were carried out by both genders were evaluated with the SQG2as they made it difficult for the setter of the opposing team to organize the game. However, it was also notable that the serve proportion evaluated with the SQG0 and SQG4 was found to be higher after carrying out the PJS instead of the FJS. This is in line with the results of previous studies which stated that PJS isappropriate for achieving direct points but involves a high risk of error (Palao et al. 2009;Quiroga et al. 2010; Ciuffarella et al. 2013; Garcia Tormo et al. 2015; Stamm et al. 2016). Another interesting finding of the current study was the lower proportion of effectiveness (GQR4) which was shown by the men concerning the women when both of them carried out PJS (7.4% vs 12.1%). This may be due to the higher risk taken by the men or even to the large number of PJS carried out by them (1249 vs 91).

Additionally, it was also notable that men showed a higher proportion of PJS which were evaluated with the SQG3 compared to women (20% vs 8.8%). This difference observed between genders seemed to be expanded in respect to the previous decade since during the 2005 Mediterranean Games of Almeria it was found that the PJS which resulted in no opponent attack options (SQG3) wasthe 9.1% for the men and the 8.3% for the women (Palao et al. 2009). This change reflected the evolution of the serve skill and probably the attention given by the men for the performance improvement of the PJS. As for the performance evaluation when men and women carried out FJS it was shown that it was balanced between genders. In total irrespective of the serve type used men showed a higher proportion of serve actions which were evaluated with the SQG0 compared to women who provided more often ideal conditions for the opponent setter in the organization of the game compared to men.

Conclusions

Male volleyball players mainly preferred the PJS while female the FJS. Both genders irrespective of the serve type used chose mainly the SA1 for the execution of their serves. However, men used the SA5 for the execution of their FJS more frequently compared to women who preferred the SA1 for the execution of both the PJS and the FJS as well. Women directed the PJS into the central part of the court and the FJS into zone 5 more frequently than men. On the other hand, men directed the PJS into zone 5, the FJS into zones 7 and 8 and made more mistakes than women. Moreover, they presented a higher proportion of PJS which directed into zone 5 and evaluated with SQG3 compared to women. In addition, irrespective of the serve type they made more errors than women who created more often ideal conditions for the opponent setter to organize the game. In the future it is proposed that a similar study should be carried out taking into consideration different game and age levels.

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