

Spatiotemporal analysis of setting per game complex and team rotation in junior volleyball

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Abstract

Introduction. In volleyball, setting is a critical skill from a technical and tactical point of view, as it affects attack directly: the better the quality of the setter's performance, the more excellent attack actions are carried out by men and women attackers. **Aim of Study.** This study aimed to assess the spatial and temporal characteristics of the setting choices made by junior male volleyball setters and their performance concerning the game complex per match rotation. **Material and Methods.** A three-member group of experienced coaches assessed the setting zones choices, the setting tempo, and the performance of junior male setters from 20 volleyball games of teams competing in the final phase of the 2016 Greek Junior Championship. A five-level ordinal scale was used to evaluate the setting. The test of independence for the categorical variables was carried out using the chi-square test (χ^2). Following the overall independence test, the difference in proportions among all levels of variables was tested. **Results.** Results showed that zone 4 was the junior setters' first choice irrespective of the game complex. More detailed, in Complex II, the most preferable setting zones were 4 and 6, while zone 3 was the primary selection in Complex I. The setting in the first tempo was the most favorite option in Complex I, although second slow tempo was the most frequently used setting option in Complex II. As for the quality of the setting, the dominant value for both complexes was quality level 2. **Conclusions.** In conclusion, the junior male setters directed the ball mainly to position 4 by using the slow 2nd tempo settings irrespective of the game rotation. Moreover, they showed a higher proportion of excellent setting actions and used fast settings (first tempo) more frequently in Complex I than in Complex II.

KEYWORDS: volleyball, juniors, high level, setter's distribution, rotation, tempo of setting, performance analysis.

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Introduction

Volleyball is probably one of the most popular sports in the world [20]. Therefore, numerous studies have investigated the players' performance to determine the factors that result in improving the effectiveness of training and, consequently, competition. Among those factors, setting is considered to determine the next action's efficacy and, up to a certain level, the final result of the game [6, 18, 21]. Indeed, setting is an essential action in volleyball, not only from the technical point of view but also from the tactical one, as it affects the attack, with the setter being the specialist player who is responsible for organizing the game [6, 21]. The setter is the player that makes the majority of tactical decisions as he or she is responsible for deciding where the ball is to be passed. The setter has to evaluate the limitations encountered concerning the context of the game seeking his or her action to impair the attack-defense of the opposite team [2]. According to Bergeles, Barzouka, & Nikolaidou [5], the higher performance of the setter leads to the higher performance of the attackers. More specifically, the percentages of excellent attack actions carried out by

men and women attackers got higher as the quality of the setters' performance got higher.

One of the characteristics of volleyball that distinguishes it from the rest of the team sports is that all players have to pass through all positions of the court and, as a consequence, to adapt in the execution of their skills concerning each position [17]. According to Silva et al. [22], each team has six "teams" that correspond to the six-game rotations since in each rotation the positions, functions, and relations between players are different. The above mentioned cyclic and sequential nature of volleyball [26] results in two major game complexes: the side out complex (CI) and the defense complex (CII) [5]. CI entails organizing the attack [2] and is comprised of the receiving, setting, and attacking actions as well as the attack coverage [21]. The main objective of CI is to neutralize the rival's serve and to employ an offensive organization [19] to gain possession of the serve [16]. CII is known as the defense complex defined as the situation where the opposing team will perform the actions of serve, block, floor defense, set, and counter-attack in sequential order. In CII, the ball does not reach the setter in the best conditions [7, 11]. Consequently, the setting tempo is slow (i.e. 2nd and 3rd tempo) and setting is mostly carried out at the edges of the net [11]. Regardless of the previous action efficacy, high-level setters can achieve optimum sets under difficult circumstances [19, 27]. This results in the setters being able to diversify the attack of their teams, producing a high variability of their setting actions [12] concerning their spatial or/and their temporal characteristics. Besides, the attack tempo is considered to be a crucial variable when analyzing the relationship between attack and defense [14]. Recent studies revealed that in CI the elite male setters used mainly quick setting actions [8]. Although zone 4 was their first choice, their distribution strategy included all setting zones [4, 24]. This variability caused the teams to be less predictable in the attack, destabilizing the opposing block in this way [14].

What is worth mentioning about the relevant literature is that the majority of the related studies have analyzed the players' and team's performance in several adult high-level volleyball tournaments while there is limited research in younger age groups. Taking into account that physical characteristics and skill level of junior male players may not be as well developed as in the adults, the lack of specific information about setting may produce misleading effects on the training and competition evaluation in junior men's volleyball teams. That is the reason why it could be of interest to analyze the skill of setting in junior teams.

Aim of Study

The present study aimed to assess the spatial and temporal characteristics of the setting choices made by junior male volleyball setters and their performance concerning the game complex per match rotation.

Material and Methods

A three-member group of experienced coaches assessed the setting zones' choices as well as the setting tempo and the performance of junior male setters from 20 volleyball games of teams competing in the final phase of the 2016 Greek Junior Championship. Firstly, the coaches were asked to observe and categorize the setting quality according to the 5-level tactical rating scale proposed by Eom and Schutz [9], which quantifies the effectiveness of skill performance within a range of points from 0 to 4. Secondly, the coaches were asked to observe and categorize the setting choices according to the consequent attacking area, i.e. to zones 1, 2, 3, 4, 5, 6, and the setting tempo. The tempo of setting is defined as the combination of two variables: the moment when the setter contacts the ball and the start of the attacker approach. The categories are: tempo 1 (the attacker jumps simultaneously or before the setter touches the ball), tempo 2 fast (the attacker starts the approach when the ball leaves the setter's hands), tempo 2 slow (the attacker starts the approach when the ball reaches the first half of its upward trajectory after leaving the setter's hands), tempo 3 (the attacker starts the approach when the ball reaches the highest point of its trajectory after leaving the setter's hands).

The sample for this analysis consists of 2827 setting actions (Complex I = 1930, Complex II = 897). 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 test of independence for the categorical variables "game complex" and "setting zone" was carried out using the χ^2 test for each one of the six levels of the variable game rotation (implemented with the statistical package SPSS v. 17). Following the overall independence test, we tested the difference in proportions between the two-game complexes for each level of the "setting zone" variable in each one of the six levels of the variable "game rotation" (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 "game complex" and "setting tempo" as well as for the variables "game complex" and "setting performance".

Results

Setting zone choices of junior setters in relation to game complex per game rotation

The statistical analysis showed that there was a statistically significant relationship (χ^2 test, p-value < 0.05) between

the game complex and setting zone in 4 of 6 game rotations (Table 1). Moreover, after testing the difference in proportions of the setting zone between game complexes within each level of the “game rotation” variable, it was found that 1) in rotation 1, junior setters in CI carried out a significantly higher

Table 1. Setting zone choices per game complex and rotation

R	C	Setting zones						χ^2
		1	2	3	4	5	6	Value
		% (N)	% (N)	% (N)	% (N)	% (N)	% (N)	Sig.
1	CI	7.5 (25)	27.2 (91)	22.1 (74)	39.4 (132)	0.0 (0)	3.9 (13)	21.423
	CII	9.6 (16)	16.2 (27)	12 (20)	54.5 (91)	0.0 (0)	7.8 (13)	0.001
	Z	-0.81	2.74	2.73	-3.21		-1.85	
	P	ns	0.006	0.006	0.001		0.06	
2	CI	7.3 (21)	20.4 (59)	19 (55)	50.9 (147)	0.0 (0)	2.4 (7)	8.655
	CII	4.5 (6)	18.8 (25)	17.3 (23)	51.1 (68)	0.0 (0)	8.3 (11)	0.07
	Z	1.09	0.38	0.42	-0.04		-2.79	
	P	ns	ns	ns	ns		0.005	
3	CI	8.1 (22)	19.6 (53)	20 (54)	48.5 (131)	0.0 (0)	3.7 (10)	7.967
	CII	3.7 (4)	21.1 (23)	11 (12)	59.6 (65)	0.0 (0)	4.6 (5)	0.093
	Z	1.54	-0.33	2.09	-1.96		-0.41	
	P	ns	ns	0.04	0.05		ns	
4	CI	9.7 (31)	17.9 (57)	22 (70)	47.2 (150)	0.0 (0)	3.1 (10)	15.081
	CII	9.4 (12)	17.3 (22)	8.7 (11)	56.7 (72)	0.0 (0)	7.9 (10)	0.005
	Z	0.09	0.15	3.28	-1.81		-2.21	
	P \leq	ns	ns	0.001	ns		0.03	
5	CI	9.2 (32)	18.4 (64)	20.4 (71)	48.3 (168)	0.0 (0)	3.7 (13)	15.844
	CII	8.2 (14)	17.1 (29)	8.8 (15)	57.6 (98)	0.0 (0)	8.2 (14)	0.003
	Z	0.37	0.36	3.33	-1.99		-2.17	
	P \leq	ns	ns	0.001	0.05		0.03	
6	CI	7 (26)	24.3 (90)	20 (74)	45.7 (169)	0.0 (0)	3 (11)	26.901
	CII	6.8 (13)	17.8 (34)	9.4 (18)	55.5 (106)	0.5 (1)	9.9 (19)	0.001
	Z	0.09	1.76	3.21	-2.2		-3.44	
	P \leq	ns	0.08	0.001	0.03		0.001	
Sum	CI	8.1 (157)	21.5 (414)	20.6 (398)	46.5 (897)	0.0 (0)	3.3 (64)	
	CII	7.2 (65)	17.8 (160)	11 (99)	55.7 (500)	0.1 (1)	8 (72)	
	Z	0.83	2.27	6.24	-4.55		-5.45	
	P \leq	ns	0.02	0.001	0.001		0.001	

Note: C – game complex, R – game rotation

proportion of setting (p-value < 0.05) to zones 2 and 3 (27.2% and 22.1%) in comparison to CII (16.2% and 12%), while they carried out a significantly higher proportion of setting (p-value = 0.001) to zone 4 during CII than during CI (54.5% vs 39.4%), 2) in rotation 2, junior setters in CII carried out a significantly higher proportion of setting (p-value = 0.005) to zone 6 (8.3%) compared to CI (2.4%), 3) in rotation 3, junior setters performed a significantly higher proportion of setting to zone 3 in CI (20%) compared to 11% in CII (p-value < 0.05) and a lower proportion of setting to zone 4 (48.5%) compared to 59.6% in CII (p-value = 0.05), 4) in rotation 4, junior setters performed a significantly higher proportion of setting to zone 3 in CI (22%) compared to 8.7% in CII (p-value = 0.001) and a lower proportion of setting to zone 6 (3.1%) compared to 7.9% in CII (p-value < 0.05), 5) in rotation 5, junior setters performed a significantly higher proportion of setting to zone 3 in CI (20.4%) instead of 8.8% in CII (p-value < 0.05), while they performed a lower proportion setting to zone 4 (48.3%) and zone 6 (3.7%) compared to 57.6% and 8.2%, respectively, in CII (p-value ≤ 0.05), and 6) in rotation 6, junior setters performed a statistically significantly higher proportion of setting to zone 3 in CI (20%) instead of 9.4% in CII (p-value = 0.001), while they performed a lower proportion setting to zone 4 (45.7%) and zone 6 (3.0%) compared to 55.5% and 9.9%, respectively, in CII (p-value ≤ 0.05).

In total, irrespective of the “game rotation”, junior setters in CI carried out a statistically significantly higher proportion (p-value < 0.05) of setting to zones 2 and 3 compared to CII (21.5% vs 17.8% and 20.6% vs 11%), while in CII they carried out a statistically significantly higher proportion (p-value = 0.001) of setting to zones 4 and 6 compared to CI (55.7% vs 46.5% and 8% vs 3.3%).

Tempo of setting of juniors setters in relation to the game complex per game rotation

The statistical analysis showed that there is a statistically significant relationship (χ^2 test, p-value < 0.05) between game complex and setting tempo in 5 of the 6 game rotations (Table 2). Furthermore, after testing the difference in proportions of the setting tempo between game complexes, within each level of the “game rotation” variable it was found that: (a) in rotation 2, statistical analysis did not show a significant relation between game complexes and setting tempo, (b) in rotations 1, 3, 4, 5 and 6, junior setters in CI carried out a significantly higher proportion of setting 1st tempo (21.5%, 20%, 21.7%, 19.5%, and 19.5%) compared to 12%, 11%, 8.7%, 8.8%, and 9.4%, respectively, in CII (p-value < 0.05) and

(c) in rotations 1, 3, 4, 5 and 6, junior setters in CII carried out a statistically significantly higher proportion of setting 2nd slow tempo (84.4%, 86.2%, 85.8%, 85.3%, and 83.2%) compared to 71.9%, 72.6%, 71.7%, 74.7%, and 72.7%, respectively in CI (p-value < 0.05).

Table 2. Setting tempo per game complex and rotation

R	C	Setting tempo				χ^2
		1st % (N)	2nd fast % (N)	2nd slow % (N)	3rd % (N)	Value Sig.
1	CI	21.5 (72)	0.3 (1)	71.9 (241)	6.3 (21)	10.352
	CII	12 (20)	0.6 (1)	84.4 (141)	3 (5)	0.016
	Z	2.59	-0.5	-3.09	1.57	
	P	0.009	ns	0.002	ns	
2	CI	18.3 (53)	0.7 (2)	73 (211)	8 (23)	2.879
	CII	17.3 (23)	0.0 (0)	78.2 (104)	4.5 (6)	0.411
	Z	0.25	-	-1.14	1.32	
	P	ns	ns	ns	ns	
3	CI	20 (54)	0.7 (2)	72.6 (196)	6.7 (18)	8.449
	CII	11 (12)	0.0 (0)	86.2 (94)	2.8 (3)	0.038
	Z	2.09	-	-2.83	1.5	
	P	0.04	ns	0.005	ns	
4	CI	21.7 (69)	0.6 (2)	71.7 (228)	6 (19)	11.258
	CII	8.7 (11)	0.8 (1)	85.8 (109)	4.7 (6)	0.010
	Z	3.22	-0.23	-3.13	0.54	
	P	0.001	ns	0.002	ns	
5	CI	19.5 (68)	0.9 (3)	74.7 (260)	4.9 (17)	9.971
	CII	8.8 (15)	0.6 (1)	85.3 (145)	5.3 (9)	0.019
	Z	3.12	0.36	-2.74	-0.2	
	P	0.002	ns	0.006	ns	
6	CI	19.5 (72)	1.1 (4)	72.7 (269)	6.8 (25)	9.788
	CII	9.4 (18)	1 (2)	83.2 (159)	6.3 (12)	0.020
	Z	3.08	0.11	-2.77	0.23	
	P	0.002	ns	0.006	ns	
Sum	CI	20.1 (388)	0.7 (14)	72.8 (1405)	6.4 (123)	
	CII	11 (99)	0.6 (5)	83.8 (752)	4.6 (41)	
	Z	5.96	0.304	-6.4	0.23	
	P≤	0.001	ns	0.001	ns	

Note: C – game complex, R – game rotation

In total, irrespective of the “game rotation”, junior setters in CI carried out a statistically significantly higher proportion (p-value = 0.001) of setting 1st tempo compared to CII (20.1% vs 11%), while in CII they carried out a statistically significantly higher proportion (p-value = 0.001) of setting 2nd slow tempo compared to CI (83.8% vs 72.8%).

Setting performance of junior setters in relation to game complex per game rotation

The statistical analysis showed that there is a statistically significant relationship (χ^2 test, p-value < 0.05) between game complex and setting performance in 2 of 6 game rotations (Table 3). Besides, after testing the difference in proportions of the setting performance between

Table 3. Setting performance per complex and rotation

R	C	Setting performance					χ^2
		0	1	2	3	4	Value
		% (N)	% (N)	% (N)	% (N)	% (N)	Sig.
1	CI	2.7 (9)	6.3 (21)	41.8 (140)	17.3 (58)	31.9 (107)	4.199
	CII	1.8 (3)	3.6 (6)	43.7 (73)	22.8 (38)	28.1 (47)	
	Z	0.62	1.26	-0.41	-1.48	0.87	
	P	ns	ns	ns	ns	ns	
2	CI	3.5 (10)	8 (23)	42.9 (124)	19.7 (57)	26 (75)	3.777
	CII	3.8 (5)	5.3 (7)	36.8 (49)	20.3 (27)	33.8 (45)	
	Z	-0.15	1.00	1.18	-0.14	-1.65	
	P	ns	ns	ns	ns	ns	
3	CI	1.5 (4)	7.4 (20)	46.3 (125)	19.3 (52)	25.6 (69)	11.007
	CII	5.5 (6)	2.8 (3)	44 (48)	27.5 (30)	20.2 (22)	
	Z	-2.19	1.7	0.41	-1.75	1.11	
	P	0.03	ns	ns	0.08	ns	
4	CI	2.8 (9)	5.7 (18)	44.7 (142)	17.9 (57)	28.9 (92)	1.692
	CII	2.4 (3)	7.1 (9)	46.5 (59)	20.5 (26)	23.6 (30)	
	Z	0.23	-0.34	-0.34	-0.64	1.13	
	P	ns	ns	ns	ns	ns	
5	CI	1.1 (4)	6.6 (23)	43.7 (152)	23.3 (81)	25.3 (88)	1.544
	CII	0.6 (1)	5.9 (10)	48.2 (82)	20 (34)	25.3 (43)	
	Z	0.55	0.31	-0.97	0.85	0.0	
	P	ns	ns	ns	ns	ns	
6	CI	1.4 (5)	9.7 (36)	44.3 (164)	19.7 (73)	24.9 (95)	9.914
	CII	2.1 (4)	6.8 (13)	39.3 (75)	30.9 (59)	20.9 (40)	
	Z	-0.62	1.15	1.13	-2.96	1.06	
	P	ns	ns	ns	0.003	ns	
Sum	CI	2.1 (41)	7.3 (141)	43.9 (847)	19.6 (378)	27.1 (523)	
	CII	2.5 (22)	5.4 (48)	43 (386)	23.9 (214)	25.3 (227)	
	Z	-0.67	1.88	0.45	-2.61	1.01	
	P	ns	ns	ns	0.009	ns	

Note: C – game complex, R – game rotation

game complexes within each game rotation, it was found that in rotation 3 junior setters in CII carried out a statistically significantly higher proportion of setting errors evaluated by 0 (5.5%) compared to 1.5% in CI (p-value=0.03), while in rotation 3, they performed in CII a statistically significantly higher proportion of setting with quality grade 3 (27.5%) instead of 19.3% in CI (p-value = 0.003). In total, irrespective of the “game rotation”, junior setters in CII carried out a statistically significantly higher proportion (p-value<0.05) of setting with quality grade 3 compared to CI (23.9% vs 19.6%).

Discussion

The purpose of this study was to assess the spatial and temporal characteristics of the setting choices made by junior male volleyball setters and their performance concerning the game complex per match rotation. Our results revealed that irrespective of the game rotation and complex, junior setters’ distribution strategy included most of the setting zones with zone 4 being their first choice. This corroborates the results of previous studies [4, 25] which have found that elite male setters directed their settings mainly to zone 4. The choice of the junior setters could be partially explained by the ability of the left side wing spikers to attack effectively [8, 15] or by the fact that under difficult situations setters very often sent the ball to position 4 [10] in a slower tempo, especially when they have to move outside the ideal setting area [2]. According to Costa et al. [7] in elite youth male volleyball, the serve-reception percentage that resulted in organized attacks was 74.2% of the total. On the contrary, the offensive actions’ percentage that resulted in the continuity of the game was found to be 34.9% of the total while almost half of it (47.1%) did not allow organized counter-attacks. This may explain why the setters of the current study chose the setting to zone 4 more frequently in CII compared to CI. Besides, even adult male setters in difficult situations very often send the ball to position 4 attackers [10], who are characterized as security players because of their ability to attack effectively [15] even when they have to confront a compact double or triple block [3]. This happens especially when the opponent setter is in the attack zone making the block less efficiently.

Another interesting finding of the current study was that irrespective of the game phase (i.e. when the setter was in the attack or the defense zone) the setting distribution to zone 1 was not differentiated between the side out and the transition complex. However, when the setters were in rotations 1 and 6, they sent the ball to zone 2 more frequently in CI compared to CII. An almost

similar differentiation between the two complexes was also seen in the setting distribution to zone 3 in most of the team rotations. This may be because in CI the setters had enough time to concentrate on the carrying out of a more complete tactical plan than in CII. Besides, it is known that in CI the initial conditions are rather stable and predictable since the ball is received from an action that has less contextual interference (i.e. the serve) and is executed far from the net, thus creating favorable conditions to the offensive organization [27]. On the contrary, in CII the attack organization becomes more difficult because the ball comes from the attack, which is executed near the net and with a steeper trajectory [13]. Taking into consideration the aforementioned complex differences regarding the initial conditions that interfere with the attack organization, it would be logical to hypothesize that the highest setting distribution frequency found in the current study towards zone 6 did not rely upon a predetermined offensive tactical plan but on the restrictions imposed by the previous action. This seems to be quite different in the case of elite men setters who were found to send a remarkable percentage of their settings to positions 3 and 6 only in the case of an excellent previous defensive action [23]. However, this discrepancy may be explained by the physical characteristics and the skill level of the junior players which may not have been as well developed as in the case of the elite adult players.

Concerning the attack tempo, this study showed that irrespective of the game complex and team rotation, the setters used mainly the slow 2nd tempo settings but rarely the fast second (0.7%) and the third tempo (5.8%). The latter contradicts partially the results of Costa et al. [7] who found that 34.4% of the attacks which were carried out during the 2007 World Youth Male Championship were 3rd tempo attacks. The above-mentioned discrepancy denoted the tendency of the game to become faster even in the transition phase which is characterized by unpredictable and unstable initial conditions [13]. According to Costa et al. [7] playing fast in the transition phase is decisive in creating favorable conditions for delaying the blocking action of the opponent and thus for increasing the chances of making the point. On the other hand, the same authors stated that in the side-out phase the attack effect is not dependent on its speed since playing fast in this complex is common. However, this study showed that in CI the proportion of the fast settings (1st tempo) carried out by the junior setters was higher compared to CII probably because CI offers more stable conditions for the offensive organization [13].

Concerning the setting performance, most of the setting actions of the junior setters were evaluated as “good” probably because the lack of synchronization between the setter and the attackers allowed the opponent team to form a compact double or even triple block. It is worth mentioning that in CI the proportion of the excellent setting actions in most of the game rotations was higher compared to CII. On the contrary, the proportion of the setting actions which were evaluated as very good were found to be higher in CII than in CI in almost all the game rotations. Additionally, when the setter was in the attack zone and specifically in rotation 3, the proportion of the setting errors was found to be higher in CII than in CI. These differences between complex I and II are associated with worse conditions to perform an organized attack in CII probably due to the first touch difficulties [7, 13]. Besides, the current study showed that the attack tempo, which seemed to be a strong indicator of the offensive organization [1], was faster in CI than in CII.

Conclusions

In conclusion, the junior male setters directed the ball mainly to position 4 by using—irrespective of the game rotation—the slow 2nd tempo settings. Moreover, they showed a higher proportion of excellent setting actions and used fast settings (1st tempo) more frequently in CI than in CII.

Conflicts of Interest

The authors declare no conflict of interest.

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