Original Paper DOI: 10.5604/20831862.1019666 Biol. Sport 2012;29:281-284

VALIDITY OF THE STANDING SPIKE TEST AS A MONITORING PROTOCOL FOR FEMALE VOLLEYBALL PLAYERS

Accepted for publication 24.06.2012

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ABSTRACT: The purpose of this paper was: a) to provide reference values for the standing spike test for female volleyball players and b) to study whether the standing spike test is valid for assessing the theoretical differences between female volleyball players. The sample included 83 players from the first nine teams of the Spanish women's first volleyball division (52 Spanish players and 31 from other nationalities). The variables studied were the ball speed of the standing spike test, the age of the players, the player's role (outside hitter, opposite, middle-blocker, libero, or setter), height, and nationality of the players (Spanish or foreign). The results demonstrate the ranges for the standing spike among female performance volleyball players (70-82 km · h^{-1}). The differences regarding nationality, player role, height, and age seem to indicate that the test is a valid instrument for monitoring the performance of female volleyball players.

KEY WORDS: sport, performance, training, monitoring, volleyball, spike

INTRODUCTION

In volleyball, the spike is one of the actions that are most correlated with the set's result because it is the technique where the most points are awarded [7,10]. The spike's effectiveness depends on several factors, such as the trajectory of the set, opponent positioning (blockers and second row players), the physical and technical abilities of the attacker, etc. From the perspective of technique execution (i.e. biomechanical analysis), the three basic aspects that affect the efficiency of the spike's basic technique are [5,13]: a) hit height, b) speed of the ball, and c) direction.

The spike is usually monitored in training and/or competition due to its importance in a set's outcome. This monitoring attempts to serve as an evaluation of and guide for the training process that is being done and to quantify the work done by the players [2,12]. Of the issues related to technical execution, hit height is indirectly monitored through the jump height (e.g. Bosco test), and ball direction is monitored by observation or scouting (e.g. Datavoley software). However, the speed of the spiked ball is an aspect that is not monitored much in training or competition, despite being a key aspect in its effectiveness, due to reducing the time that blockers and second-line defenders have for carrying out their actions.

In an ideal situation, proposals such as the one by Palao and Valades [9], which assesses progression of the spike, would be adequate for monitoring the spike in practice. However, having the team execute a large number of tests can usually only be done at specific times of the season and only when training and competition allow for it. Another inherent problem is that the execution of these tests increases the physical load (i.e. jumps and hits) of the players. Therefore, it is necessary to use simple tests that can be integrated into training so that monitoring can be performed consistently throughout the season [12]. The present study assesses the possibilities offered by the standing spike test to indirectly monitor spike performance in volleyball players. The theoretical advantages of this test include the following: it is quick and easy test to perform, does not increase jump load, can be performed outside the volleyball court, and is easy to organize and conduct. The test has the following possible disadvantages: not evaluating the real situation, requiring control of technique [9], requiring a radar (for direct measurement) or a camera and specific software (e.g. Kinovea for indirect measurement) to obtain the data, and there are no reference values for this test.

The difficulties of performing specific tests with a large number of performance players during competitive periods is one of the reasons for which there are no reference values for this type of test. Currently it is unknown whether this test is valid for establishing differences between high-performance players (i.e. construct validity). If the test is valid, it should be able to distinguish differences between players who specialize in the spike action (e.g. outside hitters) and non-specialists (e.g. setters) or other aspects related to the performance. The purpose of this paper is: a) to provide reference values for the standing spike test for female volleyball players and b) to study whether the standing spike test is valid for assessing the theoretical differences between female volleyball players.

MATERIALS AND METHODS

The sample included 83 players from the first nine teams of the Spanish women's first volleyball division (52 Spanish players and 31 from other nationalities). Only those players who did it voluntarily, who signed informed consent before testing, and whose coaches allowed them to participate, participated in the study. The average age and height of the players are described in Table 1. A descriptive and correlational study was done. The variables studied were the ball speed of the standing spike test [9], the age of the players, the player's role (outside hitter, opposite, middle-blocker, libero, or setter), height, and nationality of the players (Spanish or foreign).

The measurements were taken during the morning training session before a match (regular phase of the competition). All measurements were taken at the same time of day, in the same place, and after the team's warm-up (jogging, stretching exercises and active joint mobility, ball exercises (attacking without jumping and defence in pairs), and a spike exercise at the net). The order in which players executed the test was decided by the coach of each team. After taking the test, the player continued practising with her team. The test protocol was the one proposed by Palao and Valades [9]. The players self-tossed the ball and they spiked without jumping to the marked area. The execution area and self-toss height were limited to prevent any initial velocity of the ball. The players had both feet in contact with the floor to perform the test, and they had their non-hitting arm slightly forward. They did not change the basic spike technique, they stood in the execution area, and they had 30 seconds between repetitions. Each player had three trials. The maximum speed reached in the test by the player was recorded. A researcher was located laterally to the player to monitor the execution of the test. If some aspect of the execution was incorrect, the test was considered null (e.g. not hitting the ball directly toward the target area). Ball pressure, proper orientation of the radar, and radar calibration were monitored.

The instruments used in the study were a Stalker Radar Pro (Applied Concepts, Inc, Texas, USA), a tripod with a support for a radar, and a Mikasa MVP-200 ball. To monitor external variables and for the measurement protocol, the following were also used: a pressure gauge (Imsport, Spain), a scale with altimeter (Salter 996, Electronic Scale Batron, USA), and a laser pointer (to orientate the radar).

A descriptive analysis and an inferential analysis were performed using SPSS software (IBM, USA). For inferential testing, to establish the existence of differences between the different population strata, the non-parametric Mann-Whitney U test, Spearman correlation, and

TABLE 1. CHARACTERISTICS OF THE SAMPLE'S DIFFERENT POPULATION STRATA

Variable	National [1]	Foreign [1,2]	Total
Age (years)	22.13 ± 3.47	25.84 ± 3.75	23.52 ± 3.99
Height (m)	1.80 ± 0.06	1.86 ± 0.05	1.82 ± 0.07

Note: [1] National players: outside hitter (10), opposite (8), middle-blocker (10), libero (7), or setter (4). Foreign players: outside hitter (10), opposite (5), middle-blocker (14), libero (0), or setter (2).
[2] The players from the foreign strata originated from: Argentina (2), Australia (1), Brazil (5), Canada (1), Cuba (2), Dominic Republic (2), Hungary (1), Italy (1), Mexico (1), Netherlands (2), Peru (2), Poland (1), Romania (1), Slovenia (2), Ukraine (4), and USA (3).

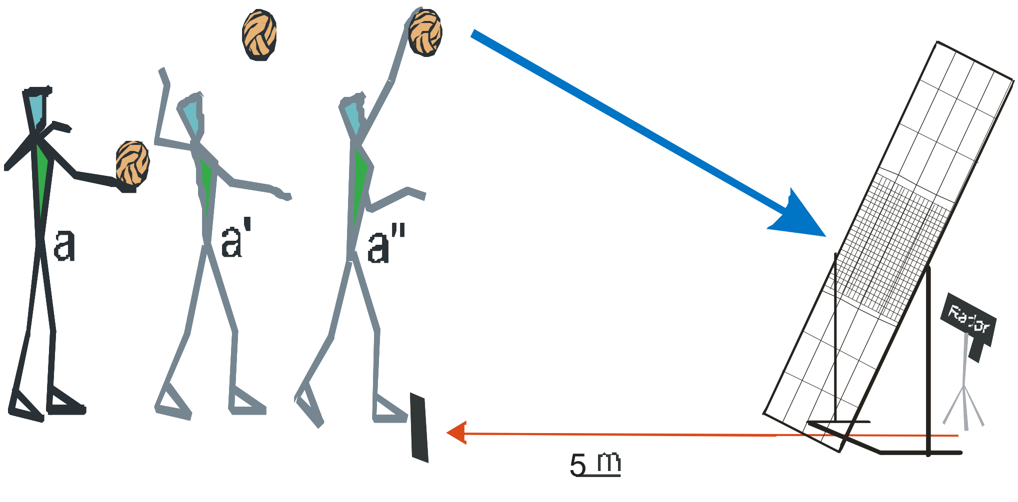

FIG. 1. STANDING SPIKE TEST

ANCOVA were performed. Non-parametric testing was used because the data were quantitative and continuous, and the data were not standardized, compared with a standard normal distribution (Kolmogorov Smirnov normality test).

RESULTS

The results show that average maximum speed values of 76.1 ± 6.0 km·h^{-1}were achieved in the spike without jumping test (Table 2). The foreign players had significantly higher speeds than the national players ($p < 0.001$). The greater the age and height of the players, the higher the speed of the hit ($p < 0.019$ and $p < 0.023$, respectively). The outside hitters (hitters in zone four), opposites, and middle blockers had significantly higher speeds than the setters ($p < 0.009$).

When comparing the national players with foreign players, in the "over 25 yrs" stratum ($p < 0.010$), "middle blocker" stratum ($p < 0.011$), and "outside hitter" stratum ($p < 0.006$), the foreign players had significantly higher speeds than the national players. It was not possible to do the comparison at all the levels because there were no libero players, foreign players under 20 yrs, or players under 1.75 m in the foreign players' strata.

Significant correlations were found between ball speed in the standing spike test and age ($p < 0.027$) and height ($p < 0.001$), using the Spearman correlation. The ANCOVA analysis of the variables studied showed that ball speed depends primarily on the variables "age" ($p < 0.041$, Wald chi-square of 4.156), "nationality" ($p < 0.014$, Wald chi-square of 6.019), and "nationality x height" ($p < 0.002$, Wald chi-square of 12.982).

DISCUSSION

The results demonstrate the ranges for standing spike speed among female performance volleyball players (70-82 km·h^{-1}). In the reviewed literature, reference data for the standing spike test have not been found. When comparing the results with the available information on the spike (with jump), the values found in this population are higher than the data provided by Selinger and Ackerman [13] for the U.S. women' national team (average speed of 62 km·h^{-1}). The results are similar to the spike speed of U.S. college players in the NCAA Division I (average speed of 75.6 km·h^{-1}) [3] and below the results of the China-Taipei national team (average speed of 82.5 km·h^{-1}) [6]. It is necessary to carry out further studies to provide reference values for the standing spike test and the spike test for different levels of performance, different age groups, and men. The absence of this information limits the evaluation of the results obtained by this specific test. The differences found with regard to nationality, player role, height, and player's age seem to indicate that the test is a valid instrument for monitoring the performance of female volleyball players. At this competition level, the incorporation of foreign players into the teams is done with the theoretical goal of increasing the level of the teams and making them more competitive. The foreign players are taller and older (theoretically, more experienced). Thus, in theory, these players should have higher levels than the national players. The differences found show that the test is able to distinguish these population strata. The aim of this study was not to assess the cause of these differences (e.g. anthropometric characteristics, physical abilities, skills, etc.), but rather it was to study whether the standing spike test discriminates the population strata. The differences between the players who specialize in spiking and the ones who do not indicate that the test is valid for differentiating these population strata (player role). These differences have been found regarding physical and technical aspects by other studies [8,11,14]. At the same time, this aspect is confirmed by the differences found with regard to players' age (older players have higher speeds), height (higher speeds at higher player height), and nationality (foreign players had higher speeds). Theoretically, older players have more experience in training and competition, and therefore higher performance.

TABLE 2. AVERAGES OF BALL SPEED IN THE STANDING SPIKE TEST BETWEEN THE DIFFERENT POPULATION STRATA

Variable		n	Speed	p	Differences between population strata
Nationality	National (N)	52	74.4 ± 6.1	<0.001	"National" <"Foreign"
	Foreign (F)	31	79.0 ± 4.7		
Age	Under 20 yrs	15	73.5 ± 5.6	<0.019	"< 20 yrs" < ">25 years"
	20-25 yrs	34	75.5 ± 6.3		
	Over 25 yrs	34	77.9 ± 5.6		
Height	<1.75	16	72.3 ± 5.7	<0.023	"<1.75" < "1.80-1.85, & >1.85"
	1.75-1.79	16	74.9 ± 6.6		
	1.80-1.85	29	76.9 ± 6		
	>1.85	22	78.7 ± 4.5		
Playing position	Setter	16	71.9 ± 5.5	<0.009	"Setter" < "Middle blocker, Opposite, & Outside hitter"
	Opposite	13	78.0 ± 5.8		
	Middle blocker	24	76.9 ± 5.7		
	Outside hitter	23	78.2 ± 5.5		
	Libero	7	73.0 ± 6.1		

Note: Values are mean ± SD; ball speed is expressed in km·h^{-1}; [1] non-parametric Mann-Whitney U test

Volleyball is a sport where the peak performance age is achieved around 26 years [1,4]. Likewise, due to the existence of the net, height is a criterion that determines the spike and its success [16].

CONCLUSIONS

The present study describes the viability of using the standing spike test for indirectly monitoring the spike. This test has sufficient sensitivity to differentiate between the different strata of this population at the performance level (player role, age, height, and player level (national or foreign players). This study provides reference values of the ranges obtained by the players who were analysed. These ranges are applicable only to samples similar to that which was used in this study. It is necessary to execute further studies to examine the relationship between this test (adapted from the technique used in competition) and the real spike action, as well as to monitor the changes in this ability throughout the season. The absence of reference databases for specific tests makes it more difficult to monitor training due to not having external criteria to assess the data.

The standing spike test allows for monitoring the evolution of the physical fitness of the players, and it involves the player more in the process (e.g. providing immediate feedback about their performance). The fact that this test does not involve jumping means that the test can be done by players with lower-body injuries (e.g. ankle or knee). This allows them to stay involved with the team, continue to work on improving upper-body strength (e.g. hitting action) and participate with teammates in team activities.

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