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THE EFFECT OF BLOCK MOVEMENT DONE BY DIFFERENT APPROACHES ON THE HEIGHT OF JUMPS IN VOLLEYBALL

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Abstract. **Aim.** The effect of blocking done by different approaches on the height of jumps was aimed to be determined in our study. **Materials and methods:** 6 female athletes (age 18.83 ± 2,137 years, body-weight 64.83 ± 9,020 kg, height 174.50 ± 7.503 cm, training years 5.33 ± 2.733) of Kocaeli Province Ihsaniye Sports Club participated in the study voluntarily. In determining the performance parameters of the athletes, vertical jumping, sidestep block jumping, and cross-step block jumping tests were performed. The tests were recorded with two Basler 120 FPS cameras and analyzed with the Simi Motion 9.2.0 software. **Results.** As a result of the tests conducted, no significant difference was found between sidestep block jumping and vertical jumping ($p > 0,05$). On the other hand, significant difference was found between cross-step block jumping and sidestep block jumping, and between vertical jumping and cross-step block jumping ($p < 0,05$). Since the best jumping height is achieved with cross-step blocks, going for this block technique in the game will affect the performance of the match and athlete positively. **Conclusions.** As a result, the best jump height was obtained from the block done with cross-step block jumping. Considering that volleyball is a defense game, these increases in the block performance of the players will directly affect the result.

Keywords: block, performance, jumping, volleyball

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ВЛИЯНИЕ РАЗЛИЧНЫХ ВАРИАНТОВ ПЕРЕДВИЖЕНИЯ ПРИ БЛОКИРОВАНИИ МЯЧА НА ВЫСОТУ ПРЫЖКА В ВОЛЕЙБОЛЕ

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Аннотация. **Цель.** Цель настоящего исследования состояла в определении воздействия различных вариантов передвижения при блокировании мяча на высоту прыжка. **Материалы и методы.** В исследовании на добровольной основе приняли участие 6 спортсменок (средний возраст 18,83 ± 2,137 года, средний вес 64,83 ± 9,020 кг, средний рост 174,50 ± 7,503 см, средний стаж занятий

спортом 5,33 ± 2,733 года), занимающихся в спортивной секции провинции Коджаэли. Для определения параметров результативности спортсменов проведены тесты: вертикальный прыжок, блокирующий прыжок с приставным шагом, блокирующий прыжок со скрестным шагом. Выполнение всех тестов регистрировали с помощью двух камер с частотой 120 кадров/с, полученные данные анализировали с использованием программного обеспечения Simi Motion 9.2.0. **Результаты.** При сравнении результатов тестов на выполнение вертикального прыжка и блокирующего прыжка с приставным шагом статистически значимых различий не обнаружили ($p > 0,05$). Статистически значимые различия были обнаружены при сравнении результатов тестов на выполнение блокирующего прыжка со скрестным шагом и блокирующего прыжка с приставным шагом, а также на выполнение вертикального прыжка и блокирующего прыжка со скрестным шагом ($p < 0,05$). Поскольку оптимальная высота прыжка достигается при помощи блокирующей техники со скрестным шагом, ее использование оказывает положительное влияние на исход матча и результативность спортсменов. **Заключение.** Оптимальная высота прыжка достигается при использовании блокирующей техники со скрестным шагом. Принимая во внимание важность защитных действий в волейболе, повышение эффективности блокирующих игроков непосредственно определяет исход игры.

Ключевые слова: блокирующие действия, результативность, прыжок, волейбол

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Introduction. Volleyball is one of the most popular team games in the world. Passes, set hits, attacks, and blocks form the base of the game. It is a field where especially the jump and fall movement phases take place in the game quite a lot. The jumping skill plays a crucial role in the game's success in terms of both defense and attack. Besides, it requires high-level motor skills, flexibility, and speed [14].

Performance in volleyball changes depending on many variables such as technique, tactic, bio-mechanic, mental, and physical areas [9].

In volleyball, the vertical jump is the foremost of the motor skills that affect attack and defense performances. The acts of spike, block, and top net are technique actions that require rapid explosive power. Jumps in the game are generally performed with or without the maximal speeding step by 1 or 2–3 sequential repeats [11].

In volleyball, a defense organization is quite as important as a good attack organization. The evaluations made during and after the match are generally on services, receptions, block touches, and attacks [20].

The attacks for scoring points on the high net and the height of the jump in the blocks done for defense are among the most basic performance elements that determine the score of the game. The jumping skill plays a crucial role in the game's success in terms of both defense and attack [18].

The block technique which is the first step of defense divides into two as sidestep block jump and cross-step block jump. Performance reviews of athletes and teams are usually carried out on these factors [13].

There are two types of kinetic chains related to DKV, which are top-down (i.e., proximal origins) and bottom-up (i.e., distal origins). Regarding the top-down kinetic chain, the function of muscles and other soft tissues either at the trunk or hip joint may influence the occurrence of altered kinematic patterns at the subsequent distal joints [10].

Jumps in volleyball are performed from various positions with different angles and techniques. Usually, when a player has to do a quick vertical jump, they are expected to show explosiveness and this is common in sports like volleyball. In volleyball, block jump (BJ) is performed with a quick and rapid elevation in the face of a spike. The height of the jump, promptness of the performance of the jump, the timing of the start of the jump are among the crucial elements of performing BJ's during the game. The right combination of these elements will position the player, who performs the block, to the best height at the right time correctly to block the ball. Volleyball players use two different BJ techniques starting from upright or squat positions, and a counteraction is performed in both cases [14]. Movement of one segment affects segments both proximal and distal to the first segment [10].

In vertical or curved jumps, the outcome force and hence, the acceleration of the move changes depending on the reaction force from the ground. When the gravity ($W = m \times g$) is equal to the reac-

tion force (R) from touching the ground (W = R), that means the body stands steady. When ground reaction force is greater than the force of gravity, that is, the body weight, the body will accelerate upwards, and as a result, the force will push the body upwards. On the contrary case (W > R), the outcome force will push the body down and acceleration will be downward. The outcome force that causes this is effective on the vertical component. Controlling changes in speed by flexion-extension of the lower extremities during vertical jumping, skiing, skating, and the forces that occur between the feet and the ground are the best examples of this. Forces happening during the vertical jumps and the potential power of the net force pushing the athlete upwards can be given as the most distinct examples to this case [8].

It is usually seen that in volleyball, jump performances play an important role in defense and attack. Since we observed that block jumps in defense, as well as attacks, changed the result of the game, our aim in our research is to evaluate the relationship between the sidestep block jump and cross-step block jump and the jump height of the volleyball players. The effect of blocking done by different approaches on the height of jumps was aimed to be determined in our study. The hypothesis determine that the best jump height was obtained from the block made with CBJ.

Material and methods

Participants. Study group: 6 female athletes (age 18.83 ± 2,137 years, bodyweight 64.83 ± ± 9.020 kg, height 174.50 ± 7.503 cm, training years 5.33 ± 2.733) of Kocaeli Province Ihsaniye Sports Club participated in the study voluntarily.

Research Design. The athletes were informed about the research protocol, and they were warned not to drink harmful drinks and take substances that would affect the performance 24 hours before the evaluations. The ground and weather conditions of the volleyball hall were within the frame of standards, and no situation that would affect the performance was encountered. Before the test and study, 10 minutes of dynamic, 5 minutes of mobility, 5 minutes of stability, a total of 20 minutes of a warm-up protocol was applied on the athletes, and a model practice was performed before the tests. First, it was started with the vertical jump test. The athletes were made to do twice repeated vertical jump test and the best results were recorded. Then SSBJ and CBJ tests were performed. The ground the subjects were to cover in front of the net was determined as 3 meters. Then, the starting and ending points of the move were marked. Markers were affixed on the athlete's umbilicus. For each of the two approaches, test subjects started the move from the middle point and ended with block jumping. The move was done with the arms in front of the body in the basic block position at chest level. The moves were recorded with two Basler 120 FPS cameras and analyzed with the Simi Motion 9.2.0 software. The calibration scope used for the calibration of the move analysis program is 30 × 40 × 30 cm in size, and 8 calibration points were determined. All measurements and moves were performed on the same day, in the same place.

Bodyweight (BW) measurements were done with athletes in sportswear (shorts, T-shirt) without shoes and with an electronic scale (SECA, Germany) the degree of precision of which was 0.1 kg. The heights of the athletes were measured with a stadiometer (SECA, Germany) degree of precision of which is 0.01 m according to the measuring technique.

Procedures. Vertical Jump Test (VJ Testing), the squat jump test, in which the explosive force characteristic of the leg muscles depending on the maximal force is measured, was applied in the form of performing a full jump upwards with the knees in the squat position with 900 flexion and the hands on the waist. All measurements were repeated three times, and the best value was recorded.

Sidestep Block Jump Test (SSBJ Testing), the participant took a step sideways with her foot which is appropriate for the direction she was to do block and took her other foot along. Then, she took a step sideways again with the foot she took the step with at the start and took the other foot along. Finally, she performed the approach again and actualized the block jump. It is done in three steps. The athletes performed the move in front of the net.

Cross-step Block Jump Test (CBJ Testing), the participant took a step sideways with her foot which is appropriate for the direction she was to do block and took a step in cross direction towards the block direction with her other foot in front of the foot she started with. Then, after she took a step sideways again with the foot, she took the step with at the start, she performed the block jump. It consists of three steps. The athletes performed the move in front of the net.

Statistical Analysis, after looking at the descriptive statistics, correlation between the data, and normality test, the statistical analysis of

the data obtained was performed in the SPSS 21.0 package software. When data were analyzed and compared, a significant difference was found between the groups according to the Friedman's test ($p < 0,05$). In this study, the difference between two different block approach techniques was analyzed by using the nonparametric Wilcoxon test (Table 1). As a result of this analysis, no significant difference was seen between SSBJ and VJ ($p > 0,05$). Yet, a significant difference was found between CBJ and SSBJ, and between VJ and CBJ ($p < 0,05$) (Table 2).

Results

Arithmetic means and standard deviation values for different jump heights are given in Table 2.

Table 1

Wilcoxon Test Data of the Athletes

	Sidestep Jump-Vertical Jump	Cross Jump-Sidestep Jump	Vertical Jump-Cross Step Jump
Z	–,943b	–1,992c	–2,201b
Asymp. Sig. (2-tailed)	,345	,046*	,028*

* A significant difference was found between the jumps ($p < 0,05$).

Table 2

Vertical Jump (VJ), Sidestep Block Jump (SSBJ) and Cross-step Block Jump (CBJ) Means and Standard Deviation Values

	N	MEAN	SS
Vertical Jump (cm)	6	52,90	6,025
Side-step Block Jump (cm)	6	51,417	5,7572
Cross-step Block Jump (cm)	6	57,583	5,3742

Discussion. In today's volleyball, the pace of movement plays an important role in block performance. Blockers need to detect the point where the setter of the opposing team will throw the pass well and determine the location to perform the block quickly according to that. By watching the opposing team's setter and attacking positions and studying the setter's movement, they can predict the progress of the game to a certain extent.

In a study, the authors state that certain trunk movements are required to provide kinetic chain and postural control biomechanically [19]. The kinetic chain is a necessary factor for the function of the trunk muscles, balance, force transfer, walking and activities in daily life. When the weight is shifted in any plane, the trunk reacts with a move to counteract the change in the center of gravity. This reaction is thought to be one of the important reasons for the strong positive relationship between leg force and trunk force [19].

The kinetic chain model is a biomechanical model that is used to analyze many sporting activities, which generally defines the body, which runs sequentially from proximal to distal, as an inter-segment linked system in order to reveal the desired activity in the distal segment. It has been observed that since the disorder in any segment of the kinetic chain model will affect the quality of the movement in the lower and upper segments, there is a direct relationship with the vertical jump and block jump heights in volleyball [2].

Understanding the key role all segments of the kinetic chain play in the complex biomechanical segmental rotations required for high-level throwing and serving will assist clinicians who work with overhead athletes [10].

Male and female athletes with normal range of DKV showed a significant relationship between ankle strength and knee kinematics at specific landing phases. These relationships varied with increased landing height [10].

According to Harry, it has been observed that coordinated movements of the limbs can increase or decrease the angular momentum by causing jumping, and it is thought that the angular momentum is directly related to the jump height [7].

In another study examining the relationship of momentum with jump performance, it was seen that free arm activity during vertical jump constitutes approximately 13% of the total vertical jump momentum. This shows us that arm mo-

mentum is important in high percentages in block and vertical jump height [15]. Since, in our study also, one of the reasons why the cross-step block jump performance is better than the other jumps is that the arm movement used in the cross-step jump provides better momentum upward, and since it is an approach style known as the approach step or acceleration steps as in the spike steps, it is thought that it increases the contribution to jumping.

Middle blockers have to go to both corners quickly for block assistance. Hence, it is important to use the quickest block approach technique. Blockers did not have to go to the block points quickly as passes were done high in volleyball in the past. Therefore, sliding steps were used in the steps to the block. Nowadays, the speedup of the volleyball game has made it necessary for middle blockers to go to block points faster. In fact, it was important in block defense that other players went to those points quickly during the block contributions they provided at different points.

For this reason, we evaluated the relationship between different block jumps and vertical jumps in this study. While many volleyball coaches seem to prefer the cross-step as the best technique for a quick side shift, it appears that using the sliding step from time to time is more balanced and effective. Cox's findings showing the superiority of the side-approach technique, made choosing difficult for practitioners [3].

In another study conducted on volleyball players, it was observed that the players showed performance close to the maximal in the block jump technique, which they applied with or without stepping [18].

Anthropometric structure of the upper and lower extremities and angular joint velocity appears as the most important criteria for jumping and the speed of the technique to be applied in volleyball. It has been observed that the angular differences of certain joints cause changes in the performance of the athletes in punting and block techniques [4, 6].

The time of taking off from the ground is an important factor in vertical jump. The VAM velocities of the subjects in both right and left approaches may have affected the duration of their stay on the ground. Additionally, no statistically significant difference was found in endurance in air times in the block jump after the cross approach from 3 to 2 and the cross approach from 3 to 4 ($p > 0.05$). As a result, between the side approach and cross approach, no differences were found in terms of the parameters examined, except for the taking off from the ground stage between the two approaches made from 3 to 2 for the block jump. For the subject group, this means that both approach techniques can be used equally according to positions.

Approach in the horizontal plane and speed are thought to play an important role in jump height and jump speed. In another study in the literature, the spike jump height of young elite male volleyball players who do squat jump exercises were observed as (266.3 ± 8.33), and the height of block jump after the squat jump exercises of the same group was observed as (257 ± 9.20) [16].

Again, in another study, the block and attack jump heights were compared with and without the ball, and it was observed that the jump without the ball was higher in both jumps, and when the relationship between block and attack jump was considered in the same study, the attack jump values were found to be higher [18].

Biomechanical differences of the lower extremities in the jump and landing stages in volleyball directly affect the jump and fall performance. According to the study of Amasay, a significant difference was found in favor of maximal jump values in the relationship between maximal and explosive block jump, and it was again high, looking at the squat jump between maximal and explosive jump [1].

In the study of Sattler, vertical jump performances of volleyball players were analyzed according to their positions, and it was observed that middle blockers generally had a higher jumping performance [17].

Examining the literature, in a study similar to ours, it was determined that the side and cross-block approaches used when going from number 3 to number 2 and 4 and the mean of the VAM velocity in the taking off from the ground of the cross-step block jump from number 3 to number 2 according to the results obtained was more than sidestep block approach [5].

In another study in the literature, the relationship between the height of attack and the height of the block jump in defense with the success of the tournament was examined [12]. When the findings were evaluated, it was seen that the teams with higher block jump performance in defense ranked high in the tournament success rankings. Since the best jump height was obtained from the block done with cross approach in our study, it is thought that the use of this block technique

by coaches in the game may positively affect the match and player performance.

We examined the effect of blocking moves done by different approaches on the height of jumps in our study. According to the results we obtained, no significant difference was observed between SSBJ and VJ ($p > 0,05$). On the other hand, a significant difference was found between CBJ and SSBJ, and between VJ and CBJ ($p < 0,05$). One of the reasons for this is thought to be that it provides a better upward momentum with the arm movement used in the cross-step jump.

In another study examining the relationship of momentum with jump performance, it was seen that free arm activity during vertical jump constitutes approximately 13% of the total vertical jump momentum. This shows us that arm momentum is important in high percentages in block and VJ height [15].

Another reason is that the movement capacity of the joints is limited in jumps done by sidestep approach and has a stopping effect, and the explosive force obtained by the ground reaction force cannot be carried from the proximal to the distal in accordance with the kinetic chain forms and therefore the slowing effect occurring in the movement speed. CBJ, on the other hand, has a form of action that facilitates explosive power.

Conclusion. As a result, the best jump height was obtained from the block done with CBJ. Considering that volleyball is a defense game, these increases in the block performance of the players will directly affect the result.

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