

Rubric Analysis of the Youth Volleyball Athletes from Sport Biomechanics

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Abstract Objectives: The aims of the study were to determine: (1) the quality of the basic open spike technique for the male athletes of the Dhaksinarga Gunungkidul volleyball club and (2) the quality of the basic open spike technique for the female athletes of the Dhaksinarga Gunungkidul volleyball club. Methods: The study used a quantitative descriptive method. The population of the study was the athletes of the Daksinarga Gunungkidul volleyball club, totaling 28 people. The sampling technique used purposive sampling, with the following criteria: (1) male and female adolescent athletes, (2) playing as a speaker, (3) not being sick. Samples that met the criteria were 14 athletes (7 males and 7 females). The instrument used an open spike technique of assessment rubric. Data analysis used descriptive percentages. Results: The results showed that: (1) The basic technique of open spike in male athletes of the Dhaksinarga Gunungkidul volleyball club is in the "very poor" category of 0.00%, "fewer" 71.43%, "good" 28.57%, and "very good" by 0.00%, (2) The basic technique of open spike female athletes of the Dhaksinarga Gunungkidul volleyball club is in the "very poor" category of 0.00%, "fewer" of 100.00%, "good" of 0.00%, and "very good" by 0.00%. Thus, the basic open spike technique for male and female athletes is in the poor category.

Keywords Basic Technique, Open Spike, Adolescent Athletes

1. Introduction

Volleyball is a game sport in which each team consists of 10 players which include 6 core players and 4 reserve players. If there are less than 6 players on the field, then the team is considered to have lost [1]. Volleyball games can run well and smoothly if each player has good and correct basic technical skills. Moreover, there are six types of basic techniques in volleyball, namely: service, dig (receiving the ball by digging), attack (attacking), volley (bouncing the ball), block, and defense [2].

Each basic technique in volleyball has a different function for both attack and defense. Volleyball victory is determined by the player's ability to attack. Marcelino, Afonso, Moraes, and Mesquita [3] stated that attack is the decisive factor in achieving team victory. The lethal attack in volleyball is the spike. The basic spike technique is one of the surest techniques to get points [4]. That is, the spike is the most dominant basic technique for getting points in volleyball games. Because of that, spike hits are done with good technique and correctly will produce a fast and hard ball movement so that it is relatively difficult to block and be returned by the opponent.

Based on the type of bait given, spikes are divided into five, namely: open spike, semi-spike, quick spike, back attack spike, and direct spike [5]. Lenberg & American Volleyball Association [6] states that the types of spike are: frontal spike, frontal spike with a twist or front spike, wrist spike, and dump or trick spike. Furthermore, Drikos & Vagenas[7] attacks carried out using the open spike technique have an effective level of 15.9%. Thus, an attack

with an open spike has the highest level of effectiveness to generate points and is considered a determinant of victory in the match. For this reason, the basic open spike technique must be given from the start of training, especially for adolescent athletes.

The open spike technique is said to be successful if the athlete can hit it sharply and enter the opponent's field. An open spike is said to be successful if it cannot be blocked and is difficult for the opponent to reach. At the age of teenagers, the success of doing open spike is prioritized on the correctness of the movement of the open spike technique. That is, accuracy in hitting and directing the ball in the opponent's field is a top priority in the training process.

The implementation of the open spike technique is a series of complex movements that are carried out simultaneously. The phases of the open spike movement involve a series of movements which include stepping, jumping, hitting, and landing. According to [6], the spike movement consists of four phases, namely: run-up phase (stepping), take-off phase (jumping), hit phase (hitting), and landing phase (landing). Therefore, the phases of the spike movement are: prefix, repulsion/pedestal, hitting the ball, and landing [8].

The prefix is a step taken before jumping where the last step is the foundation for taking off. The initial movement is carried out when the ball leaves the feeder's hand. Errors in making steps can result in take-off not being done perfectly and will affect the next movement. The initial phase is important for athletes to gain maximum momentum and height leading to a vertical jump [9]. Based on the initial phase, momentum is the result of the athlete's mass and walking speed [10]. To gain maximum momentum, athletes must apply a certain amount of force to increase inertia and produce a change in speed [11].

Based on a review of sports biomechanics, the basic principle that must be understood when analyzing the jump phase in the open spike technique is the application of Newton's Laws of Motion. Newton's First Law is often referred to as Newton's Law of Inertia which states that an object will remain at rest or continue to move at a constant speed as long as the force acting on it is zero [11]. The tendency to resist changes in the state of motion is described as inertia. An athlete needs to overcome the inertia of the body when making a jump by changing the position from rest to vertical motion. This means that a force is applied to overcome the inertia. The smaller the athlete's body mass will be for the athlete to gain maximum height. In addition, the arm swing is one of the factors that can contribute to vertical jump height. Because the arm can increase the angular velocity and torque at the lower extremity joint, COM height, and take-off speed.

The impact of the ball by hand (impact) is done when the spiker reaches the maximum height of the jump and at the highest arm reach. The height of the ball from the feeder in the implementation of an open spike is around 3-4 meters. For this reason, the spiker must have a high jump ability so

that the results of the stroke can be carried out optimally [12]. In addition to the height of the jump, the success of doing a spike is also determined by how the athlete can maintain his position after reaching the maximum height. Leg extension movements at peak heights need to be considered because they allow the athlete to hold for a moment in the air. This effort can be done by straightening the legs from a flexed position during take-off. Straightening and stretching the legs at the peak of the height of the jump can help maintain vertical momentum upward so that the athlete can temporarily maintain the position of the body's center of mass in the air. This effect will give you a moment in the air so you can determine the optimal position and angle for a successful spike.

The results of observations at the Dhaksinarga Gunungkidul volleyball club in March 2021, several problems emerged for athletes when doing open spike, including 1) the implementation of the spike movement was not rhythmic and seemed rushed, 2) the initial attitude was not right, 3) the steps before taking off is still varied, 4) the position of the arm when hitting the ball (impact) is not right, 5) the level of accuracy on the target is relatively low, and 6) the follow-through movement is not in the direction of the target. This means that athletes have not been able to apply a series of open spike movements properly and correctly. For this reason, it is necessary to have a more in-depth analysis of each athlete through science and technology studies, especially sports biomechanics. Thus, it will be known which phases are the problems for each athlete when doing an open spike.

2. Objectives

The aims of the study were to determine the quality of the basic open spike technique for the male athletes of the Dhaksinarga Gunungkidul volleyball club and the quality of the basic open spike technique for the female athletes of the Dhaksinarga Gunungkidul volleyball club.

3. Methods

The research used a quantitative descriptive method. The study was conducted at the Dhaksinarga Gunungkidul volleyball club in July 2021. Then, the research participants were done through purposive sampling. The research sample consisted of 14 athletes, namely 7 male athletes and 7 female athletes with the following criteria: male and female adolescent athletes who played as spikers and were not sick. The instrument used a rubric or observation sheet based on a study of sports biomechanics. The research data was taken through video observations which were documented when the athletes performed an open spike. The content validity test of the rubric instrument was carried out by 4 experts (3 trainers and 1 expert in sports biomechanics). To equalize the perception

of the experts, an assessment guide was created which was synchronized with the sports biomechanics expert for scientific review. Meanwhile, the data analysis technique used descriptive percentages with a range of assessment scores from 1 to 4. This technique was adopted from Sudijono [15] with the formula:

$$P = \frac{F}{N} \times 100\%$$

Note:

P = the Relative frequency

F = the Frequency

N = the Number of Respondents

4. Results

The expert's assessment resulted in a detailed analysis rubric for each phase of body movement when performing an open spike, namely: head, arms, backbones, and legs. Each body part performance is assessed at each phase of motion from starting, jumping, hovering and hitting the ball, and landing. The criteria for assessing movement using points 1-4, namely: (1) very poor score 1, (2) fewer score 2, (3) good score 3, and (4) very good score 4. The preparation of assessment criteria aims to make it easier for raters to analyze the basic technique of open spike volleyball through a sports biomechanics approach. The research results can be submitted as follows.

4.1. Basic Skills Open Spike Male's Athlete

The results of the analysis of the basic open spike technique for the male athletes of the Dhaksinarga Gunungkidul volleyball club were presented based on the initial/preparation phase, jumping, flying and hitting the ball, and landing. Those were shown in fewer categories. In detail, the results of the analysis can be explained as follows:

Table 1. Frequency Distribution of Male Athletes in Initial Phase

No	Interval	Category	Frequency	Percentage
1	85%-100%	Very good	0	0,00%
2	65%-84%	Good	1	14,29%
3	45%-64%	Poor	6	85,71%
4	25%-44%	Very Poor	0	0,00%
Amount			7	100%

First, the initial or preparation phase was analyzed. Statistical descriptive of the basic open spike technique on male athletes of the Dhaksinarga Gunungkidul volleyball club based on the initial phase showed that the mean value was 59.39 and std. deviation was 5.97. The frequency distribution of the basic open smash technique for male athletes at the initial stage can be presented in table 1.

Table 1 showed that the basic open spike technique for male athletes of the Dhaksinarga Gunungkidul volleyball club based on the initial phase was categorized below. No athletes performed in very poor and very good categories of 0.00%. Then, 6 athletes could be categorized as a fewer category with 85.71% and only one athlete was included a good category with 14.29%. Thus, the basic open spike technique of the male athlete of the Dhaksinarga Gunungkidul volleyball club based on the initial phase is in the poor category.

Second, in the jumping phase, statistical descriptive of the basic open spike technique on male athletes of the Dhaksinarga Gunungkidul volleyball club based on the phase at which they jump, the mean value was 62.74; std. deviation was 6.04. The frequency distribution of the basic open smash technique for male athletes at the stage of jumping can be presented in table 2 below.

Table 2. Frequency Distribution During Jumping Phase for Male Athletes

No	Interval	Category	Frequency	Percentage
1	85%-100%	Very good	0	0,00%
2	65%-84%	Good	2	28,57%
3	45%-64%	Poor	5	71,43%
4	25%-44%	Very Poor	0	0,00%
Amount			7	100%

In this phase, no athletes have indicated a very poor category of 0.00%, there were 5 athletes in fewer categories of 71.43%, only 2 athletes were considered as a good category of 28.57%, and no athletes could get a very good category was 0.00%. To sum up, the basic open spike technique of the male athletes of the Dhaksinarga Gunungkidul volleyball club based on the phase when jumping was in fewer categories.

Table 3. Frequency Distribution When Floating and Hitting the Ball for Male Athletes

No	Interval	Category	Frequency	Percentage
1	85%-100%	Very good	0	0,00%
2	65%-84%	Good	1	14,29%
3	45%-64%	Poor	6	85,71%
4	25%-44%	Very Poor	0	0,00%
Amount			7	100%

Flying and hitting the ball phase was a statistical descriptive of the basic open spike technique for male athletes of the Dhaksinarga Gunungkidul volleyball club based on the phase when flying and hitting the ball, the mean value was 57.02 and std. deviation was 5.42. The frequency distribution of the male athletes' basic open smash technique at the stage of flying and hitting the ball can be shown in table 3.

The basic open spike technique for male athletes of the Dhaksinarga Gunungkidul volleyball club based on the phase of flying and hitting the ball was categorized followed by the percentage. Fewer categories were 85.71% by 6 athletes and good categories reached 14.29% by 1 athlete. Meanwhile, no students performed in a very poor and very good category. Moreover, the basic open spike technique of the male athlete of the Dhaksinarga Gunungkidul volleyball club based on the phase when he floats and hits the ball is in the fewer categories.

Next, statistical descriptive of the basic open spike technique on male athletes of the Dhaksinarga Gunungkidul volleyball club based on the phase of landing the ball, the mean value was 60.00 and std. deviation was 8.66. To add, the frequency distribution of the basic open smash technique for male athletes at the landing stage can be illustrated in Table 4 below.

Table 4. Frequency Distribution when Landing Phase for Male Athletes

No	Interval	Category	Frequency	Percentage
1	85%-100%	Very good	0	0,00%
2	65%-84%	Good	2	28,57%
3	45%-64%	Poor	5	71,43%
4	25%-44%	Very Poor	0	0,00%
Amount			7	100%

In the landing phase, the basic open spike technique for male athletes of the Dhaksinarga Gunungkidul volleyball club based on the landing phase was as follows. There were no athletes who could attempt very poor and very good categories. The highest number of athletes was mentioned in the "poor" category of 71.43% with 5 athletes, and only 2 athletes were said as a good category with 28.57%. To conclude, the basic open spike technique of the male athletes of the Dhaksinarga Gunungkidul volleyball club based on the landing phase is in the poor category.

4.2. Basic Skills Open Spike Female's Athlete

The results of the analysis of the basic open spike technique for female athletes of the Dhaksinarga Gunungkidul volleyball club based on the initial phases, jumping, hovering and hitting the ball and landing are in the fewer categories. In detail, the results of the analysis can be explained as follows:

First, in the preparation or initial phase, a descriptive statistic of the basic open spike technique for female athletes of the Dhaksinarga Gunungkidul volleyball club based on the initial phase found the mean value in 57.45 while std. deviation got 1.69. Furthermore, the frequency distribution of the basic open smash technique for female athletes at the initial phase can be presented in table 5.

Meanwhile, based on the results of the analysis at the initial stage, it illustrated that the basic open spike

technique for female athletes of the Dhaksinarga Gunungkidul volleyball club was reached by 7 athletes as fewer categories or obtain 100%. Other categories were not placed by athletes or 0.00%. Thus, the average value of the basic open spike technique of the female athletes of the Dhaksinarga Gunungkidul volleyball club based on the initial phase is in the fewer categories.

Table 5. Frequency Distribution of Female Athletes in Initial Phase

No	Interval	Category	Frequency	Percentage
1	85%-100%	Very good	0	0,00%
2	65%-84%	Good	0	0,00%
3	45%-64%	Poor	7	100,00%
4	25%-44%	Very Poor	0	0,00%
Amount			7	100%

In the jumping phase, a statistical description of the basic open spike technique for female athletes of the Dhaksinarga Gunungkidul volleyball club had the mean value of 56.67 and std. deviation reached 6.50. The frequency distribution of the basic open smash technique for female athletes at the phase when jumping can be presented in the following table 6.

Table 6. Frequency Distribution During Jumping Phase for Male Athletes

No	Interval	Category	Frequency	Percentage
1	85%-100%	Very good	0	0,00%
2	65%-84%	Good	2	28,57%
3	45%-64%	Poor	5	71,43%
4	25%-44%	Very Poor	0	0,00%
Amount			7	100%

To add, the basic open spike technique for female athletes of the Dhaksinarga Gunungkidul volleyball club based on the phase performed various results. However, there were always two categories that were not gotten by the athletes, namely very poor and very good categories or 0.00%. Furthermore, five athletes belonged to fewer categories and 2 athletes as good categories of 28.57%. As a consequence, the basic technique of female athletes' open spike based on the phase when they jump was still in fewer categories.

Statistical descriptive of the basic open spike technique for the female athlete of the Dhaksinarga Gunungkidul volleyball club based on the moment of flying and hitting the ball showed that the mean value was 57.14 and std. deviation was 50.83. The frequency distribution of the female athletes' basic open smash technique at the phase of flying and hitting the ball can be demonstrated in table 7.

Besides that, the basic open spike technique for female athletes of the Dhaksinarga Gunungkidul volleyball club based on the phase when flying and hitting the ball also had

different results. Again, none of the athletes were categorized as very poor or very good categories. In this phase, 6 athletes had categorized in fewer categories of 85.71% and only one athlete attempted the good category of 14.29%. In other words, the basic open spike technique of the female athlete of the Dhaksinarga Gunungkidul volleyball club based on the phase of flying and hitting the ball is in the fewer categories.

Table 7. Frequency Distribution When Floating and Hitting the Ball for Female Athletes

No	Interval	Category	Frequency	Percentage
1	85%-100%	Very good	0	0,00%
2	65%-84%	Good	1	14,29%
3	45%-64%	Poor	6	85,71%
4	25%-44%	Very Poor	0	0,00%
Amount			7	100%

Next, it was the landing phase. Statistical descriptive of the basic open spike technique for female athletes of the Dhaksinarga Gunungkidul volleyball club based on landing, the mean value was 54.29 and std. deviation was 13.05. In addition, the frequency distribution of the basic open smash technique for female athletes at the landing stage can be presented in table 8.

Table 8. Frequency Distribution when Landing Phase for Male Athletes

No	Interval	Category	Frequency	Percentage
1	85%-100%	Very good	0	0,00%
2	65%-84%	Good	2	28,57%
3	45%-64%	Poor	5	71,43%
4	25%-44%	Very Poor	0	0,00%
Amount			7	100%

The basic open spike technique for female athletes of the Dhaksinarga Gunungkidul volleyball club based on the landing phase was illustrated as follows. In terms of the landing phase, no athletes were categorized as very poor or very good. 5 athletes were indicated as fewer categories of 71.43% while 2 athletes were mentioned as good categories of 28.57%. Moreover, the basic open spike technique of the female athletes of the Dhaksinarga Gunungkidul volleyball club based on the landing phase is in the poor category.

5. Discussion

This study aims to determine the basic technique of open spike in volleyball club athletes Dhaksinarga Gunungkidul based on the initial phases, jumping, hovering and hitting the ball, and landing. Based on the average value, the basic open spike technique for male and female athletes of the Dhaksnarga Gunungkidul volleyball club is in the poor category. This means that the basic open spike technique of the athlete of the Dhaksinarga Gunungkidul volleyball club is not under the indicators of the open spike technique.

The basic technique of open spike volleyball is a series of movements that are carried out simultaneously. In sports biomechanics, the efficiency of technical motion is largely determined by the accuracy and correctness at each phase of motion. That is, motion errors made since the initial phase will result in motion errors at a later phase. The male and female athletes of the Dhaksinarga Gunungkidul volleyball club have a tendency to make mistakes in the early phases so that the implementation of the open spike motion cannot be carried out optimally.

Overall, the problems of the male and female players of the Dhaksinarga Gunungkidul volleyball club can be explained in table 9 below.

Table 9. Problems with Male and Female Athletes during Open Spike

Movement Phase	Male	Female
Preparation	The swing of the arm when moving forward looks stiff, the movement of the steps is not rhythmic	The arm swing when moving forward looks stiff
Jumping	Athletes tend to bend over when they are about to jump	Athletes raise their arms first before jumping
Flying and hitting the ball	Impact with the ball is often late, the stroke tends to result in the ball float	Athletes are often late swinging arms up, impact with the ball is not right at the point of hit
Landing	Athletes tend to land on both feet at the same time making it difficult to make the next move	Athletes tend to land on both feet at the same time making it difficult to make the next move

The results above indicate that in the analysis of the biomechanics of sports, male and female athletes of the Dhaksinarga Gunungkidul volleyball club have not mastered the basic open spike technique. In the initial phase, basic mistakes have been made, namely in the steps and arm swing. Steps and arm swings that are done correctly can provide an additional force (strain energy) when taking off. Accuracy in taking off will make it easier for athletes to reach maximum height. The process of spike as usually was divided into three steps: run-up, stop-jump, and stroke with a swinging arm [13]. The results of the correlation analysis showed that starting with a walking step was the only technique that gave higher jumps for a longer performance time [9].

Open spike is a basic technique that involves a series of movements performed at high speed. For this reason, it is necessary to synergize the performance of body segments to obtain good and correct movements. The results showed that the success of the open spike is determined by the step in the initial phase, the angle of support when doing the repulsion, the angle when making a jump and the height of the jump, the angle when hitting the ball and the time from the repulsion phase to the stroke phase [14]. Most male and female athletes make mistakes in the early phases. To sum up, there is a need for a more detailed biomechanical analysis of the implementation of the open spike technique of the athletes of the Dhaksinarga Gunungkidul volleyball club so that they can produce efficient motion.

6. Conclusions

Based on the results of the rubric analysis through the study of sports biomechanics, the implementation of the basic open spike technique for the male and female athletes of the Dhaksinarga Gunungkidul volleyball club is in the poor category. To be able to improve the quality of technical movement, training must be carried out gradually from the start, jumping, when flying and hitting the ball, and landing.

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