Kinematics Analysis and Research on Volleyball Serving Using Computer Technology

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Abstract. As one of the most important competitive sports, volleyball is gradually developed in many countries and regions due to its strong interest and simple operation. Volleyball serve is a basic technique for beginners in volleyball sports. This paper firstly analyzes volleyball serve technology and volleyball serve kinematics. At the same time, it makes use of computer technology to analyze volleyball serve kinematics for readers' reference.

Keywords: Computer Technology, Volleyball Service, Kinematic Analysis, Take-off Technology

1. Introduction
With the continuous development of volleyball, the development trend of volleyball is height, speed and volleyball skills. Volleyball as a competitive sport, the main purpose is to win the game, and volleyball service is an important part of the whole process. Through the analysis and research of volleyball kinematics, it is beneficial to promote the development of volleyball serve.

2. Research on volleyball service technology

2.1. Ball
Throwing is the beginning of the jump serve and also the premise of the quality of the serve. Its distance and height determine the running distance. Run-up speed and take-off height. Serve the players want to combine their actual bounce height: choose reasonable ball if the ball is too high, when the ball falling under the influence of gravity, falling speed, take-off time is not easy to grasp, the palm of your hand when the stroke is not easy to whole palm filled with the ball, caused the batsman momentum and speed can't ACTS on the ball, all of which influence the ball speed. If the ball is thrown too low, the server does not have enough time to take off and extend his stomach in the air, so as to reduce the take-off height and hitting point, and the flexion elbow of his arm when he swings the ball, which affects the transfer of momentum and speed, at the same time, shorten the stretching distance of relevant muscle groups, reduce the contraction force and explosive force of muscle groups, and thus reduce the power of the serve [1].
2.2. Run-up
Run-up is the premise of takeoff, good run-up speed and rhythm is the basis of reasonable takeoff
Angle and takeoff speed. So that the ball throwing, running, jumping and air hitting links closely,
freely [2-3]. In the approach, there are mainly one-step approach and two-step approach. The former is
conducive to improving the accurate judgment of the landing point of the throwing ball and choosing
the appropriate takeoff time, while the latter is beneficial to improving the run-up speed and forward
impact distance and increasing the difficulty in judging the landing point and grasping the takeoff
time. In the run-up rhythm, more and more steps, lower and lower center of gravity, faster and faster.

2.3. Take-off technique
In terms of takeoff time, some studies have shown that "shorter takeoff time is beneficial to the loss of
horizontal velocity of run-up takeoff,'"

It has to do with the fact that the jump serve has to achieve a certain level of speed. After all, the
take-off time only reflects the speed of the departure from the take-off action, rather than the quality
effect of the action, which can not be one-sided emphasis on shortening the take-off time. In takeoff,
the right foot lands before the left foot, and gets off the ground before the left foot (take right-handed
hitting as an example, the same below), Step in front of the left foot, the right foot behind; The
horizontal distance between the feet is about shoulder width, and the longitudinal distance is related to
the throwing distance and body forward impact distance. After the right foot is off the ground, the left
knee begins to give full force. The angular velocity of the two knees showed different synchronization,
that is, the right knee reached its maximum extension, followed by the left knee reached its maximum.
According to one study, "the task of right knee extension is mainly to achieve vertical velocity, while
the task of left knee extension is mainly to achieve horizontal velocity."

2.4 Hitting skills in the air
An air shot is a takeoff at which the body is inverted in the air and turns slightly to the right. When the
ball reaches its highest point,

The use of violent abdominal action to drive the arm quickly forward swing to hit the ball, the full
palm to hit the back of the middle, at the same time active hard flexor wrist flexor forward push
pressure, so that the ball was the highest point flying into the opponent's field. Since the air hitting
technique is to complete a series of movements such as stretching belly and stretching chest, drawing
belly and serving force and swinging arm in the air after taking off, it is the most difficult point in all
technical links of the whole jump serve [4]. At the stage of maximum back bow, after the body is
airborne, swing the left arm forward to the chest to maintain balance: The right arm bends the elbow
backward and puts it on the side of the head. Its purpose is to reduce the radius of the arm and increase
the angular speed of the arm. At the same time, extend the abdomen, extend the hip, rear flexion calf,
PR stretch the initial length of the working muscle group, so that the entire human body to form a back
bow state.

3. The research status of volleyball technology kinematics analysis

3.1. Research status of volleyball technology kinematics analysis
In the study of the kinematic characteristics of volleyball technology, the early research was due to the
technical bar. The limitations of the piece also do not allow 3d photography of the technical action in
the field and its analysis, so in obtaining the phase. The analysis results are not very accurate. In recent
years, the analysis results have been greatly limited. With the gradual maturity of internal technical
conditions, many corresponding scientific articles appear, and they will be filmed on site. After
analyzing by computer and other advanced instruments, the corresponding data can be obtained for the
diagnosis and development of volleyball sports technology [5]. A great deal of valuable information
was provided.
3.2. Application of 3D kinematics in motion analysis technology diagnosis
Three-dimensional camera is one of the commonly used methods in sports technology research in recent years. Three-dimensional kinematics analysis originated in the mid-1980s and was first applied to track and field technology by foreign scholars. In the 1990s, some domestic scholars gradually began to analyze various movements from the three-dimensional perspective, and some effective results have been achieved. Japan started earlier in this aspect, from the early 1990s began to be used in volleyball technology research. With the advent of high-definition digital camera and the further development of 3D video analysis software, the 3D camera method becomes more and more accurate and its practical scope becomes wider and wider. Compared with 3D high-speed photography, 3D photography uses video tape instead of film, which can save a lot of money. Therefore, a lot of technical actions, even the whole game, can be shot according to the needs during the competition. It enables researchers to have a greater choice, with large sample content, strong representativeness and high credibility. In the process of action analysis, the technical action can be repeated and observed carefully, which brings convenience for researchers. Sports is a complex three-dimensional human activity.

4. Research on the kinematics analysis of volleyball serve by using computer technology
4.1. Research Methods
4.1.1. Literature method
Refer to 1980-2002, a large number of domestic and foreign experts, scholars and researchers on the front of the drop shot, the back drop shot, jump serving technology and relevant content of more than 60 articles, related information for the sorting, comprehensive analysis, applying the sports biomechanics and sports training, sports physiology, sports statistics, and so on knowledge, discussed the essential characteristics of jump serving technology.

4.1.2. Expert interview method
Visited many volleyball coaches and professors. To further understand the technical characteristics of the jump, serve and the internal relations of each component, on the basis of previous research on the jump serve technology analysis.

4.1.3. Observation
Watch the whole process of the third race of the World Women's Volleyball Grand Prix in 2001, watch the video and master the external features of the jumping serve.

4.1.4. Camera method
Matsushita M9000 photography system was used to photograph the test subjects. Two Panasonic M-9000 video recorders from Nissan, shutter speed 1/1000 seconds, shooting frequency of 50 Hz, from the front and back of the front and side fixed focus, fixed distance shooting the whole process of the race, range of 5*5 M. At the same time, the 3D calibration frame was photographed before and after the competition.

4.2. Results and analysis
The action of hitting the ball in the air is driven by the opposite movement of the upper and lower limbs in the state of flying. The action of hitting the ball with the upper limbs is the most critical link in the technique of jumping serve.

4.2.1 Analysis of shoulder rotation Angle
Shoulder rotation Angle refers to the Angle formed between the two shoulders and the horizontal plane, indicating the rotation Angle of the upper body. The change of shoulder rotation Angle between
the arm at the maximum and the moment of hitting can reflect the amplitude of body rotation (Table 1 is the change of shoulder rotation Angle and Angle of the ball in the air).

Table 1. Ball shoulder rotation Angle and Angle variation table position

| number | When the guide arm is maximum | Ball moment | Angle change |
|--------|--------------------------------|-------------|--------------|
| A      | 52.37                         | 22.24       | 30.13        |
| B      | 49.15                         | 11.32       | 37.78        |
| C      | 48.05                         | 18.49       | 29.56        |

Note: In this paper, Yang Hao from China, Burrows from America, Tom from America and Angrena from Germany are numbered A, B and C.

4.2.2. Analysis of left arm hem movement during hitting

In the study, it is found that all the subjects have the characteristics of active and rapid left arm hem and bending arm in the side or in front of the body when hitting the ball with the right hand, which is beneficial to improve the speed of hitting arm. Because human muscle strength is limited, muscle strength is also limited to a certain axis of the muscular moment. When the muscular moment is constant, the rotational law formula \( EM=I \) shows that the rotational inertia \( I \) is inversely proportional to the angular acceleration. If the angular acceleration is increased, the moment of inertia of the limb is reduced, and finally the angular velocity of rotation can be increased, the linear velocity of the limb is increased, the momentum transmitted by the limb is increased, and the arm swing speed is improved. Therefore, the human body in the state of flight to change the angular velocity action, can be achieved by changing the moment of inertia. According to the moment of inertia \( I=MR^2 \), when the radius of rotation is changed, the moment of inertia is changed. Therefore, in the rotation process of the limb, if the mass of the limb is as close to the joint axis as possible, reduce the moment of inertia of the limb to the joint axis, and increase the angular velocity of the limb, the linear velocity of the limb and the moment transferred can be increased. Therefore, the stroke of the opposite arm (left arm) when the hem of the bending of the arm, is conducive to the right arm speed increase [6]. The internal relationship between them and their mutual influence need to be further studied in the future.

4.2.3. Correlation analysis of shoulder Angle, elbow Angle and finger speed during hitting

Some scholars believe that the Angle between the hitting arm and the torso is about 160°. This can not only improve the explosive power of muscles, but also improve the linear speed of hitting the ball; The closer the elbow Angle is to the swing straight, the better the transmission effect of hitting force and momentum is, the best value is 180. The Angle of shoulder and elbow affects the effect of hitting.

Table 2. Numerical table position of Shoulder Angle and elbow Angle (°)

| number | Shoulder angle | Elbow angle | Hand speed |
|--------|----------------|-------------|------------|
| A      | 167            | 187         | 14.73      |
| B      | 176            | 185         | 15.32      |
| C      | 173            | 174         | 13.14      |

Table 3. Correlation between shoulder Angle, elbow Angle and finger speed

|                        | Shoulder angle | Elbow angle |
|------------------------|----------------|-------------|
| Finger speed           | R1 = 0.828     | R2 = 0.938   |
|                        | P1 < 0.05      | The P2 < 0.05|

It can be seen from Table 2 that the average shoulder Angle and elbow Angle of the study subjects are 169 and 178 when they hit the ball, and there are different degrees of correlation with finger speed when they hit the ball (Table 3). When A and B hit the ball, shoulder Angle and elbow Angle are
relatively reasonable, in line with the mechanical requirements of hitting action, and finger speed is also high.

5. Conclusion
To sum up, in the course of volleyball service training, we should pay attention to the training of throwing, running, taking off and hitting in the air to improve the effect of volleyball service. At the same time using the computer technology to study volleyball serve, volleyball serve the process of one step to explore, promote the development of volleyball serve.

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