

Technical Analysis of Pulling Ball in Table Tennis Teaching Based on Big Data

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Abstract: With the continuous development of society, the requirements of table tennis teaching in our country are also increasing. Reverse loop technique is an important technique for athletes in sports. Almost every high-level athlete can use it. It is very important to improve the skills of the players to improve their loop skills. The purpose of this paper is to analyze the technology of table tennis reverse loop based on big data, and provide theoretical guidance for table tennis teaching. In this paper, through a series of research methods, such as literature review, experimental method, etc Vicon system is the main experimental equipment. Six male table tennis players from a university in our city are selected as the experimental objects to analyze their movement process in two important technical movements, that is, anti pull high loop technique and anti pull forward loop movement. The order of each link movement, the parameters of upper and lower limbs movement and the change value of body gravity center are obtained Kinematic parameters, through the comparison of data to find out the range of action to improve the level of athletes. After the experiment, it can be found that the twist angle of the body will be larger when the technical action of back pulling the high hanging loop ball is in progress; while the pitch angle between the ball and the racket is larger when the forward running loop ball is in progress.

1. Introduction

With the development and change of the times, the table tennis technology of our country is more and more advanced. The development of table tennis is so rapid, on the one hand, because of its own characteristics, on the other hand, the research of scientific researchers on table tennis has entered a relatively mature stage, greatly promoting the popularity of table tennis [1-2]. Forehand loop technique plays a very important role in table tennis. The level of loop technique is an

important reference to measure a table tennis player. Improving the player's pull technique has an important impact on the result of the game [3-4].

Many scholars have their own research on the technology of table tennis reverse loop [5-6]. For example, sagayama h selected some table tennis players from China table tennis college to collect data and conduct EMG analysis on their loop technique, so as to understand and master the law of muscle changes of athletes in the process of sports, so as to carry out targeted muscle training for athletes [7]. Guo, Z. and other scholars used the method of data analysis to make a comparative study on the influence of students' forehand forward loop technology on the winning points in the competition, in order to explore a more optimized forehand technology of table tennis [8].

In this paper, on the research of the technology of pulling the ball, we first put forward the important winning factors in playing table tennis, and then selected six table tennis players from a university in our city as the research object, and carried out the experimental research on the two technical movements of backward pull forward loop and backward pull high hanging loop, so as to obtain the order of each link of the body movement, the parameters of upper and lower limbs movement and the results Change value of body center of gravity [9-10]. Through statistical analysis of these data, find out the movement characteristics and differences between the two kinds of technical movements, and draw the conclusion of improving table tennis skills [11-12].

2. Research on the Technique of Pulling the Ball in Table Tennis Teaching

2.1 Research on Loop Technique

2.1.1 Biomechanical Analysis

The rotation of the hip joint can make the big arm obtain an initial velocity, thus increasing the angular velocity at the moment of hitting

$$V = \omega \times r \quad (1)$$

Where V is the linear velocity, ω is the angular velocity, and R is the radius.

2.1.2 Kinematic Analysis

When the players use the loop ball for forehand and loop technical movement, they take their own body as the final central axis. During the forced rotation of the waist and abdomen, the athletes' arms can directly obtain the initial speed of rotation, which makes the initial kinetic energy of the two hands of hitting the ball gradually expand to increase. In this way, the players can directly transfer the initial kinetic energy to the table tennis through an arc racket, so that the players of the arc racket can also directly obtain a larger initial speed, thus aggravating the difficulty of the other side's interception.

2.2 Kinematic Data Processing

In this study, the multiple correlation coefficient (CMC) was used to evaluate the similarity of the curve trend of the lower limb joint angles of the same type of athletes. The CMC calculation formula is as follows:

$$CMC = \sqrt{1 - \frac{\sum_{i=1}^m \sum_{j=1}^n (Y_{ij} - Y_j)^2 / n(m-1)}{\sum_{i=1}^m \sum_{j=1}^n (Y_{ij} - Y_j)^2 / (nm-1)}} \quad (2)$$

The mean value of the data in the numerator row represents the variance of the parent data curve. M is the number of curves, Y_j is the j data of M curve.

3. The Experiment of Pulling Technique in Table Tennis Teaching

3.1 Research Objects

In this paper, six male athletes who participated in the 2020 provincial college table tennis competition were selected as the experimental subjects. In order to make the data more convincing, other influencing factors need to be controlled, so six players use the same table tennis racket, the forehand position uses fengbiao 03 rubber, the backhand position uses Dominic F1 rubber, and all the players hold the racket with their right hand. The basic information of athletes is shown in Table 1.

Table 1: Personal information of athletes

Serial number	full name	Age	height /cm	weight /kg	Grip mode	Sport level
1	Sun**	21	177.0	72.1	Horizontal board	second level
2	Cheng**	21	172.0	64.8	Horizontal board	second level
3	Chen*	20	171.0	70.5	Horizontal board	second level
4	Liu**	22	169.0	63.2	Horizontal board	second level
5	Wang*	22	178.0	66.3	Horizontal board	second level
6	Gao*	21	180.0	70.4	Horizontal board	second level
7	Hua*	20	175.0	65.3	Horizontal board	second level
8	Ding**	21	173.0	62.8	Horizontal board	second level

3.2 Research Methods

3.2.1 Literature Research Method

This paper mainly searches through Wanfang database, CNKI, sport focus and other literature databases. The key words such as "table tennis", "loop ball", "backward pull forward loop ball", "backward pull high hanging loop ball" and "kinematics" were used as the literature search basis to search, and the literature conforming to the writing theme was recorded. Objective to understand the research progress and current situation of loop technique in table tennis at home and abroad. At the same time, we should read the literature and learn the important ideas in the literature, such as the design ideas of the research, the arrangement of the experiment and the method of data recording.

3.2.2 Experimental Research Method

(1) Experimental instruments

Vicon infrared three-dimensional motion analysis system, two cameras, celluloid table tennis, fixed tripod, a standard table tennis table.

(2) Experimental methods

In the experiment, Vicon system and two baslerplia640-210gc cameras were used to analyze and test the kinematics of the forehand backhand high hanging loop and the backhand forward charging

loop in table tennis. The experiment was carried out in the gymnasium of our school.

(3) Test equipment commissioning

Two horizontal marker points are evenly placed in the test space, and the calibration rod is constantly shaken in the test space. Through the calibration screen to determine whether the calibration is successful. Secondly, the height, pitch angle and distance of the two cameras placed on the ground are adjusted to ensure the integrity of action collection.

(4) Test method

There are four stages in the test method, which are the early measurement stage, the equipment debugging stage, the sticking stage and the beginning stage.

3.2.3 Mathematical Statistics

The collected athletes' motion parameters are processed. The 3D model of the whole body joints is established through the 3D motion acquisition system vicon nexus1.8.5. The model is filtered and flattened. Finally, the kinematics parameters such as the angle and displacement of the whole body joints are calculated. After that, Excel 2007 was used for routine statistical analysis and graphic drawing of the original data, and SPSS was used for statistical processing of kinematic and dynamic parameters such as linear quantity and angular quantity required by the research content. T-test was performed on the data collected from the two groups of technical actions, so as to find out the difference between the two, which was expressed by mean standard deviation, with the symbol of \pm . Use p value to test the difference between the two, if p value is greater than 0.05, it means that the difference between the two is not obvious; if p value is less than 0.05, it means that the difference between the two is obvious; if p value is less than 0.01, it means that the difference between the two is very obvious. After the analysis of the data, the data are arranged in charts to present the experimental results more clearly and intuitively.

3.3 Data Processing

Through the Vicon nexus 1.8.5 software, the technical actions of six people pulling the high hanging loop ball backward and rushing the loop ball forward were collected, and then the coordinates of the collected points were processed and analyzed. Finally, the speed, angle, angular velocity and other data parameters of the two technical actions needed for the experimental results were obtained. From the three-dimensional image acquisition, the three-dimensional images of six subjects performing two groups of technical actions were obtained, and the hitting time of all the subjects at the beginning of the technical action was found. After that, the kinematic analysis of the obtained technical action is carried out through the dynamometer, and all the data are collected synchronously, and the comprehensive analysis and processing are carried out.

4. Results and Analysis

4.1 Time Sequence of Body Movements

In this paper, the forehand pull loop technology in the action of two techniques, forehand pull loop high hanging and forehand pull loop forward. In order to better analyze the technical points and subtle differences in the two kinds of technical movements, this paper analyzes the kinematic characteristics of the body joints at the time of preparing to swing and hit the ball, mainly for the three moments of the swing and hit the ball, the hit time and the end of the hit, so as to prove the coordination between the body joints. As shown in Table 2, it is the peak value of each link and

speed of the body.

Table 2: Peak value of combined speed of each link of the body

name	ankle joint	Knee joint	hip joint	shoulder joint	elbow joint	wrist joints
Backward pull forward	0.64±0.03	0.65±0.09	0.53±0.31	1.13±0.08	4.51±0.12	6.74±0.19
Reverse pull high lift	0.13±0.10	0.45±0.07	0.78±0.14	1.47±0.23	4.44±0.11	6.63±0.08
P value	>0.05	>0.05	<0.05	<0.05	<0.05	<0.05

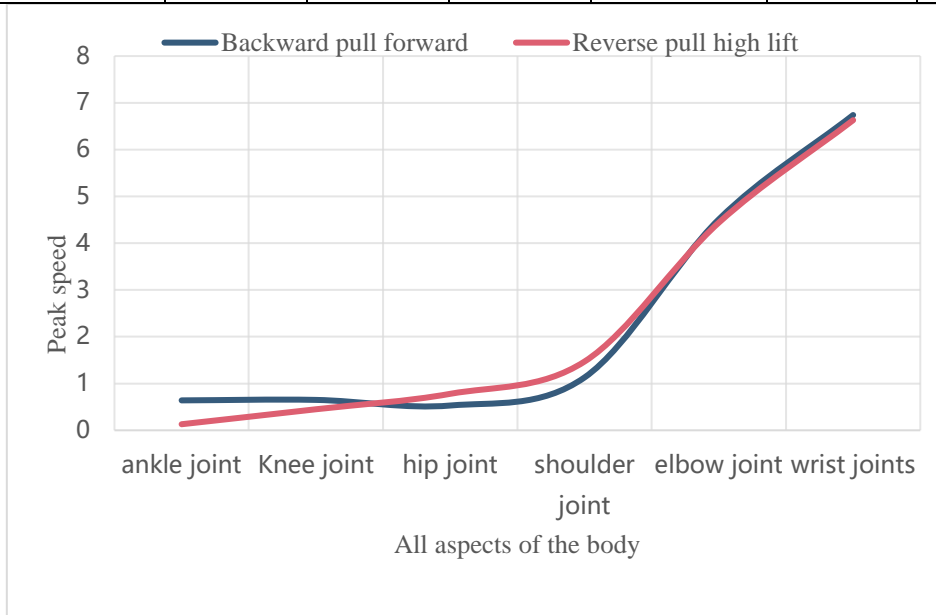


Figure 1: Peak value of combined speed of each link of the body

It can be seen from Figure 1 that compared with the two kinds of technical movements, the hip joint speed of forehand reverse pull forward loop technology movement is relatively large, which is greater than the hip joint speed of forehand reverse pull high loop technology movement. The reason why there are such differences is that there are differences between the two kinds of technical movements in pulling the ball, and the other is that there are differences in strength between the two kinds of techniques.

4.2 Motion Analysis of Lower Limb Joints

4.2.1 Analysis of the Angle Changes of Lower Limb Joints

The angle of the left joint is smaller than that of the right joint in the same technical movement of ankle joint, knee joint and hip joint. Therefore, at the beginning of the swing, the hitting force of the forehand reverse pull forward loop ball and reverse pull high loop ball will fall on the right part of the body and lower limbs. In the swing stage, the angle of the left joint all increased, while in the forehand backhand loop technique, the angle of the right knee joint and hip joint changed significantly, which indicated that the power was transferred from the lower limbs upward. Through comprehensive observation and analysis, it is found that the transfer of force in the reverse loop technique starts from the right sole from the bottom to the top, and drives the external rotation of the heel after the force of the sole, so as to ensure the transfer of force, which is in line with the law of angle change.

After data processing, the tilt angles of lower limb joints in the following swing stage of backward pull forward loop and backward pull high loop are shown in Table 3.

Table 3: Joint angles of lower limbs in the following swing stage after hitting

category	ankle		knee	
	left	right	left	right
Backward pull forward	64.32	82.41	135.75	132.68
Reverse pull high lift	84.98	82.78	114.53	97.79
P value	<0.05	<0.05	<0.05	<0.05

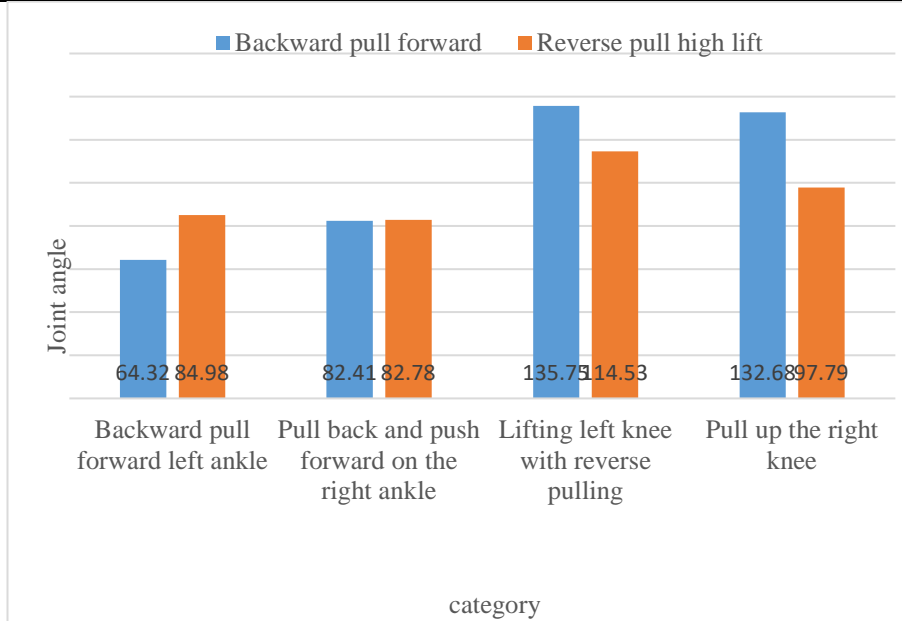


Figure 2: Joint angles of lower limbs in the following swing stage after hitting

In Figure 2, in the two technical movements, the twist angle of the knee and joint is larger than the traditional reverse pull forward; the angle of the right knee and the left leg joint has an increasing trend, and the increasing range of the angle of the right knee and the left leg joint is relatively reduced when the high loop ball is pulled back.

4.3 Analysis of Body Gravity Center Displacement

After a detailed analysis of the changes in the position and angle of the lower limb joints, we can understand that the forehand reverse pull forward loop technology has less influence on the change of the position and angle of the lower limb joints than the forehand reverse pull high loop technology. Because the center of gravity of forehand backward loop and other backward loop technology is closer than the stage of leading, and the whole body center of gravity of these two technologies is slightly smaller than that of other backward loop technology.

4.4 Kinematics Analysis of Trunk

The twist angle of the body trunk of the two kinds of technical movements has a downward trend. The potential energy is converted into kinetic energy, and then the kinetic energy is transferred to the upper limb and acted on the ball by the trunk.

4.5 Upper Limb Kinematics Analysis

The changes of the upper limb joint angles of the two techniques are similar, in which the changes of the shoulder joint are small, and the elbow joint angles show a downward trend, but the decrease of the elbow joint angles of the forehand backward arc ball technique is obvious, and the changes of the upper limb joint angles are similar, in which the changes of the shoulder joint are small, and the elbow joint angles show a downward trend. However, the angle of elbow joint of the reverse pull loop is smaller than that of the reverse pull loop.

5. Conclusion

According to the analysis of the movements of the two techniques, the following conclusions are drawn: due to the important role of the body trunk in table tennis, it is necessary to strengthen the exercise of the muscles on both sides of the body trunk and the biceps and triceps of the upper limbs, especially the small muscles of the forearm, so as to improve the speed of arm swing. In the training of the details of backhand loop movement, we should pay attention to the power sequence of each joint of the body, starting from the power of the right ankle joint, pay attention to the conversion of the center of gravity and hip rotation and other details of training, master the transmission of forehand backhand forward loop and backhand high hanging loop movement strength direction, and be able to find the relationship between the two technical movements in the process of touching the ball Key timing, so as to more effectively improve the reverse loop technology.

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