

## **4 Application and outlook about Sports Biomechanics in table tennis**

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### **1 Introduction**

It is well known that Sport Biomechanics plays an important role in improving the technique level of all the sport events. The method and means of Sports Biomechanics have been applied in many sport events, but the application of Sport Biomechanics in table tennis is limited. In recent years, the ITTFSC has taken three great reformations in table tennis match rules, which influences the techniques of table tennis. In order to promote the development of table tennis, we should ask for the help of technological power to recognize the regulation of table tennis more completely and deeply.

According to the actuality of the biomechanical researches on table tennis, the development trend of Sports Biomechanics, and the development of table tennis, the authors analyzed the application and outlook of Sport Biomechanics about table tennis. This paper was expected to use for reference on how to apply Sports Biomechanics into Table Tennis efficiently.

### **2 The outlook on research contents of Sport Biomechanics in table tennis**

Seeing from the angle of Sports Biomechanics, the event of Table Tennis is an activity, which includes the activity of the athlete (motor technique), the activity of ball in the air (speed, revolve, curve), and the collision activity of ball with the racket and the table. To analyze and research those three parts of activities in biomechanics, some certain equipments and methods are required. The former sport biomechanical studies on the activity of table tennis have focused on the above aspects. But the researches on the flying of ping-pong ball, the motor technique and the principle of collision are not sufficient, and the studies on the sport equipment and the sport cloth are few.

According to the developing trend of Sport Biomechanics and table tennis, it can be anticipated that the applied research field of biomechanics in table tennis is that the research on the technique research will still occupy the big comparison, at the same time, the research can be carried out in the aspects of

sports for all, sports medicine, recovering medicine, exercise machine, clothing and experimenting instrument equipments etc. The following concrete studies can be carried out:

- (1) on the diagnosis of the technique of the table tennis players.
- (2) on the collision of ball and the racket, ball and table tennis table
- (3) on the movement of the racket
- (4) on the manufacture of the racket and playsuit of the table tennis players
- (5) on the character of muscle and skeleton of the table tennis players
- (6) on the exploration of the experimental apparatuses fitted for table tennis
- (7) on the mechanism and prevention of players' trauma

### **3 The outlook on research methods of Sports Biomechanics in Table Tennis**

The research methods, which are about applying Sport Biomechanics to Table Tennis, can be divided into two types: the first is the research method of theoretical mechanics; the second is an experiment research method. Those two methods should be combined closely, so that Sport Biomechanics can be betterly applied to the research on the table tennis.

#### **3.1 The outlook on the research method of theoretical mechanics in applying Sport Biomechanics to Table Tennis**

This research method is to imitate the movement of human being by the method of simulation means, which includes five steps generally: First, confirming the sports character, establishing the target function; second, choosing the rigid body model and confirming the free degrees of the rigid body; third, establishing the dynamics model; Fourth, acquiring the known datum by the experimental method, and then putting the datum into the function. ; Fifth, using the result of the function to explain the sports regulation. This step is changing the mathematics regulation that acquired by the function into the sports language, which can give the sport technique a reasonable guidance.

The present research condition of applying Sports Biomechanics to table tennis is that the previous study only made use of the mechanics principle to explain the some phenomenon of table tennis, and made few use of the theoretical mechanics. Using the theoretical mechanics, many problems of table tennis can be researched.

For example, in the previous studies of the wounds of the table tennis players, there is little study on the quantitative analysis of the force and the moment of wrist, elbow, shoulder, cervical vertebra, waist vertebra etc during the process of attacking ball. And those studies are beneficial to the cognition and prevention of the wounds to the table tennis players. The joint force and moment can be calculated by the method of theoretical mechanics. According the above ap-

proach, the joint force and moment of the upper limb can be calculated. First, confirming the sports character of the table tennis player's attacking ball, and then establishing the target function; second, choosing the upper limb rigid model (upper arm, small arm and hand which includes ball), the number of the free degrees of the upper limb is 7; third, using the method of Kane to establish the dynamics model; Fourth, acquiring the kinematics parameters of the upper limb by the method of upper limb, and then calculate the joint force and the moment of wrist, elbow, shoulder; Fifth, using the result of the joint force and moment to explain the motion wounds of table tennis players.

There is no quantitative analysis on the motion extent of attacking ball with racket. The motion extent of attacking decides the quantity of the attacked ball. The work loop theory can be used.

### **3.2 The outlook on the experimental method in applying Sports Biomechanics to Table Tennis**

The present condition of the experiment research method of Sports Biomechanics applied to the table tennis is that the dynamics research is quiet a few at all, kinetics test is some, and used biomechanics apparatus are also a few too. So, experimental research method in table tennis research has a large development space in future.

#### **3.2.1 The extensive application of the common Sports Biomechanics apparatus to Table Tennis**

The common Sports Biomechanics apparatus, such as 3 - D force platform, muscle electricity apparatus, foot bottom pressure shoe mat apparatus, have been used widely in other sports event, but they are used a little in the sports event of table tennis. 3 - D force platform can show the ground reaction force to the human body. The attacking force with racket of the table tennis player is reflected by the GRF. But the dynamics characteristic of GRF of table tennis player have not described until now. The muscle electricity apparatus can be used to describe the strength and time of the activity of participating muscle when completing a certain sports motion, making sure the primary participating muscle. When it is used in the table tennis player, it is clear to know the forcing order of participating muscle when attacking the ball, which can offer conference on the strength training in table tennis players.

#### **3.2.2 Developing specialized and quick - feedback technique testing apparatus**

Developing specialized and quick - feedback technique testing apparatus is the developmental trend of Sports Biomechanics testing apparatus. There has been no such apparatus in table tennis field so far. But such specialized and quick -

feedback testing apparatus has been applied to other sports events, such as Gymnastics, Track and Field, Boating, Swimming, Skating, etc. .

The specialized testing apparatus of the other sports events can give light to the research of Table Tennis. For example, an acceleration sensor perhaps can be fixed on the racket. With the quick development of technique, the volume and mass of the acceleration sensor can be very small, and the accuracy of it can be very high. So if such an apparatus is used, it can supervise and control the 3 - D speed, acceleration and angle speed of the racket, and then the force of the racket, the beginning speed of ball can be calculated.

The other assumption is that four pressure sensors can be fixed beneath the table of table tennis. The whole table is viewed as a big force platform. So the collision of the ping - pong and the table can be described clearly. The speed, angle speed of the ball both before and after collision, the force of collision, and the point which the ball falling can be reflected timely and accurately too.

If these assumptions can be realized, the ping - pong theories knowledge can be enriched.

### **3.2.3 The research of the synchronous testing in a few testing apparatus**

The research of the synchronous testing in a few testing apparatus is the development trend of Sports Biomechanics research. The motion of the human being is very complicated. Therefore, the research of the synchronous testing in many testing apparatus is very important.

The technique of Table Tennis requires accuracy. But the former studies are most from the angle of 1 - D, to discover the regulation of Table Tennis more comprehensively, the study of a few dimensions is the developing trend of the application of Sports Biomechanics in Table Tennis.

For example, using the synchronous testing method of recording system and force platform system, the recognition of Table Tennis can be combined with kinetics and dynamics.

### **3.2.4 Applying the living creature feedback technique to the technique training of Table Tennis**

It provides the data of the speed, range, direction, power etc. for athlete, coach in the sport biomechanics test directly, but the athlete perhaps hardly control in training. If such test data converted into a signal hints of sound and light directly to the athlete, which means that its current action whether come to a request or a certain scopes or not, the athlete can make the reaction right away after receiving a signal, and then, the athlete can adjust the range, strength, speed of motion more easily.

In this study field, there has made a certain progress in other sports events. For example, Yan Songhua ( Ph. D of Beijing Sports University ) and her tutor

Prof. Jin jichun invented a pair of “testing shoe” for short running, which can supervise the time of landing and swinging of each step. And it was proved to be successful.

This testing method can be used to the Table Tennis training also.

#### **4 Conclusions**

According to the actuality of the biomechanical researches on table tennis, the development trend of Sports Biomechanics, and the development of table tennis, the authors analyzed the application and outlook of Sport Biomechanics about table tennis. The authors'view was that the outlook of the Sport Biomechanics in Table Tennis is to apply various sport biomechanical methods including the theoretical mechanics methods and experimental methods into many research fields of Table Tennis.

#### **5 References**

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