

3 The experimental research on the relationship between the biggest power of smash and the perimeter of handle

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1 Introduction

The five factors of the table tennis are velocity, strength, accurateness, the point of fall, rotating speed. The magnitudes of those factors are primarily decided by techniques, and are also decided by tools. In the last decade, within the scope of rule, the first - rank table tennis players in all countries have strongly noticed the quantity and the function of the racket. A number of the sport science researchers have studied and got results for manly deserving drawing lessons from the racket shape, weight, elasticity, feels, etc. Because ping - pong device equipments rule did not take into the concrete restrict of the perimeter of the handle, the majority of athletes rely on the experience or the help of the experienced player to choose the racket. It seems that there is no much relationship between the perimeter of handle and ping - pong sports. There has been little specialized research on the biggest power of smash and the perimeter of handle in the domestic and international literatures. From the angle of biomechanics and the Ergonomics, we can presume that when the athletes choose the certain perimeter of handle, and hold the handle with certain method, in other words, when the hand joint construction is certain and also the athlete training is certain. In this case, the biggest smash for the athlete will be within the certain scope, also this is related to the hand joint construction while the athlete is smashing, i. e. this is related to the perimeter of handle. Only if choosing the perimeter of handle fitly, can the athlete have an ideal joint construction and scope of smashing power? Improving the athlete action of already set will get the contrary result but perhaps it is the better way to change the perimeter of handle. Although the athlete can improve the power after improving the handle, on the one hand, they can gain initiative with the ball speed and revolving strongly; on the other hand, they can also threaten opponent mentally in competition. The thesis will find the fixed quantity in relation to the biggest smash and the perimeter of handle during experiments, and afford some use in refer-

ence to all kinds of athletes when they are choosing the appropriate perimeter of handle; On the other hand, the thesis will provide the way to study the shape of the racket and make the racket more characterized and humanized.

2 Methods and Materials

2.1 Participants

The subjects are 10 students who came from sport School of Beijing Sport University. All of them are male. Their ages are between 14 and 16 years old. The grade of the athletes is the first band - 1 of our country. The training time of the athletes is 8 to 9 years. The method of holding racket is straight and right hand.

2.2 Design

This research chose the maximal moment of velocity, which is the average velocity of the ball leaving the racket in 0.01 second, to replace the biggest power of smash, because it is difficult to measure the biggest power of smash. For the sake of decreasing the rotation of the ball and getting the maximal velocity of the ball, the subjects were required to smash, not to drive. In order to get the maximal velocity, we let the ball drop freely, and only with that the ball can be smashed easily.

2.3 Procedure

The box that puts on upright 1.1m from the table 20 cm, can control the single ball that choose three stars of double happiness (40 mm) to drop freely. When player is ready at the base line, operator makes the ball dropping freely from the box, and the player smashes with the maximal power at the regular action when the ball bounces on the top, at the same time, on the left side of the player 9m the other operator shoots the smashing action by high speed video (HSV - 400, 400 case/ second), and analyzes the velocity when the ball leaving the racket in 0.01 s as the maximal velocity of ping pong ball, and also the research considers that the velocity is the maximal smashing power for the athletes. Each athlete uses their own racket to smash with the maximal power three times at first and average the value as the maximal power with the perimeter of the handle for himself; once more everyone in turn smash the ball three times with the experiment - racket by the same perimeter of handle, and adopt average value of the maximal velocity as the maximal power of himself for the perimeter. There are 11 rackets, the perimeter of handle is 6 to 11 cm, and the player changes the racket per 0.5 cm, until all rackets are experimented.

Table 1. Racket and perimeter of handle

Racket number	1	2	3	4	5	6	7	8	9	10	11
Perimeter of handle(cm)	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11

3 Results and Discussion

3.1 racket parameters

In table 2 and table 3, we can see that, when the perimeter of handle is less than 7.5cm, the power of smash reduces obviously with athlete ($\alpha = 0.01, P = 0.0036, p < \alpha$); The data shows that the power of smash reduces obviously with athlete ($\alpha = 0.01, P = 0.0012, p < \alpha$) when the perimeter is over 10cm; We can also see that there is no notable difference between the maximal smashing power and the smashing velocity when the perimeter of handle is between 7.5 and 10cm. According to the data, the perimeter will affect the maximal power of smash, if the perimeter is too small or too big, only the appropriate perimeter is propitious to powerful smash. But appropriate perimeter is related to the length of fingers and palms etc.

Table 2. Players and the perimeter of handle need by themselves

Player serial number	1	2	3	4	5	6	7	8	9	10
Perimeter of handle(cm)	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Average of the max smashing velocity (m/s)	17.7	16.2	18.2	16.4	16.7	18.4	16.8	17.9	18.1	17.8

Table 3. The max velocity of different Players using the different perimeters of handle

	Perimeter of handle (cm)										
	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
1	10.2	11.8	13.5	15.8	16.6	17.4	17.8	17.4	17	14.5	12.5
2	11	12.6	13.1	15.6	16.2	17	16.8	16.4	16.2	14.8	12.7
3	10.9	12.4	14.2	16.1	16.9	17.8	18.4	18	17.6	15	12.9
4	10.6	11.8	13.4	15.9	16.7	17.6	16.8	16.4	16	14.2	12.4
5	11.1	12.1	12.7	15.4	16.6	17.4	16.8	16.6	16.1	13.8	13
6	10.2	12.2	13	16	17	17.5	18.2	18	17.2	14.8	12.7
7	10.4	11.6	12.6	15.6	16.4	17.2	17	16.2	15.8	13.6	13.2
8	10.3	11.9	13.6	16.4	17.2	17.2	17.5	17.1	16.5	13.4	12.2
9	10.6	12.1	13.2	16.8	17.4	17.6	18	17.8	17.1	14.2	13.4
10	10	11	12.9	16.5	17	17.2	17.6	17.6	17	14.2	13

3.2 The contrast analysis

In contrast to the table 2, we can see in table 3 that, the players of number 2, 4, 5 and 7 can have more power in smashing when the perimeter of handle is different from the perimeter they use usually, especially the player No 4. For the player No. 4, when he uses the perimeter of handle of 8.5, he could increase the power by 20% compared to his usual power. Perhaps the player No 4 feels that his racket has a better weight and feeling in hand etc. or the perimeter of handle is too little for him and not propitious enough to exert his maximal power, the author suggests him to reduce the perimeter of his handle in the case of keeping the constant circumstance in part of other rackets. The author suggests the player No. 2, 5 and 7 that, they could compare the result of experiment to adjust the perimeter of their handle, only with this, they could be benefit from exerting the power of smashing more.

3.3 The analytical result

From the result of experiment, we can see from the normal case that the better range for the perimeter of handle is 7.5 to 10 cm, but as to concrete player, because of individual difference and the method of holding difference, they could choose the perimeter of handle in a large range. We know that the player has better ability to adapt to the perimeter of handle, but the better range of them should not be over 1 cm. Thus the athlete must consider the affection of the perimeter of handle to him, and choose the suitable racket with the suitable perimeter of handle, in other words, the perimeter must be suitable to the athletes, and not the athletes adapt himself to the perimeter of handle when they are choosing rackets.

4 Conclusions and Suggestion

4.1 conclusions

(1) The perimeter of handle affects directly to the maximal power of smash. The maximal power of smash will descend when the perimeter of handle is over 10cm or less than 7cm.

(2) Each athlete has the perimeter for him to smash with the maximal power. While choosing the racket, he must choose the racket of which the perimeter suits him, instead making himself to suit the racket.

(3) This experiment can offer a method for measuring the maximal power of smash.

4.2 suggestion

(1) Experiment belongs to the measurements indirectly to the maximal power of smash. We could measure the maximal power of smash directly by installing

sensor on racket when the technology of sensor develops and the situation of the experiment is promised.

(2) The number of the subjects is little. We could not explain all problems of the maximal power of smash and the perimeter. So the author suggest that people must enlarge the quantity of the sample and the category of the subjects in order to obtain data completely and open the relationship between maximal power of smash and the perimeter of handle.