

The Technique Analysis of The China's Most Elite Female Hammer Thrower

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Abstract: Based on the hammer score at the 2017 London world championships, we had a study about the characteristics of the best Chinese female athlete Zheng Wang's hammer throw technique and improve her performance, we used biomechanical video analysis to analyze the technical characteristics of 6 world top female hammer players. We found that in the process of holding the ball, Zheng Wang's double stance and single stance phases in the first, third and fourth turn was reasonable, but in the second turn it was unbalanced. Zheng Wang's rotation were relatively faster, and rotation was fluent. She was one of the fastest female hammer throwers in the world. During the rotation in the last turn, Zheng Wang maintained the same rotation time as the third circle, which lead to less speed-up, compare with the third circle. During the rotation, the Angle of the fan was basically reasonable, but the increment of the second, third and fourth circle was unstable than that of the previous turns. Through the long-term observation of Zheng Wang's training and competition, it was found that there were some problems in the psychological stability of the competition.

Keywords: female hammer thrower, technical analysis, hammer throw

1. INTRODUCTION

The hammer developed late in China. In 1910, The Frist Sport Games had held in China and this competition events included the hammer, with a score of about 34 meters. At the time, the ball weighed only 12 pounds, so there was no official record of the hammer. With the continuous development of our country sports enterprise. In 2008, the Beijing Olympic Games, the China hammer throw athletes, Wenxiu Zhang, with 74.32meters scored in the history of track and field in China only a bronze hammer project. It is worth mention that Zheng Wang won a silver medal in the female hammer in the 2017 London world championships.

Top six female hammer players in the 2017 London world championships: Anita Wlodarczyk, Malwina Kopron, Zheng Wang, Wenxiu Zhang, Hanna Skydan, Joanna

Flodorow were taken as subjects, and Chinese hammer player Zheng Wang was the key point. Analyze the data of the athletes' presets, rotation of each circle, supporting time of single-foot and double-foot, etc. And to study the throwing processes and technical characteristics of the players.

2. METHODS

The six testers in this study are the elite female hammer throwers who participate in the 2017 London world championships: Anita Wlodarczyk, Malwina Kopron, Zheng Wang, Wenxiu Zhang, Hanna Skydan, Joanna Flodorow are taken as subjects, and Chinese hammer player Zheng Wang is the key point. Analyze the data of the athletes' presets, rotation of each circle, supporting time of single-foot and double-foot, etc. To study the throwing processes and technical characteristics of the players.

By China knowledge network, such as Web of Science literature database retrieval arrangement about hammer project related research results in recent years, analysis of recent data on women's hammer throw, providing theoretical basis for research.

In April 2017, we used the high-speed camera of German HSVISION to shoot the competition video in the Chinese track and field grand prix (zhengzhou station), We also have the women's hammer of the 2017 London track and field world championships video. By using the professional video analysis system, we analyzed the technical characteristics of the athletes and reached the conclusion.

3. RESULTS

Hammer technique is often divided into three major technical phases: preliminary swings, rotation and final exertion in teaching and researches. Athletes apply an initial force to the apparatus, so that the devices have initial velocities in the preliminary swings procedure. Rotation technology is the core part of athletes applying actual force to the apparatus, and usually top athletes in the world adopt four-circles rotation technology. Each rotation of the four circles is interchanged by single-foot and double-foot supporting respectively. Before throwing the hammer, athletes should try their best to surpass the device's action effect by technical motion and personal physical characteristics, so as to reach a better effect of imposing the power generate from motion to hammers. Relevant studies have also shown that: prolong double-foot supporting time and shorten single-foot supporting time is the development trend of hammer in the future, and it is also the direct expression of the modern hammer throwing technology [1].

3.1 Analyze the stance phase of each turn in rotation

Athletes in the hammer throwing process, each turn of the single, double stance phase to a certain extent, reflects the athlete's rotation rhythm and degree of acceleration. The double

stance phase is one of the main indicators to determine whether to give high-efficiency force to the instrument during the rotation. The higher percentage of the double stance phase within a reasonable range, To some extent, it can be judged the throwing effect improved.



Fig.1 The time data of single and double stance phase of each turn (s)

As can be seen from Fig.1, in the first turn rotation speed, Anita Wlodarczyk and Zheng Wang's double stance phase was about 0.31 seconds, and the difference is not large. The single-and-double stance phase ratio is above 1, the ratio is more reasonable. Some studies show that: the best ratio of the double stance for the total rotation time is about 55% [3]. Anita Wlodarczyk's double stance in each turn accounted for 53%, 57%, 53%, 50% of the total stance phase, respectively, which is relatively stable and more fluent. Zheng Wang's double stance accounted for 48%, 52%, 50%, 51%, respectively. The double stance in the first turn didn't reach 50%, which means the propulsion of the lower limb was not enough.

3.2 Analysis of the rotation time of the top six female hammer players in the World Championships in London

The top six female hammer players in the 2017 world championships in London all adopted four-circles rotation technology. They used the rotation technique to complete each circle with single-foot and double-foot supporting, and speed up the swing through the interchange and adjust supporting. The table below is analysis of the top six female hammer players' single-foot and double-foot supporting time in the World Championships in London.

The above table shows that: in the acceleration phase of the first lap, all the six athletes' double-feet supporting time is in the mean of 0.33 seconds. All the supporting time ratios of single-foot and double-foot are greater than or equal to 1, this means the supporting time ratios are reasonable. Relevant researches show that the rotation effect is the best when the double-foot supporting time accounts for 55% of the total rotation time [2]. During the second circle of Zheng Wang's rotation, there was an imbalance in the supporting time of single-foot and double-foot, and double-foot supporting time increased from 50% in the first lap to 61.54%. However, a slight imbalance occurred in single-foot and double-foot supporting during the

rotation of the second circle, double-foot supporting time too long affects the acceleration process and final throwing effect [3].

3.3 Analyze the rotation time length of each turn during rotation

The time length of rotation affects the speed of rotation and throwing of the athlete, and the total time length of rotation is made up of the rotation time of each turn. The length of rotation time and the stability of each turn greatly affect the throwing velocity of the athlete. In order to obtain the best initial velocity and throwing distance, the players are required to shorten the rotation time of each turn, so that the sports equipment has a greater acceleration.

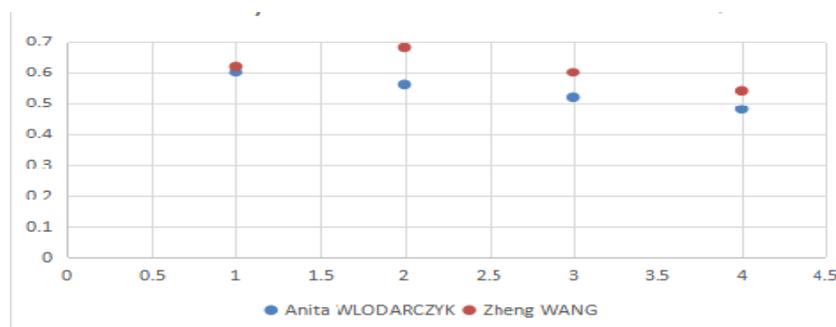


Fig.2 Analysis of rotation time of each tur (s)

We can see from Fig.2, Anita Wlodarczyk four turns rotation time consistent with the regular of shortening the time, more reasonable. And Zheng Wang four turns rotation time has fluctuated, the first turn time slightly less than the second turn time, indicating the first turn and the second turn movement cohesion is not smooth, the second, third and fourth turn basic in line with the regular of rotation.

3.4 Analysis of total rotation duration of athletes

The four-circles rotation is the process of speeding up hammers through athletes' rotation, and acquire bigger initial velocity throwing distance. There is obvious difference in rotation time in each lap of different athletes. Times should be gradually shortened from the first lap to fourth lap by acquiring acceleration through rotation. The longest rotation time is Zheng Wang, about 0.64 seconds. Malwina KOPRON took the shortest time of 0.56 seconds, the other athletes took 0.60 seconds. The average time of the six athletes in the first lap was 0.60 seconds. The longest time in the fourth lap is Wenxiu ZHANG, which is 0.52 seconds. The shortest was Zheng Wang and Malwina KOPRON, which lasted for 0.44 seconds. The average time of the six athletes in the fourth lap was 0.47 seconds. In this six athletes, only Anita WLODARCZYK had a linear change from the first to the fourth lap, the overall change trend was 0.60-0.56-0.52-0.48 seconds. It shows that Anita WLODARCZYK has stable acceleration and

fluent movements in all the four cycles. Therefore, she gained a better performance. The rotation times of Zheng Wang in the first three circles are also basically linear, which are 0.64-0.52-0.44 seconds and the acceleration is obvious. While in the fourth laps, Zheng Wang's time was also 0.44 seconds, which was the same as that of the third circle, and the rotation speed was not increased considerably. Changes in speed during the rotation of other athletes also showed signs of instability. Analysis shows that the rotation time of Zheng Wang in the last lap is the same as that of the third circle, the rotation speed is similar. This is the technical adjustment to maintain stability, but it will affect the maximum speed of the final shot.

3.5 Fan analysis of the rotation of top six female hammer athletes in the World Championships in London

In the researches of hammer, the angle of the fan is used to reflect the ability of the players to overcome the centrifugal force caused by the device [4]. The angle of the fan is also called angle of the hammer's track, it is the angle between the line from the lowest point to the highest point and horizontal plane. In the process of acceleration, as the rotation speed of the athletes accelerates, the lowest point of the hammer should gradually decrease, and the highest point should gradually increase, thus the angle of the fan should be gradually larger [5]. Angle of the fan is the main parameter to determine the ability of the athlete to overcome the centrifugal rate and the control ability of the device. The larger angle of the fan is, the stronger the ability to overcome the centrifugal rate of the athletes and the control ability of the apparatus would be. As the rotation speeds up and the speed of the hammer is increasing, the centrifugal effect of the apparatus is increasing. Thus athletes need to constantly change the position of body movement so that the angle of the trajectory of the instrument and the position of the lowest and highest points meet the requirements of the modern throwing technique.

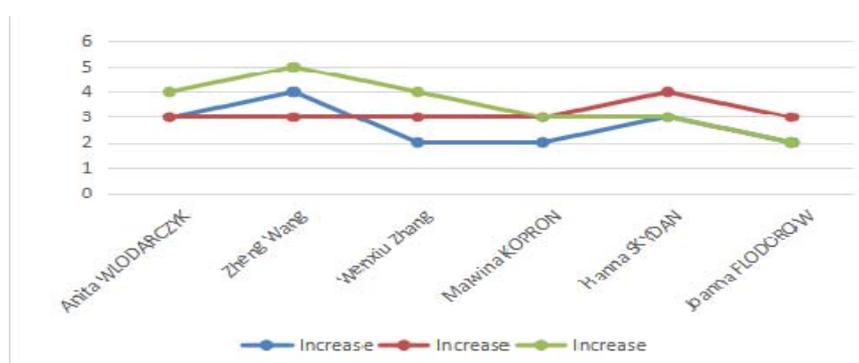


Fig.3 Angle incremental comparison diagram

According to statistics and analysis of the angle in Fig.3, it can be seen that during the throwing process of the six athletes, the average angle of the fan from the first lap to the fourth circle increased from 28.8 degrees to 31.5 degrees, 34.7 degrees and 38.2 degrees respectively.

Both Anita WLODARCZYK and Zheng Wang were close to the mean value. In other words, the average angle of fans of the first six athletes was close to Anita WLODARCZYK and Zheng Wang, and the comparative analysis showed that Zheng Wang and Anita WLODARCZYK had reasonable angles of rotation, and angles of delivery were moderate.

After analyzing the incremental changes in the angle of fan of the six athletes in the process of rotation, we can see that the champion, Anita WLODARCZYK, the angle increment was 4, 3 and 3 respectively, and the angle increment was from large to small. In addition, Wenxiu Zhang and Malwina KOPRON's angle increment in rotation also showed an increasing trend. It is shown that these athletes have good control ability in the process of rotation. In the rotation process of Zheng Wang, the angle increment is 5, 3 and 4 respectively, and the stability of angle increment is not strong lead to the weakness of Zheng Wang's control of the apparatus.

4. CONCLUSION

Wang maintained the same rotation time as the third lap during the rotation of the last lap, and acceleration was not obvious compared to the third circle. It is harmful for athletes to break through themselves and create better athletic performance.

During Zheng Wang's rotation of hammer, the distribution of single-foot and double-foot supporting time in the first, third and fourth laps are reasonable, but that of the second rotation is unbalanced, the ratio increased to 1.6, which is beyond 55% (double-foot supporting time should account for 55% of the total rotation time). This leads to instability of the "man-hammer" system and in turn affects the acceleration smoothness and final throwing effect.

Throughout the throwing process, Zheng Wang's single and double stance phase were shorter than Anita Wlodarczyk's. In the first turn, double stance phase only took up 48%, which was not conducive to the subsequent rotation acceleration. It is suggested that the training of hammer throw should pay attention to the ratio of single and double stance phase during the rotation, which could make the technical movement of the athlete more fluent.

Zheng Wang's time in the overall rotation and throwing process is relatively short, and has a good rotation fluency. She is one of the fastest female hammer players in the world to complete the whole throwing process. However, in the meantime of fast completion of action, perfect performance of the technical stability needs to be improved.

Angle of fan in the rotation of Zheng Wang is basically reasonable, but the increment of the second circle, the third circle and the fourth circle is more unstable than that of the previous circle. The angle increment is "5-3-4", this "large - small - large" angle increment reflects the inadequacy of the control ability and the unreasonable changes in body posture of Zheng Wang in the process of rotation and acceleration.

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