Effect of Strength Training on Forehand Pull Quality of Table Tennis Players under Eagle Eye Measurement

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Abstract: Objective: This study aimed to investigate the impact of strength training on the quality of the forehand pull technique in table tennis players.Methods: Two Chinese national second-class table tennis players, both aged 32, were selected as the experimental subjects and underwent a 4-week strength training program. The training program consisted of two sessions per week, including full-body strength training and special strength training.Results: Using the Eagle Eye System, the forehand topspin and backspin processes of the two athletes were recorded and analyzed. The results indicated that the athletes made some progress in their forehand pull technique, although the improvement was not statistically significant. Notably, the stability and speed of their return shots showed improvement.Conclusion: Continuous full-body and special strength training did not yield significant improvements in the quality of the forehand pull technique in table tennis players. The enhancement of a specific technique in table tennis relies more on skill utilization than solely on strength training. These findings provide valuable insights for coaches and players, highlighting the need to emphasize personalized training plans that consider the importance of strength training. Moreover, the Eagle Eye System proved to be an effective measurement tool for evaluating technical improvements and monitoring athlete progress.

Key words:strength training, table tennis, forehand pull, eagle eye system

1 Introduction

As a sport with high technical and speed requirements, table tennis has an important impact on the forehand pull technology of athletes[1] . Forehand pull is one of the most commonly used hitting methods in table tennis matches. Its accuracy, stability and rotation speed have a significant impact on the results of the game[2]. Therefore, it is of great significance to improve the level of athletes' forehand pull technology. Strength training is widely used in sports training, and has been proved to improve athletes' explosive power, strength output and body control ability[3] . However, in the field of table tennis, the higher the level of athletes, the more difficult it is to find the subtle changes reflected in the training. Therefore, we need to use the eagle eye system to observe the technical changes of athletes in order to get the changes of athletes' technical level after strength training[4] . At the same time, strength training is not much in the training of Chinese table tennis professional teams. Speed training, sensitivity training and endurance training often occupy the majority of physical training[5] .

ITEI 2023, November 24-26, Zhengzhou, People's Republic of China

DOI 10.4108/eai.24-11-2023.2343582

Through this experiment, we try to find out the reasons, and do not provide a theoretical basis for the reasonable arrangement of physical training[6] .

As an advanced measurement tool, Hawk Eye system shows great potential in the evaluation and analysis of batting technology. It can track and record the trajectory, speed, height of the ball passing the net, impact point and other data in real time, and provide objective and reliable results[7] . By using the eagle eye system for measurement and analysis, we can more accurately evaluate the performance of athletes in forehand pull technology, and monitor any changes that may be caused by strength training.

2 Method

2.1 Experimental object and test method

The subjects were two 32 year old Chinese national second-class athletes, both of whom were college teachers. The test method is as follows: two players take turns to test forehand topspin and forehand backspin. The ball is served by a unified serve machine with the same rotation and speed. Each player has 20 balls in each item. The process is recorded by eagle eye. After 4 weeks of strength training, the two athletes were tested twice, and the content and equipment were the same as before 4 weeks.

2.2 Training arrangement

The strength training program implemented in this study aimed to enhance muscular strength and power. The program consisted of two sessions per week: a full-body strength training session and a special strength training session. The specific details of the exercises, sets, and repetitions performed in each session are as follows:Full-Body Strength Training:Squats: Five sets of squats were performed, with each set consisting of three repetitions. The weight used for squats was set at 100 kg. Squats are a compound exercise that targets the lower body, particularly the quadriceps, hamstrings, and glutes.Sit-ups: Five sets of sit-ups were performed, with each set comprising 30 repetitions. Sit-ups are an effective exercise for strengthening the abdominal muscles.Push-ups: Five sets of push-ups were performed, with each set consisting of 20 repetitions. Push-ups primarily target the chest, shoulders, and triceps.

Special Strength Training:Weighted Racket Exercises: Five sets of weighted racket exercises were performed, with each set comprising 50 repetitions. The weight of the racket used was set at 3 kg. These exercises involve swinging the racket to improve upper body strength and power.Elastic Belt Exercises: Five sets of exercises using an elastic belt were performed. Each set consisted of 50 repetitions of pushing and rotating movements. The elastic belt used had a resistance of 30 pounds. These exercises aim to enhance core strength and rotational power.

By incorporating these exercises into the strength training program, participants were able to target various muscle groups and improve both overall strength and specialized strength for specific movements in table tennis.

2.3 Introduction to the program of eagle eye system

The Eagle Eye System used in this study is the Pombert Hawk Eye Seeker, a cutting-edge technology designed to enhance the analysis and evaluation of table tennis performance. The

system incorporates advanced functions and technologies to provide comprehensive data and insights.

High-Definition Cameras: The Hawk Eye system is equipped with two high-definition cameras that capture table tennis actions with exceptional clarity. These cameras have an 8-core processing chip, enabling them to capture up to 240 photos per second. The high frame rate ensures precise and detailed analysis of player movements and ball trajectories.Wide Coverage: The cameras in the Hawk Eye system have a wide field of view, covering a width of 270. This extensive coverage allows for comprehensive monitoring of the table tennis table and captures the entire playing area. The cameras are positioned directly above the center of the table, ensuring optimal visibility and accurate tracking of the ball and player positions.Marking System: Before recording and testing begins, the four corners of the table tennis table are marked. These markings serve as reference points for the system to accurately track the ball's movement and determine its position on the table. The precise tracking capabilities of the Eagle Eye System contribute to the accuracy of the data collected and analyzed.Data Analysis: The captured video footage is processed and analyzed using sophisticated algorithms and software. The system can track the trajectory of the ball, measure the speed and spin of each shot, and provide detailed statistics on player performance. This data analysis enables coaches and players to identify strengths, weaknesses, and areas for improvement in technique and strategy.The Eagle Eye System, with its high-definition cameras, wide coverage, precise tracking, and advanced data analysis capabilities, offers valuable insights into table tennis performance. It provides coaches and players with objective and comprehensive feedback, facilitating skill development and strategic refinement.

3 Result

The assessment requirements for the return ball are as follows: 1. it is qualified if the return ball falls to the left 1/3 platform and is 2/3 close to the baseline; 2. if the return speed is between 13m/s and 16m/s, it is qualified; 3. it is qualified if the height between the ball and the net edge is 0m-0.03m.

As shown in Figure 1, it is the test data of forehand topspin ball before the training of a, and Figure 2 is the test data of forehand topspin ball after four weeks of strength training. We can find that the rate of reaching the standard of falling point has increased from 62% to 75%; The rate of reaching the standard of ball speed increased from 66% to 81%, and the average ball speed increased from 14. 11m/s to 14.57m/s; The standard rate of the height of the ball distance net increased from 66% to 81%, and the average height increased from 0.04m to 0.05m.

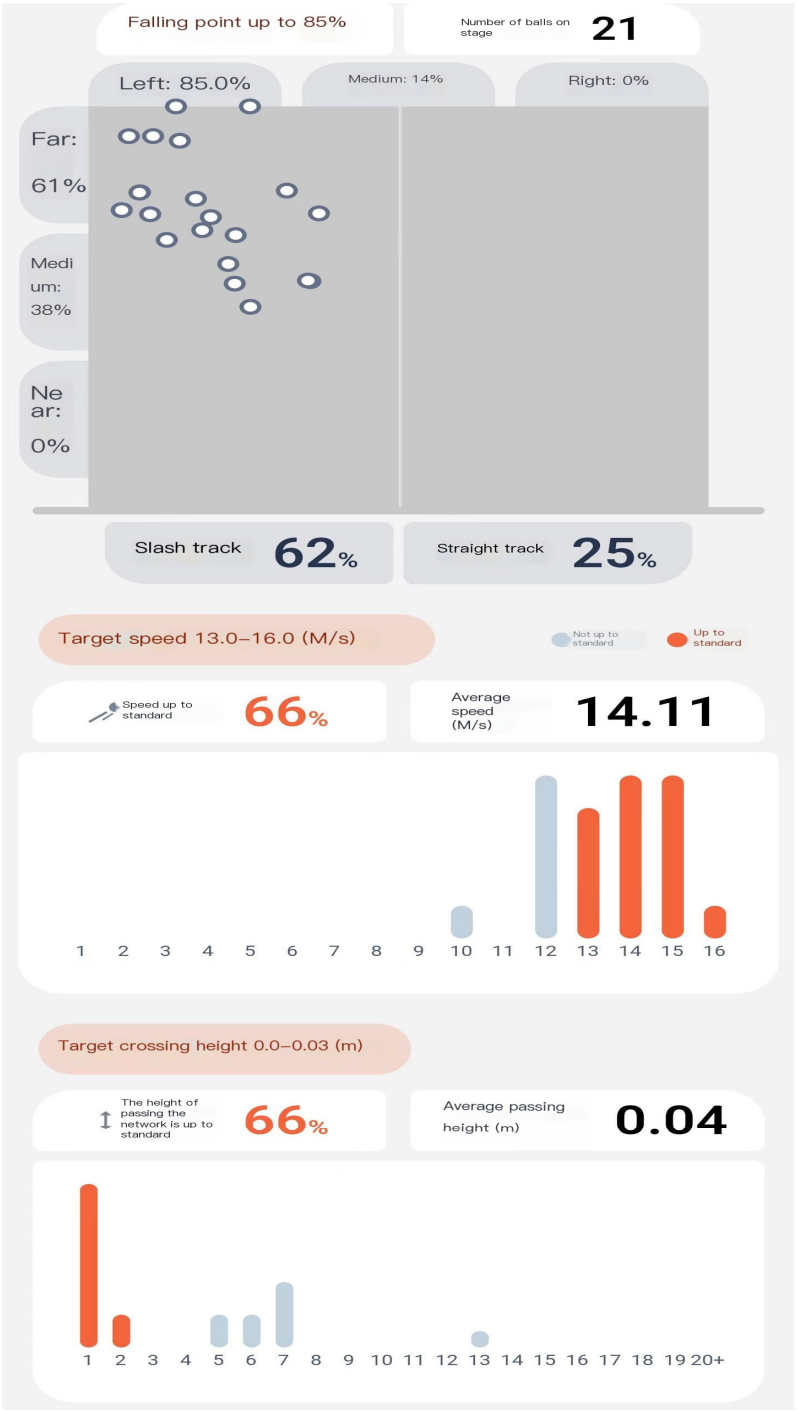

Figure 1. Forehand topspin before training A

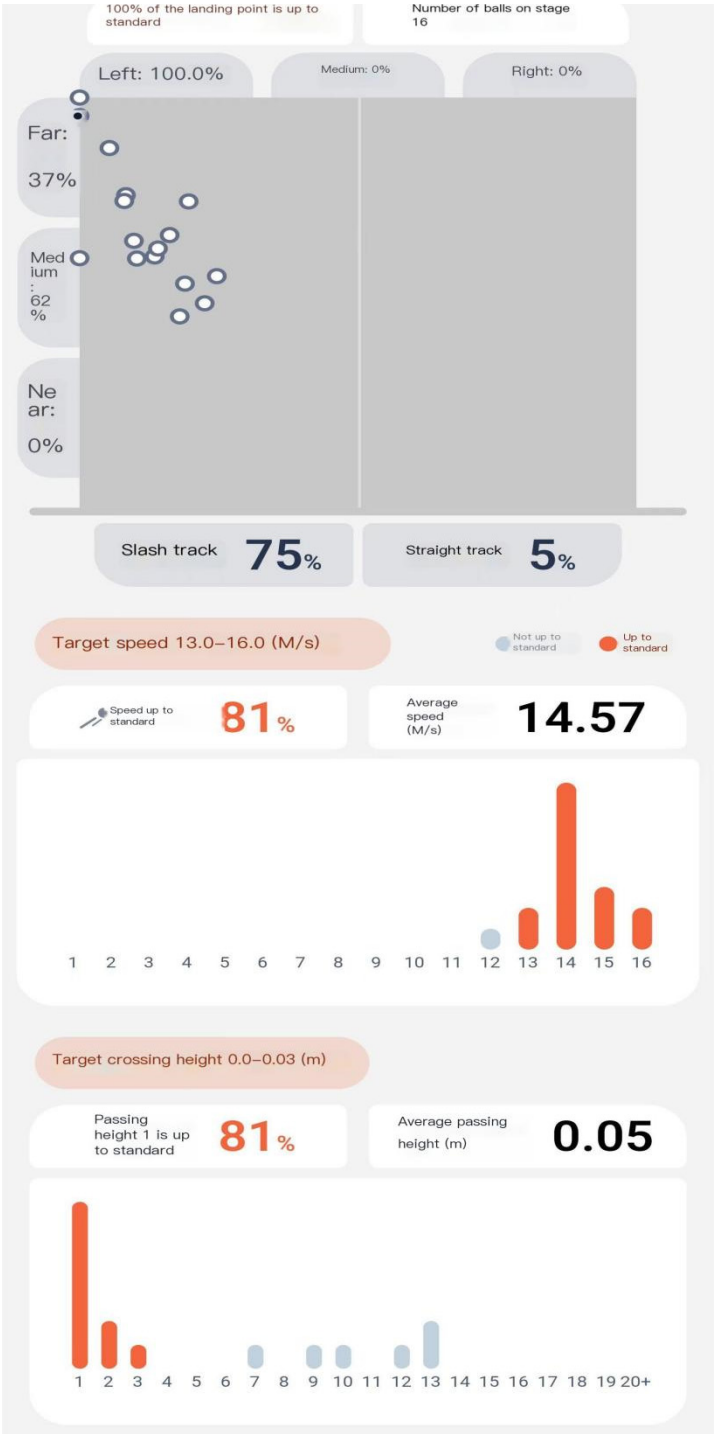

Figure 2. Forehand topspin after training A

As shown in Figure 3, it is the test data of forehand topspin ball before the training of B, and Figure 4 is the test data of forehand topspin ball after four weeks of strength training. We can find that the rate of reaching the standard of falling point has decreased from 85% to 45%; The rate of reaching the standard of ball speed increased from 83% to 86%, and the average ball speed increased from 14.25m/s to 14.31m/s; The standard rate of the height of the ball distance net increased from 83% to 86%, and the average height decreased from 0.06m to 0.04m.

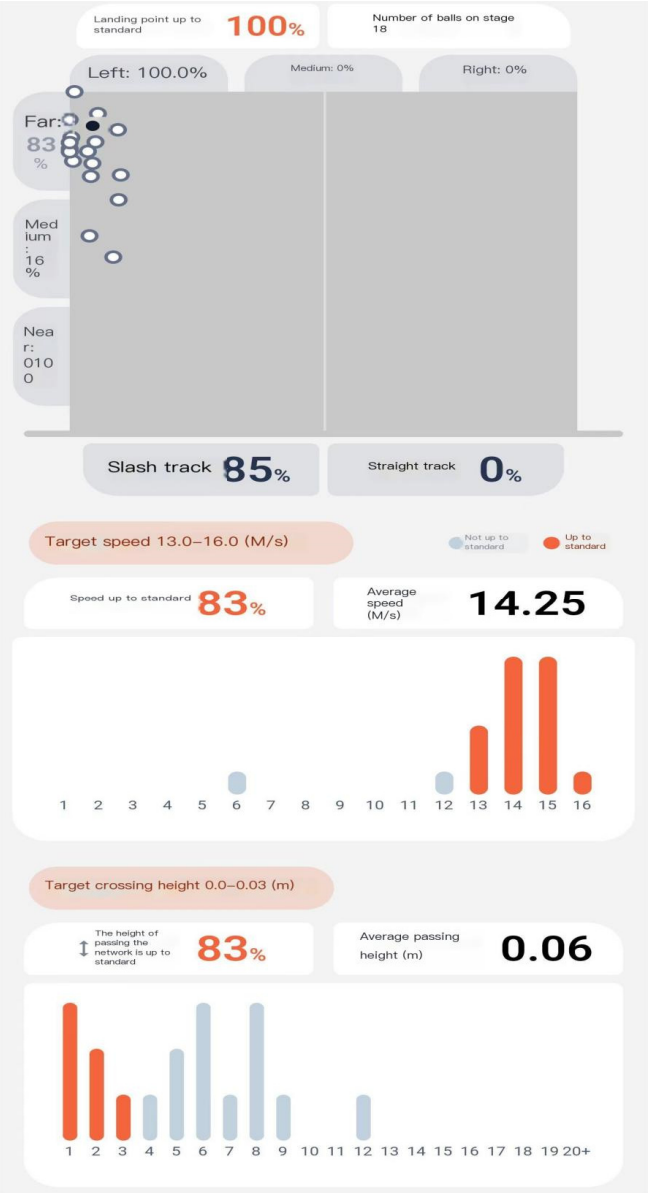

Figure 3 Forehand topspin before training B

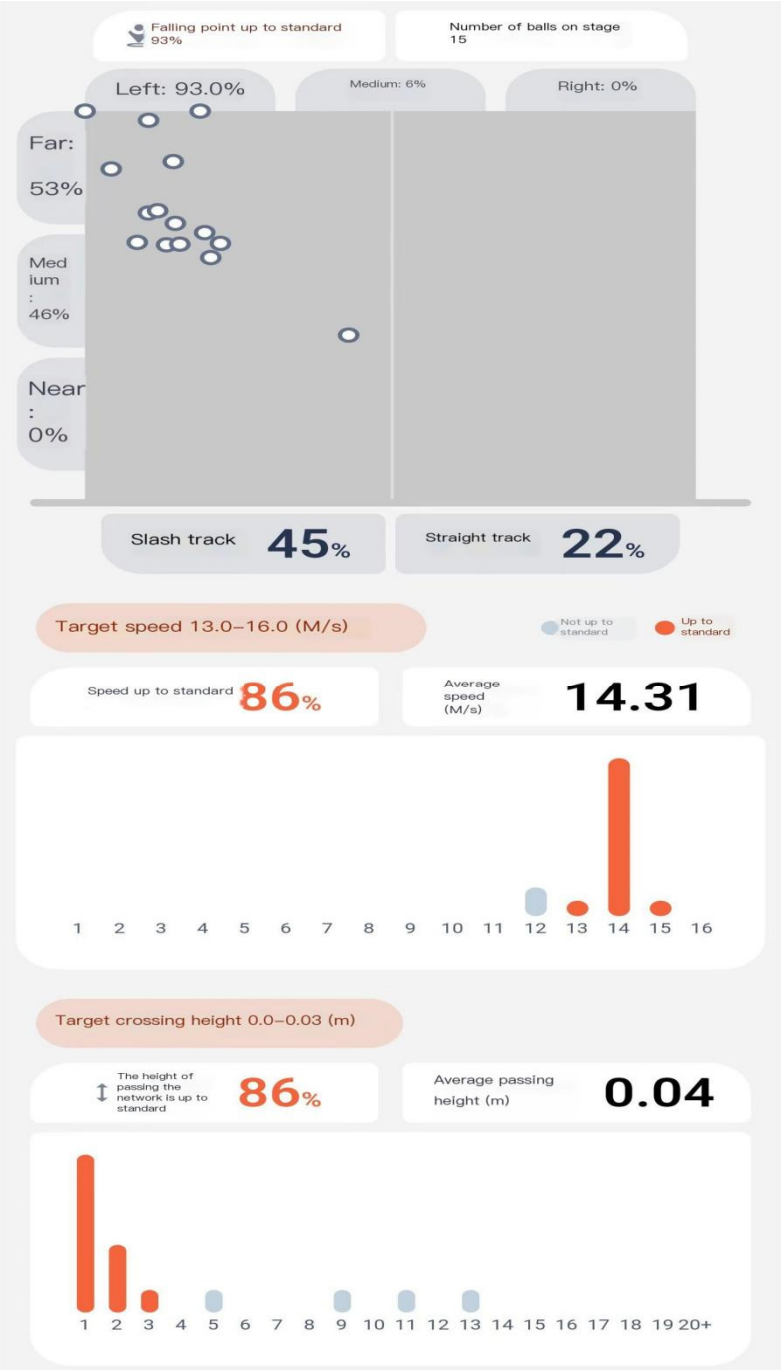

Figure 4 Forehand topspin after training B

As shown in Figure 5, it is the test data of forehand underspin punch ball before the training of a, and Figure 6 is the test data of forehand underspin punch ball after four weeks of strength training. We can find that the rate of reaching the standard of falling point decreased from 70% to 65%; The rate of reaching the standard of ball speed increased from 35% to 38%, and the average ball speed increased from 13.66m/s to 13.68m/s; The standard rate of the height of the ball distance net increased from 35% to 38%, and the average height increased from 0.04m to 0.05m.

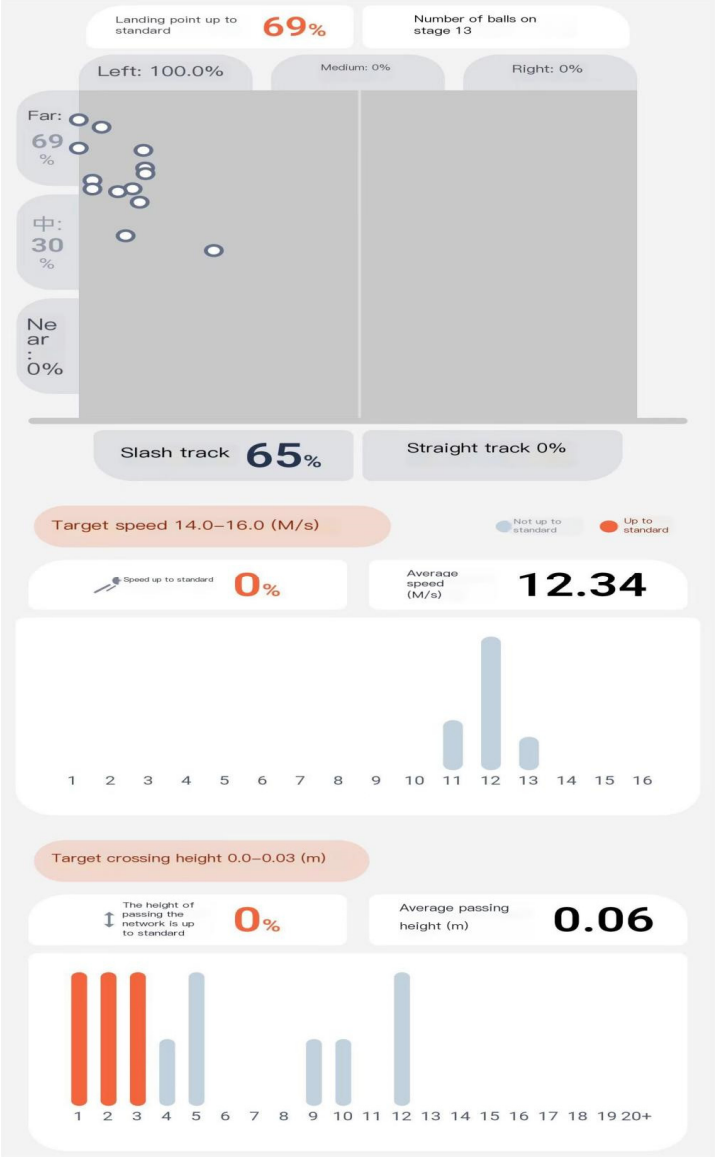

Figure 5 Forehand underspin dash before training A

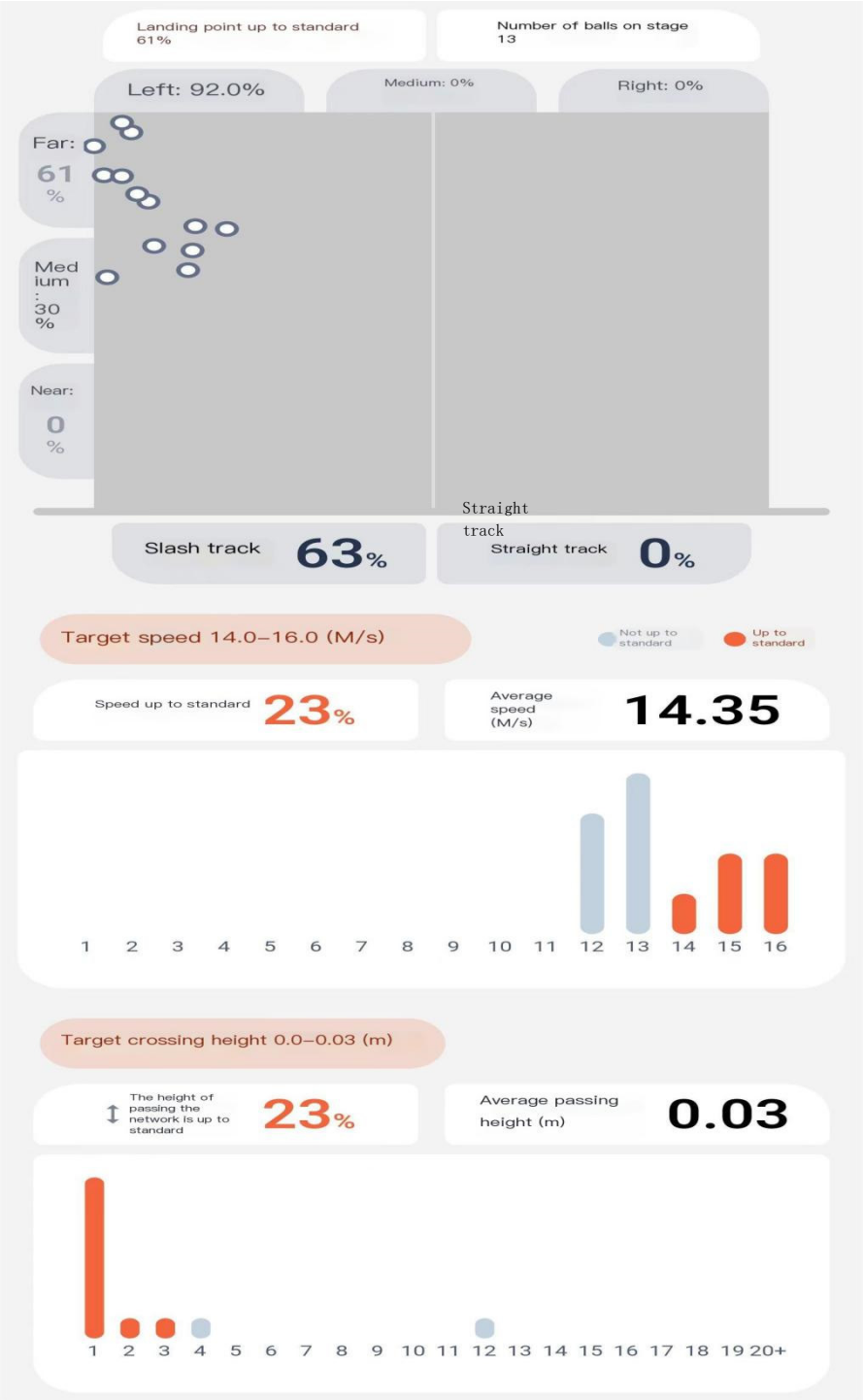

Figure 6 Forehand underspin punch before training A

As shown in Figure 7, it is the test data of forehand underspin punch ball before the training of B, and figure 8 is the test data of forehand underspin punch ball after four weeks of strength training. We can find that the rate of reaching the standard of falling point has decreased from 65% to 63%; The rate of reaching the standard of ball speed increased from 0% to 23%, and the average ball speed increased from 12.34m/s to 14.35m/s; The compliance rate of the height of the ball distance net increased from 0% to 23%, and the average height decreased from 0.06m to 0.03m.

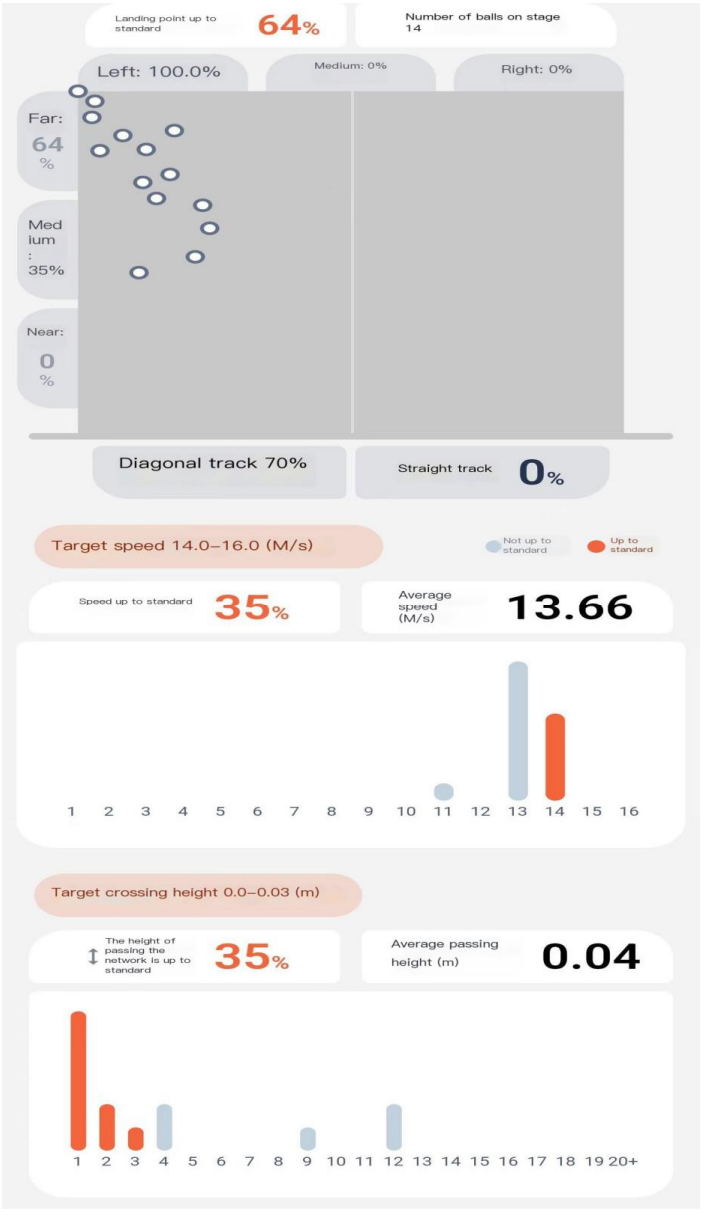

Figure 7. Forehand backspin punch before training B

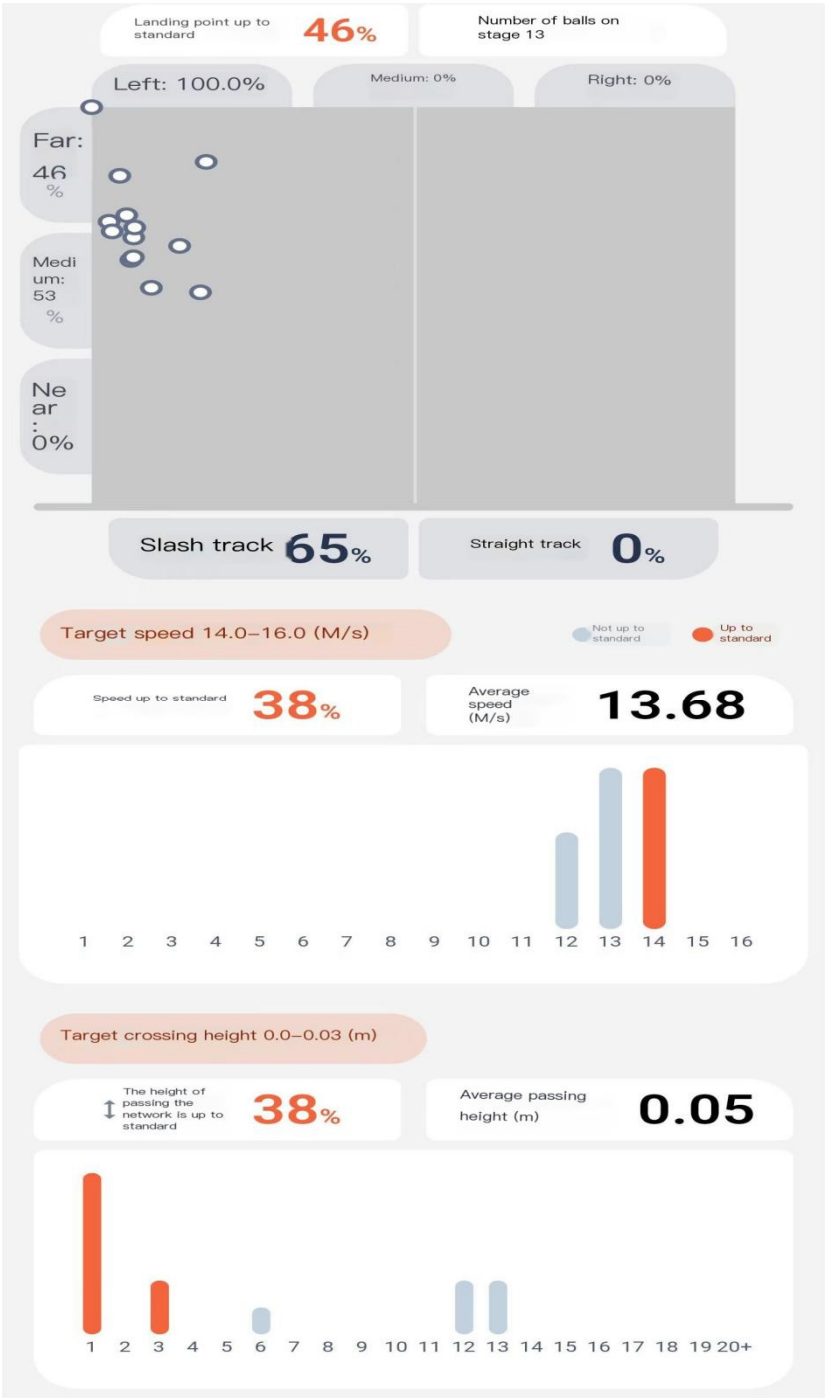

Figure 8. Forehand backspin punch after training B

4 Discussion

After four weeks of strength training, a comprehensive analysis of the recorded data on forehand topspin and backspin was conducted, leading to the following conclusions:Player A:Forehand Topspin Technique: Player A demonstrated a significant improvement in performance. The compliance rate of the falling point increased from 62% to 75%, indicating better control and accuracy. The stability of the ball improved significantly, as evidenced by the increase in the speed compliance rate from 66% to 81%. Additionally, the average speed of the shots increased. The rate of reaching the standard height of the ball from the net also improved from 66% to 81%. Although the average height increased, the rate of reaching the comprehensive net height standard indicated a lower average ball arc. These changes in data indicate significant progress, particularly in the stability of movement.

Player B:Forehand Topspin Technique: Player B did not show significant improvement in the forehand topspin technique, and some indicators even displayed a downward trend. The compliance rate of the falling point dropped from 85% to 45%. Although there was a slight improvement in the ball speed compliance rate and average ball speed, and the ball off the net height was reduced, indicating improved ball quality, there were major stability issues.

Significance Criteria:The significance of the observed improvements was determined based on specific criteria set by the researchers. However, the exact significance criteria used in this study were not explicitly mentioned in the provided information.

Interpretation:The strength training program designed by the coach targeted the muscles required for the forehand topspin technique, including both full-body strength training and special strength training. However, the athletes' performance in individual techniques did not improve significantly. This suggests that in table tennis, the impact of strength training on the improvement of individual techniques for normal athletes may not be as pronounced as the improvement achieved through skill development. It is possible that changes in timing, stroke execution, and playing style may have a more noticeable effect on shot quality.

Role of the Eagle Eye System:The Eagle Eye System, specifically the Hawk Eye system, played a crucial role in this experiment. By utilizing the Hawk Eye system to test forehand topspin and backspin shots, key data such as hitting point, ball speed, and ball arc were accurately recorded and analyzed. These data values are often imperceptible to the naked eye, highlighting the system's ability to provide an objective basis for evaluating changes in players' technical abilities. The Eagle Eye System contributes to a better understanding of the influence of strength training on the quality of the forehand pull technique in table tennis.

5 Conclusion

After 4 weeks of continuous strength training, player a has made significant progress in the forehand topspin technique, showing better control and stability. However, player B did not show significant improvement in the same technology. As for the forehand reverse spin technique, there was no significant change between the two players in this study. It should be noted that the results of this study are only based on the data of two 32 year old Chinese national secondary athletes, and only cover 4 weeks of strength training. Therefore, we should

be cautious in the promotion of these conclusions, and consider other factors such as individual differences, training plan and time. Further research can expand the sample size and extend the training cycle to obtain more comprehensive and accurate conclusions. In addition, the application of eagle eye system in table tennis technology research is also worth further exploration and development.

Acknowledgments.This study is supported by a university-level project of Tianjin University of Technology

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