

KINEMATIC ANALYSIS OF BASKET WITH 1/2 TURN TO HANDSTAND OF HAIBIN TENG ON PARALLEL BARS

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The basket with 1/2 turn to handstand has become a powerful weapon of world famous competition for the gold medal of parallel bars. Therefore, we make movement analysis on Haibin Teng, who won the champion in Athens Olympic, over the movement in qualification trial, and obtained kinematics references, which provides theoretical and technical basis for the development and improvement of the skill of Chinese athletes.

KEY WORDS: basket with 1/2 turn to handstand, Haibin Teng, kinematics

INTRODUCTION: The basket with 1/2 turn to handstand on parallel bars is an representative movement of E group, which not only has some difficulty, but also has a higher connection value. There are lots of athletes use this action in the parallel bars matches, but it is not an easy thing to accomplish. In order to better grasp this action, improve and enhance the quality of this action, it is very necessary to study this action from both qualitative and quantitative aspects. Access to the parallel bars literature, to understand the history of the development and research status, and haven't seen the quantitative research papers for it.

This paper makes researches on the shooting and analyzing technique movies from Haibin Teng who won the champion in Athens Olympic, and makes quantitative analysis on some major technology aspects including the downswing stage, the upswing stage and the 180 degree turn stage, so as to look for reasonable factors and internal relations for improving achievements.

METHODS: The whole process of the competition was recorded by two GC-PX10 video cameras (JVC, Japan) at 50 Hz from different angles (the included angle of the principal optic axes of two cameras was about 90°). After the match, we put three-dimensional scale with 24 control points in filming area. We used 3-D Signal TEC V1.0C software, and built the coordinate system (shown in Figure 1). In order to meet the research needs, we added the parallel bars as the 22 test points in Songjing Model (16 links, 21 joints). The original data was smoothed by low-pass filter with a cut off frequency of 6 Hz.

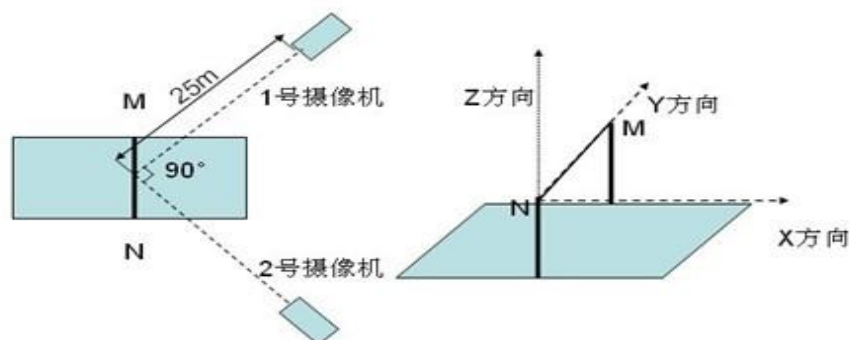


Figure 1 (N: Coordinate origin MN: parallel bars)

RESULTS AND DISCUSSION: In order to analyze the basket with 1/2 turn to handstand of Haibin Teng on parallel bars, we divided the movement into three stages, including the downswing stage, the upswing stage and the 180 degree turn stage.

The downswing stage analysis: This stage is the movement process from handstand hem to vertical position under the bars after passing post-level part. This stage requires as much as

movement kinetic energy as possible, and makes each link of the body in the most reasonable place, which creates conditions for moving upwards swiftly. One should improve the center of the body as possible as he can, the distance between the center of gravity and the hand bar was 1.0m. And the body should be straight; the shoulder joint should be open, with the angle at 177° on average. The left and right hip was 178° on average. The left and right knee angles were 175° and 176°. The basket with 1/2 turn to handstand has a highly demand of shoulder joint flexibility. In this study, His shoulder joint angle reached 177°, which showed that he had an excellent shoulder joint flexibility and that this is one of the basic conditions needed to successfully perform this skill. The center of gravity speed was relatively small when falling at first, at 0.31m/s, which was mainly moved by the backward level speed. When the body moved behind the bars at level, the left and right shoulder angle reduced obviously to 67° and 66.6°, the left and right hip angles were 136.1° and 136.7°, the left and right knee angles were 175° and 174°, and the center of gravity speed increased to 2.89m/s, which made the gravity length the largest.

The body moved downwards after passing the level of bars, the shoulder joint started to sink, and the shoulder angle gradually increased. When the bar was in vertical position, the distance between the center of gravity and the hand bar was 0.89m, and the left and right shoulder angles increased to 83° and 87°. The left and right hip angles reduced to 32.4° and 32.8° at the least, and the left and right knee angles were 175° and 173°. In this stage his shoulder sank obviously, the aim was to increase the parallel bars down force, to make the parallel bars downward deformation, and would finish the next act by taking advantage of the elastic potential energy from the parallel bars, while his body moving upwards. For gravity reason, the center of gravity speed was the fastest at 3.90m/s when body moved to vertical level below the bar. It cost total 0.8s from the below movement to gravity, and Haibin Teng laid foundation for the afterwards steps.

The upswing stage analysis: This stage is the process from vertical face under the bars passing the level face before the bars to the right bars. This stage is mainly to reduce the resistant moment of force, and keep faster speed to move upwards as possible and use inner power to play, which create good conditions for the air turn. When the center of gravity turned to the front bar, the left and right shoulder angles reduced to 71.6° and 72.1°, the left and right hip angles increased to 114.2° and 118.8°, and the left and right knee angles were 174° and 173°. In order to complete the pocket legs, the velocity of the feet rapidly increased, attained 12.50m/s. Technically, during the legs accelerated upswing, the shoulder joint should be well controlled to avoid raising both the shoulder and head. Failing to do this will diminish the speed of the legs. In this phase, the velocity of shoulder was low, only 2.48m/s. At this time, the center of gravity speed was lower, but it was still keep upward movement faster, attained 3.32m/s, with the upward vertical speed playing the main role.

When the body moved upwards above the front bar level, the body turned left from far edge. The right hand started to release the bar, the high body turned obviously, and the left and right shoulder angles increased to 112.2°. Because the body turned left and the right shoulder angle was 76.3°, the left and right hip angles increased to 151.4° and 153.3° respectively, and the left and right knee angles reduced to 173° and 172°. Before release, He's feet braked, which resulted in feet velocity decreased to 3.80m/s. In contrast, the velocity of shoulder started to increase. When hands released the bar, the value of 3.15m/s was achieved. This explains technique that during feet brake, the arms were pressing the bar. At the same time, the center of gravity of the body was 0.830m apart from bar in the horizontal direction and 0.150m higher than the bar, forming an angle of 13.5° with the bar horizontal level.

The 180 degree turn stage analysis: This stage is the movement process from the right hand passing the 1/2 turn to handstand. This stage keeps the gravity center speed as possible, and strives for more air time, which provides time and space conditions for finishing 1/2 turn. Most of body gravity falls to the left arm when the right hand releases the bars, and the turn process should strengthen the hip joint, and the body should be straight enough. Before release, due the upward vertical speed was much larger than the horizontal speed, the parabolic path of

the center of gravity was almost vertically rising up. At this time, shoulder angles and hip angles reduce obviously. The left and right shoulder angles were 108° and 70°, the left and right hip angles were 141° and 143°. He reduced the moment of inertia by his shoulder contracted and hips rapidly flexed, the smaller moment of inertia of the body angular velocity, the more conducive to swivel. She completed a major feature of this action. Withdraw from the right hand bar to return to the handstand position, the vertical axis of angular velocity of 5.83 rad/s. When the body center of gravity turned to the hand place, the center of gravity was 0.99m at highest, the left and right shoulder angles were 175° and 174°, the left and right hip angles were 175° and 176°, and the knee joint angles were 175° and 176°. The center of gravity speed reduced to 0.52m/s, in which the horizontal speed played the key role.

CONCLUSION: Through the above analysis over the tests, we can conclude as follows: Haibin Teng was able to make each step of the body in the premium position, when obtaining the longest moment of force in downswing stage; able to provide advantageous conditions for 1/2 turn, when keeping upward speed under gravity in upswing stage; When the center of gravity of the body was 0.830m apart from bar in the horizontal direction and forming an angle of 13.5° with the bar horizontal level, He began to twist in this position and angle was reasonable; He reduced the moment of inertia by his shoulder contracted and hips rapidly flexed, the smaller moment of inertia of the body angular velocity, the more conducive to swivel, he completed a major feature of this action in 180 degree turn stage.

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