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KINEMATIC ANALYSIS OF KAI ZOU'S STOOP IN SHOOT AND 1/1 TURN THROUGH HANDSTAND IN UNDERGRGRIP ON HORIZONTAL BAR

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The stoop in shoot and 1/1 turn through handstand.in undergrip performed by Kai Zou, who was the champion of the World Championship in London(2009) and Tokyo(2011), and was 3-D recorded and analyzed. The athlete was analysed with kinematic technical model based on rules of gymnastics and theory of sports biomechanics,. The kinematic characteristics of this high skilled movement was analyzed to provide useful information for the technical training of coaches and athletes, and enriched theories of horizontal bar.

KEYWORDS: Kai Zou, horizontal bar, stoop in shoot and 1/1 turn through handstand in undergrip, kinematic

INTRODUCTION: Through biomechanics appraising of the stoop in shoot and 1/1 turn through handstand in undergrip (shown in figure 1) performed by Kai Zou (age:25, body weight:47kg, years of practice:12 years), and forming the kinematics model, this study provided useful reference data for the technical training of coaches and athletes, and enriched theories of the horizontal bar.

Figure 1: The process figure of the stoop in shoot

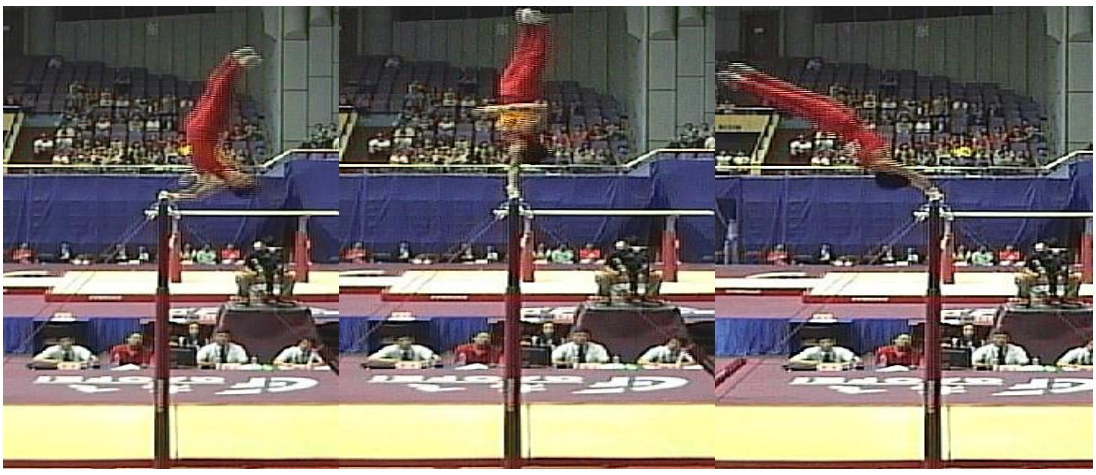

Figure 2: The process figure of the 1/1 turn through handstand in under grip

METHOD: In 2012, as of the Final of the horizontal bar in Chinese Gymnastics Championships, the whole process of the stoop in shoot and 1/1 turn through handstand in undergrip performed by Kai Zou was recorded by two video cameras (Basler, Germany) at 100 Hz from different angles (the included angle of the principal optic axis of two cameras was about 90 °). The video was analyzed by 3-D Signal Tec system, with Japanese Matsui Hideharu (Yan H.G, Feng N,2005) male body model. The original data was smoothed by low-pass filter with a cutoff frequency of 6 Hz. The significant kinematic parameters of the connecting movement were acquired by this method.

RESULTS AND DISCUSSIONS: The stoop in shoot and 1/1 turn through handstand in undergrip was analyzed into two parts: the stoop in shoot stage and the 360 degree twist stage. The stoop in shoot stage. Zou's body deviated to the right side at right hand off the bar moment. His hip flexion was fast and sufficient during the downswing of the stoop in shoot. At the lowest point of the downswing, his shoulder shook sufficiently, and his hip stretched gradually during the upswing. These all accorded with the principle of biomechanics. The time of the downswing of the stoop in shoot was 0.71s, and the time of the upswing was 0.32s. At the moment of the lowest point of the center of gravity (CG), the angle of shoulder, elbow, hip and knee was 40.41°,175.57°,27.71°and 177.01°respectively. At right hand off moment, the height of CG was 0.40m. The distance away from the bar was 0.45m, and the direction was the positive direction of X. The left and right hip angle was 142.87°and 115.27°respectively.

The 360 degree twist stage. From the beginning to the end of the twist action, the included angle of the body and the vertical line above the bar met the competition rules. During the whole process, the shoulder joint extended sufficiently, and the body was stretched almost straightly. The dip angles of the body to the both legs were all less than 45°. It shows that the gesture of Zou was well. However, not all things went that well. The turning angle was 329.58°, less than 360°. When turning , the hip angle of the left and right was asymmetric. The body deviated to the right side. And the phenomenon that the legs split appeared. At the moment of right hand off and re-grasp the bar, the included angle of the body and the vertical line above the bar was 25.01°and 28.13°respectively. During the whole twist process, the variation range of the knee angle was from 167.31°to 176.98°. The variation range of the dip angle of the body to the leg was from 22.07°to 41.69° . The variation range of the left hip was from 125.70°to 171.51°and the variation range of the right hip was from 129.35°to 160.70°. The degree of turning was 329.58°, the time was 0.79s, and the average angular velocity was 7.28rad/s.

CONCLUSIONS： Based on the analysis of research results, Zou has well performed the stoop in shoot and 1/1 turn through handstand in undergrip . But some technical links had flaws. This action performed by Zou was technical analyzed. The part that corresponded the rules of gymnastics and the principle of sports biomechanics provided the kinematics movement model.

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