BIOMECHANICAL ANALYSIS OF BACK HANDSPRING TO BACKWARD SALTO WITH TRIPLE TWIST IN GYMNASTIC FLOOR EXERCISE

Ying Liu, Xin Ma, Qi Yan and Ge Wang
Beijing Research Institute of Sports Science, People's Republic of China

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INTRODUCTION: The degree of difficulty in gymnastic movements has increased dramatically during the last 30 years, a fact is which is unimaginable to those not skilled in the art. For the gymnast, practice of a new movement is one of the most important ways to learn a new skill. The discipline of Sports Biomechanics can provide the knowledge to increase the efficiency of learning. The purpose of this study was to provide biomechanical analysis of their technique in order to identify specific characteristics and problem areas so that the skill can be mastered in as short a time as possible.

METHODS: Three of China's top woman gymnasts were selected as subjects for this study. For the sake of anonymity, they will be identified as Gymnast A., B., and C. The routine chosen for analysis was performed three times and included a back handspring to triple twist with a backward salto, across the diagonal on the floor exercise mat. Two gen-locked 3-CCD video cameras of 50Hz (1/500s) were fixed in the left and right side of the gymnasium. The angle of the two cameras was 110°. The movements of the gymnasts were filmed. The best trial out of three, for each gymnast, was selected for analysis using the Peak Motus system.

RESULTS: According to the degree of skill in the movement, the routine was divided into two phases. The first is Back Handspring: In this phase the gymnast increases the horizontal velocity of body weight with propulsion, backward rotation around the transverse axis and pushing of the ground with hands. The gymnast would transfer the horizontal velocity into vertical velocity of the body weight, at the phase between the feet touching the ground, and the return of the body to a vertical position, strengthening braking when landing. This will ensure that the parabola of the center of the body would be higher at that phase. The second phase is the triple twist with backward salto: It is considered a very important phase. This study has established the most appropriate length of the time for the feet to remain in contact with the floor, during the Back Handspring Phase. This data could provide a good basis for improved training techniques by identifying vertical initial velocity of take-off.

CONCLUSION: **Gymnast A** (1) In Back Handspring Phase, A better effect was obtained in acceleration by increased force from the floor with hands. In contrast, increasing the force through the feet was not sufficiently effective to increase acceleration. (1) In Backward Salto Phase, the transition from horizontal to vertical momentum is critical in maximizing the height of the body during the salto. **Gymnast B** (1) In Back Handspring Phase, this gymnast was more effective in using feet rather than hands to order to accelerate the horizontal momentum. Therefore, emphasis should be placed on strengthening the contact of hands. (1) In Backward Salto Phase the gymnast lacks adequate vertical velocity and therefore should increase horizontal momentum of the back handspring. In addition the transition from horizontal to vertical momentum must be improved in order to enlarge the angle of jumping and increase the height of jumping. **Gymnast C** (1) In Back Handspring Phase, this gymnast achieved good acceleration by effective use of force through the feet. (2) In Salto Backward Phase, the subject had satisfactory horizontal and vertical velocity of the body mass at take-off, reaching a vertical velocity of 4.89 m/s. Although, with this velocity, the optimal height of the salto was achieved, the execution of the twists was less effective because of poor form.

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