BIOMECHANICAL STUDY ON THE PREPARATORY MOTIONS FOR THE TAKEOFF IN THE WOMEN'S LONG JUMP

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Introduction

Many studies on the approach or takeoff in the long jump had been done. Recently, some scientific studies have focused on the techniques used by the jumpers in making the transition from sprint to jump. For example, Lee et al. (1994) reported that approach speed reached its peak within the last two strides, and jumpers lowered the center of mass (CM) during the contact phase of the last stride significantly. However, there are few data on how the long jumpers are lowering the CM or using the body segments for the last three strides of the approach. Ae et al. (1999) and Omura et al. (1999) reported some findings of the techniques used by the men's elite long jumpers during the last three strides, but there is no scientific data on the preparatory motions of women's elite long jumpers. The purpose of this study was to investigate the preparatory motions of women's elite long jumpers to obtain fundamental findings on effective preparatory motions.

Methods

Eight women's long jumpers, with personal best records ranging from 6.05m to 6.61m, were filmed at the final of 1998 Japan National Track & Field Championships by the Biomechanical Project team of the Japan Amateur Athletic Federation. The last three steps of the approach were recorded using a high-speed video camera (200f/s) placed perpendicular to the runway. The best trials of the finalists were analyzed using FRAME DIAS system (DKH Co., Japan), calculating step length, step frequency, approach velocity, angle and angular velocity of leg and trunk, and height of the CM.

Results and Discussion

Figure 1 shows the change in horizontal velocity during the last three steps of approach. Mean horizontal velocities at touchdown of the last step were significantly lower (p<0.001) than those of top eight women's jumper in the 6th IAAF World Championships (1997). Every jumper decreased her horizontal velocity during the support phase of the last step. According to the data on the 6th IAAF Championships (1997), most of the top eight women's jumpers tended to maintain or increase their horizontal velocity during the support phase of the last step. Since there is a high correlation between approach velocity and record in long jump, the inferior national record of Japanese women (6m61) compared to the world record (7m51) might be due to the low approach velocity during the contact phase of the last step. Therefore, Japanese women's jumpers should improve the approach run in order to prevent losing horizontal velocity during the last step.

There is no significant difference, but the subordinate four jumpers tended to decrease their horizontal velocity (ranging from -0.54m/s to -1.40m/s) more than the top four jumpers (ranging from -0.21m/s to -0.36m/s) did during the last step. This difference might be due to the following characteristics shown by the subordinate jumpers during the second-to-last step.

1) The subordinate jumpers tended to increase the horizontal velocity, while the top four jumpers
tended to decrease the horizontal velocity.

2) They tended to maintain almost the same CM height, while the top four jumpers tended to gradually lower the CM.

3) They tended to maintain a large knee joint angle of the supporting leg during the contact phase of the second-to-last step, while the top four jumpers tended to bend the knee joint of the supporting leg during the contact phase more deeply than that of the last step.

These results suggested that the subordinate four jumpers tended to run the second-to-last step with sprint-like motion, and they delayed the preparatory motion of the supporting leg for the takeoff. Such a delayed preparatory motion might be the caused of the loss of horizontal velocity during the last step.

Furthermore, the subordinate four jumpers tended to lean the trunk backward during the second-to-last step. A previous study on Japanese men's long jumpers (Ae et al., 1999) revealed that they tended to lean the trunk backward too early, and this decreased the horizontal velocity remarkably. From these results, the subordinate four jumpers should improve trunk back-inclination timing and the knee flexing of the supporting leg in order to prevent losing horizontal velocity.

References
IAF Biomechanics Research Project Athens, 1997
Omura et al. BIOMECHANICAL STUDY ON THE PREPARATORY MOTION FOR THE TAKEOFF IN THE MEN’S LONG JUMP. Abstract XVIIth ISB Congress. 918,1999.