EFFECTS OF AN INCLINED BOARD ON THE TAKEOFF MOTION OF LONG JUMP

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The purpose of this study was to investigate effects of the inclined board on the motion during the takeoff and the preparatory phases in long jump and to obtain suggestion to effectively use the inclined board as a training tool. Five male long jumpers were videotaped with a high speed VTR camera. Three kinds of trials were performed with a middle length of run-up: Normal 1 trial, the subject's own manner; Board trial, with the upward inclined board; Normal 2 trial, the subject's own manner; in turn. In Board trail, the forward rotation velocity of the body and the run-up speed during the preparatory phase were larger than those of Normal 1 trial. In Board trial, the timing of the backward lean of the trunk was delayed and the change in the knee angle implied that the jumpers could step up to the takeoff. It is suggested that the inclined board is an effective training tool to learn a quick takeoff motion with less decrease in the horizontal velocity.

KEY WORDS: long jump, training tool, takeoff, inclined board.

INTRODUCTION: In long jump, the velocity of the center of gravity (CG) of a long jumper at takeoff is one of the most important factors to determine the distance of the jump. An inclined board on which the jumper places the takeoff foot and jumps up is frequently used as one of training tools for the improvement in the takeoff motion. However, the effect of the board on the jumper's motion during the takeoff and the preparatory phases is still unclear. The purpose of this study was to investigate effects of the inclined board on the motion during the takeoff and the preparatory phases in long jump and to obtain suggestion to effectively use the inclined board as a training tool.

METHOD: Five male long jumpers, personal best record ranging from 6.45m to 7.35m, were videotaped with a high speed VTR camera (200Hz). Three kinds of trials were performed with a middle length of run-up, 12 to 13 steps. The first trial was a long jump in the subject's own manner (henceforth, Normal 1 trial). The second one was a long jump with the upward inclined board (Board trial). The third one was a long jump that was similar to the first one (Normal 2 trial). Normal 2 trial was performed to test the immediate effects of Board trial on the takeoff and the preparation motions. The board made of wood was 92 cm in length, 5cm in height with an inclination of about 1.3 deg. two dimensional coordinates of the body landmarks were obtained by digitizing VTR images. The velocity of the CG, angular kinematics of the leg and trunk segments, and the angular velocity of the forward rotation of the body during the takeoff phase were calculated. The angular velocity of the forward rotation of the body was calculated from the change in the angle between the line connecting the CG to the mid point of the big toe and heel of the takeoff foot and the ground. Data of all subjects were normalized by the time of the takeoff phase and averaged.

RESULTS AND DISCUSSION: The jumping distances for Board trial (6.54±0.35 m) and Normal 2 trial (6.24±0.31 m) were significantly larger than that of Normal 1 trial (6.17±0.23 m). Although there was no difference in the horizontal velocity of the CG at the instant of takeoff foot touchdown between Board trial (8.69±0.19m/s) and Normal 1 trial (8.62±0.31 m/s), there was a significant difference in the takeoff velocity between Board trial (7.44±0.30 m/s) and Normal 1 trial (7.15±0.36 m/s). Figure 1 shows changes in the angular velocity of the forward rotation of the body during the takeoff phase in three trials. The angular velocity quickly increased in the first half of the takeoff phase in three trials. However, the angular velocities in Board trial and Normal 2 trial were larger in the first half than that of Normal 1 trial. Shank angle of the takeoff leg, which indicates the angle between the shank and the vertical line, in Board trial was smaller than that of Normal 1 trial at the touchdown of the take off foot. These results suggest that the inclined board help the jumper to rotate or drive the body onto the takeoff foot quickly in the first half so as to reduce the deceleration of the horizontal velocity of the CG during the takeoff phase.

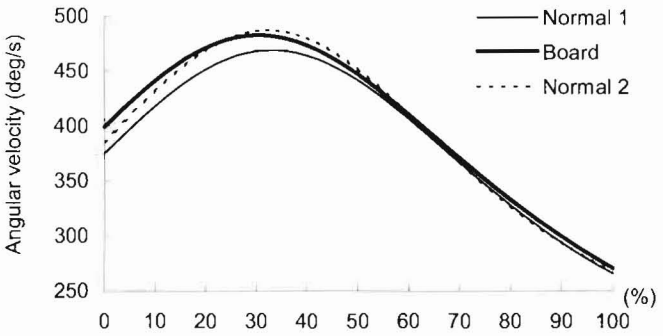

Figure 1. Changes in the angular velocity of the forward rotation of the body during the takeoff phase in three trials.

Figure 2 shows changes in the horizontal velocity of the CG during the preparatory phase, in the last 3 steps in three trials. In general, the horizontal velocity of the CG will decrease in the last stride of the run-up of full length. However, the horizontal velocity of the CG did not decrease in this study because the jumpers used their middle length of run-up. In Board trial the increase in the velocity during the last 3 steps was larger than that of Normal 1 trial. In Normal 2 trial the increase of the velocity was also larger than that of Normal 1 trial. This suggests that the inclined board may affect the velocity of the CG and the motion of the body during the preparatory phase. Figure 3 shows changes in the trunk angle during the preparatory phase in three trials. Positive angle means the forward lean of the trunk. The

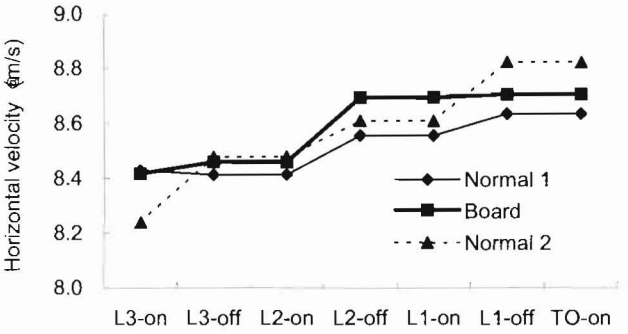

Figure 2. Changes in the horizontal velocity of the CG during the preparatory phase in three trials.

trunk angle was the largest at the touchdown of the third last step, and it was negative at the touchdown of the takeoff. While the trunk began to be backward during the preliminary step, the backward lean in Board trial was the smallest at the takeoff of the last step. Iiboshi et al. (2000) pointed out that too early backward lean of the trunk might cause the large decrease in the approach velocity. These results indicate that using the inclined board may help to delay the backward lean of the trunk so as to retain the approach velocity during the preparatory phase. Figure 4 shows changes in the knee joint angle of the support leg during the preparatory phase in three trials. In Normal 1 trial the flexion of the knee joint increased during the support phase of the second last step and at the last step the flexion further increased. In Board trial, after the knee joint flexed in the second last step, it began to extend in the last step. This change in the knee flexion angle implies that the so-called stepping up to the takeoff occurred in Board trial, which is considered to be a good technique of the

preparation for takeoff. Therefore, the inclined board would be a tool appropriate to guide the jumper to perform the technique not only for the takeoff but also the preparation of the long jump.

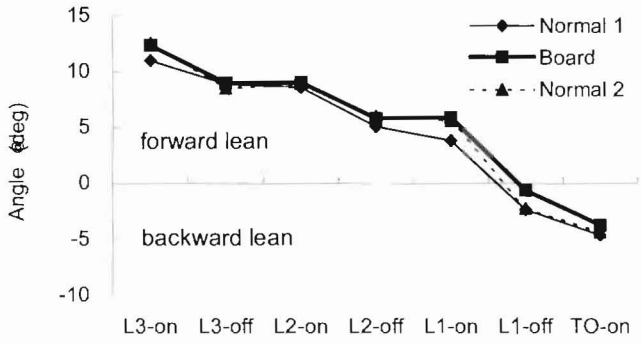

Figure 3. Changes in the trunk angle during the preparatory phase in three trials.

CONCLUSIONS: In Board trial, the angular velocity of the forward rotation of the body and

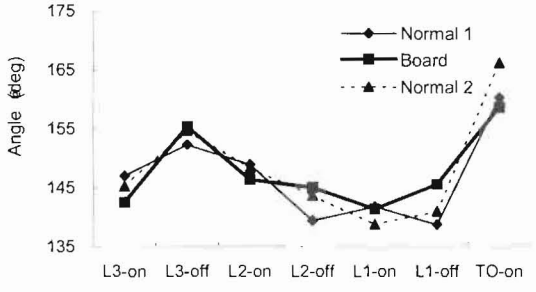

Figure 4. Changes in the knee joint angle of the support leg during the preparatory phase in three trials.

Normal 1 trial. The timing of the backward lean of the trunk in Board trial was delayed, and the change in the knee flexion angle in Board trial implied that the jumpers could easily step up to the takeoff. The following suggestions on the use of the inclined board as a training tool for long jump can be drawn: The inclined board is an effective training tool to learn a quick takeoff motion with less decrease in the horizontal velocity of the CG. By using the inclined board, long jumpers can improve motions of the trunk and the knee joint of the support leg so as to reduce the decrease in the approach velocity during the preparatory phase.

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