EFFECTS OF APPROACH VELOCITY TO THE CONTRIBUTION OF EACH BODY SEGMENTS TO THE TAKE-OFF MOVEMENT IN THE LONG JUMP

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INTRODUCTION

Much study suggested that approach velocity gave significant effects to the long jump performance(Hay,1986). However high the velocity of approach may be, high records won't be achieved without the efficient take-off movement. Ae et al.(1983) reported the changes in the segmental contribution to the take-off in the high jump for height due to difference in the length of approach run. Then, we expected the changes in the segmental contribution to the take-off in the long jump for distance due to difference in the approach velocity. However, there are very few study effects of approach velocity to the role or the contribution of each body segments to the take-off movement in the long jump, which is the porpose of this study.

METHODS

Nine male long jumpers performed the long jump of the three types,Slow jump(10～15m approachrun), Medium jump (25～30m approachrun), Fast jump (full approach of their own:40～50m). Their take-off motions were filmed at 200Hz with high speed camera. Two dimensional coordinates were obtained by digitizing the motions with a sampling frequency of 200Hz.The data was filtered with a Butterworth digital filter(Winter,1979) at 10Hz.BSP of Chandler et al.(1975) were used to estimate the segmental centers of gravity and mass center of the whole body. This data used to calculate the generated momenta (Horizontal, Vertical) of the arms, trunk(head and trunk),free leg and take-off leg, using the method of Ae et al.(1983).The equations of the generated momenta were (1) to (4).

$$GM_a=m_aV_{a/s} \quad (1)$$
$$GM_t=m_aV_{s/h}+m_tV_{t/h} \quad (2)$$
$$GM_{fl}=m_{fl}V_{fl/h} \quad (3)$$
$$GM_{tl}=(m_a+m_t+m_{fl})V_h+m_{tl}V_{tl} \quad (4)$$

(m_i=mass, V_i=velocity, $V_{i/j}$=velocity of i relative to $_j$; a= arms, s=shoulder, h=hip, t=trunk, fl=free leg and tl=take-off leg)

Mean impulses of the body segments were calculated from the changed in the momenta generated. The mean percent contribution of the segments were obtained by dividing total impulses of each segment over the take-off phase by the whole body impulse.

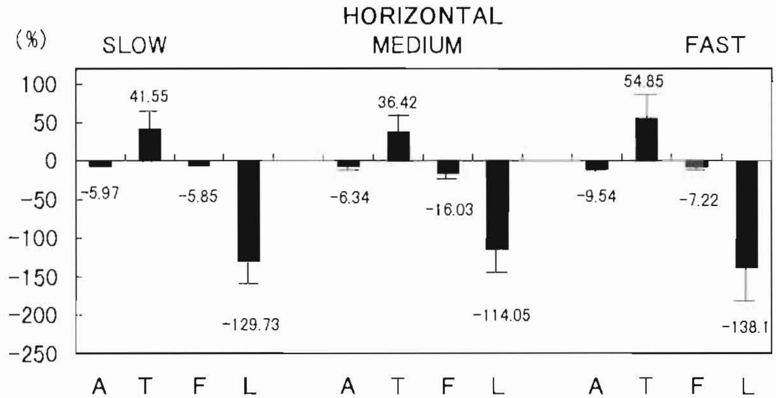
RESULTS

The results of approach velocity of all performances were 8.549±0.615m/s. Then, they were divided into three groups by judging 1SD;Slow:7.676 ± 0.270m/s,Midium:8.494±0.377m/s, Fast:9.494±0.296m/s ($P<0.01$).

Mean percent contribution(figure 1)

With the regard to the horizontal direction, The proportion of the contribution of all the body segments were the same in the all three-type jumps. The highest positive contribution (plus contribution to horizontal velocity) was made by the trunk. The arms, free leg and take-off leg were negative(minus contribution to horizontal velocity). Most negative contribution was made by the take-off leg.

As for the vertical direction, the all body segments contribution of the three types jumps showed positive contribution(plus contribution to vertical velocity).The take-off leg showed the highest percentage contribution. As the approach velocity increased, so did the contribution of the arms, while the contribution of the take-off leg decreased.



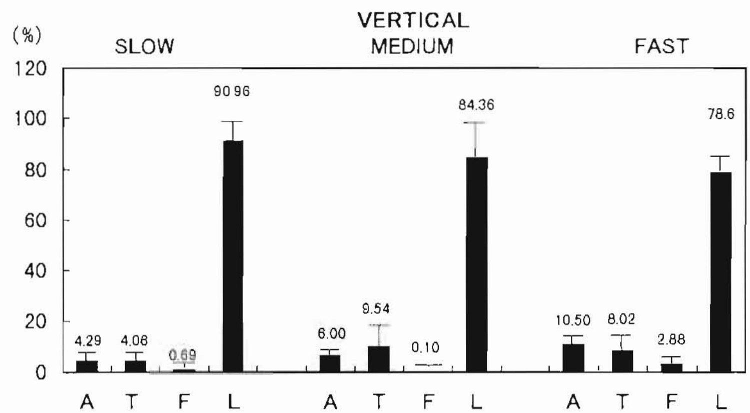


Figure 1. Changes in mean percent contribution of the body segments

A : Arms T : Trunk F : Free leg L : Take-off leg

CONCLUSION

With regard to the horizontal direction, the proportion of the contribution of all the body segments were the same in the all three- type jumps. These results met that as the approach velocity increased, the segments contribution showed no change to the take-off in the long jump. Then, the trunk made positive contribution to the horizontal velocity, the other body segments made negative contribution in it. The positive contribution of the trunk was generated by its rotate movement with the axis of the hip in checking the linear movement from Ae et al.(1983). The study suggested that the plus contribution of the trunk decreased, the minus contribution of the take-off leg also decreased. Then, the trunk and the take-off leg have a mutually supportive relationship in horizontal direction from Aoyama et al.(1995).

On the other hand, in the vertical direction all body segments showed positive contribution in the three-type jumps. With regard to the proportion pattern of the contribution, as the approach velocity increased, take-off motion changed from "depending on the-take-off leg type" to "using to other-body- segments type".

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