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Characteristics of the mechanical energy changes during the single leg jump movement in speed skaters

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INTRODUCTION:
There are some imitating motions used in dry land training to develop the push-off movement required in speed skating (1). Particularly, the single leg jump movement is not only a dry land training motion but also a useful test for evaluating the power exertion needed in the lower limb. This study identified the characteristics of the mechanical energy changes during the single leg jump movement in speed skaters.
METHODS:
This study enrolled 10 junior (17.2 ± 1.0 y) and 9 senior (21.8 ± 1.4 y) elite male Japanese skaters providing informed consent, and who had participated in the 500-m race of a domestic speed skating competition in Japan or a time trial. The skaters performed single leg skate jump test on a floor that required maximal effort to reach the maximal height. Two synchronized high-speed video cameras (250 fps) were used to record their performance using a direct linear transformation technique. Ground reaction forces (GRF) of the right support leg were determined using the force platform (500 Hz). The GRF and three-dimensional coordinates of the segment endpoints were determined to calculate the kinetic variables of the right support leg by using an inverse dynamics approach. Parameters related to mechanical energy of the right support leg were calculated to identify the energetic characteristics, and they were normalized from onset of push to take-off time.
RESULTS:
Although goal time of the 500-m race for the senior group (36s 45 ± 0s 73) was significantly faster than that of the junior group (37s 96 ± 0s 65, $p < 0.001$), no significant difference in the maximal height of center of mass during the single leg junp movement was observed between the two groups. While mechanical energies of the thigh and shank slightly increased during the mid-phase of the single leg junp movement in both groups, the mechanical energies of the junior group were greater than those of the senior group. Significant differences were observed in the values of normalized time at 60, 70, and 80-% ($p < 0.05$-0.01). During the final phase of the single leg junp movement, mechanical energies of the thigh and shank greatly increased in both groups, and the mechanical energy of the junior group during take-off was greater than that of the senior group.
CONCLUSION:
Results in this study indicate that speed skaters with high performance avoid increasing the mechanical energies of the thigh and shank of their support leg during the mid-phase of the single leg jump movement. Single leg skate jump movement could be a useful test to identify an effective technique in the support leg extension of speed skaters.
REFERENCES:
(1) Foster C, de Koning JJ (1999): Physiological perspectives in speed skating. In: Gemser H, de Koning JJ, van Ingen Schenau GJ (eds.), Handbook of Competitive Speed Skating, 117-137, Lausanne, Switzerland, International Skating Union.

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