A Comparison of Techniques for Two Groups of Elite Male Long Distance Speed Skaters: Keeping and Declining Groups

J. YUDA¹, M. YUKI², M. AE³, N. FUJI³

¹ Doctoral Program in Health and Sport Sciences, University of Tsukuba, Tsukuba/Japan
² Faculty of Education, University of Shinshu, Nagano/Japan
³ Institute of Health and Sport Sciences, University of Tsukuba, Tsukuba/Japan

Introduction

It is very important in long distance speed skating to sustain a high speed as long as possible over the racing distance. Because most of the biomechanical studies in speed skating focused on sprint event, there was little finding on the techniques to enhance the performance in long distance speed skating. The purpose of this study was to investigate the technical factors in curving for sustaining the velocity in long distance speed skating.

Methods

Sixteen elite male skaters who participated in men’s 5000m race at the World Speed Skating Championships Single Distance 2000 were videotaped with two high speed VTR cameras (250fields/s) at the mid portion of the inner second curve using a panning DLT technique. Three dimensional coordinates of the segments endpoints of the body and skate blade at the first and second halves in 5000m race were collected to calculate temporal parameters of the strokes, velocity of the center of mass, joint and segment angles of the lower limbs. The definitions of the angles are shown in Fig.1. One skating cycle was divided into the right and left strokes. Each stroke was further divided into the gliding and push-off phases. The onset of the push-off was defined as the instant that the angular velocity of the knee joint of the support leg exceeded 50 deg/s. These kinematic parameters were normalized by the time in each stroke.

Results & Discussion

The skaters could be divided into keeping and declining groups, based on the decline of the skating speed (%) during the race. Although there was no difference in velocity of the center of mass and stroke frequency for both groups in the first half, these values in the keeping group (12.70±0.34m/s, 0.91±0.07Hz) in the second half were significantly larger than that of the declining group (12.31±0.32m/s, p<0.01; 0.86±0.04Hz, p<0.001). There were significant relationships between the time of the gliding phase and the velocity of the center of mass in the right and left strokes (r=-0.687, p<0.01; r=-0.544, p<0.05, respectively) in the second half.

Fig.2 shows that the changes in segment angles of the support legs for two groups. In the keeping group, the segment angle of the thigh during the gliding phase in the second half was larger than the first half. On the other hand, in the declining group, both the thigh and shank angles increased during the gliding phase in
the second half. Fig.3 shows that the trajectories of the center of mass on the horizontal plane, relative to the ankle of the support leg during the left stroke for keeping and declining groups. The circles are drawn at every 20% time of stroke. During the gliding phase, the center of mass in the second half was located more forward than the first half in the keeping group, while the similar pattern was not clearly seen in the declining group. Fig.4 schematizes these differences and changes in the support leg motion of both groups during the gliding phase of the left stroke. In the keeping group, the center of mass in the second half was located more forward than the first half because of greater rotation of the thigh. In the declining group, since the thigh and shank angles increased during the gliding phase and the backward rotation of the shank negated the effect of the thigh rotation, there was no remarkable change in the horizontal displacement of the center of mass.

These results may suggest that effective thigh rotation with less shank rotation is one of the important technical factors so as not to increase in the time for the gliding phase in the left stroke in the second half in long distance speed skating on the curves.

Fig.2
Changes in segment angles of the support legs for keeping and declining groups during both phases.
Fig. 3
Trajectories of the center of mass on the horizontal plane, relative to the ankle of the support leg during the left stroke for keeping and declining groups. The circles are drawn at every 20% time of stroke.

Fig. 4
Change in the support leg motion of both groups during the gliding phase of the left stroke in 5000m race.

References