A COMPARISON OF THE SKATING TECHNIQUE IN THE CURVE FOR ELITE AND JUNIOR SPRINT SPEED SKATERS

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The purpose of this study was to investigate the technical factors in the curve by comparing the skating techniques for elite (n=1) and junior (n=5) sprint speed skaters. They were videotaped with two VTR cameras at the mid portion of the inner second curve in the 500 m races. Three dimensional coordinates of the skaters were collected to calculate some kinematic parameters using a panning DLT technique. The onset of the push-off in the elite skater (left stroke; 44.0 %, right stroke; 42.0 %) was earlier than that of the junior skaters (53.6±2.5 %, 68.4±6.4 %, respectively). In the left stroke, the ankle of the free leg (right ankle) at the onset of the stroke for the elite skater placed more forward than that of the junior skaters. In addition, the elite skater pulled the free leg forward rapidly during the first half of the left stroke. These results indicate that hastening the timing of the skating movement is very important for skating in the curve lane under high skating velocity.

KEY WORDS: speed skating, skating technique, panning DLT technique, kinematics.

INTRODUCTION: The innovation by the klapskate resulted in the remarkable improvement in the speed skater's performance. Although the klapskate led to the remarkable increase in the skating velocity, it would increase in the difficulty to sustain high speed in a curve lane because of the increased centrifugal force. Since most of the biomechanical studies on speed skating focused on the comparison between the klapskate and the conventional skate, there was little information about the skating technique in the curve. The purpose of this study was to investigate the technical factors in the curve by comparing the skating techniques for elite and junior sprint speed skaters.

METHODS: Data of elite male skaters, who participated in the 500 m races during the Japanese Speed Skating Championships Single Distance 2001, were collected with a videography. One skater of the 1st place in this competition, whose personal best time in 500 m sprint was 34.62s, was selected for comparison; another set of data for five junior sprint skaters was collected in the experimental trials of 500 m with maximal effort. All subjects in this study used klapskates. Two VTR cameras for a panning DLT technique were used to videotape the technique of the skaters at the mid portion of the inner second curve lane (Elite skater, 60 Hz ; Junior skaters, 250 Hz). Three dimensional coordinates of the segments endpoints of the body and skate blade were collected to calculate temporal parameters of the strokes, velocity of the center of mass, joint and segment angles of the lower limbs and tilt angles. The definitions of the angles are shown in Figure 1. One skating cycle was divided into the right and left strokes. Each stroke was further divided into the gliding and push-off phases, as shown in Fig.2. 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.

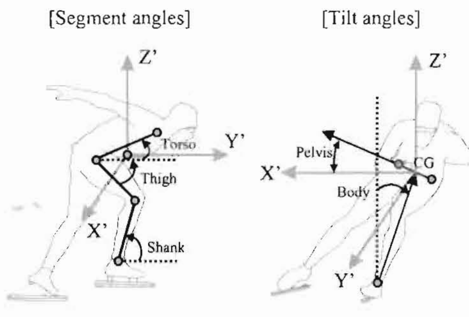

Figure 1. Definition of the angles in this study.

RESULTS AND DISCUSSION: The velocity of the center of mass and cycle frequency for the elite skater (15.72 m/s, 1.11 cycle/s) were larger than those of the junior skaters (13.86± 0.46 m/s, 1.00±0.03 cycle/s). Figure 2 shows the changes in the torso, thigh and shank angles of the support legs for the left and right strokes. The segment angles of the thigh and shank during both strokes in the elite skater were larger than those of the junior skaters. There were remarkable differences in the angle of the shank during the first half of both strokes. On the other hand, the onset of the push-off for both strokes in the elite skater (left stroke; 44.0 %, right stroke; 42.0 %) was earlier than that of the junior skaters (53.6±2.5 %, 68.4±6.4 %, respectively). De Koning and van Ingen Schenau (2000) observed that the skaters could not increase the push-off force remarkably till the onset of the push-off. These results indicate that the elite skater hastened the timing of development of the push-off force by leaning the shank more forward at the onset of both strokes than the junior skaters.

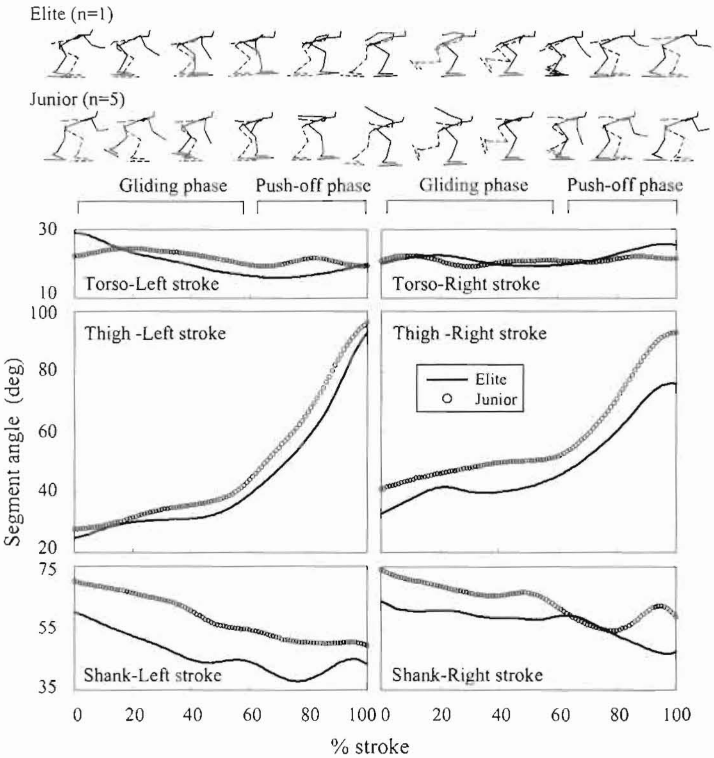

Figure 2. Changes in segmental angles of the support legs during both strokes.

Figure 3 shows the trajectories of the ankle of the free leg relative to the center of mass in the horizontal plane during both strokes. The circles were drawn at every 20 % time of stroke. In the left stroke, the ankle of the free leg (right ankle) at the onset of the stroke for the elite skater located more forward than that of the junior skaters. In addition, although the ankle of the free leg at the 40 % stroke for the elite skater already located forward his center of the mass, that of the junior skaters was left behind the center of mass. Pulling the free leg forward rapidly during the first half of the left stroke was one of the characteristics of the elite skater, which would help to extend the support leg easily. Figure 4 shows the changes in tilt angle of the skaters during both strokes. The tilt angle of the body during both strokes for the elite skater was larger than that of the junior skaters. This difference partially resulted from the largest skating velocity of the elite skater in the curve. However, the tilt angle of the pelvis for the elite skater was smaller from the second half of the left stroke to the first half of the right stroke than that of the junior skaters. This indicated that the pelvis of the elite skater was retained more horizontally during this phase.

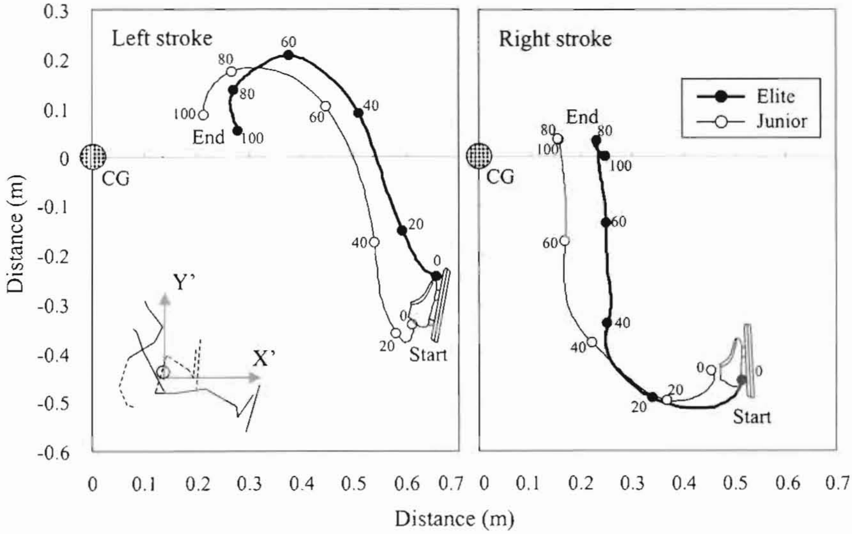

Figure 3. Trajectories of the ankle of the free leg relative to the center of mass in horizontal plane during both strokes.

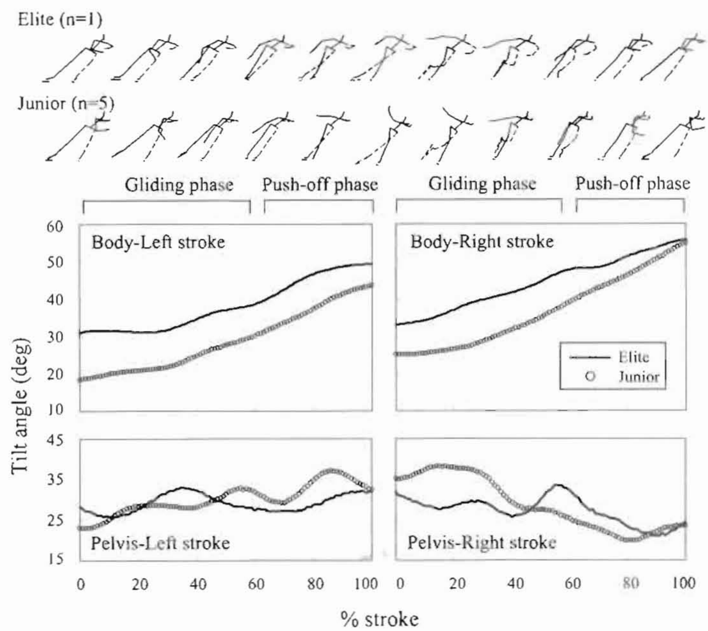

Figure 4. Changes in tilt angles of the skaters during both strokes.

CONCLUSION: It is very important in skating that in the curve lane under high skating velocity the skaters hasten the timing of their skating movement. Technical factors identified for skating in the curve lane were: leaning the shank of the support leg more forward at the onset of both strokes, pulling the free leg forward rapidly during the first half of the left stroke, and retaining the position of the pelvis more horizontally from the second half of the left stroke to the first half of the right stroke.

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