THE MODIFICATION OF PEDALING SKILL WITH REAL-TIME REPRESENTATION OF PEDALING FORCE IN NON-CYCLISTS

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INTRODUCTION

By the real-time representation of the force on the pedal during bicycling, even non-cyclists can quickly modify the pedal force. The effect of such feedback instruction will vary in individuals. We examined the effect of modification on the pedaling mechanics induced by the real-time representation of the force-pattern applied to the pedals during bicycling in non-cyclists. Also the modified force pattern was examined in relation to the energy consumption.

METHODS

Seven males (23-31yrs) participated in a maximal Vo_2 test, baseline test, and feedback test. In the baseline test, the subjects were asked to pedal naturally without any feedback instruction using a racing type ergometer. Both feet were fixed to the pedals. They pedaled the load of 30, 50 and 70% Vo_2max, at a cadence of 70 rpm. The pedaling forces of tangential (F_{tan}) and radial (F_{radial}) directions to the crank arm were measured in the left and right pedals using a strain-gauge method. The resultant force (F_{result}) was determined from F_{tan} and F_{radial}. The crank angle was measured by a potentiometer and defined 0 degree at the top position. Each pedal force was averaged on thirty revolutions of the crank. The Vo_2 was averaged on the last 30 seconds of each 5 minute load. The delta mechanical efficiency was calculated from oxygen consumption and mechanical work in each load. After two to five days of the baseline test, the feedback test was conducted with visual and oral instructions. The visual instructions show the subjects the PC monitor displaying F_{result} and F_{tan} on the clock diagram every 30 degree of crank cycle. The subjects were given an explanation of the mechanisms of F_{tan} and F_{result}. After at least 5 minutes practice periods, the subjects were asked to try the following movement, "F_{result} turn to the direction of F_{tan} in 90-180 and 180-360 degree of crank cycle on the both pedals". The representation of the clock diagram on the both sides continued during the bicycling while oral instruction was sometimes given.

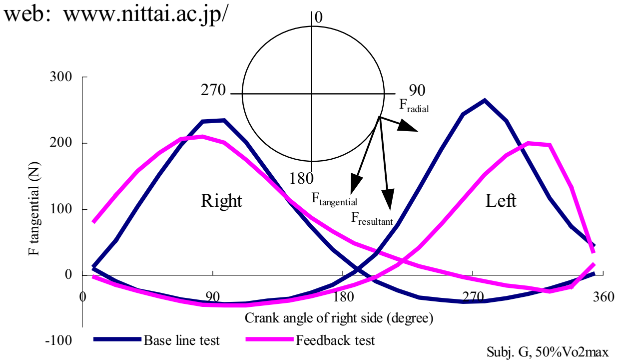

Figure 1: Averaged tangential force in thirty cycles.

RESULTS AND DISCUSSION

In the modification of the pedaling mechanics with the feedback intervene, the F_{tan} decreased in the push phase (0-180 degree of crank angle) and increased in the pull phase (180-360 degree) (Fig. 1, 2). Generally, as shown in Fig. 2, the modified right F_{tan} in the pull phase showed large increase, which was the predominant side in all subjects, in comparison with the left one, and the left F_{tan} of the push phase showed large decrease than the right one.

In the load of 30%Vo_2max, the increase of the right F_{tan} in the pull phase was correlated to the increase of Vo_2 in the modified pedaling. Such the modification of pedaling force was not always reflected effectively for the oxygen consumption. Thus, the excessive modification of the pedaling force made the mechanical efficiency decrease. However, the changes of the pedaling mechanics, such in pull or push phase and the left or right leg, was varied in the subjects. It was confirmed that the feedback effect of the pedaling skill should be evaluated in the relationship between the individual difference of the pedaling modification and energy consumption.

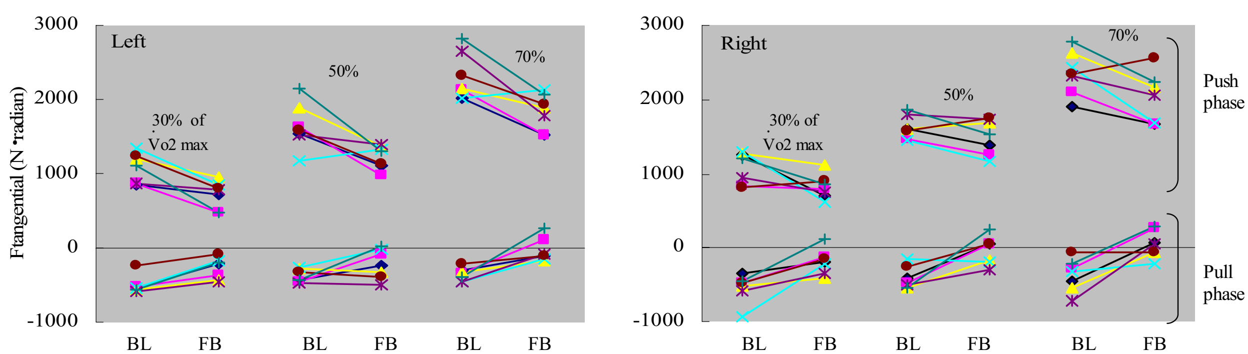

Figure 2: The modification of integrated tangential force by the feedback instruction in seven subjects. BL; base line test, FB; Feedback test.