INFLUENCE OF TOE CLIPS ON MECHANICAL CHARACTERISTICS OF SPRINT CYCLING

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INTRODUCTION: Toe-clips are assumed to enhance the mechanical efficiency of pedaling. However, the effect of toe-clips on power production during the maximal sprint has not been extensively studied, especially when friction loaded cycle ergometers are used (Arsac *et al*., 1996, Capmal and Vandewalle, 1997). The aim of this study was to evaluate the effect of toe clips during maximal sprints performed on a friction loaded ergometer.

METHODS: Force, velocity and power-production in cycling were studied during all-out sprints with (WI) and without (WO) toe-clips on a friction loaded ergometer. This friction loaded cycle ergometer (Monark 818E) was specifically equipped with both an optical encoder and a strain gauge in order to measure the instantaneous flywheel velocity and the friction force, respectively (Arsac *et al.*, 1996). The power output at each pedal down stroke was computed as the product of velocity and total force (inertial force + friction force). Values of maximal force (F), maximal velocity (V), maximal power (P), optimal force at P (FP) and optimal velocity at P (VP) were determined. Twenty-four subjects volunteered for this study. They were specialists in cycling, whose age, height and body mass were 24 $\pm$ 5 years (mean $\pm$ SD), 178.3 $\pm$ 5.4 cm and 69 $\pm$ 7 kg respectively. Each subject performed four maximal sprints of 6-s duration with different (i) shoe-pedal interface (WI or WO) and (ii) friction force applied to the friction belt (0.5 or 1.1 $N.kg^{-1}$ body mass).

RESULTS: The mechanical data obtained in the WI and WO conditions are presented in table 1. F, V, P and FP were significantly higher in the WI than in the WO condition. These differences were observed at both 0.5 and 1.1 $N.kg^{-1}$. VP was higher in the WI condition at 1.1 $N.kg^{-1}$ only.

	F (N)		V ($m.s^{-1}$)		P (W)		FP (N)		VP ($m.s^{-1}$)	
	WI	WO	WI	WO	WI	WO	WI	WO	WI	WO
0.5	80.2 *** + 7.3	67.1	15.5 ***	14.5 + 1	685 *** + 76	629.1 + 71.4	51.2 ***	47.6 + 6.1	13.4 + 1.1	13.3 + 1.4
1.1	110 *** + 12	92.8 + 10.4	10.9 ***	9.0 + .9	923 *** + 122	746.6 + 105	86.3 * + 8.9	84.8 + 9.2	10.7 ***	8.82 + .96

Table 1. Mean $\pm$ standard deviation values of F, V, P, FP, VP measured in the WI and WO conditions at force friction of 0.5 and 1.1 $N.kg^{-1}$ body mass (*: P<.5,**: P< .01, ***: P< .001). See text for legend.

DISCUSSION: Values of F, V and P were in agreement with the literature (Arsac *et al*., 1996, Capmal and Vandewalle, 1997). The significant enhancement observed on mechanical force and power production in the WI compared to the WO condition further support the hypothesis that toe clips could have a positive effect

on the performance of sprint cycling. Higher force and power in WI are probably due to the fact that toe clips allow greater and longer activity of flexor and extensor lower limb muscles during a complete pedal revolution (Tate and Sherman, 1977). However, VP was not improved in the WI condition at 0.5 $N.kg^{-1}$, suggesting that the toe clips effect is more efficient at high friction force and high power.

REFERENCES:

Arsac, L. M. et al. (1996). *Eur. J. Appl. Physiol.* **74**, 100-106.
Capmal, S., Vandewalle, H. (1997). *Eur. J. Appl. Physiol.* **76**, 375-379.
Tate, J., Sherman, G. (1977). *Bicycling* **18**, 57.