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Assessment of the Effects of Saddle Position on Cyclists' Pedaling Technique.

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ABSTRACT

Several studies have investigated changes in pedaling technique when the cyclist to bicycle interface is altered: however, none have investigated the effects of changes in fore and aft saddle position. **PURPOSE**: To analyze the effects of altering body position with the following variables: (1) economy of movement (EC); (2) pedal forces; (3) index of effectiveness (IE); (4) alteration in the trunk, hip, knee, and ankle joint angles; and (5) electrical activation of the muscles selected. **METHODS:** Three (n = 3) elite cyclists participated in this study. The protocol consisted of the evaluation of four different saddle position (fore, aft, up, and down) compared to the reference position while cycling at the cyclists preferred cadence. All measurements were obtained at the same $V0_2$ for each subject. The subjects' bicycles were assembled in a magnetic cycle simulator, and the dynamometric pedal was fixed on the bicycles to acquire the normal and tangential components of the force applied on the pedal. Electrical activation of six lower limb muscles were recorded: *gluteus maximus*, *rectus femoris*, *biceps femoris*, *vastus lateralis*, *gastrocnemius medialis*, and *tibialis anterior*. The resultant and effective forces were calculated from normal and tangential forces to obtain the IE. Analysis was calculated from 10 pedal cycles. The EC was calculated from VO_2 and from the power output. **RESULTS:** Saddle position altered the direction and magnitude of the forces and consequently the IE. Subjects demonstrated a better IE and a better EC in the reference position. Kinematic data showed little variation in the joint angles due to changes in the saddle position. Electrical activation changed both in the activation period and in the magnitude of the root mean square in all the saddle positions evaluated. **CONCLUSION:** EC and IE are optimal in the reference saddle position which may indicate an adaptation of skeletal muscle to years of training in this position. However, changes in saddle position from the reference position could lead to improved EC and IE with prolonged training.

INTRODUCTION

Analyzing the pedal forces magnitude and his direction is possible to determine the cyclist's technique. Many studies have investigated the changes in the pedaling when the system cyclist-bicycle is altered, including changes in saddle height, power output and cadence [1], but no research was found investigated the effects of changes in forwards and backwards saddle position.

PURPOSE

Considering the importance of optimizing the pedal forces and the horizontal positions of the saddle on pedal forces, the purpose of this study was to analyze the effects of different body postures of cyclists during pedaling by shifting the saddle position on: (1) economy of movement (EC); (2) pedal forces; (3) index of effectiveness (IE); (4)

alteration in the trunk, hip, knee, and ankle joint angles; and (5) electrical activation of the muscles selected.

METHODS

Three elite cyclists have participated in this study. The protocol consisted of the evaluation of four different positions of saddle (forwards, backwards, upwards, and downwards) from the reference position in which the cyclists usually training, pedalling in their preferred cadence. The cyclists pedaled during 30 s in each position after the respiratory exchange rate has reached between 0.90 and 1 [2] and the oxygen consumption was stable for more than three minutes. The athletes' bicycles were assembled in a magnetic cycle simulator, and a dynamometric 2D right pedal [3], was used in order to acquire the normal and tangential components of the force applied on the pedal [4]. The data analyzes was made from the mean of 10 pedaling cycles. The saddle position was shifting 1 cm in randomized sequence.

RESULTS

Table 1. The angular impulse of effective force (IFE) normalized by reference position and the index of effectiveness (IE) in all the saddle positions evaluated. Values are expressed in %.

Cyclist	Reference		Upward		Downward		Forward		Backward	
	IFE	IE	IFE	IE	IFE	IE	IFE	IE	IFE	IE
A	100	63	92	59	91	60	99	60	94	55
B	100	52	99	51	93	49	99	53	-	-
C	100	51	93	48	96	50	91	48	94	49

Table 2. The activation period in all the saddle positions evaluated. Values are expressed in %.

Muscles	Reference			Downward			Upward			Forward			Backward		
	A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Gluteos Maximus	14	-	26	29	-	26	21	-	-	30	-	-	19	-	27
Rectus Femoris	16	43	37	43	42	28	18	42	36	45	43	33	17	-	37
Biceps Femoris	18	59	76	50	76	75	17	70	72	46	75	76	16	-	80
Vastus Lateralis	16	38	35	31	35	32	19	36	42	32	37	32	17	-	36
Gastroc Medialis	22	51	38	61	-	40	22	-	41	59	-	41	18	-	-
TibialisAnterior	29	26	27	67	26	37	23	31	60	79	28	46	16	-	35

CONCLUSION

Saddle position altered the direction and magnitude of the forces and the electrical period activation. Subjects demonstrated a better IE and a better EC in the reference position which may indicate an adaptation of skeletal muscle to years of training in this position. However, changes in saddle position from the reference position could lead to improved EC and IE with prolonged training.

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