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EFFECTS OF SADDLE POSITION ON MUSCLE ACTIVITY DURING A SUPRAMAXIMAL CYCLING TEST

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SUMMARY

The aim of this study was to analyze the muscle activation during a supramaximal test in different saddle positions. Twelve competitive cyclists performed, randomly, a supramaximal test in three different saddle heights (reference, downward, and upward). Muscle activation was assessed from the right rectus femoris, vastus lateralis, biceps femoris, and gastrocnemius lateralis. The data suggest that during a supramaximal test small changes in the saddle position do not lead into great muscular activation of competitive cyclists.

INTRODUCTION

Changes in muscle activity during pedaling cycle have been reported when bicycle configuration is altered [1,2]. Saddle position is among the often adjustments made by cyclists. Despite the considerable number of studies found in the literature, there is no consensus among authors on the effect of changes in saddle height on muscle activity. It has been reported that shifting saddle height (downward and upward) had small effect on muscle activation during cycling [3]. In the other hand, it has also been reported that an increase of the saddle height increased the muscle activity of selected muscles in the lower limb [2]. A number of studies have investigated the influence of saddle height on muscle activation during steady-state or submaximal exercise intensity [1,4]. To our knowledge, there has been no study providing information about muscle activation during a supramaximal test. Therefore, the aim of this study was to analyze the muscle activation during a supramaximal test in different saddle positions of competitive cyclists.

METHODS

Subjects: Twelve competitive cyclists with a mean age of 31.7 ± 5.9 years old, body mass of 73.8 ± 6.6 kg, maximal oxygen uptake of 56.8 ± 3.8 $ml \cdot kg^{-1} \cdot min^{-1}$, and maximum power output of 316.4 ± 35.6 W, participants from regional and national championships, were volunteers in this study. The subjects were fully informed of the risks and discomforts associated with the experimental procedures. All participants signed an Informed Consent Form in agreement with the Committee of Ethics in Research of the Institution where this study was conducted.

Protocol: All tests were performed in four different days, with an interval of 48 hours between them. On first day, cyclists were submitted to an incremental maximal cycling test to determine the aerobic variables and also to perform a familiarization with the supramaximal test. On subsequent days, randomly, cyclists performed a 30-second Wingate test [6] in three different saddle heights. The saddle height was individually shifted upward and downward [seeing 2.5% of the distance from the pubic symphysis to ground (DPSG)] and to the reference position, saddle height used by cyclists in training and competition (Figure 1).

Figure 1. Saddle height calculated from the distance from the pubic symphysis to the ground and the three positions adopted during the Wingate tests: upward (+2.5% DPSG), reference position, and downward (-2.5% DPSG).

Data collection: The incremental test and Wingate tests were performed on an electronically braked cycle ergometer (Excalibur Sport, Lode, Netherlands). The incremental test began at 100 W, followed by increments of 30 W every 3 min, until the voluntary exhaustion. During Wingate test cyclists were instructed to remain seated and do the maximum effort throughout the test. During the test athletes were verbally encouraged to make every effort possible.

Data analyses: Muscle activation was assessed by means of surface electromyography (EMG) from the right rectus femoris (RF), vastus lateralis (VL), biceps femoris (BF), and gastrocnemius lateralis (GL). Signals were amplified and recorded at a sampling rate of 2000 Hz with 14 bit resolution using Miotool system (MioTec Biomedical, Brazil). Pairs of Ag/AgCl electrodes (bipolar configuration) with a diameter of 22 mm (Kendall Meditrace, Canada) were positioned on the skin after careful shaving and cleaning of the area with an abrasive cleaner and alcohol swabs to reduce the skin impedance. The raw EMG signals were divided into six five second epochs and smoothed with a 4^{th} order band pass Butterworth digital filter at 20-500 Hz. After full wave rectification and offset correction, the onset and offset of EMG activity were determined by the signal's variation two standard deviations above the baseline value recorded between each EMG burst [5]. The root mean square (RMS) values of each epoch were used as an index of the total muscle activation and normalized by the first epoch.

Statistics procedures: Data normality, sphericity and homogeneity of variances were verified by Shapiro-Wilk, Levene, and Mauchly test, respectively. RMS was compared by means of a two-way ANOVA for repeated measures. The level of significance was set at $p<0.05$. Data were analyzed in SPSS version 15.0 for Windows (SPSS Inc., USA).

RESULTS AND DISCUSSION

Table 1 show RMS results throughout the test in the three saddle heights evaluated. In general, muscular activation did not differ when saddle height was altered. To our knowledge, only one study has explored the combined effects of bicycle saddle position, by changing the seat tube angle (STA - 72 and 82º), and EMG during a supramaximal test [7]. Comparing to our protocol the STA 82º could be related to upward position. No differences were observed for BF in the present study among the positions. In contrast, authors observed a significantly reduction in BF activation at STA 82° compared to STA 72°. According to the authors, increasing the STA shifts the cyclist forward relative to the crank axis. As a result hip is more extended during the propulsive phase of pedaling (0-180º) allowing the cyclist to generate greater hip torque with lower levels of BF activation [8]. In the present study, cyclist's position relative to the crank axis did not change in three different saddle heights assessed.

The main finding in this study was the significant increased observed for RF activation (10%) from the start to the end of the test at reference position. In contrast to our findings, Hunter et al. [6] did not find differences for RF when 10 subjects performed a supramaximal cycling test in their preferred saddle position. According to the authors it may be caused by minimal afferent signal (metabolic receptors) from the active muscles, due to short period of the test (30 s), to influence a reduction in central drive and consequently altering the level and pattern of muscle activation. Differences observed between both studies could be explained by the level and the technique skill of the participants. In the aforementioned study, voluntaries were physically active men and in the present study were competitive cyclists.

CONCLUSIONS

The data suggest that during a supramaximal test small changes in the saddle position do not lead into great muscular activation of competitive cyclists.

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Table 1. Mean ± standard-deviation of the RMS values (normalized by the first epoch) of the muscles assessed (vastus lateralis, rectus femoris, biceps femoris, and gastrocnemius lateralis) in the three saddle position (reference, downward, and upward) during the six epochs of the Wingate test.

	W_{5s} %RMS	W_{10s} %RMS	W_{15s} %RMS	W_{20s} %RMS	W_{25s} %RMS	W_{30s} %RMS
Vastus Lateralis						
Reference	100	98.8 ± 8.2	98.6 ± 11.7	97.9 ± 9.7	100.3 ± 12,7	100.8 ± 10.9
Downward	100	99.7 ± 5.7	101.3 ± 8.8	105.0 ± 11.7	106.0 ± 14.7	106.6 ± 15.1
Upward	100	99,8 ± 6,6	100,2 ± 12,1	102,1 ± 13,9	102,6 ± 15,3	102,2 ± 16,7
Rectus Femoris						
Reference	100	106.4 ± 9.3	106.3 ± 12.0	106.8 ± 11.3	108.1 ± 16.2	110.3 ± 16.3*
Downward	100	97.6 ± 10.1	98.0 ± 13.5	96.2 ± 7.5	101.0 ± 7.4	101.6 ± 8.6
Upward	100	105,4 ± 14,0	102,0 ± 12,3	98,1 ± 12,9	103,1 ± 14,0	105,2 ± 15,4
Biceps Femoris						
Reference	100	104.1 ± 5.3	106.6 ± 9.3	105.9 ± 11.0	106.5 ± 15.3	104.9 ± 15.0
Downward	100	96.2 ± 18.2	96.6 ± 17.6	97.3 ± 18.8	98.5 ± 21.1	95.5 ± 18.9
Upward	100	101,5 ± 5,7	100,7 ± 6,6	102,0 ± 11,2	107,1 ± 7,5	105,2 ± 6,1
Gastrocnemius Lateralis						
Reference	100	98.9 ± 3.8	98.2 ± 4.0	99.3 ± 4.5#	99.4 ± 7.0	99.8 ± 7.4
Downward	100	97.0 ± 4.3	96.8 ± 4.6	95.3 ± 4.9	100.3 ± 12.6	95.4 ± 5.4
Upward	100	97.9 ± 2.7	97.4 ± 5.6	96.8 ± 4.3	97.2 ± 6.0	100.0 ± 12.5

#Significant difference between reference and downward position ($p<0.05$). *Significant difference relative to W_{5s} ($p<0.05$).