Correlation between Temperature and Fatigue of Thigh in the Resistance Training

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1 OBJECTIVES

To effectively enhance the athlete's performance is important to monitor and adjusts the training load parameters, whenever necessary (Szmuchrowski and Couto, 2013). The fatigue control allows adjustments during a training session, such as reducing the number of sets, increasing the intervals or even determines its interruption (Szmuchrowski and Couto, 2013). Muscle temperature measured by infrared cameras (IRC), has a significant correlation with fatigue displayed during a training session (Bartuzi et al., 2012). Therefore, the monitoring of the muscle temperature may allow control of the recovery process (Bandeira et al., 2012). Thus, the use of IRC to monitor muscle fatigue can be a practical and non-invasive way to assist the monitoring and contributing for the adjustments on the load parameters in the resistance training. The hypothesis of this study is that the reduction in resistance training performance in a resistance training session is correlated to the increase of the muscle temperature. Facing this, the present study aimed to investigate the correlation between the temperature of the thigh and fatigue in the resistance training.

2 METHODS

The sample consisted in 18 untrained male subjects (22.12 ± 4.1 years , 1.73 ± 0.05 m , 67.25 ± 5.5 kg, skinfold from the right thigh: 12.5 ± 2.1 mm). All volunteers signed a consent form agreeing to participate in this study. Initially, the volunteers underwent a familiarization to 10 repetition maximum (10RM) test and the exercise Horizontal Leg Press. After an interval of 72 hours from the familiarization, all volunteers underwent the 10RM test (Shaw et al., 2009). Then, after an interval of 72 hours, the volunteers underwent a single test session in which they performed 5 sets of the exercise Horizontal Leg Press using the weight determined in the 10RM test. The volunteers were instructed to perform as many repetitions to concentric failure (maximum repetitions) in each set. The intervals between the sets were 90 seconds. Prior to initiate the exercise, the temperature of the right thigh was measured in all volunteers at the midpoint between the anterior superior iliac spine and the superior border of the patella, in the longitudinal axis. This measurement was repeated immediately after the last set. Before the first measurement and during the intervals between sets, the volunteers remained seated with the thigh exposed to the environment (temperature: 25°C, relative humidity of air: 57%), without receiving solar radiation and air flow. To obtain the temperature of the right thigh was used an IRC brand FLIR® model E6 (FLIR Systems, Boston, USA). The camera was positioned in a distance of 50 cm from the voluntary and three pictures of the thigh were taken before and after the exercise. The average temperature recorded in the three photos in each volunteer was used for data analysis. The mean maximal repetitions performed in the first and last set and the average temperatures of the thigh before and after exercise were compared by paired t test. The percentage change in the maximum number of repetitions performed between the first and last set was correlated (Pearson correlations) with the percentage change in the temperature of the thigh before and after exercise. The level of significance adopted was set at 5% ($p<0.05$). The normality of data was checked by Shapiro-Wilk test.

3 RESULTS

All data revealed normal distribution. Results showed a significant reduction between the maximum repetitions performed during the first and

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last set (p=0.009) and between the temperatures of the thigh before and after exercise (p=0.006), as showed in Table 1 as means and standard deviations. The correlation between the mean percentage change of maximum repetitions performed during the first and last set and the percentage change in the temperature of the thigh before and after exercise was positive (r=0.12) but was not significant (p=0.631).

Table 1: Maximum repetitions, thigh temperatures and their variations.

	First serie	Last serie	Variation
Maximum repetitions	9.75±0.41	6.37±1.26*	-4.39±2.5%
	Before	After	Variation
Thigh temperatures	35.5±1.2ºC	34.4±1.5ºC*	-3.2±1.63%

*Significant difference compared to previous values.

4 DISCUSSION

From the presented results it was evident that the reduced performance in the proposed exercise was not accompanied by an increase in the temperature of the thigh, which refutes the hypothesis of this study. Possibly the reducing in the temperature of the thigh occurred due to its exposure to the environment, and was not correlated with fatigue generated in the resistance training session.

These results are contrary to findings by Bandeira et al. (Bandeira et al., 2012) that indicated a significant correlation between the temperature and the thigh muscle fatigue. However, the authors monitored the temperature 24 hours after the completion of the training session, associating the temperature increase to microlesions and inflame-mation in the muscle group trained. Thus, these results do not allow discussing the monitoring of fatigue during the training session. The results of the present study are also contrary to the assertions of Bartuzi, Roman-Liu and Wiśniewski (2012), which indicate a positive and significant correlation between fatigue and muscle temperature. But it is important to highlight that in this study was measured the temperature of the arm, in the brachial biceps, which generally has lower muscle mass and area of heat dissipation, plus smaller skinfold thickness and skin.

The results of the present study suggest that the measurement of the temperature of the thigh is not an effective way to control the fatigue generated in a session of resistance training. Therefore, it does not permit to knowing the fatigue levels and, if necessary, to promoting the adjustments as suggested by Szmuchrowski and Couto (2013), in the training session load. However, the results may be different in other muscles, body parts and other exercises settings in a resistance training session, which makes it necessary further studies about the topic.

From the results of this study it can be concluded that a reducing in the performance from a resistance training session for thigh muscle, is not accompanied by an increase in temperature of the thigh. Therefore, the measurement of the temperature of the thigh using IRC may not be an effective way of load control during a session of resistance training.

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