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EFFECTS OF AGONIST-ANTAGONIST PAIRED SET VS TRADITIONAL PROCOTOL ON TOTAL TRAINING VOLUME, MUSCLE ACTIVATION AND FATIGUE.

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INTRODUCTION

The agonist-antagonist paired set training (APST) is characterized by alterations on muscles activation and strength performance between agonist and antagonist muscles through antagonist manipulating, and my induce an enhancement on agonist activation and decreases on antagonist coactivation [1]. The purpose of this study was to investigate the total training volume (TTV) and electromyography (EMG) parameters of fatigue during APST vs. traditional protocol (TP) through two exercises: bench press (BP) and wide grip seated row (SR) with trained men.

METHODS

Fifteen recreationally trained men (22.4 ± 1.1 years, 175 ± 5.5 cm, 76.6 ± 7 kg, 12.3 ± 2.1 body fat percentages) with previous resistance training (RT) experience (3.5 ± 1.2 years) participated as subjects in this study. In the first and second test session was performed the 10 repetition maximum (RM) test and retest for BP and SR exercise (48-72h apart). In the third and fourth test sessions were applied two protocols: TP – 3 repetition failure sets of BP followed by 3 repetition failure sets of SR exercise with 2-minutes rest interval between sets and exercises; APST – 3 paired sets of BP and SR exercise with 2-minutes rest interval between paired sets.

The EMG data was captured through passive bipolar surface electrodes (Kendal Medi Trace 200, Tyco Healthcare, Pointe-Claire, Canada). These electrodes were acquired by means of an EMG data acquisition (EMG System of Brazil, Sao Jose dos Campos, SP, Brazil). The EMG signals were amplified by 1,000 with a common mode rejection ratio of 100dB. The signal was sampled at 1000Hz after band-pass filtered (10-500Hz). The reference electrode was placed in the clavicle bone. After positioning the electrodes, the impedance was checked and accepted when it was less than 5 kΩ.

The median frequency of EMG power spectrum is traditionally used to evaluate muscle fatigue. However, to overcome the problem of low sensitivity of those spectral parameters obtained during dynamic instead isometric exertions, a new highly sensitive spectral index called FInsm5 were adopted for quantifying the spectral changes of muscle EMG during fatigue [2]. The EMG spectral index of FInsm5 (Cf5) were recorded for latissimus dorsi (LD), biceps braquii (BB), pectoralis major (PM) and triceps braquii lateral head (TL) during SR exercise. The statistical analyses include the test-retest reliability of 10RM loads and EMG spectral parameters using the intraclass correlation coefficients [ICC = $((MS_b - MS_w)/[MS_b + (k-1)MS_w)]$. The Shapiro-Wilk test of normality and homoscedasticity (Bartlett criterion) were applied. All variables presented normal distribution and homoscedasticity. The two-ways ANOVA (2 x 3) with repeated-measures were used to determine whether there were significant main effects or interactions for type of training (TP and APST) and the sets (1-3).The ANOVA was also applied to EMG data (e.g. FInsm5) of four monitored muscles, and to the other variables investigated. The LSD post hoc test was used when necessary. The level of statistical significance was set at 0.05 for all tests.

RESULTS AND DISCUSSION

The SR and BP exercises volume load per set and TTV were significantly less under TP when compared to APST (table 1). Significantly augmentation on volume load per set and TTV were observed for BP and SR during APST when compared to TP. For the Cf5 computed during the repetitions of each set, significant differences were found over the three sets during TP and APST for LD, BB and PM in the SR exercise (figure 1), except for set 3 for PM and TL muscle that did not show any difference between sets and protocols. In addition, the Cf5 was significantly higher for LD during APST than TP during set 1 and set 2. Significant differences were also found for BB during APST over the three sets compared to TP. The antagonist PM average Cf5 was significantly lower during TP when compared to APST during set 3, however, no significant differences were observed during set 1 and set 2 between APST and TP. Additionally, the average Cf5 was significantly higher during set 2 compared to set 1 for TP and APST protocols, respectively. These results may be associated to an increasing on muscle performance induced by the antagonist manipulating (e.g. BP) followed for an exercise for agonist muscle (e.g. SR). These results are in agreement with previous studies that found an enhancement in strength performance and agonist muscle activation after antagonist manipulating [3,4,5].

CONCLUSIONS

In the current study, the SR and BP exercises showed significantly augmentation on TTV compared to TP, and also a higher increasing on EMG parameters of muscle fatigue (e.g. Cf5). These results suggested that APST is more fatiguing than TP, and may be an interesting alternative to improving the TTV and also reducing the total time spend in the RT session. Thus, is possible that elevated levels of fatigue, as a result of the increased training density inherent in APST, may facilitate strength development over extended training periods.

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Table 1. Volume completed in each set and fatigue index for both super-set exercise orders.

Protocol	Exercise	Set 1	Set 2	Set 3
TP	BP	480.0 ± 34	417.4 ± 60.3*	352 ± 55.6*§
	SR	382.3 ± 31.2	313.5 ± 39.5*	264.6 ± 45.3*§
APST	BP	476.8 ± 36.2	448.6 ± 50.2*¥	382.8 ± 72.2*§¥
	SR	484.9 ± 50.1¥	385.1 ± 37.8*¥	318.4 ± 35*§¥

TP: traditional protocol; APST: Agonist-antagonist paired set; BP: bench press; SR: wide grip seated row. *Significant difference from set 1 ($p < 0.05$) *Significant difference from set 1 ($p < 0.05$); § Significant difference from set 2 ($p < 0.05$); ¥ Significant difference from TP;

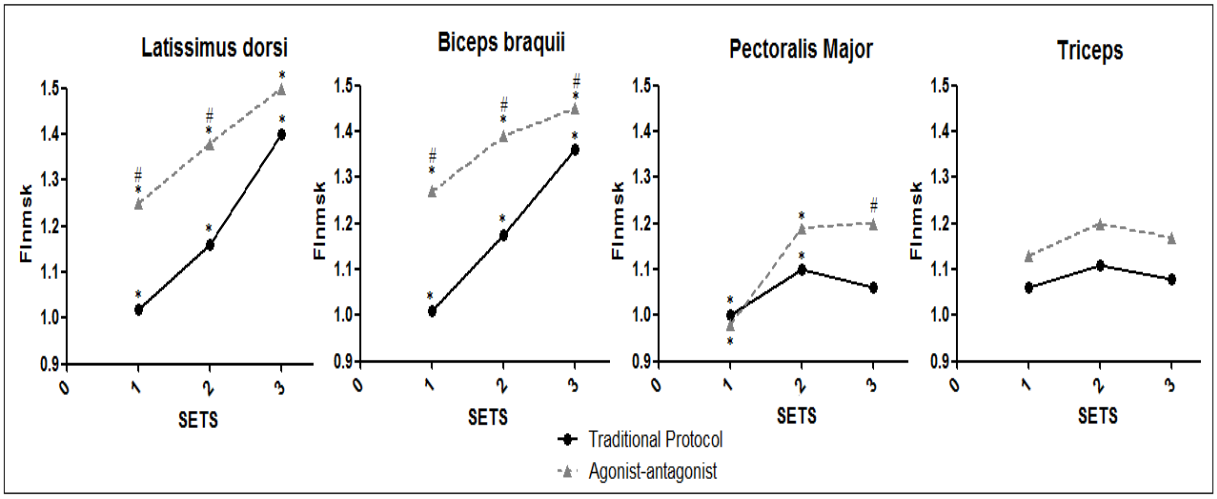

Figure 1. Coefficients calculated over the FInsm5 (Cf5) during three sets in wide grip seated row exercise between experimental protocols for latissimus dorsi, biceps braquii, pectoralis major and triceps lateral head muscles. * Significant difference between sets ($p < 0.05$). # Significant difference between protocols ($p < 0.05$).