ACUTE MUSCLE ADAPTATIONS TO A RESISTANCE EXERCISE

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INTRODUCTION

The neural factor (NF) and hypertrophic factor (HF) are the two major mechanisms related to improvements in neuromuscular efficiency [1]. Progressive resistance training results in neural and muscle hypertrophic adaptations that are primarily responsible for improved efficiency. Initial gains are related to the NF, which involves the interaction of facilitatory and inhibitory phenomena at various levels of the nervous system. Subsequent increases are attributed to the HF [2,3]. However, the timing of the neural adaptations is not yet documented. The purpose of this study is to examine neural adaptations resulting from a single-session of resistance exercise training. We hypothesized that the neural adaptations will be observed following a single session of resistance exercise training.

METHODS

Subjects: Twenty-six healthy subjects (14 M, 12F) provided informed consent prior to participation in this study. Their age, height and mass were 28.9 ± 5.8 yrs, 1.8 ± 0.1 m and; 68.3 ± 11.6 kg, respectively.

Experimental protocol: Surface electromyographic (EMG) activity of biceps brachii and triceps brachii on the dominant arm were recorded (2000 Hz, gain 1000, bandpass filter 15-500 Hz, CMRR 130 dB) during an elbow flexion task with resistances of 0 lbs and 3 lbs (pre-training). Subjects were then asked to perform the same task with 10 lbs resistance as a heavy resistance training exercise. Subsequently, EMG data were again obtained during the same task with resistance of 3 lbs and 0 lbs (post-training), respectively. Each lifting task was repeated five times within a 15 second period. The pace of movement was controlled by an audible cue of 60 bpm. The start and end of each repetition was determined with an electrogoniometer placed at the elbow.

Data analysis: Median frequency (MF) and integrated EMG (iEMG) were calculated for the concentric (CON) and eccentric (ECC) phases of each repetition. Data of middle three repetitions of each task were averaged for statistical analysis. A two-factor ANOVA [load (0 lbs, 3 lbs) × training (Pre, Post)] with repeated measures was employed to test for significant changes in iEMG and MF. Separate analyses were performed for the CON and ECC data for each muscle. An alpha level of 0.05 was used for all tests of significance.

RESULTS AND DISCUSSION

Following a single session of resistance exercise, significant reductions of biceps MF ($p<0.05$) and iEMG ($p<0.05$) during the CON action were noted (Table 1). Similar trends were noted in the ECC triceps MF ($p=0.17$) and iEMG ($p=0.08$). No changes were noted during the ECC action of the biceps. This CON neuromuscular efficiency gain of the biceps may be explained by the NF. Neural adaptations involve prime-mover motor unit activation and synchronous coactivation of the antagonist [4]. Given a hierarchical slow-twitch to fast-twitch motor unit recruitment pattern, decreased biceps CON iEMG in the post-training condition may indicate that less fast-twitch motor units were necessary to effectively accomplish the same task. The lower median frequency of stimulation may also be indicative of less fast-twitch motor unit involvement. The fact that no significant decreased changes of the iEMG or MF were found for the biceps during ECC action may reflect that there is less potential for neural adaptations with ECC than CON contraction. In the ECC action of the biceps, gravity could be considered the agonist while the biceps was the antagonist. It is not known how long these neural adaptations will persist or if there will be any carryover in the next training session. Also, a future study with isokinetic dynamometer at both directions may be needed to discriminate the dominance of neural adaptations in either CON or ECC muscle action.

CONCLUSIONS

Our research indicates increased neuromuscular efficiency following a single session of resistance training can be observed in the agonist muscle during CON activation. This improved efficiency is attributed to neural activation rather than to muscle hypertrophy. This information must be considered when interpreting data of subjects who have performed multiple trials in various conditions in the laboratory. Our results may provide alternative training for athletes to improve their performance within a short period of time.

REFERENCES

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Table 1: Mean iEMG and MF values during 3 continuous elbow flexion tasks. * significant difference due to main effect of training

		Concentric action of Biceps		Eccentric action of the Triceps	
		Pre-training	**Post-training**	**Pre-training**	**Post-training**
0 lb load	iEMG ($\mu v{*}s$)	41.95 ± 23.92 *	34.67 ± 17.05 *	9.03 ± 7.25	7.18 ± 5.04
	MF (*Hz*)	53.87 ± 12.47 *	51.21 ± 12.79 *	49.21 ± 19.54	42.95 ± 32.59
3 lb load	iEMG ($\mu v{*}s$)	81.81 ± 38.91 *	78.60 ± 32.90 *	12.21 ± 9.39	12.05 ± 8.38
	MF (*Hz*)	55.71 ± 8.63 *	52.92 ± 9.86 *	50.67 ± 11.30	47.31 ± 17.39