

EFFECTS OF 5 WEEKS OF GASTROCNEMIUS MUSCLE STRETCHING ON EMG & MAXIMUM VOLUNTARY CONTRACTION IN PLANTAR FLEXION

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Review of Literature

Previous studies found temporary decreases in muscle strength immediately following acute stretch training, which has since been termed, “stretching-induced force deficit” (Fowles et al. 2000). Chronic stretch training, however, has resulted in mixed results ranging from increased muscle strength or force to no significant change in muscular strength performance (Herda et al., 2011; McMillan et al. 2006, Fowles et al. 2000).

Several mechanisms could be responsible for the ensuing decreased muscle strength post-static stretching including, decreased myoelectric activity, decreased motor unit recruitment and altered viscoelastic muscle properties - negatively affecting the relationship between muscle length and tension.

This study will be conducted to observe and record the effects chronic static stretching will have on the motor unit recruitment of the muscle along with the force generated by the gastrocnemius post-stretching.

Materials & Methods

5 male and 5 female college-aged individuals participated in the study. One leg for each subject was assigned as a “control” leg, while the other a “training” (EXP) leg.

The EXP leg participated in gastrocnemius muscle stretching program for 5 weeks, 7 days per week. Subjects completed a series of 5 stretches for 30 seconds and a rest period of 10 seconds. The CON leg did not participate in the program.

Before (PRE) and after (POST) the 5 weeks, muscle strength and motor unit activation were measured in both legs:

Muscle strength: Gastrocnemius muscle strength was measured isometrically using a Lafayette Sciences Manual Muscle Tester in a fixed position of 90° of dorsiflexion. The best value of three trials was used for analysis.

Motor Unit Activation: Surface electromyography (sEMG) via electrodes on the lateral gastrocnemius were recorded with 10-KHz sampling. Signals were filtered with Butterworth high-pass filter (with a cutoff frequency of 10 Hz) and a low-pass filter (with a cutoff frequency of 500 Hz). Then signal was rectified and smoothed using standard root mean square (RMS) algorithms over 300ms.

Results were presented as mean ± standard deviation. A two-way repeated-measures ordinary ANOVA was performed in order to assess differences between groups and time. All differences were considered significant at $p < 0.05$.

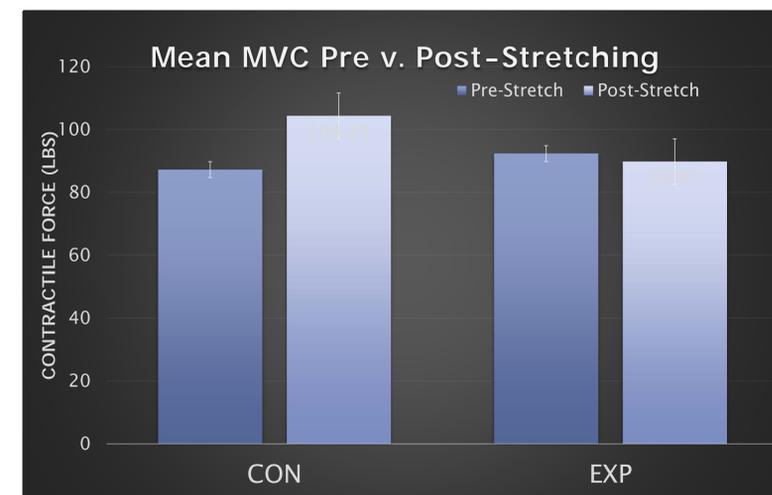
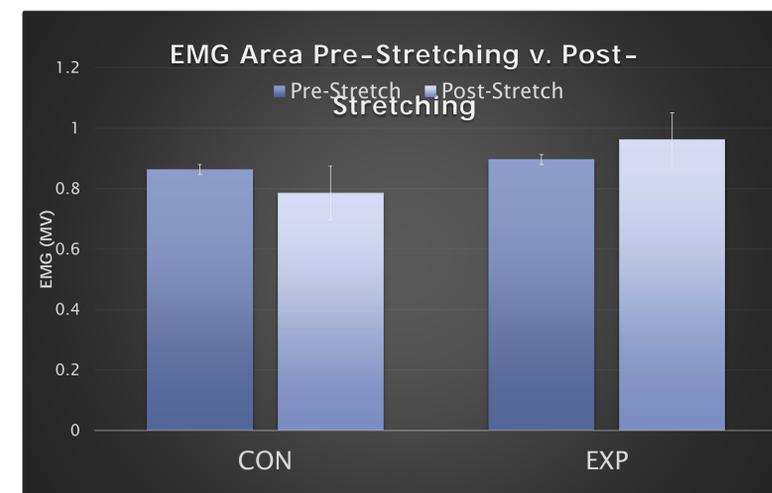
Results

Table 1. Subject Characteristics

	Height (in)	Weight (lbs)	Age (yrs)
n=10	69.23 ±3.75	148.7 ±17.98	21.3 ±0.95

Table 2. Force and EMG values in CON v EXP

	GROUP	PRE (±SD)	POST (±SD)
Mean MVC (lbs)	CON	87.25 ± 21.7	104.35±15.2
	EXP	92.34 ± 21.8	89.81±8.8
Mean EMG (mV)	CON	0.165 ±0.06	0.161 ±0.07
	EXP	0.194 ±0.11	0.190 ±0.04
Max EMG (mV)	CON	0.319 ±0.168	0.324 ±0.159
	EXP	0.364 ±0.153	0.315 ±0.091
Mean-Mid EMG (mV)	CON	0.202 ±0.091	0.187 ±0.086
	EXP	0.197 ±0.092	0.231 ±0.050
Area (mV)	CON	0.864 ±0.416	0.786 ±0.444
	EXP	0.897 ±0.348	0.963 ±0.219



Findings

In the CON leg, the mean maximum EMG to begin with was 0.319 ± 0.168 mV while the post stretching mean maximum EMG was 0.324 ± 0.159 mV. In the EXP leg, the mean maximum EMG started at 0.365 ± 0.153 mV prior to the stretching protocol. After the five-week stretching protocol, the maximum EMG mean was 0.315 ± 0.09 mV. Although there was a slight drop in mV among the EXP leg tests post-stretching, p -value > 0.05 therefore the change in maximum EMG was not significant. The mean for the middle portion of the EMG test in the CON pre-stretch was 0.202 ± 0.09 mV. After the five-week protocol, it dropped slightly to 0.187 ± 0.086 mV. As for the EXP leg, the initial mean of the middle portion of the EMG reading was 0.197 ± 0.092 mV increasing slightly to 0.231 ± 0.05 mV after the five-week protocol. None of the changes were statistically significant. For the maximum voluntary contraction, The mean force increased by 17.1 lbs. in the CON leg. In the EXP leg, the mean maximum voluntary contraction force slightly decreased by 2.53 lbs.

References

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- Herda, T. J., Costa, P. B., Walter, A. A., Ryan, E. D., Hoge, K. M., Kerksick, C. M., Cramer, J. T. (2011). Effects of Two Modes of Static Stretching on Muscle Strength and Stiffness. *Medicine & Science in Sports & Exercise*, 43(9), 1777-1784. doi:10.1249