Journal of Exercise Physiologyonline

December 2012
Volume 15 Number 6

JEPonline

Official Research Journal of the American Society of Exercise Physiologists

ISSN 1097-9751

Time Course Effect of Static Stretching on Maximum Grip Strength

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ABSTRACT

de Paula GP, Koch AJ, Cerqueira MS, Rocha JAS, Borges LS, Schettino L, Machado M, Pereira R. Time Course Effect of Static Stretching on Maximum Grip Strength. **JEP**online 2012;15(6):31-36. This study investigated the effect of a stretching procedure on maximum grip strength. Eleven adult men were submitted to two stretching protocols of finger flexors constituted by three sets lasting 30 or 60 sec and with a 20-sec rest interval between sets, and a control protocol where they rested without stretching for 4 min. The protocols were assigned in a random order. The peak handgrip force was measured before, immediately after, and 5 min after each protocol. Maximum grip strength decreased (-15%, $P<0.05$) only immediately after the stretching procedure sustained for 60 sec. We have found novel evidence that maximum grip strength is impaired after static stretching sustained for long periods. Additionally, the observed impairment was transient, with strength returning to the pre-stretching values 5 min after the stretching procedure.

Key Words: Stretching, Handgrip Strength, Muscle Performance

INTRODUCTION

Static stretching is commonly used in sport and rehabilitation due to its effectiveness in the maintenance and improvement of joint range of motion owing to possible changes in the viscoelastic properties of the muscle. Exercise physiologists, athletic trainers, coaches, and physical therapists generally include static stretching prior to the strength and conditioning training routines because of the belief that it can improve performance and/or reduce the risk of musculoskeletal injuries (15).

While there is a strong consensus that joint range of motion is improved by static stretching (2,8), the impact of static stretching prior to a muscular performance is more controversial. Numerous studies have suggested that the static stretching of lower limb muscles can immediately compromise the muscle strength (1,3,4,9,11,12). Fowles et al. (6) described the time course of post-stretching strength deficits of the ankle plantar flexors, and found that the strength deficit was highest immediately after stretching. The strength deficit returned to normal after ~1 hr. Viale et al. (14) demonstrated an immediate decrease in strength of knee extensors after a stretching procedure, which was maintained for 4.5 min after an active recovery. Also, an interesting effect is that the duration of stretching (particularly when the stretching procedure is sustained for a long period of time, =60 sec) may induce force impairment (7).

The effects of static stretching of the upper limb muscles just prior to a strength exercise have not been extensively studied (7). In fact, only a few studies (5,13) have examined upper body strength after stretching. Thus, the purpose of this study was to investigate if a routine stretching procedure would result in a decrease in maximum grip strength decrement and if the effect (should it occur) is maintained for short time period. We hypothesized that maximum grip strength would be decreased immediately after a static stretching procedure, which would return to previous values in ~ 5 min.

METHODS

Subjects

Eleven healthy men (mean ± SD, age 22 ± 1 yrs; height 180 ± 2 cm; weight 75 ± 2 kg) volunteered to participated in this study. All the subjects were right-handed with no known neuromuscular disorders. The study was approved by the local ethics committee and conducted in accordance with the Helsinki protocol of ethical principles for medical research involving human subjects. All subjects gave written informed consent to participate in the study.

Procedures

In order to monitor initial baseline (pre-stretching) and post-stretching handgrip strength, we chose a within-subject study design. Each subject was used as his own control. The subjects were submitted to three protocols: two stretching protocols and a control protocol (72 hr apart) in a randomized order. The stretching protocols were designed to stretch the finger flexors and consisted of three sets lasting 30 or 60 sec depending on the protocol for that particular day. During the flexibility sessions, each subject remained standing with the shoulder joint flexed at 90^o, the elbow joint extended at 180^o, and the forearm and hand in the supinated position.

A researcher was positioned in front of the subject to manually position the subject's forearm flexors in the extended to the hyperextended position. The stretches were done slowly until a mild discomfort (i.e., the point of tolerable pain) was acknowledged by the subject, who was instructed to relax while the stretched position was maintained for 30 or 60 sec. Each stretching of the forearm and finger flexors was repeated 3 times with a 20-sec rest interval between sets. During the control procedure volunteers rested without stretching for 4 min after the first handgrip strength measure. The forearm and finger flexors were chosen because the muscles of the anterior compartment of the forearm participate in the majority of the movements and exercises of the upper-body.

Handgrip strength was measured before, immediately, and 5 min after each stretching protocol and after the control protocol) using a load cell (EMG System Brazil, São José dos Campos, SP) coupled to a custom-made apparatus as reported by Pereira et al. (10). Two trials of 3-sec maximum isometric voluntary contraction (MIVC) were carried out to determine maximum grip strength. Each trial was separated by 30 sec. The greater maximum grip strength between the trials was considered for comparisons.

Statistical Analyses

A two-way ANOVA (3 procedures x 3 measures) with repeated measures on all factors was used to compare the maximum grip strength. Significant ANOVA results were followed by appropriate post hoc tests with Bonferroni corrections. The alpha level was set at $P<0.05$ for a difference to be considered significant. Statistical analysis was completed using SPSS 17.0 statistical package (SPSS Inc., Chicago, IL. USA). The data are presented as means ± SD.

RESULTS

Handgrip strength from each condition is shown in Figure 1. ANOVA found a significant interaction ($F_{4,60}$ = 4.44, P=0.003), among the handgrip strength procedures over time. Post-hoc tests identified significantly lower handgrip strength at the immediate stretch after 60 sec, which returned to the baseline values in 5 min.

DISCUSSION

We hypothesized that stretching would decrease handgrip strength, and that loss would be resolved shortly. We found an immediate handgrip strength decrease (-15%) after static stretching for 60 sec. This deficit was eliminated after 5 min. Short stretches (=30 sec) had no effect on force output while longer stretches (45+ sec) increased the risk of decreasing muscular strength (7). Our results agree, since strength was decreased only when prior stretching was sustained for 60 sec, demonstrating a dose-response effect. It has been proposed that this force output decrement after muscle stretching is underpinned by mechanical, physiological, and neurological mechanisms (6,7,11).

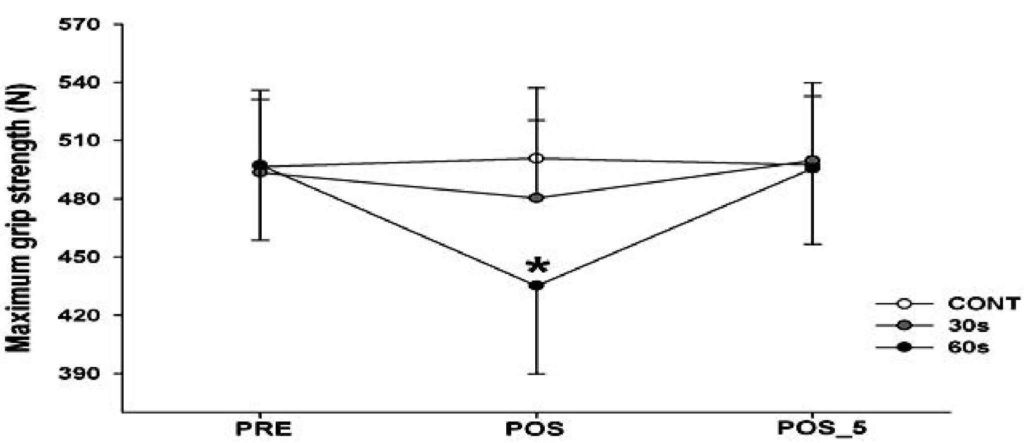

Figure 1. Mean ± SD Absolute Maximum Grip Strength (N) from Control, Stretching for 30 and Stretching for 60 sec, Before (PRE), Immediately (POS), and 5 min (POS_5) after Stretching or Control. *Different from all measures (P<0.05).

Fowles et al. (6) reported that 60% of the stretching-induced reduction of force up to 15 min is due to neural factors. Thus, neural factors affect strength initially and mechanical factors may last for a longer period, affecting strength for up to 1 hr. The results appear to indicate that the acute changes in proprioceptive feedback after stretching can lead to an interruption of motor unit recruitment (6,11). Here, though, it is important to note that Fowles and colleagues (6) used an unconventional stretching protocol. In contrast, we used a stretching routine similar to those commonly used before exercise. Therefore, the shorter duration of impaired strength we observed compared to Fowles et al. (6) may be related to the methodological differences as well the muscle group stretched (ankle plantar flexors vs. forearm and finger flexors).

Most research on stretch-induced strength decrements has focused on lower limb stretches (1,3,4,7, 9,11,12). In a rare study investigating upper arm muscles, Torres and colleagues (13) applied four different stretching protocols (no stretching, static stretching, dynamic stretching, and combined static and dynamic stretching) for upper-body muscles followed by four performance tests. They found no short-term effect of stretching on upper-body muscular performance.

The results of the present study corroborate Torres et al. (13), since we also found that no strength decease after a shorter (30 sec) stretch (given that they employed either two sets of 15 sec static stretch or 30 repetition dynamic stretch). Similarly, our findings support Evetovich et al. (5), who found static stretching of the forearm flexors decreased isokinetic strength at slow (30°•s-1) and fast ($270° \cdot sec^{-1}$) speeds. Stretches performed in that study were of 30 sec duration, which we found to be insufficient to produce a strength decrement. However, subjects in Evetovich and colleagues' study (5) performed 4 sets of 30 sec stretches with 15 sec rest intervals in between them, presenting the possibility of a cumulative effect equal to a single stretch of a longer duration. In the present study, the magnitude of strength loss was ~15% for the stretches maintained for 60 sec, which could be characterized as a minor stretching-induced strength loss for the forearm and finger flexors. This is similar to the 4.6% strength decrease in the forearm flexors observed after stretching by Evetovich and colleagues (5).

CONCLUSIONS

The findings of the present study indicate that there is a dose-response effect of muscle stretching on the maximum grip strength, which indicates that stretching for 30 sec (a duration that is commonly recommended) has no impact on strength while a longer stretches (60 sec) can decrease it. Additionally, it appears that the strength decrement following stretching is transient, and even when stretches are of sufficient duration (i.e., >60 sec) to impair strength, the impairment is resolved within a few minutes.

Since maximum grip strength was unaffected by static upper-body stretching maintained for short time periods (30 sec), and only transiently affected when the stretching is maintained for long time periods (60 sec), athletes competing in the field events could perform upper-body stretching, if enough time is allowed before the performance effort. Based on the current study, a 5-min period is sufficient to restore maximum grip strength after stretching.

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