Comparison of selected recovery techniques on grip strength and endurance following a simulated static hang.

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Abstract

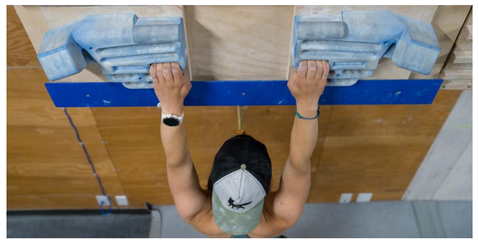
Due to the growing popularity of sports climbing and other grip strength dependent sports, there has been increasing interest in determining the best method of intermittent recovery during extended climbing bouts in order to help combat forearm and finger flexor fatigue. The two main methods utilized by climbers to do so are “shaking out” and passive stretching via wrist and finger extension. Presumably, these techniques are used to reduce the occluded arterial inflow brought upon by intramuscular pressure, which reduces oxygenation of the active muscles.
Methods: 44 college-age males and females were randomly assigned to 3 groups: “shaking out”, stretching, and resting (control) with the arms at the side. Prior to assessing a maximal hang time, each participant’s grip strength was measured. Subsequently, each participant was asked to hang by the proximal interphalangeal joints of digits 2-5 for maximal time. Following the maximal hang time the participants performed, one of the three protocols for 30 s and grip strength was again assessed and a second maximal hang time was recorded. Data was compared by repeated measures ANOVA with an alpha level set at $p<0.05$. Results: There were no significant differences among pre- grip strength results between the groups and no significant ($p>0.05$) differences from pre- to post grip strength assessments for any of the conditions. However, the shake and stretch conditions recorded slightly larger post-test grip deficits (-13.3% and -13.1% respectively) than the rest condition(-8.1%). For maximal hang time no pre-hang significant ($p>0.05$) differences were found among the conditions. However, each condition registered significant ($p<0.05$) pre- to posttest changes and no significant differences were found among the conditions.
Conclusion: While the rest condition resulted in slightly less grip strength fatigue following maximal hang time, post-hang time was not affected by any of the conditions presented in this research. These results suggest that none of the protocols used in the current study is superior in reducing occlusion and restoring of muscle oxygenation.

Introduction

Many competitive sports and recreational rock climbing relies on forearm and finger flexion strength and endurance. Climbing typically involve extended periods of time where finger flexors are in static contractions eventually resulting in muscular fatigue and discomfort (1). To speed recovery, hand shaking (shaking out) is often used to try to re-oxygenate (2) and to maximize forearm blood flow (3). Also recovering between pitches, climbers often stretch their fingers and wrists in order to attempt to recover more quickly. Researchers have concluded that strong muscle contractions tend to occlude arterial inflow due to intramuscular pressure (4). Results of a recent study regarding rock climbers and forearm oxygenation of blood flow during submaximal sustained contractions suggests that muscle oxidative capacity may offset the blood flow occlusion in the forearm muscles (3). Macleod et al. (5) concluded that muscle re-oxygenation during rest phases was a predictor of endurance performance. Therefore, re-oxygenation of the finger flexors is likely essential to continue climbing. In order to speed grip strength recovery one study (6) compared four methods: passive recovery or active recovery involving cycle ergometry, elecromyostimulation, or cold-water immersion of the forearms and found that active recovery and cold-water immersion was superior in preserving performance. The researchers concluded that these positive effects were accompanied by a greater lactate removal and a decrease in subcutaneous tissue temperatures. Studies seeking to determine if “shaking out” provides a means for forearm and finger flexor recovery have met with mixed results. For instance, Baláš (2) compared shaking and non-shaking and determined that hand shaking during a short rest period produced significantly ($p<0.05$) greater and quicker re-oxygenation of the forearm muscles over the non-shaking group. Green and Stannnard (4) compared passive rest, “shaking out”, and handgrip vibration on forearm recovery and found no significant ($p>0.05$) difference in recovery among the protocols. It should be noted that other than shaking out which can be done briefly during a climb, the aforementioned recovery protocols required much more time and, in some cases, equipment (bicycle, vibrator, etc.) which constitutes a longer recovery period. The purpose of this study was to compare short-term passive rest, shaking out, and stretching on grip strength and time to grip exhaustion.

Methods

Participants were healthy, college-age male and female (n=44) volunteers free from previous wrist/hand/shoulder musculoskeletal injuries. Prior to beginning their role in the study, participants were briefed on the protocol of the study and asked to sign a university approved IRB consent form. Each of the participants were randomly placed into one of three groups (PR = passive rest, SO = shaking out, or ST = stretching) prior to testing. Grip strength was measured using a hand dynamometer (Jamar Technologies Hydraulic Hand Dynamometer, Sammons Preston Inc., Bolingbrook, Ill 60440), prior to performing a timed max hang test. Following the timed max hang test each participant engaged in one of the three protocols for 30 seconds and subsequently were tested on hand grip and maximal hang time.



For the handgrip protocol the participants were asked to flex 90° at the elbow and to squeeze the hand grip dynamometer with maximum force. Following the hand grip assessment, participants were told to hang as long as possible from a round 1.25” diameter bar using only the proximal interphalangeal joint of digits 2-4, with the medial phalange atop the bar, and without the use of the thumb. Following the timed hang, participants in group PR (n=14) passively rested with the arms to their side for 30 seconds, group SO (n=15) “shook out” the forearms with the arms to their side for 30 seconds, and group ST (n=15) passively stretched both fingers and wrists simultaneously for 30 seconds. Shaking and stretching methods were demonstrated prior to testing. After the completion of the recovery protocols each participant’s grip strength was measured followed by a second timed max hang test. The time until failure was recorded for each trial. Group results were compared using repeated measures ANOVA (SPSS, Statistics 28.1) with an alpha level set at $p<0.05$

Results

Overall pre- to post grip strength diminished by an average 10.7% in the three protocols. The reduction in pre- to post grip strength by resting protocol was 7.9% (0.77 kg), by the shaking protocol 13.1% (1.22 kg), and by the stretching group 11.0% (0.95 kg). While no significant ($p>0.05$) differences among the protocols were found, the resting protocol was slightly superior in grip strength recovery (Table 2), with shaking reflecting the largest loss of recovery. The passive rest protocol reduction in maximal hang time for the resting group was 36.6% (11.1 sec), the shaking group 31.8% (9.3 sec) and the stretch group 36.0% (10.2 sec) (Table 3). Again, no significant ($p>0.05$) pre-to post hang time differences were found among any of the protocols. However, the shaking protocol slightly exhibited the greatest recovery of the three protocols.

Figure 1. Pre- to post hand grip strength by condition

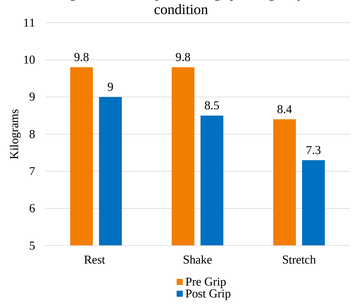
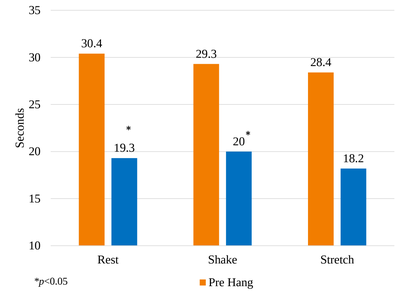


Figure 2. Pre- to post static hang time (s) by condition



Discussion

Previous studies have used intermittent contraction and relaxation protocols (4), however; the ratio between the two has not been determined (1). It has been suggested that shaking the hands close to the body likely increases micro- and macro-vascular blood flow thereby enhancing the delivery of oxyhemoglobin to the muscle (1). Few studies have sought to compare acute recovery methods. The present study did not attempt to ascertain the ratio of contraction and relaxation time on muscle recovery, rather we chose to measure time to fatigue following the three protocols. One study (8) compared “easy climbing” and walking as means of climbing recovery and found that climbers were able to ascent further in a set time after easy climbing. More specific to the current study, Balas (1) found that during intermittent tests, shaking the hand with the fingers pointing down resulted in significantly quicker re-oxygenation which contradicts the results found by Green and Stannard (4) who concluded that neither “shaking out” or low-frequency vibration were unlikely to affect climbing performance. Based on the present study, passive resting with the arms to the side appeared to be slightly, but not significantly, superior to shaking or stretching at improving grip strength, while shaking may be slightly, but not significantly, superior at improving performance during prolonged isometric contractions.

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