Zlagboard Forearm Endurance Workout

Jędrzej May 22, 2019 No Comments

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Quick summary

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Zlagboard Forearm Endurance Workout

The Zlagboard comes with a built-in protocol for forearm endurance training, developed by Duncan Brown, an Australian climber and coach [1][2]. The idea behind the Zlagboard Forearm Endurance Workout is to generate a severe forearm pump, targeting the anaerobic lactic energy system. This allows you to train both physiological tolerance and psychological tolerance to high acidic loads [3]. The Zlagboard Forearm Endurance Workout could perhaps be viewed as a rather extreme version of Hangboard Repeaters, or Eva Lopez SubHangs protocol, where the hang time and the rest times are one minute each [4][5].

Zlagboard Forearm Endurance Workout details

1. Mount the hangboard and support your feet on a chair, or some screw-ons on the wall.
2. Choose a pair of holds, e.g., 20 mm edges, and hold it for 1 minute.
3. Dismo[illegible]angboard and shakeout for 1 minute.

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Table 1: Zlagboard Forearm Endurance Workout summary.

Zlagboard Endurance	
Approx. BM load	30 - 70%
Sets	10
Positions/Set	1
Hang time [s]	60
Rest betw. sets [s]	60
TUT [s]	600
Total time [min]	19

Zlagboard Forearm Endurance Workout remarks

- To prevent blood from flooding your forearms directly after dismounting the hangboard, hold them up for a couple of seconds, and shake out.
- You may apply the above strategy after finishing a pumpy route – holding your hands up will help you regenerate faster before your next burn.
- You can increase the level of intensity of the exercise by squeezing and releasing your fists in the upright position throughout the 1 minute of rest.

Muscle endurance and fatigue mechanisms

Muscular endurance in itself is a complex subject, and forearm endurance in climbing is no exception. In general, endurance can be defined as the ability to maintain or to repeat a given force or power output, which perfectly describes the periods of intermittent contractions mixed with periods of sustained contractions of the finger flexors, characteristic for climbing on a sport route [6][7][8]. Currently, the physiological mechanisms that allow elite level climbers to maintain repeated intense isometric contractions for prolonged periods of time are not fully understood, but there is evidence that flexor muscle oxidative capacity, capillarity, and ability to profuse O_2 may be the governing factors. For one thing, it was discovered that high-level climbers are able to de-oxygenate the flexor muscles to a greater extent than intermediate climbers and non-climbers during sustained contractions. What is

climbers during both sustained and intermittent contractions, while it is known that enhanced O_2 delivery to the exercising muscles directly attenuates muscle fatigue and increases muscle efficiency [9][10][11].

Since blood flow brings oxygen necessary for aerobic adenosine triphosphate (ATP) production and removes by-products of metabolic processes in working muscles, it plays an important role in the maintenance of force output. As the muscles contract, the mean arterial blood pressure increases, leading to a decrease in the net blood flow to the working muscle and inducing fatigue. Surprisingly, blood flow occlusion does not seem to be the critical factor in the development of fatigue, as the decrease in the MVC force was found to precede significant changes in the blood flow to the muscle [10][12].

ATP is the energy source fuelling muscle contractions, and glycogen oxidation is the primary source for ATP regeneration during high-intensity intermittent exercise [13]. Glycolysis leads to blood lactate (Lac) and hydrogen ions (H+) accumulation, which until recently was thought to play a vital role in the development of muscle fatigue. This view is now being challenged, as several recent studies have shown that decreased pH may have little effect on contraction and MVC of human muscle [10][14].

Anaerobic metabolism in skeletal muscle also involves hydrolysis of phosphocreatine (PCr) to creatine and inorganic phosphate (Pi). The concentration of Pi increases rapidly during intense contractions, which appears to be the most important cause of fatigue. It is hypothesized that elevated levels Pi can lead to decreased force production by limiting Ca_2 release from the sarcoplasm (SR) [14][15]. Finally, mitochondrial respiration produces ATP and consumes O_2 in a process that generates reactive oxygen species (ROS) that are known to contribute to muscular fatigue [10].

Zlagboard Forearm Endurance Workout hang intensity determination

So what does happen when the Forearm Endurance Workout is being executed? Let's first take a look at the hang intensity. Based on a simple analysis of the mechanical system involved and some very rough measurements, we can state that the hang load lies in the range between 30% – 70% of the climber's body mass (BM), depending on the type and position of the feet support used [16]. This result can be confirmed through a simple experiment, as it is shown in Figure 1. In terms of the %MVC, this could mean anything, but if we choose a reasonably comfortable hold, on which the training climber's MVC is around 150% BM, then the hang intensity should lie somewhere in the range between 20 – 45% MVC. Such training load should result predominantly in the recruitment of slow-

[20].

Figure 1: Climber's weight distribution during the Zlagboard Forearm Endurance Workout at vertical (left) and overhung (right) hang angle.

PCr and pH response during anaerobic exercise

In the work period of the protocol, partial blood flow occlusion is bound to take place, causing Lac, H+, Pi, and ROS accumulation. At the same time, PCr stores are being quickly spent, which causes the majority of ATP to be produced through glycolysis. It was found that during low-intensity intermittent exercise, the contribution of aerobic glycolysis to ATP synthesis reaches from 75% in untrained individual 5% in endurance athletes. The rest of the ATP is produced in anaerobic processes

Throughout the 60-second rest period, the PCr stores are partly replenished, and the rate of PCr recovery is much faster in endurance-trained athletes than in sprint-trained athletes. This result is attributed to differences in the mitochondrial density in the muscles between the two groups [22][23]. What is interesting is that the lactic acid levels keep going up even during the rest period, as a result of PCr resynthesis, as it is shown in Figure 2 [21][24]. Since there is little chance that the PCr stores get fully recharged in 1 minute, this means that lactic acid is continuously being produced throughout the entire 20-minute duration of the protocol, leading to very high blood lactate concentrations in the forearms and very painful pump buildup [25].

Figure 2: PCR restoration dynamics and lactic pH changes in calf muscle during rest, exercise, and recovery periods of a high-intensity plantar flexion test according to [24].

Endurance training adaptations

The goal of aerobic endurance training is to increase the vascularization, enzyme activity and the number of mitochondria in slow-twitch muscle fibers, which in most sport disciplines is done by means of high-volume training at low intensities of up to 40% MVC [17]. In route climbing the goal of such training is to increase the athlete's critical force (CF), allowing performing without fatigue at intensity levels reaching as high as 60% MVC. High CF makes it possible to save more energy for the crux sequences and facilitates recovery on large holds [8].

Research results confirm that exercise training-induced growth of capillaries is most significant in the muscle tissue with the highest relative increase in fiber activity during training bouts [26]. However, it was also shown that ischemia resulting from blood occlusion, causes quick fatigue of type I fibers, leading to increased recruitment of type II fibers, even at very low loads. This phenomenon is taken advantage of in blood flow restriction (BFR) training methods [27]. The above considerations lead to the conclusion that the Zlagboard Forearm Endurance protocol mostly targets vascularization of fast-twitch type II fibers and not the type I slow-twitch fibers.

Based on the definitions given by Holloszy [28], we can classify the Zlagboard Forearm Endurance Workout as a form of anaerobic interval training. The protocol increases adenosine monophosphate protein (AMP) levels, triggering mitochondrial growth, and enhanced vascularization of type II muscle fibers, induced by hypoxia. What is even more important, the activity of enzymes involved in anaerobic metabolism is boosted. Further, resistance to lactic acid is enhanced, while the A-VO2 difference increases. PCr recovery rates are also improved, and the total PCr levels in the muscles are heightened [29]. Finally, muscle hypertrophy is expected, owing to anabolic hormone secretion, caused by lowered blood pH, and fast-twitch muscle recruitment [28].

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Thus it seems that Zlagboard Forearm Endurance Workout is more of a strength-endurance training method, and is less likely to trigger improvements in the aerobic energy system.

Zlagboard Forearm Endurance Workout conclusions

The main idea behind the Zlagboard Forearm Endurance protocol is to produce a severe forearm pump, which is aimed mostly at developing tolerance to high acidic loads in the forearm muscles. The Forearm Endurance Workout is somewhat similar to Eva Lopez SubHangs protocol, but even longer hang times and employed. It is likely to be more gentle on the shoulders though, because the arm position is more neutral, and it is possible to adjust the posture and relax the shoulders a bit if required [5].

The 1-minute hangs lead to a rapid and painful pump buildup, PCr depletion, and type II muscle fiber recruitment, which is characteristic of anaerobic endurance training. The method is likely to increase your ability to endure through a long sequence of hard moves, but it will probably not improve your CF. This means that by the time you arrive at the crux you might already be pumped anyway. The chances are that you're better off training the aerobic energy system with Endurance Repeaters, or by low-intensity wall traversing. Steve Bechtel recommends repeated climbing down to even eight grades below your RP level, to prevent getting pumped in the first place [3].

What is more, Zlagboard Forearm Endurance Workout seems to deviate too much from the actual process of climbing a route, and intermittent protocols are likely to be more appropriate in this respect. Still, all that does not mean that Zlagboard Forearm Endurance Workout is bound to be ineffective! On the contrary, this might be just what you need to get you through long, hard, and pumpy cruxes. Even boulderers might benefit from the increases in PCr muscle stores and recovery rate, which will allow for faster regeneration between attempts. On top of that, muscle hypertrophy caused by growth hormone release triggered by lowered blood pH is not to be disregarded. Go ahead and give it a try if you like suffering, but keep your climbing goals in mind!

If you have any questions or comments, feel free to contact me. Please subscribe to the blog, to keep up to date with the upcoming posts on cutting edge methods of climbing training!

1. www.zlagboard.com (link)↩
2. www.athle' com (link)↩

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About the author

Jędrzej

A veteran hangboarder and a Moonboard fan, Jędrzej is crazy about training for climbing. There's nothing he likes more than trying out different protocols and applying the newly acquired skills on the wall. Jędrzej also enjoys playing the electric guitar, baduk, and reading articles on the science of sports training. He holds a Ph.D. in electrical engineering.

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