



Short Communication

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Want to Climb Matterhorn? - Train in Blocks



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Abstract

Alpinists often practice different disciplines. Often in winter they are backcountry skiing whereas in summer they like climbing. From a physiological point of view these two disciplines have different requirements. Whereas backcountry skiing mainly affords to have a good cardiovascular system uphill and eccentric muscle activity downhill climbing mainly affords to have a good training state mainly in the upper body especially arm flexor musculature. Often during practicing a wish comes up for a challenging goal respectively a difficult mountaineering tour. This often requires special preparation and changes the focus while training to improve the relevant skills in order to increase security. Besides other challenges e.g. psychic such tours often have some more difficult passages, where security can be substantially increased when climbing skills are good. This poses the question how to improve these abilities in a short and effective manner in order to increase security. From a physiological point of view skeletal muscle must be trained respectively force production has to be increased. Due to the fact that alpinists often have a sufficient general training state of cardiovascular system a solid base for strength training exists. Due to the fact that endurance and strength training is perceived by different signal cascades partly inhibiting each other it is therefore recommended that before such a challenging tour such as climbing e.g. Matterhorn a block training of climbing is conducted. This can be done by e.g. bouldering three to four times a week for about 45 minutes. This will within 6 - 8 weeks substantially increase strength and as consequence ability to climb key parts of difficult tours resulting in a more enjoyable and secure way of reaching the mountain.

Keywords: Strength versus endurance training; Cortisol; Testosterone

Introduction

Since some time it's known, that endurance and strength training can inhibit each other [1-4]. Reasons can be detected on molecular level on organ system of skeletal musculature. While endurance training yields to an improvement of better vascularization and to an increase of mitochondria and therefore better ATP regeneration, strength training up regulates myofibrillary proteins. Due to the fact that different stimuli adapt different in strength and endurance signal cascades inhibiting each other, block training is recommended to have substantial improvements in short times. Also, for alpinists block training is recommended especially for alpinists practicing backcountry tours in winter and climbing in summer and now willing to climb a difficult route in the mountains e.g. Matterhorn. Especially, in advance of a difficult tour block training in urbane region e.g. in a boulder hall is recommended in order to improve climbing skills yet increasing security.

A Good Alpinist has Many Skills

Alpinists often have different interests' eg. Climbing in summer and backcountry skiing in winter. When making sinful training recommendations physiological demands have to be mentioned. Focusing on the physiological demands in

climbing the anaerobic strength endurance of the forearm flexor muscles is crucial and represents one main limiting factor [5-9]. Furthermore possessing greater strength and endurance in the arms and shoulders could be advantageous [10]. Concerning kind of route it can be mentioned that routes with an upward displacement and or a vertical displacement on overhanging wall have highest physiological demands. Elite climbers recorded significantly higher values for finger strength and arm endurance than advanced climbers [11]. Furthermore clear hints exist that training can result in substantial improvement of climbing performance [12]. To keep in mind, success in climbing is not only related to individual physiological variables but is the result of a complex interaction of physiological and psychological factors.

Besides climbing Alpinists often like backcountry skiing. Performance analysis of backcountry skier allow to suggest that due to an often long period of time spent just below and above respiratory compensation threshold ski-mountaineering can be viewed as one of the most strenuous endurance sports like cross-country skiing, running and off-road biking [13]. Analyses from the most popular backcountry race Patrouille des Glaciers in Switzerland confirm the exhaustive character of backcountry

skiing. Furthermore, often during long-lasting backcountry tours energy balance may be negative and caloric intake is below recommendations [14]. Interestingly, experienced skiers select a speed that minimizes their metabolic cost [15]. To sum up, backcountry skiing requires a good cardiovascular system uphill and a well-developed equilibrium as well as eccentric muscle activity for downhill skiing [16-18].

Strength Versus Endurance Training

Human skeletal muscle exhibits an outstanding phenotypic plasticity. Endurance training leads to massive increases of mitochondria and improves capillarization. Strength training increases muscle cross-sectional area mainly by increasing myofibrillar proteins [19]. Multiple parallel pathways increasing mainly transcriptional activities for selected muscle proteins are responsible for endurance training related muscle changes. Muscle changes associated with strength training are dominantly achieved by modifying translational mechanisms.

Concurrent effects of strength and endurance training are described. Hickson was already in the 1980 able to show, that parallel training of strength and endurance inhibits strength increase. Furthermore, in mice models it was shown that a high frequent stimulation pattern yields to an activation of Akt-mTOR-axis, while low frequent stimulation activates AMPK-

PGC-1-System. In training with humans it was elucidated that endurance training immediately before strength training reduces anabolic answer [20]. The effects of repeating stimuli on skeletal muscle are dependent from manner and intensity, whereby through constant stimuli a pooling in some direction seems to take place. This pinpoints the relevance of the premise of block periodization of training and is therefore recommended by different findings.

Coffey 2009 examined acute molecular responses in skeletal muscle to repeated sprint and resistance exercise bouts [21]. Study participants were assigned to trials consisting of either resistance exercise followed by repeated sprints or vice-versa. Muscle biopsies from vastus lateralis were obtained at rest, 15 min after each exercise bout, and following 3-h recovery to determine early signaling and mRNA responses. Specifically, initial resistance exercise significantly increased S6K phosphorylation approximately 75%, but there was no effect when resistance exercise was undertaken after sprints. When resistance exercise was followed by repeated sprints PGC-1alpha mRNA was increased (Figure 1). To sum up, repeated sprints may promote acute interference on resistance exercise responses by attenuating translation initiation signaling. It was suggested that sprint-activities are isolated from resistance training with allowing training divergent exercise modes.

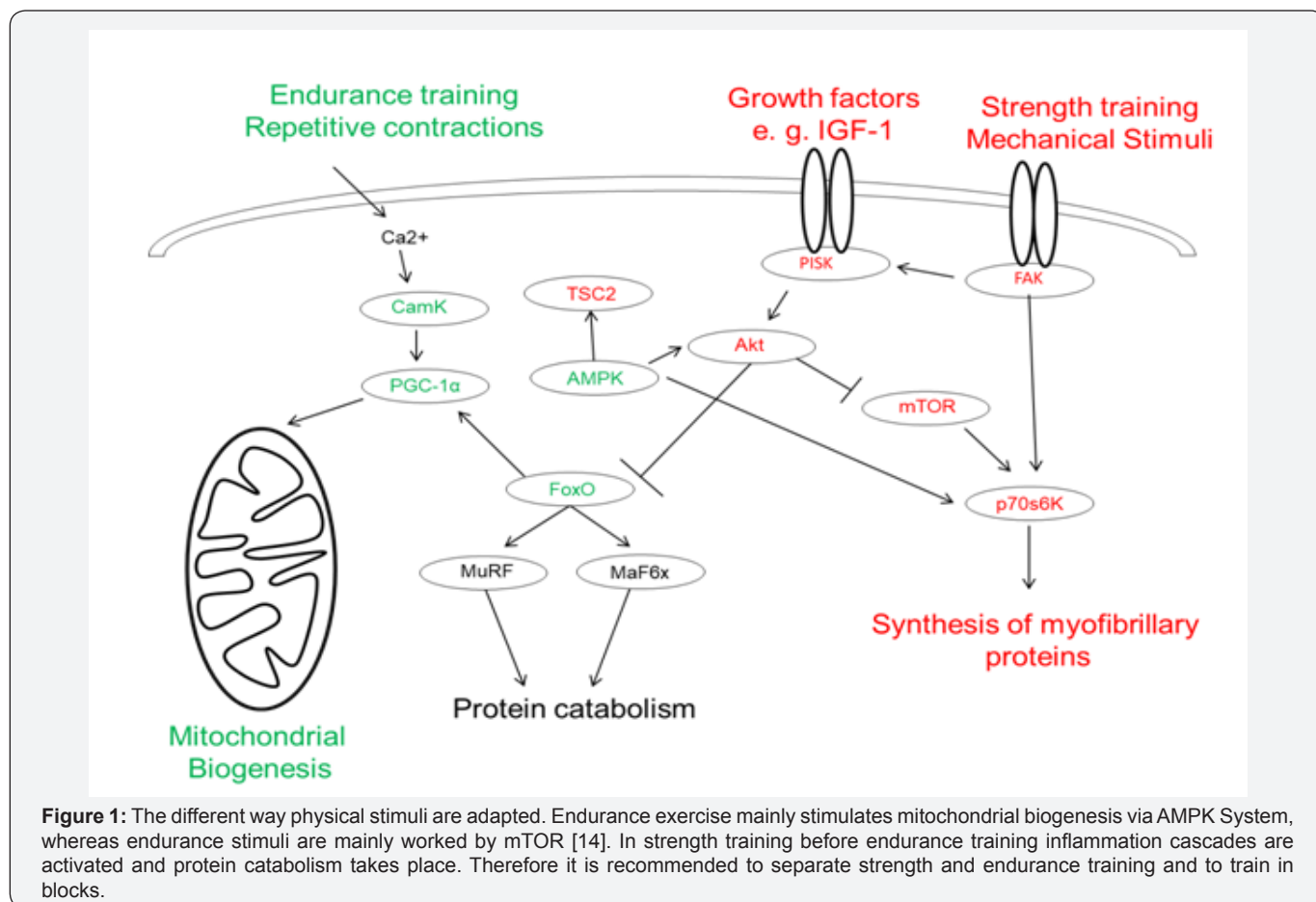


Figure 1: The different way physical stimuli are adapted. Endurance exercise mainly stimulates mitochondrial biogenesis via AMPK System, whereas endurance stimuli are mainly worked by mTOR [14]. In strength training before endurance training inflammation cascades are activated and protein catabolism takes place. Therefore it is recommended to separate strength and endurance training and to train in blocks.

Describing effects of endurance training it allows performing higher or during a longer time. This requires a higher performance capacity of cardiovascular system. On level of musculature capillarization an improvement can be detected and muscle cells entail more mitochondria. Thus, having muscle cells with more cell organelles responsible for ATP regeneration. As mentioned above the increase of capillarization and mitochondria density is taxed up to 30%. This is an enormous synthesis performance of muscle cells. AMPK can activate PGC1- α (the most important activator of mitochondria biogenesis) and it seems important for cellular homeostasis as well as the transcriptional up regulation under chronic endurance performances [17].

For strength training analyses were conducted. Even after short training interventions of only 6 weeks Isokinetic torque production of the knee extensor muscles increased by a total of 17.6%. The cross-sectional area of the vastus lateralis muscle increased by 8.4%, mainly during the second half of the training period [20]. In contrast, the volume density of mitochondria decreased by 9.6%. Other studies elucidating the relationship between strength and endurance training came to similar findings [3]. To sum up, even strength training seems to yield not only an improvement of strength but also cardiovascular system. This allows implying, that cardiovascular training is a good base for strength training.

Summary

It seems generally established that molecular adaptations in endurance versus strength training are different. While in endurance training mainly an up regulation of transcriptional factors over PGC-1 α is coordinated, in strength training a translational response is released by mTOR. Furthermore in strength training we see a DNA-recruitment through activation of satellite cells and repressors such as Myostatin and Interleukins. In endurance- and strength training the controlling of molecular adaptations through endurance and strength training is regulated by complex signal paths with multiple input points with parallel signal pathways which are controlled by feedback and feed forward processes. However, a precise mechanistic understanding with prospective meaning is out of view. Different Stimuli strength versus endurance, whereby signal cascades inhibit each other, exist [22-24]. Therefore block training is recommended in order to release substantial improvements within short time. Also for alpinists this form of training is recommended which often make backcountry tours in winter and climbing in summer. Especially before difficult mountaineering tours in order to increase security a short intensive e.g. boulder training block is therefore recommended.

Practical Implications

a) Mountaineering consists of different performance determining physiological components which can be arbitrarily divided into strength and endurance.

b) Due to the fact that the two training regimes endurance and strength can inhibit each other through to different signal pathways partly inhibiting each other, it is recommended to first build a solid cardiovascular base.

c) Shortly before a hard tour it is recommended to train in a block of around 6 - 8 weeks e.g. in a boulder hall in urbane area in order to gain strength and improve security for the difficult climbing parts of a tour e.g. in the Alps such as climbing Matterhorn. In this short time theoretically and practically proven high increases in strength can be achieved increasing security and comfort during a hard mountaineering tour.

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