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Review

The training process: Planning for strength–power training in track and field. Part 1: Theoretical aspects

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Abstract

The process of strength–power training and the subsequent adaptation is a multi-factorial process. These factors range from the genetics and morphological characteristics of the athlete to how a coach selects, orders, and doses exercises and loading patterns. Consequently, adaptation from these training factors may largely relate to the mode of delivery, in other words, programming tactics. There is strong evidence that the manner and phases in which training is presented to the athlete can make a profound difference in performance outcome. This discussion deals primarily with block periodization concepts and associated methods of programming for strength–power training within track and field.

Keywords: Periodization; Strength–power training; Track and field; Training process

1. Introduction

There is little doubt that the method employed makes a significant difference in the physiological and performance adaptations resulting from a resistance-training program.[1] For example, high-volume programs generally have a greater influence on body composition, enhancement of muscle cross-sectional area, and work capacity factors than do low-volume higher intensity programs. In contrast, high-intensity programs have a greater influence on maximum strength, peak power, and velocity compared to low-intensity programs.[2,3] Evidence also indicates that the level of the athlete results in somewhat different adaptations to training at least quantitatively. For example, among relatively untrained or weak athletes, strength training will provide as great or greater increases in power as compared to power training alone. Furthermore, evidence indicates that prior strength training or having higher maximum strength levels can potentiate further power training.[3–7]

Training should be recognized as a process which prepares an athlete, technically, tactically, psychologically, physiologically, and physically for the highest possible levels of performance.[8] First is the realization that training is a process that requires considerable forethought and planning. Training is multi-factorial in nature; as such the attempt is to exploit known principles of physics, physiology, and psychology in order to maximize the effects of the training stimulus. The training process is vitally concerned with the positive enhancement of performance—therefore the process must provide:

- an appropriate stimulus for adaptation;
- an appropriate means for assessing progress (monitoring);
- and additional means beyond sets and reps (i.e., stimulus) including rest–recovery phases, psychological re-enforcement, daily nutrition, supplements, sleep, *etc*. so that recovery–adaptation is optimized.

The sport training process attempts to take the athletes as close as possible to their genetic limits, thus training is not simply recreational exercise. Considering this concept, a good coach should be viewed in the same context as a good physician. Therefore the training process can be viewed as a prescription.

When developing a training process there are several "realizations" that are major factors in the development of a successful training process:

Every athlete does not progress to the elite level.[9] There is no substitute for innate talent (genetics). There are two aspects to this realization. First, there are genetically linked physiological characteristics that relate to superior performance. These heritable characteristics range from higher testosterone

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concentrations in both men and women to differences in muscle fiber types.[10–12] As a result of these genetic links athletes with specific traits simply are able to perform better in specific sports. For example: athletes with more Type I motor units typically have a higher VO_{2max}, handle lactate more efficiently and have endurance event advantages.[13] Second is the relationship between heredity and the training "window of adaptation".[10,14,15] Everyone responds to a well-planned training stimulus; however, because of heredity some athletes respond to the same program with greater adaptation, and so are able to progress further than typical athletes. Athletes that have both traits are most likely to progress to the elite level.

Being stronger can make a substantial difference in performance. Maximum strength is related to:[4–6,8,16–20]

- Magnitude of force production with greater peak and average forces that may allow for higher velocities and power outputs to be achieved when using submaximal loads;
- Rate of force development (RFD) which can describe faster muscle activation with resultant greater force during critical time periods;
- Superior ability to develop and respond to stretch shortening cycles (SSC);
- Greater peak and average power, which means that work is accomplished at a higher rate;
- Greater absolute endurance, especially high intensity exercise endurance (HIEE) that may reduce "central" (nervous system) fatigue; i.e., more total work can be accomplished;
- Greater postural strength, which describes the ability to hold static and dynamic positions better during performance;
- Some evidence that force sensitivity and sensation is superior (may be a result of strength training partially independent of maximum strength)—ability to appropriately modulate force production is superior;
- Importantly, among weaker athletes (most scholastic and collegiate athletes), strength training alone may produce equal or superior results in terms of RFD, power, *etc*. compared to power or speed training,[4–6,8] particularly when performed in an integrated fashion with sport training programs.

2. Components of the training process

A major component of planning concerns the understanding of both the developmental and conceptual aspects of the training process. Considering that training is multi-faceted, the degree of success achieved will relate to how well a coach learns to plan conceptually and subsequently creates detailed subcomponents oriented to produce superior results. These factors of the training process include the following.

2.1. Construction of the annual plan[8]

The most important aspect of the planning process is the creation of a sound annual plan. The annual plan is a road map for the overall training process and its development is the first step in constructing the athlete's program (the program can be found online at doi:10.1016/j.jshs.2015.07.003 as Table S1). The annual plan lists the coming competitions, the projected testing/monitoring dates and a general guide to conceptual training (periodization and programming).

Conceptually, periodization is a blueprint dealing with fitness phases and timelines. This blueprint allows the coach to project an approximate timeline for when various types of fitness phases (e.g., endurance, strength–endurance, strength, power, speed, taper, *etc*.) will be emphasized, the order of the phases and how long each of these phases will last. The annual plan also contains the programming for the periodized training plan.

Programming deals with creation of appropriate sets, repetitions and exercise selection that make the different phases efficient and efficacious. Programming is a primary factor in fatigue management and directing training toward the desired goal(s). Excessive accumulative fatigue inhibits physiological adaptation to training stimuli, produces non-beneficial psychological aspects and increases the injury potential. Thus a primary aspect of programming deals with appropriate variation of training volume, intensity, and exercise selection such that fatigue is controlled and adaptation is optimized.

The separation of these two aspects (periodization and programming) within the training process is often difficult. Depending upon the type of periodization process chosen (e.g., classic *vs.* block), the programming can be different. Regardless, development of the annual plan is the primary step in creating an efficient and successful training process.

Most important, the success of a training plan resides in how collaborative and willing the head coach and assistant coaches (and strength–conditioning coaches) are to learn the intricacies of, and become fully immersed into, the planning process, a factor that does not always occur. Predictably, for coaches not accustomed to a conceptual planning process, a difficult, but temporary, adjustment period often takes place.

2.2. Factors during the annual plan development

A sound understanding of the basic training principles and their application during training can make a substantial difference in training process outcomes.[1,7,8,21–24] There are four basic training principles: overload, variation, specificity, and reversibility. When these principles are appropriately addressed and properly integrated into the training process as a result of logically applied programming, adaptation is optimized, fatigue management is enhanced, overtraining potential is reduced, and the potential for superior performance is augmented.

2.2.1. Overload

Overload entails providing an appropriate stimulus for attaining a desired level of physical, physiological, psychological, and performance adaptations. Overload can be conceptualized as a training stimulus that forces the athlete beyond normal levels of physical performance. Thus the application of an appropriate overload stimulus can include range of motion, absolute and relative intensity (RI) levels, frequency, and time factors. All overload stimuli will have some level of intensity, RI (percentage of one repetition maximum, 1 RM), and volume. The determination of appropriate overload stimuli for different modes (weights, variable resistance devices, semi-isokinetic devices, *etc*.) of resistance training can be challenging. Quantification of