

Velocity-Based Strength Training

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Introduction

Velocity-based strength training (VBT) is one of the strength development training methods. This method is achieved by tracking the movement speed of the exercise and measuring this speed using some technological devices. VBT provides feedback to coaches and athletes about the speed at which the movement should be performed (Dahlin 2018). Verbal or visual feedback of speed can improve the athlete's performance and motivation level. Velocity-based training can be applied to all parts of a strength training program and supports the number of sets, repetitions, load and programming method used (Weakley vd 2020a). VBT is a current resistance training method that accounts for fluctuations in the athlete's physical characteristics and daily changes (Mann vd 2015). In addition, the application of VBT can enable coaches to accurately set speed loss thresholds (e.g. 10% speed loss threshold) targeting specific kinetic and kinematic outcomes (Pareja-Blanco vd 2017a). Speed loss thresholds are calculated from the maximum speed achievable during a workout, typically determined from the first repetition of the first workout, and allow the coach to decide when to terminate a workout (Padulo vd 2012).

Aim of The Study

The aim of this study is to give information about speed-based strength training and to present the techniques related to the subject.

Velocity Measurement Methods

In velocity-based training, some technological equipment is needed to calculate movement speed accurately and quickly. These include devices such as linear position transducers (LPT), video cameras or three-dimensional motion capture systems, low-cost smartphone apps and inertial measurement units (Balsalobre-Fernandes ve Torres-Ronda 2021, Hirsch 2018). However, cost, portability and time constraints associated with data processing limit the use of some of these methods. LPT and inertial measurement units are the most commonly used methods by researchers and exercise professionals to measure movement speed. LPT is often used to record position data of an object (Hirsch 2018). It works by being attached to an object such as a weight bar or directly on an athlete performing a vertical jump (Dahlin 2018). As the person or object moves, changes in the length of the cable in the device are converted into an electrical signal that is measured

and recorded by a computer system. Data on displacement, speed of movement and acceleration are collected. Velocity is calculated through the difference in displacement and time (velocity = displacement/time) (Harris vd 2010). LPT devices instantly display velocity-based feedback via a display screen or a second device, allowing to measure several different velocity values during exercise (Dahlin 2018). It is an important aid for coaches and athletes in achieving their training goals. It provides athletes with immediate feedback on the actual velocity of movement, regardless of the load being lifted, and helps them work at maximum effort. Direct velocity measurement allows speed-specific training to be optimized and monitored. Feedback of real-time performance, such as peak velocity, enables adaptation and great impact (Randell vd 2011).

Load - Velocity Relationship

Creating a load-velocity profile is a positive contribution for coaches to monitor the development of an athlete over time. It is especially important for coaches who are interested in speed-specific adaptations and not just focusing on maximal power development. Measuring speed during training sessions helps to determine 1TM values that can be used to evaluate the effectiveness of training programs and the athlete's training status (Jovanovic ve Flanagan 2014). The load-velocity profile of the athlete is determined by instruments such as LPT during exercise. There is an inseparable relationship between load and velocity in order to be able to predict one from the other during execution. The speed of concentric muscle movement decreases with increasing force output and increasing load (Gonzalez-Badillo ve Sanchez-Medina 2010, Sanchez-Medina vd 2010). There is an optimal balance between force and speed for each individual that will maximize power output and this is also known as strength velocity profiling. Through load-velocity profiling, training can be personalized by determining whether the athlete is lacking in strength or speed during a given movement, regardless of their strength capabilities (Samozino vd 2014). It is possible to determine the maximum load, defined as the load at which an individual produces the highest amount of power, through the load-velocity profile. To most effectively increase power output, athletes need to train with the highest resistance possible. Theoretically, maximal loads provide an ideal combination of force and velocity magnitude that produces high power outputs (Dahlin 2018).

Physical and Physiological Responses to Velocity Based Training

When we examine the responses of velocity-based training, it is seen that there are chronic and acute effects. In acute responses, as speed loss decreases, training scope, perceived difficulty, metabolic responses and neuromuscular exhaustion decrease, while these responses increase as speed loss increases. At higher speeds in chronic adaptations, there are smaller responses in muscle volume change, an increase in Type IIX myosin heavy chains, a decrease in Type I myosin heavy chains, less improvement in muscle endurance and greater improvement in strength. At slower speeds, there are larger responses in muscle volume, a decrease in Type II myosin heavy chains, an increase in Type I myosin heavy chains, a larger improvement in muscle endurance and a smaller improvement in strength (Pareja-Blanco vd 2017a, Pareja-blanco vd 2017b, Weakley vd 2020a).

Programming Velocity-Based Training

Understanding the various programming methods that can be used in strength and

conditioning through velocity-based training is critical to designing effective training programs. Velocity associated with 1TM percentage appears to be consistent throughout the training (Soslu ve Çuvalcioğlu 2021). However, the speed in the 1TM percentage can vary, influenced by fatigue or a short period of power-oriented resistance training (Weakley vd 2020b). The speed at each 1TM percentage is very stable when individual load-velocity profiles are calculated. The application speed with a constant absolute load is therefore a good indicator of effort and actual performance (Balsalobre-Fernandes ve Torres-Ronda 2021). Estimating 1TM on a daily or weekly basis and assessing daily variables in training readiness helps coaches to adjust workouts appropriately when using 1TM% to program training load (Jovanovic ve Flanagan 2014). The individual load-velocity profile may show different effort levels depending on age, gender, training level and anthropometric profile. Therefore, it is very important to create individual load-velocity profiles for each athlete. Velocity-based training programs allow flexibility in the number of sets and repetitions compared to traditional methods, reducing differences in athletes and physiological characteristics (Weakley vd 2017). The use of velocity bands or velocity limits in the training program instead of the traditional absolute load, set, repetition count allows for automatic regulation of training volume and load for both intra-set repetitions and sets, identification of fatigue responses, calculation and personalization of daily preparation, while ensuring a high level of consistency in both velocity and power output within and between athletes (Dankel vd 2017, Weakley vd 2017). Therefore, the load-velocity relationship must be periodically evaluated in order to correctly adjust the relative loads (Weakley vd 2020b). Between athletes and between workouts, relative losses in exercise velocity result in consistent internal and external responses of a given intensity (Weakley vd 2019).

Conclusion: Why Velocity Based Strength Training?

Velocity is commonly used in strength training over other kinetic or kinematic outputs (e.g. power) for 3 reasons. First, it is well known that as the external load increases, losses in lifting speed occur (Izquierdo vd 2006, Weakley vd 2020a). This loss of velocity continues until a load of 1TM corresponding to the minimum velocity threshold is achieved (Izquierdo vd 2006). Second, there is an almost perfect linear relationship between velocity and intensity as a percentage of maximal power. This has been consistently demonstrated across a range of exercises and submaximal loads (Cook vd 2018, Garcia-Ramos vd 2018). Third, a common element of many definitions of exercise-induced fatigue is a transient decline in the capacity to generate force, resulting in reductions in muscle fiber shortening rates, relaxation times, and movement speed as fatigue increases (González-Badillo vd 2017, Sanchez-Medina ve Gonzalez-Badillo 2011). Simply put, as fatigue increases, movement speed decreases. By recognizing these basic concepts, practitioners can use speed parameters to accurately and objectively determine external loads and training volumes for each workout, regardless of fatigue and fluctuations in the athlete's readiness to train (Izquierdo vd 2006, Weakley vd 2020a).

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