Model for Progression of Strength, Power, and Speed Training

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SUMMARY

PERIODIZATION IS A PROCESS TO SEQUENTIALLY AND LOGICALLY MANIPULATE TRAINING VARIABLES TO OPTIMIZE PERFORMANCE. FOR STRENGTH-POWER ATHLETES, PERIODIZATION MODELS HAVE BEEN PRESENTED, WHICH INDICATE AN INCREASING INTENSITY AND DECREASING VOLUME OF EXERCISE WITH DAILY VARIATIONS IN VOLUME AND INTENSITY AS WELL. ALTHOUGH THIS ADDRESSES THE PROGRESSION OF STRENGTH, THIS MAY NOT NECESSARILY ADDRESS THE PROGRESSION OF POWER AND SPEED, WITH POWER BEING THE PRODUCT OF BOTH FORCE AND VELOCITY. THIS ARTICLE IS A DISCUSSION OF THE POSSIBLE PROGRESSION OF STRENGTH, POWER, AND SPEED TRAINING AND NOT A DESCRIPTION OF A COMPLETE PERIODIZATION MODEL.

INTRODUCTION

Periodization is a process to sequentially and logically manipulate training variables to optimize performance (9). For strength-power athletes, periodization models have been presented, which indicate an increasing intensity and decreasing volume of exercise with daily variations in volume and intensity as well (8). Although this addresses the progression of strength, this may not necessarily address the progression of power and speed, with power being the product of both force and velocity. Strength alone, however, can increase power by increasing force production capabilities; thus, this variable is of concern as well. Increasing intensity represents an increasing load, which would lead to a decrease in movement velocity in the squat and jump squat. Therefore, although it is important to maintain or increase strength sequentially, there is also a need for increasing velocity of movement as well by changing the proportion of training to power and speed (Figure 1). The intensity or percentage of 1 repetition maximum (IRM) of a given lift determines the level of force, power, and velocity of the performed repetitions at this given load (Figures 2-4). Therefore, one must consider these variables in the context of sports performance improvement.

STRENGTH TRAINING

When implementing a program designed to increase maximal strength, careful consideration must be given as to what external load should be used to achieve the desired results (Figure 2). Although intuitively this makes sense, many times external load is de-emphasized placing emphasis on exercise selection or specificity. Increasing maximal strength primarily relies on neural and muscular adaptations, which mainly occur from repeated exposure to high external loads. Strength increases may occur after using a variety of loads, whereas optimization of strength gains occurs within a narrow range of the loading spectrum. Several investigations have examined the effect of different external loads on strength adaptations after a resistance training program (1,4). A meta-analysis performed by Rhea et al. (7) concluded that within a trained population, external loads of 80% are required to maximize strength gains. A similar meta-analysis was done by Peterson et al. (6), which examined athletic populations and concluded that for competitive athletes, maximum strength gains occur when training intensity reaches 85%. It should be noted that many of the investigations included in these meta-analyses used some form of periodization during the training period and that the 85% load represents the mean load used during the training study.

Results from the previously mentioned meta-analyses represent chronic adaptations after a training period with each training period consisting of a number of acute exposures to the training stimuli. Therefore, understanding how each variable (strength, power, and speed) is affected through manipulation of load could be of great use to the strength and conditioning coach when deciding on a training stimulus. It should be noted that a practitioner must consider other training variables.
such as rest periods and frequency when designing a comprehensive program. In the case of maximal strength, the one biomechanical variable with the highest importance is peak force output. Peak force and maximal strength are synonymous because peak force output is the limiting variable when trying to move an external load, which represents maximal strength. To increase maximal strength, one must train at loads that require high peak force output. An example based on data from Cormie et al. (2) shows peak force output across a large loading spectrum for 3 different exercises: the squat, jump squat, and power clean (Figure 1). Regardless of the exercise selected, peak force values occurred at 80 and 90% of the athletes’ 1RM.

**POWER TRAINING**

Power training involves training with various loads in various exercises that optimize power output (Figure 3). The goal is to increase force, power, and velocity capabilities across a loading spectrum by using strength and power training simultaneously and then in combination with speed training. Training with loads of 0% 1RM optimize power in the jump squat and 50% 1RM in the squat, whereas loads of 70% and higher optimize power output in the power clean (2). However, loads that maximize power in other weightlifting movements, like the clean and jerk and the snatch, may vary considerably (3). It should be recognized that loads close to the optimal load also result in high power outputs and thus could be used as well. In addition, high power output does not necessarily mean high speed of movement. Power is a combination of force and velocity to optimize force application in higher velocity movements. However, maximal velocity or speed must be addressed as the final variable to optimize on-field athletic performance.

**SPEED TRAINING**

Strength training and power training pave the way for maximal adaptations from speed training to occur. Rate of force development is an important consideration when training for these variables. Figure 3 illustrates that jump squats allow for the highest movement velocity to occur and that this occurs at 0% 1RM. With no external loading, a purely ballistic movement, like a jump squat, approximates the velocities seen during sporting movements, whereas heavier loads performed with a deceleration phase, such as a squat, do not. Even an unloaded “speed squat” will have velocities much lower than a jump squat because the athlete is required to stop, or decelerate, their body at the top of the lift. The power clean, often deemed a “semiballistic” lift, will allow for bar velocities that are similar from 30 to 90% 1RM, but these values are much lower than an unloaded jump squat. It should be noted that the exercise that has the highest movement velocity, the unloaded jump squat, does not require a weight room.
Exercises such as sprint training and plyometric training—activities that generally take place outside of the weight room—can also improve muscle function (5), meaning increased pre-activation of muscles in the eccentric phase of stretch-shorten cycle activities. For this reason, coaches should not restrict their exercise selection to traditional strength training methods when speed of movement is a goal.

**MODEL FOR PROGRESSION**

Although this article describes some basic tenants of periodization, it should be noted that many other variables can and should be manipulated to integrate and complete a true periodization model, including other possible microcycle variations and number of repetitions performed for each workout. In addition, loading alone does not determine the training response, which may be influenced to a greater extent by volume load, meaning a combination of a certain load (intensity) and certain volume (number of repetitions). However, concerning general loading considerations, it is clear from data that strength training is optimized using relatively high-intensity loading. As indicated in Figure 2, the level of force is highest in the jump squat, squat, and power clean when using loads of 80–90% 1RM. However, loading for “heavy” and “light” days during microcycle variations may fall well outside the general intensity range for a given week within each block. However, the general progression of loading over a 3 block periodization model consisting of 12 weeks might be block 1, 70–80% 1RM; block 2, 80–90% 1RM; and block 3, 85–95% 1RM (Figure 5). It should be noted that within a week, daily variations in volume and intensity would occur as well. This might include “heavy” and “light” days in volume and intensity to promote recovery. The volume of strength training would decrease with increasing intensity over the periodized 3-block example. However, within each block, the periodization of loading would not be linear but would increase each week with a de-loading phase for recovery during week 4 (Figure 5). From block 1 to block 3 that intensity is steadily increasing as volume is decreasing. Power training is optimized by training with a load that results in maximal power output or near-maximal power output. Depending on the exercise, power training primarily occurs with relatively light loading (50% 1RM or less) like in the squat and jump squat. Weightlifting movements are unique, and they allow for high power outputs under heavy loading (60% 1RM or greater) (3). Notice how the percentages are distributed for maximal power output in different exercises in blocks 1, 2, and 3. It should be noted that very strong athletes may optimize

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**Figure 2.** Peak force during the squat, jump squat, and power clean at loads ranging from 0 to 90% of 1 repetition maximum strength. Based on Cormie et al. (2).

**Figure 3.** Peak power during the squat, jump squat, and power clean at loads ranging from 0 to 90% of 1 repetition maximum strength. Based on Cormie et al. (2).
power outputs at higher loads above what is indicated in this article. Individual variations in strength should be considered when selecting loading for power. In addition, training over a wide range of loading would most likely optimize power output as opposed to simply training at one specific load. Speed training involves the highest velocities possible and thus very low percentages of 1RM. In the power clean, this occurs between 50 and 60% 1RM (2). In the squat and jump squat, this occurs at or near 0% 1RM (2). (Notice the high volume of low-intensity jump squatting that occurs in block 3.). In addition, block 3 should involve rapid high velocity on-field training specific to the movement patterns required for a specific athlete’s event.

Figure 4. Peak velocity during the squat, jump squat, and power clean at loads ranging from 0 to 90% of 1 repetition maximum strength. Based on Cormie et al. (2).

Figure 5. Distribution of volume and intensity for strength, power, and speed training for 3 blocks consisting of 4 weeks of training each.
CONCLUSION
It is recommended that the selection of percentage of IRM be carefully considered based on exercise type and the phase of periodization specific to various athlete populations (Figures 1, 5). The model presented would be best suited to athletes involved in strength-power events, such as shotput, javelin, sprinting, volleyball, basketball, and football. Other athletic activities may require more or less strength, power, and speed, and thus the model should be adjusted accordingly. The primary purpose of this article was to identify the possible shortcomings of training with too high intensities and thus not properly addressing the power and speed components of an athlete's abilities. This is not to say that the inclusion of strength training, even near competition time, should be neglected or avoided. One must incorporate strength, power, and speed in various combinations to optimize performance. Figure 1 shows how a balance must be created in terms of optimizing each variable (strength, power, and speed) to result in maximal performance. One must also realize that an athlete cannot train for all 3 variables at once optimally. Each variable must be addressed in various training blocks so that the best combination can be obtained and result in success for the athlete.

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REFERENCES