Training for Power Sports—Part 1

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WHAT IS A POWER SPORT? Before addressing the issues in training for power sports, we should consider exactly what is meant by a power sport and power training. These words would appear to be the logical choices for discussing training in the power sports.

In recent years, however, given the increasing use of the term *power training*, "power" has acquired a different meaning from the one accepted in the world of athletics. This is due to the popularity of powerlifting, in which maximal weights are lifted regardless of time. It has led to much confusion in the training of athletes (10).

In sports, power has commonly been known as explosiveness, a combination of speed and strength. This explosiveness is exhibited when the athlete overcomes a resistance (weight) in the shortest time possible. To illustrate, let's examine the definition and formula for power. Power is the amount of work done in a certain period of time. The formula is as follows:

$$P = \frac{F \times d}{t}$$

where P = power, F = force, d = distance, and t = time. Since velocity (speed) is equal to d ÷ t, power is force × velocity.

If an athlete lifts a 200-lb weight 2 ft in 1 sec, the power would be equal to 400 ft-lbs a sec (fps). If he lifts the same amount of weight in only 1/2 sec, then he would exhibit 800 fps of power! Moving 200 lbs in 1/2 sec may seem extraordinary, but keep in mind that weightlifters apply most of their force in less than 1 sec. In the jerk, for example, it is approximately 0.2 sec.

From this it can be seen that as important as strength is, if there is a decrease in time because of faster execution, then significantly more power is developed (see Figure 1). Thus there is a big difference between lifting very heavy weights slowly and lifting them quickly. However, the greatest power achieved in executing a particular skill is always a compromise between great force and great speed rather than a maximization of either one at the expense of the other (9, 10).

A power sport is associated with high levels of neuromuscular coordination. The movements are usually of a complex or compound nature (3).

Power sports are also characterized by *inertia*, *momentum*, and *acceleration*, which play minor and insignificant roles in powerlifting. In a power sport the forces are developed with acceleration, a major increase in speed of execution. This explains why there is such a high level of activity in the nervous system to coordinate the movements for optimal firing of the muscles in the shortest time possible.

When a movement is executed with explosiveness, it continues on its own inertia. It does not require the steady application of force to keep the object in motion. It may require the involvement of several joint actions, however, each with its own periods of acceleration and deceleration.

In weightlifting (an explosive sport) and powerlifting (a strength sport), maximal weights are used. But weightlifting is not just the maximal weight the athlete can lift in one singular motion. In the snatch for example, pulling the bar from about knee level to hip joint level, the athlete can usually exert 110 to 120% of the maximum weight he or she can lift for the total snatch lift. Therefore the maximal weights for the actual lift (snatch and clean & jerk) are not the maximum for portions of the lifts, or what can be lifted in individual exercises.

In powerlifting, on the other hand, athletes use the maximum load possible for a single, relatively simple and straightforward movement, as opposed to the

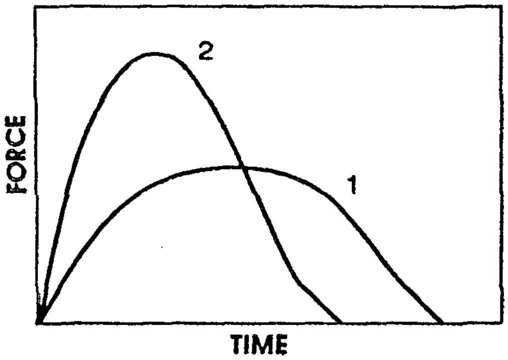

Figure 1 **1. Beginner—little power, much time; 2. advanced—great power, shorter time.**

highly complex integrated movements seen in weightlifting and other power sports. In essence, power sports are those that entail speed and coordination in executing the skills.

This is a simplified definition. Actually, some sports do entail speed-strength and some entail strength-speed. Some sports require more strength, together with speed, as for example weightlifting; other sports require more speed than strength, as for example sprinting. Thus, even though they require combinations of strength and speed, the percentage of each varies according to the particular sport.

■ Explosiveness

Power sports are referred to as explosive sports. According to Siff and Verkhoshansky (6), "explosive" can be broken down into explosive/isometric, explosive/ballistic, and explosive/reactive/ballistic movements. For example, explosive/isometric tension is inherent in movements in which there is significant resistance to overcome, such as in snatching or jerking a barbell.

Explosive/ballistic tension is characteristic of movements in which the maximum force is applied against a relatively small resistance. Examples include the shot-put, javelin, and baseball throws, tennis serve, and so forth.

Reactive/ballistic tension has the same characteristics as explosive/ballistic except for the regimen of muscular work. Here the preliminary stretch phase is more sharply pronounced, after which there is an immediate switch to concentric work. This can be seen in some throwing movements, individual elements of wrestling and gymnastics, kicking in football, hitting in volleyball or tennis, and jumping. From these it should be obvious that when we consider a sport a power sport, we are dealing with speed and explosive training (9).

Speed is needed in nearly all sports, from javelin or baseball throws in which the implements are moderately light, to events involving the weight of the body as in a vertical jump, to weightlifting in which the weights are very heavy.

In each case the key is speed of arm, leg, or body movement. For speed movements involving rapid changes in position of the working links or the entire body, the type of tension produced is a quick momentary muscular contraction, as for example in a boxing punch. It could also be a repetition of actions at a specific tempo, as in sprinting.

■ Structure

In some skills the speed, direction, or magnitude of strength displayed are strikingly obvious to the naked eye. However, with scientific instrumentation we can see that there are great variations in intensity and type of muscle activity. There are also differences in the sequence and speed of muscle involvement in the work, energy expenditure, and reliance on each of the different energy sources.

Thus when we think of training for power sports, we must consider the diversity in the sport skills that can be divided into a number of similar groups according to the primary characteristics of the muscular activity. Once the major characteristics of the muscular work have been identified, the specific character of the work at the speed needed can be developed.

For example, in the cyclical speed-strength sport of sprinting as seen in track, soccer, lacrosse, base running in baseball, or a running back in football, players can be classified into one group. In these sports maximum strength is never displayed when executing those skills. Rather, it may approach 60 to 80% of the maximum strength possible.

The key to increasing speed is to produce maximum strength in the shortest time possible during the pushoff and other phases of the run. A sprinter's foot is in contact with the ground for 0.1 sec. Half of this time, 0.05 sec, is for amortization in which, after slight absorption of the landing forces, there is a maximal preparation of the muscles—mainly the tendons—for the ensuing takeoff (9).

The amortization phase can be considered the eccentric contraction phase. When maximum tension is reached, the tendons return the energy that was built up and the muscles contract concentrically to execute the takeoff in 0.05 sec. This example of explosive speed, or speed-strength, highlights the main objective in training: to develop the ability to optimally prepare the muscles for a maximal contraction in the shortest time possible. In training, one must elicit a maximal eccentric contraction and then be able to switch it to concentric (9).

Remember that in a normal muscular contraction it may take 0.6 to 0.8 sec to develop a maximal volitional contraction (2). However, many sport skills could take from 0.1 to 0.3 sec to execute. The faster the muscular contraction, the faster the run, the higher the jump, or the farther the throw. The key is to develop maximal tension during the initial eccentric contraction in both the tendons and muscles so that the tension can be given back with maximum concentric force. Doing only heavy prolonged workloads slows the contraction speed of trained muscles. Also, excessively heavy strength loads diminish speed and power (8).

■ Connective Tissue

In power sports we are dealing with more than muscles. Connective tissues also play a vital structural role since they provide stability for the muscles, joints, and bones. They also store elastic energy for augmenting the working effect of muscle (5).

The ability to stretch the elastic component of the musculoskeletal complex, especially the tendons, increases the efficiency of movement markedly. This is especially true in sports that involve stretch/shortening of the muscle/tendon complex such as running, jumping, throwing, and rapid lifting.

Plyometric training as developed by Verkhoshansky as a special speed-strength training method relies entirely on this phenomenon. In this process the increase in concentric strength, in response to rapid "shock" loading, is a result of increased muscle tension elicited by the powerful myotatic stretch reflex. It is also elicited by the explosive release of elastic energy stored in the connective and elastic tissues of the muscle complex during the eccentric muscle contraction.

During explosive movements, the connective tissues that are not structurally linked to the muscles (e.g., those in the ligaments, joint capsules, skin, and cartilage) play the vital role of passively stabilizing the joints, facilitating contact between the moving parts and absorbing shock. The importance of this passive role should not be overlooked in overall training. It is pointless to develop bulk and strength if the remainder of the musculoskeletal system is not equipped to handle the increased rate of force production (power) (6). One should condition muscle, bone, and connective tissue if overall performance and safety is to be enhanced in the power sport. Overemphasis on muscle strengthening at the expense of strengthening tendon and other connective tissue can result in a muscular system that is prone to injury and inefficient in generating reactive strength.

This is one reason why the use of anabolic steroids can be harmful. Steroids lead to hypertrophy and a greater increase in the strength of muscles relative to tendons. As a result, musculotendinous injuries are far more common among steroid users.

The training prescription should take into account the different rates of adaptation of all the systems involved; it should avoid overtraining the systems with the slowest rates of adaptation. Training load should be increased gradually. This is particularly true during the general physical preparation phase and for persons who are new to strength or power training.

■ Technique

There is another important factor involved when dealing with power sport athletes: technique. Power athletes are usually involved in sports that call for great skill based on abilities requiring coordination. An increase in strength may change how a skill is executed, either in terms of speed of execution or amount of tension generated in a particular sequence or joint action. Thus power athletes need to train in accordance with the skills involved in the sport (4).

In the stage immediately prior to competition, technique training methods must be integrated with speed and strength training; this is critical for success against competitors. As noted, many of the power sports rely more on neuromuscular coordination than on absolute strength, speed, or flexibility (7).

As reported by Siff and Verkhoshansky (6), speed/strength, strength/endurance, and speed/endurance are not simply derivatives of strength, speed, and endurance but are totally independent qualities. An increase in absolute strength does not necessarily enhance any of these three qualities. Thus strength should be placed alongside speed/endurance in a group, each with its own methods of development (1).

The training should be progressive, with one phase of training developing the body sufficiently so that it can then handle the next stage of training, which in turn prepares the body for the third phase of training, and so forth. Merely engaging in activities to prevent stagnation, as in cross-training, will not really improve performance and can even limit development. Correct alternation (cycling) and the addition of different training methods will help prevent stagnation and, most important, will show steady gains. ▲

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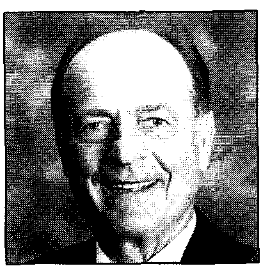

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