Power Points

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Expressions of power – or what is often called "explosiveness" – are the very essence of athletic competition and they are crucial for optimal performance. Considerable controversy exists regarding the most efficient and safest way to build the body's "power engine" in the weight room.

One faction says to lift lighter weights with high speed. An opposing view suggests using heavier weights, but with a smoother, controlled movement speed. The corollary to this discord is confusion – especially among high school coaches who are attempting to formulate strength/power-training programs. Our purpose here is to take a close, objective look at power and offer some suggestions for its development.

The Science of Power

Power is a measure of the amount of work that can be performed in a specific amount of time. The textbook formula is as follows: Power = Work/Time, which means that power can be enhanced by decreasing the time it takes to perform a given task. Power can also be defined as Force X Velocity, which means that power can be enhanced by increasing the force output. Simply put, as your muscles become stronger, they are capable of generating more and higher force. Once you are able to generate more force over the same given distance, you have improved your ability to express power.

It has been established that power involves three components: (1) muscle force, (2) the distance of force application, and (3) the time of force application. Therefore, power can be enhanced by: (1) increasing the muscle force, (2) increasing the distance of force application, or (3) decreasing the time of force application. These are basic, irrefutable laws of physics.

But what about developing power for athletics in the weight room? Is there a "best" way to go about it? Let's take a closer look.

Developing Power vs. Expressing Power

A review of the scientific literature reveals a split in the recommended methods to develop power via strength-training. Some studies suggest fast movement speeds, while others indicate that controlled movement speeds are equally effective. Two interesting studies indicate that all of the varying methods have merit.

Tohji et al. (1991) found that subjects who used a combination of moderate speed and isometric (i.e., no movement) muscle contractions enhanced their maximal muscle power production significantly greater than a group that used both moderate and maximal speeds of movement.

Behm and Sale (1993) showed that subjects who trained one limb at 300 degrees per second and the opposite limb isometrically showed similar increases in high-speed power in both limbs.

In effect, there is evidence that power is produced at slow, intermediate, and fast speeds. It can also be produced in an isometric fashion – where there is no movement at all. What, then, is the optimal speed for power development in the weight room setting? Unfortunately, there is no definitive answer.

Just about all of the published research on the appropriate movement speed for power development used isokinetic dynamometers. These are low mass devices consisting of a movement arm and either an electronic or hydraulic resistance mechanism. Since the velocity is controlled (i.e., a specific speed is set), momentum is not a significant factor in assessment. Momentum, however, is a significant factor when training with the tools (e.g., barbells, dumbbells, plateloading/selectorized machines, etc.) available to most coaches. Obviously, a certain degree of momentum is necessary to get the load moving. We are referring to unnecessary momentum.

When working with a relatively light weight, a willful effort (external force) to overcome inertia with high speed will lessen the muscle tension through the movement path. Shouldn't the downward pull of gravity on the implement result in a constant application of muscle tension? Not necessarily – and here's why:

If you are able to move the implement with any appreciable degree of speed, the ensuing momentum (Momentum = Mass X Velocity) will at some point enable it to move independently, albeit briefly. This can be easily demonstrated (though we do not recommend you try it) by pressing a relatively light object overhead with a high rate of speed. Then, at or near the top of the movement, release it.

Will it travel a short distance under its own power before falling to the ground? Sure it will. What if the implement was relatively heavy? In that case, the speed of movement would be greatly reduced.

Again, basic physics laws are in effect here: A light weight can be lifted fast, a heavy weight can be lifted slowly, but a heavy weight cannot be lifted fast. Of course, the terms "light" and "heavy" are relative to an individual's existing strength level. The point we are making is that there is a clear distinction between developing power and expressing it.

Expressions of power in the athletic setting (e.g., hitting a baseball, jumping, sprinting, blocking, tackling, throwing the discus, etc.) are the result of strength/power increases from the weight room coupled with the neuromuscular and cognitive components of skill development through quality practice. For developing power, we recommend the use of heavy weights for the given rep ranges (e.g., 6-8, 8-10, 12-15, etc.). During the initial reps, the trainee is instructed to control the rep speed in order to develop and maintain muscle tension. Otherwise, there will be a reduction in muscle fiber recruitment. As the set progresses and becomes increasingly difficult, the trainee must exert more force with a conscious attempt to move the load with "speed." However, due to proper weight selection and the effects of fatigue, it will be impossible to move the load with high speed.

What we have just described allows us to progressively overload the muscle structures while concomitantly developing power with safety and efficiency. The appropriate expression of this power must now be practiced with regard to the athletic skill(s) in question.

Neural Adaptations

Our neuromuscular system is constantly sending and receiving messages in the form of nerve impulses. Along with muscle hypertrophy (increased muscle size), there are neural aspects that make significant contributions to enhanced strength and power. Regular, progressive stimulation of the musculature with strength-training movements reduces neural inhibitory impulses. Inhibitory impulses are those that are picked-up by our proprioceptors (sensory receptors that monitor changes in muscle length), which serve as protective mechanisms. Subsequently, there will be an improved economy of motor unit (muscle fiber) firing and greater power output. This is known as motor unit "synchronization," and it is a major player in the strength and power game plan. This improvement in increased motor unit firing enhances the rate of force development – which is the speed at which a skill can be performed.

Basic neuromuscular physiology indicates that maximal fast twitch (Type II) fiber recruitment is achieved with maximal intensity, regardless of the movement speed. "Intensity" in strength-training is defined as the percent of your momentary ability to execute a given exercise – that is, the amount of effort you are able to put forth. The "size principle" of motor unit recruitment – which is one of the most supported principles in neurophysiology – states that muscle fibers are activated from smaller to larger (Type I to Type II) relative to the force requirements, not the speed requirements. The force/velocity curve indicates that there is an inverse relationship between movement speed and muscle force production. In other words, slower muscle contractions generate more force.

Remember that the "intent" to move the weight rapidly may still be evident – but the appropriate weight selection will inhibit the external speed. Therefore, in terms of muscle fiber recruitment, lifting heavier loads with a controlled movement speed is more cost-efficient than lifting lighter loads with high speed. It is known as high-tension, or high-intensity strength training. This is representative of the type of training we have advocated in past articles. While it is not the only way to build the body's "power engine," we feel that it is at least as effective as any other approach, and safer than most.

Final Rep

Any type of progressive strength-training, regardless of movement speed, will elicit gains in muscle hypertrophy with concurrent enhancements in strength and power.

Basically, we have chosen to implement smoother, more controlled lifting speeds (approximately 1-2 seconds for raising the weight, and 3-4 seconds for lowering the weight) for the following reasons:

1) Controlled movement speed reduces momentum, allowing the target musculature to perform the work.

2) Controlled movement speed minimizes abrupt acceleration and deceleration forces, thus reducing the probability of muscle and connective tissue trauma.

3) Controlled movement speed creates and maintains more muscle tension.

4) Controlled movement speed produces more force output.

For anyone preferring to implement strength-training exercises that are more ballistic in nature (e.g., Olympic-style lifting and its variations), we recommend that you seek the tutelage and advice from qualified individuals and/or organizations who have expertise in that area.

References:

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