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Periodization of Strength Part 4: Power Phase

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Power is ability of the neuromuscular system to produce the greatest possible force in the shortest amount of time. Power is simply the product of muscle force (F) multiplied by the velocity (V) of movement: P = F x V (Bompa, 1999). For athletic purposes, any increase in power must be a result of improvements in either strength, speed or a combination of the two.

An athlete can possess a very large muscle mass and a tremendous amount of strength, however lack an ability to contract those strong muscles very quickly. To overcome this deficiency, an athlete must undergo power training that will result in improving the rate of force development (Bompa, 1993). In general, power training for sports employs methods of moving objects, barbells, dumbbells and other items through space very rapidly. The following discussion will make reference to methods employed in the development of short and quick bursts of strength. Power Endurance and Muscular Endurance will be discussed in subsequent articles that follow.

Power training exercises are intended to activate the recruitment of motor units more quickly while simultaneously encouraging greater nervous system adaptation. Power training is mainly focused on the rate of force development. MxS training increases the number and frequency of motor units discharged, while Power training increases the rate at which the same motor units are recruited. Neuromuscular adaptation to power training also results in improved intra-muscular co-ordination or the abilities of the agonistic and antagonistic muscles to cooperate and perform a movement effectively (Bompa, 1999). In order to make the movements more effective, power training should closely mimic or represent the movement patterns most used in the specified sports (Bompa, 1999).

The Isotonic Method

The isotonic method, or the ability to move a weight as rapidly and forcefully as possible through the entire range of motion represents one of the most classic methods of power training (Bompa, 1999). Free weights and machines are predominately used in this method. By using a relatively light load (30-80 percent 1RM), the athlete attempts to move the barbell as quickly as possible. A comprehensive level of maximum strength is also required for the athlete to generate the acceleration necessary to move the weight explosively. For instance, an athlete performing a bench press exercise would be instructed to lift the weight off the chest as quickly as possible and stop the movement prior to the arms locking out at the top range of the movement. The athlete would than return the weight to the starting position on the chest and repeat the same explosive motion. The benefits of MxS training especially come into play during the early part of the explosive movement, when the athlete is challenged to overcome the inertia of the weight (Bompa, 1999). Consequently, the higher the maximum strength, the easier it is to overcome the inertia and the more explosive the start of the movement will be.

For most sports involving cyclic motions, such as sprinting, team sports and the martial arts, the load for the isotonic method can be 30 to 60 percent 1RM. For sports involving acyclic motions such as throwing, weight lifting and line play in football, the load has to be higher (50 to 80 percent 1RM) because these athletes have a much higher MxS to start with and must defeat a higher external resistance (Bompa, 1999). A low number of repetitions are recommended ranging from four to 10. Exercises should be performed as smoothly as possible without jerking the barbell or implement. Again, exercise selection should most closely as possible mimic the skills of the sport. Also, select the lowest number of exercises so that athletes can perform the highest number of sets (within realistic possibility) (Bompa, 1999). Table 1.1 lists the training parameters for the isotonic method. It must be noted that maximal effort must be applied in every repetition performed. Since an athlete is using a sub-maximal load, it is very tempting to simply go through the movement. The absence of maximal effort inhibits the neuromuscular adaptations that occur as a function of power training.

One problem arises with the isotonic method in power development. Research shows that traditional weight training can be counterproductive when used in a quick and explosive manner. For instance, it has been shown that when lifting a 1RM the bar decelerates for as much as 24 percent of the concentric movement (Elliot et. al., 1989). A lift performed at 81 percent 1RM increases the deceleration phase to 52 percent (Elliot et. al., 1989). Attempting to move the weight as quickly as possible may further increase the deceleration rate as the athlete must also slow the bar to a complete stop at the end of the movement (Elliot et. al., 1989). Plyometric training and ballistic training seem to overcome the negative aspects of utilizing traditional weight training methods during the conversion to power phase (Newton and Kraemer, 1994).

Table 1.1 Training Parameters for the Isotonic Method

Training Parameters	Work
Load: Cyclic	30-50%

Acyclic	50-80%
# of exercises	2-4 (5)
# of reps per set	4-10
# of sets per exercise	4-6 (8)
# of exercises per session	3-6
Rest interval	2-6 minutes
Speed of execution	dynamic/fast
Frequency per week	2-3
Bompa, 1999	

The Ballistic Method

The ballistic method of power training involves the use of shots, medicine balls, heavy bells whereby the athlete is capable of dynamically exerting force on the object and propel the object through the entire range of motion. The ability to completely accelerate through the entire range of motion without the need of a breaking phase overcomes the problem of deceleration (Bompa, 1999; Newton and Kraemer, 1994). Newton and Kraemer describe ballistic training as the projection of an object or the body into free space. Plyometric training represents a good example of ballistic training.

Ballistic exercises can be planned at the end of a training session or following the warm-up depending on the training objectives. The fast, ballistic application of force is possible as a result of quick recruitment of fast-twitch muscle fibers and effective intra-muscular co-ordination of the agonistic and antagonistic muscles (Bompa, 1993). Therefore, it is necessary that the athlete be alert, rested and motivated prior to performing the movements since a rested CNS can transmit more powerful nerve impulses to the working muscles for quick contractions (Bompa, 1999). The speed of contraction is the key to utilizing the benefits of this method, as the athlete must attempt to increase the speed constantly up to the release of the object. The number of repetitions is dependent on the speed of movement achieved. As stated by Bompa, **"Repetitions must discontinue as the movement speed declines."** The number of exercises should remain lower as the number of sets per exercise should be relatively high. The training load is simply dictated by the standard weight of the implements. Furthermore, as in any other power training method, exercise selection should most closely as possible mimic the skills present in the sport. Table 1.2 lists the suggested training parameters for the ballistic method.

Power training for sports in particular involves as vast array of methods and program suggestions that seem to span across an endless continuum. Like any other training method, a power-training program must be individualized to meet the needs and strength abilities of an athlete. This article was simply intended to introduce the reader to the world of explosive training for sports. Future articles on the topic will focus on particular methods of power training such as plyometrics and also provide specific programs for individual events and team sports.

Table 1.2 Training Parameters for the Ballistic Method	
Training Parameters	**Work**
Load	standard
# of exercises	2-5
# of reps per set	10-20
# of sets per session	3-5
Rest interval	2-3 minutes

Speed of execution	Explosive
Frequency per week	2-4
Bompa, 1999	

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