



Strength Training for Elite Athletes

Part II: Eccentric Training and Isometrics

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In this seminar I will cover the main methods of strength training, as follows: Bodybuilding, maximal weight, eccentric training, isometrics, electrostimulation, isokinetics, strength-endurance, and speed-strength.

Eccentric Methods

Eccentric strength is the amount of force produced when a muscle lengthens, versus concentric strength, which is the amount of force produced when a muscle shortens. When muscles contract eccentrically, as in lowering a barbell to the chest in a bench press, they can develop up to 40-50 percent more force than when they contract concentrically. Therefore, methods have been developed that allow athletes to lower supramaximal loads.

Variety in strength training is a critical factor in maximizing training response; unfortunately, it is likely to be the most overlooked of the training principles. Gains in strength come about faster if the athlete utilizes many types of contractions instead of only one. Lifting coach A.K. Worobjow (1984) recommends the following proportions among the different types of contractions be respected for optimal strength development: 70 percent concentric, 20 percent eccentric, 10 percent isometric.

Before recommending eccentric training to his or her athletes, the coach must consider the following:

- A. It is an advanced form of training. Athletes should have 1-2 years of weight training experience before using this method.
- B. It is associated with high levels of muscle soreness.
- C. The likelihood of muscle injury is higher.
- D. It is non-specific to most sports.

Eccentric training allows an athlete to reach the highest levels of muscular tension (Komi, 1975), which in return favors the development of muscular hypertrophy and strength (Hakkinen & Komi, 1983; Komi & Buskirk, 1972).



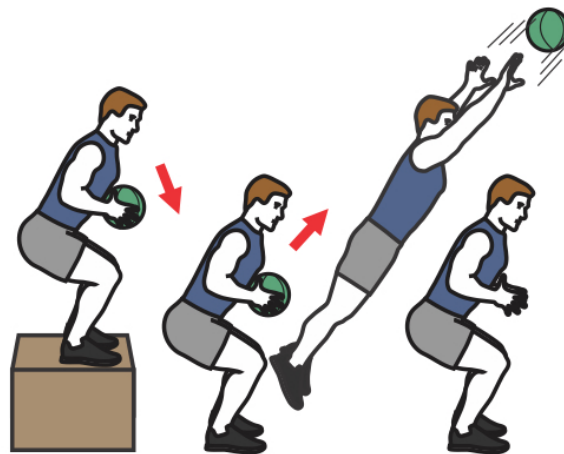
Eccentric training produces the highest levels of muscular tension, which favors the development of muscle mass.
(All photos by Miloš Šarčev)

Different combinations of concentric and eccentric training increased maximal strength faster than if concentric training is used alone (Hakkinen and Komi, 1981; Pletnjow, 1977).

Eccentric training offers the following advantages:

-- Because it is associated with the highest levels of muscle tension, eccentric training can induce more strength and muscle mass gains than concentric or isometric methods alone. This characteristic allows athletes to break through strength plateaus.

-- Fast eccentric work, such as plyometrics, cause force-time curves to shift to the left, resulting in higher rates of force development.



Plyometrics are considered fast eccentric work that can produce higher rates of force development. (All drawings by Sylvain Lemaire, www.physigraphe.com)

-- Because high loads can be used in eccentric methods, there is an impact not only on the muscle but also on the nervous system.

An eccentric workout for an accumulation (high volume) phase could follow this loading pattern:

-- 110-120%, 4-6 sets x 4-6 reps

-- Rest intervals, 4-5 minutes between sets

-- Slow tempo of execution, 8-10 seconds per lowering

An eccentric workout for an intensification (high resistance) phase could follow this loading pattern:

-- 125% x 3, 132.5% x 3, 140% x 3-6 sets of 2-3 reps

-- Rest intervals, 5-6 minutes between sets

-- Moderate tempo of execution, 3-5 seconds per lowering

Eccentric training can take various forms. Here are a few:

-- Use specially-designed equipment to increase eccentric loading.

-- At the end of a conventional concentric 4-6 RM set, additional eccentric work can be performed by adding 25-30 percent more weight to the barbell and performing additional eccentric-only repetitions. As an alternative, a training partner can manually apply resistance (i.e., push down on the bar) for the eccentric portion instead of adding weight. These additional negative repetitions will exhaust eccentric strength levels after achieving concentric muscular failure.



One practical way to increase the eccentric load during a bench press is to have a training partner press down on the bar.

Even though eccentric training shows great potential for strength improvement, it has a few disadvantages. Here are some special considerations regarding eccentric training:

-- It is vital that the athlete can control the descent of the resistance selected, or injury can occur.

-- Athletes should begin eccentric work only after 1-2 years of developing a solid base in strength training.

-- Due to the high levels of muscle soreness experienced with this type of work, training frequency is limited to once every 7-10 days. It is not recommended to use it during your competition season since it severely hampers your recovery time.

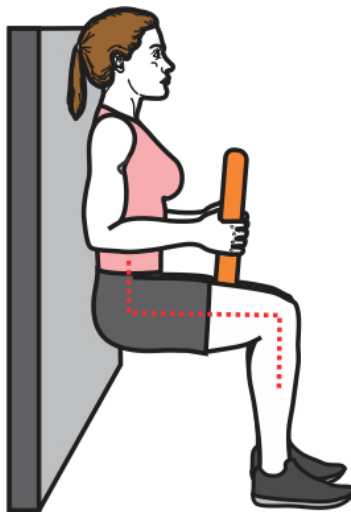
-- Slow eccentric training has been associated with a reduction in the rate of force development, suggesting it should be used mainly in the preparatory period. In contrast, fast eccentric training (plyometrics) should be reserved for the competitive period.

-- It requires, in most instances, the help of 1-2 partners or special equipment to move the resistance in the concentric range. Eccentric training can therefore be hazardous during certain weight training exercises, such as squats if the spotters are not properly trained.

Isometric Methods

Isometric training involves static contractions of a muscle group against an insurmountable resistance. Since one can produce 10-15 percent higher levels of force with isometric contractions than with concentric contractions, isometric training has been used to focus on overcoming sticking points in a range of motion. The following should be considered when performing isometric training:

- A. Only maximal isometric contractions of 6-8 seconds durations should be used for 3-5 sets of one repetition per set.
- B. Isometric exercise often requires no technical training or sophisticated equipment.
- C. Isometric work is well suited for rehabilitation.
- D. Isometric exercises should be performed with a gradual increase of muscle tension and with gradual relaxation.
- E. Gains in strength with isometrics are highly specific to the joint angle at which the work is performed.
- F. This method becomes time-costly if one tries to gain strength throughout the whole range of motion, since too many different joint angles would be required.
- G. It is hard to evaluate training progress.



Performing a wall sit is a form of isometric training, and resistance can be increased by holding a weight plate.

Unless there is elaborate equipment with visual readouts of the isometric force produced, it is difficult to determine if an athlete is producing maximal tension. With a lack of visible improvement, it is challenging to motivate athletes to push themselves with this method.

Isometric contractions are more specific to sports such as wrestling and gymnastics than swimming. Nonetheless, it can be used to breakthrough strength gain plateaus in the key lifts you prescribe. Since 10-15 percent higher levels of force can be produced in isometric contractions, this form of work can be used periodically to favor the growth of strength levels. You can implement isometric work in the following forms:

-- By performing a functional isometric contraction after pre-fatiguing the muscle with 4-6 partial repetitions. A power rack is needed with this method. After a regular warm-up, choose a weight you can move from one set of pins to another; for example, from mid-thigh to waist-level in upright rowing. Perform 4-6 RM and at the end of the last concentric repetition, then contract isometrically with maximal tension against the top pins for a count of 6-8 seconds. Lower the barbell and attempt another repetition. If you can perform another repetition, the resistance selected was too light.

-- Functional isometric contractions can be performed at various points in the range of motion to work on specific points of the force curve.



Isometric contractions can be used to strengthen specific points of a force curve, helping to overcome sticking points.

-- Isometric work can be used to prolong the intensity and duration of a conventional set carried to concentric muscular failure. Let's say an athlete has just completed the last concentric portion of a 6 RM set of barbell curls. He or she lowers the barbell 30 degrees, stops for a count of 8 seconds, and repeats the process at two other angles. In this manner, the athlete achieves greater fatigue than with a conventional set.

-- Isometric stops can be incorporated in the dynamic range of a movement. For example, 6-second holds can be incorporated at various points in a clean pull, such as: 2 inches off the floor, below knee, mid-thigh.

In Part III of this series, I will discuss electrostimulation, isokinetics and strength-endurance.

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