



The Science of Eccentric Training

An in-depth look at the most important variable for stimulating muscle growth

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Publication Date: 1996

It seems only natural that the concept of eccentric training has become associated with a man considered one of the most eccentric in bodybuilding, Arthur Jones. The marketing genius behind Nautilus and MedX, Jones was a master showman who entertained his followers with his African safaris and love-affair with alligators. But no one is born eccentric. Jones was given the label only after he became one of the most wealthy and influential men in the fitness industry. And just as you must achieve a high level of accomplishment to be labeled eccentric, you must also develop a high level of conditioning to use eccentric training.

Eccentric training is an advanced training method and, as such, must be regarded as being on the fringe of what is considered normal. Although Jones helped popularize eccentric training in this country, as in the case of the variable resistance cam he installed on his Nautilus machines, Jones did not invent it. In European strength-training textbooks, precise eccentric training protocols abound. Sylvain Bouchard, a long track speed skater I coached who won a bronze medal in the

1,000 meters at the World Championships, performed as much as 50 percent of his strength work with eccentric training to improve is starting speed.

Six Benefits Perform Eccentric Training

When scientists discuss eccentric strength, they are referring to the amount of force produced when a muscle lengthens; concentric strength, in contrast, is the amount of force produced when a muscle shortens. Here are six benefits of eccentric training:

1. It will make you stronger. Since fewer motor units are recruited during an eccentric contraction (because of the passive resistance offered by the cross-bridges), there is more mechanical load per motor unit during an eccentric contraction. As a result, eccentric training can generate up to 1.3 times more tension than concentric training. Higher tension provides increased stimulus to the muscle fibers, which in turn encourages biological adaptations. Norwegian strength expert Per Egil (Pella) Refsnes says eccentric training is the single best method to boost strength levels in elite strength athletes.

2. It will build muscle mass -- and lots of it! Many studies have confirmed that it is the lowering of weights, not the lifting, primarily responsible for the hypertrophic response. That is why training with an isokinetic machine, which offers no eccentric stimuli, is not effective for developing muscle mass. It also explains why isokinetic devices are not popular on the European continent, as they were rightly perceived as limiting an athlete's true strength potential. Unless you want a physique like Richard Simmons, stay away from isokinetic devices!



Workouts that emphasize eccentric contractions are effective for increasing muscle mass. Shown are physique champions from the 2006 Mr. Olympia, a competition won by Jay Cutler (2nd from right, standing next to runner-up Ronnie Coleman). (Lead photo and this photo by Miloš Šarčev)

3. It will improve power. Eccentric training favorably alters force/time characteristics. Finnish and Norwegian sports scientists demonstrated that eccentric training stimuli could be used periodically to improve or maintain the neuromuscular system's ability to generate fast force production. One protocol the Norwegians commonly use for the bench press is to have the

athlete bench press twice a week, once with eccentric-only contractions. For the first workout, the athlete would perform 5 sets of 4-6 reps at 80-85 percent of their current maximum (1RM) in the conventional fashion. For the second workout, the athlete would perform 120 percent of maximum with eccentric-only contractions.

4. It can be sport specific. Beyond bodybuilding and other aspects of the Iron Game, eccentric strength is specific to many activities in other sports. For example, during the follow-through of a baseball pitch, muscles must produce decelerative contractions to preserve healthy joint functioning (i.e., arthrokinematics). Eccentric strength is also important in sports that require exceptional jumping ability, but not for the reason most people think. Figure skaters often have the concentric strength to jump high enough to complete a complex jump such as the double axel, but do not have enough eccentric strength to control the landing.

5. It can prevent injuries. Eccentric training is especially valuable for athletes involved in sports that require a lot of jumping, such as volleyball, basketball, and figure skating. I tell these athletes that if their lower body muscles are not strong enough to absorb the stress of landing, their joints will have to take it, increasing their risk of injury. It's interesting that many textbooks on overuse injuries prescribe eccentric to rehabilitate overuse injuries but do not prescribe eccentric training to prevent them? If you're interested in learning more about the role of eccentric training and injuries, I recommend *Eccentric Muscle Training in Sports and Orthopedics* by Mark Albert.

6. It can improve exercise technique. When performing strength training exercises that contain a stretch-shortening cycle such as the squat and bench press, the technique is critical. American studies on elite powerlifters demonstrated that the athletes who lift the heaviest weights were the ones who could lower their weights slowly. This research implies that the inclusion of eccentric training may facilitate the process of lowering the resistance slowly under technical control. It also implies that an isokinetic exercise would have less specificity to an elite bench presser's technique because there is no eccentric component.



Great Britain's Paul Jordan put in a commanding performance to win the 220-pound bodyweight class at the 1976 IPF World Men's Powerlifting Championships. Jordan squatted 738, bench pressed 568, and deadlifted 688; his 3-lift total won the competition by 81 pounds! (Bruce Klemens photo).

Special Precautions for Eccentric Training

Even though eccentric training shows great potential for strength improvement, it nonetheless has a few disadvantages. For example, it often requires the help of training partners. Eccentric training can, therefore, be hazardous with some exercises if the spotters are properly trained or are not attentive—especially with squats.

With a little bit of imagination, you can often find a solution to lift the weight in the concentric range—one that is heavier than you could normally handle—without the assistance of spotters. For eccentric reverse curls, the resistance can be hang power cleaned for the concentric range and then lowered in a strict, eccentric fashion. There is also specially designed equipment that provides greater resistance in the eccentric range than in the concentric range, such as eccentric hooks or the Life Circuit Machines™. The Toppidretssenteret in Oslo, which is the Norwegian equivalent to one of America's Olympic training Centers, has an overhead pulley above the bench-press station. The bar is hooked to a rope attached to the pulley, and the spotter performs a triceps pressdown movement to assist in the concentric range. The built-in mechanical advantage of the pulley makes the raising of 400 pounds a piece of cake.



Many exercise machines lend themselves to the performance of eccentric training. For example, during a leg curl, a training partner can assist with the concentric portion of a rep to enable the trainee to use enough weight to overload the eccentric portion of the lift. (Miloš Šarčev photo)

Another problem with eccentric training is that the intensity of this type work is often underestimated. I saw an article in a bodybuilding magazine in which the author said eccentric-only workouts should be performed no more than three times a week for one month. Considering it takes seven to ten days to completely recover from an eccentric workout, such a protocol is more likely to result in overtraining and overuse injuries. Also, athletes should only begin eccentric work after achieving a solid base in strength training. Embarking too early on an eccentric training program could damage connective tissues and place the athlete at a high risk of injury.

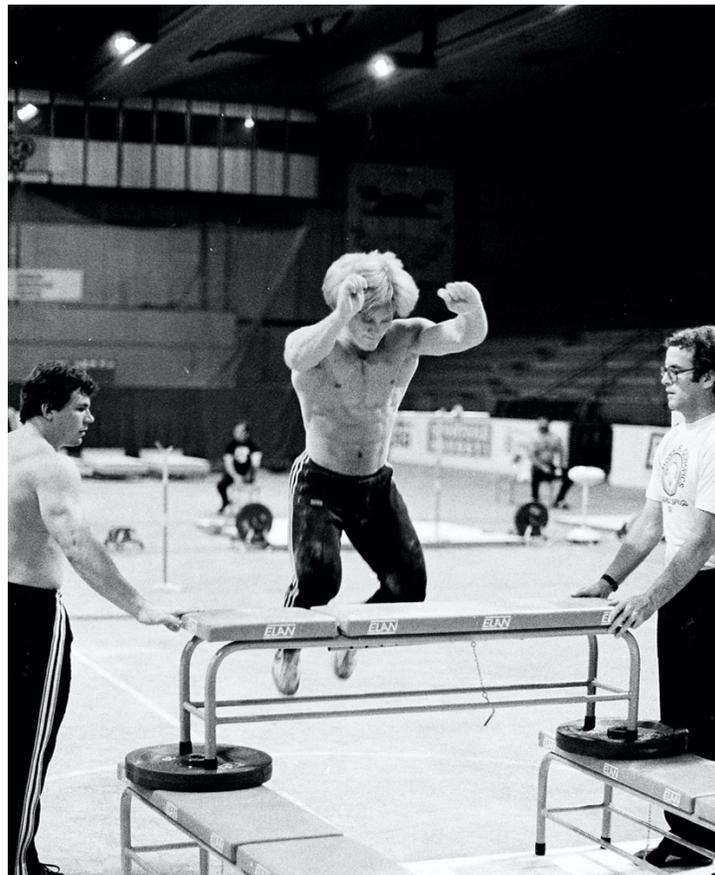
With that background, let's look at some practical guidelines for eccentric training.

Six Levels of Eccentric Training

Strength coaches recommend using anywhere from 100-175 percent of maximum for optimal loading in eccentric work. What *should* dictate how much weight to use in eccentric work is the tempo; you should have a preset time of lowering (i.e., six seconds) in your mind before doing your set. Also, consider that muscle failure in a properly-performed eccentric exercise is associated with a tetanus-like response where muscles are shaking involuntarily as they do their decelerating work.

The German word for eccentric is “nachgeben,” which means “yielding or overcoming.” As muscle and central nervous system fatigue sets in, you must concentrate on decelerating the load. Athletes should try to visualize their muscles as giant brake systems that decelerates the resistance. If you start lowering the weight faster than the present time, terminate the set. Also, consider that the greater the range of motion in the exercise, the longer the preset lowering time.

In the sporting world, slow eccentric training is at times associated with a diminution in the rate of force development; as such, it should be used mainly in preparatory periods. Fast eccentric training (i.e., plyometrics) should be reserved for the competitive period.



Plyometrics is considered fast eccentric training. Demonstrating exceptional jumping ability is Kurt White. White won the first of his six US Senior National Championships at the age of 14 and competed in the 1988 Olympics. (Bruce Klemens photo)

Outside of the slow lowering of supramaximal loads, there are many other ways to perform or combine various forms of eccentric training. Many bodybuilders would envy the musculature of elite rowers and bobsledders. One of the methods these athletes use to achieve such hypertrophy is the combination of lifting maximal loads (1-5 RM) and fast eccentric training. This would involve alternating 4-6 sets of 3-5 reps of maximal weight with 4-6 sets of 6 jumps over hurdles. The rationale is that the heavy sets tap into the high threshold motor units, and the plyometrics

create fiber damage that leads to the positive adaptation or hypertrophy of the high threshold fast-twitch Type IIb fibers.

Athletes embarking on an eccentric strength training cycle are bound to be exposed to increased connective tissue and myofibrillar damage. To help rebuild these tissues, I recommend a good antioxidant formula and supplemental glucosamine sulfate. To help offset the increased cortisol levels from the new stress imposed by eccentric training, I also recommend Vitamin C. (If your health care professional approves of its use, there is some evidence that aspirin may also be useful for dealing with cortisol and may be associated with increased storage of phosphagens in the muscle tissue.)

I believe there should be a continuous, progressive build-up of eccentric training. To help get you started with eccentric training, here are six levels of eccentric training protocols, gradually progressing in difficulty.

LEVEL 1

This level is for the athlete with less than two years of training experience. No training with eccentric loads is needed; the simple lowering of loads under control should suffice.

LEVEL 2

Use 70 percent of maximal load (1RM); go to concentric muscle failure; then do 2-3 forced repetitions with the same load. Repeat for 2-3 sets. As a variation, you could perform only one forced rep, but try to stop the descending weights 3 times for a count of 4 seconds.

LEVEL 3

Use 70 percent of maximal load: go to concentric muscle failure; then do 2-3 forced repetitions with 15 percent more weight. Repeat for 2-3 sets.

LEVEL 4

Use 80 percent of maximal load; go to concentric muscle failure, and then do 2-3 forced repetitions with 20 percent more weight. Repeat for 3-4 sets. As an alternative for Levels 3 and 4, instead of adding weight, a training partner can manually apply resistance (i.e., push down on the resistance) for the eccentric portion of the exercise. These additional negative repetitions will exhaust your eccentric strength after you achieve concentric muscular failure.



One novel way to increase the eccentric load in a bench press is to have a training partner press down on the bar during the lowering phase. (Miloš Šarčev photo)

LEVEL 5

Using 110-120 percent of maximal load, perform 4-6 *eccentric-only* reps for 4-6 sets, resting 4-5 minutes between sets. Take 8-10 seconds to lower the weight each set.

LEVEL 6

Using 125-140 percent of maximal load, perform 2-3 *eccentric-only* reps for 5-6 sets, resting 4-5 minutes between sets. Take 4-6 seconds to lower the weight each set.

Although it would be easy to prescribe a single exercise tempo such as, “It should take twice as long to lower a weight as it does to raise it,” such advice not work for advanced athletes—at least, not for very long. Eccentric training is a powerful tool that will take you to the fringe of serious training. Doesn’t that sound normal, and not at all “eccentric?”

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