

How to Incorporate Eccentric Training Into a Resistance Training Program

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ABSTRACT

ECCENTRIC TRAINING AND ECCENTRIC MUSCULAR CONTRACTIONS FOCUS ON ACTIVE LENGTHENING WHILE LOADED. WHEN COMPARED WITH CONCENTRIC MOVEMENTS, ECCENTRIC ACTIONS YIELD GREATER FORCE LEVELS WITH CONCOMITANT LOWER NEUROMUSCULAR ACTIVATION LEVELS. ECCENTRIC TRAINING IS MAINLY INCORPORATED INDIRECTLY BY STRENGTH AND CONDITIONING AND FITNESS PROFESSIONALS LEADING TO IT BEING OFTEN UNDERUSED AND UNDERVALUED. ECCENTRIC TRAINING CAN READILY BE INCORPORATED INTO A TRAINING PROGRAM ALONG WITH THE USE OF NONTRADITIONAL EXERCISES FOR ALL POPULATIONS. THIS ARTICLE EXAMINES THE SCIENCE OF ECCENTRIC TRAINING AND EXTENDS THIS SCIENCE BY FOCUSING ON PRACTICAL RECOMMENDATIONS. SUGGESTED PROGRESSIONS ARE PROVIDED DEPENDING ON TRAINING BACKGROUND ALONG WITH CASE STUDY SCENARIOS.

INTRODUCTION

Dynamic muscular contractions can be characterized by 2 primary actions, concentric and eccentric actions. A concentric contraction results in muscle shortening and occurs when the force produced during a contraction exceeds the force applied to the muscle. Alternatively, an eccentric action occurs when the muscle is forcibly lengthened or elongated. An eccentric action results when the force produced inside the muscle is less than what is applied to the muscle externally (5) and results in active lengthening of the muscle fibers under some level of load.

When directly compared, eccentric muscle actions are able to produce greater force in amounts estimated to be 20–60% greater than force levels generated during concentric activities (18). Alternatively, lower levels of neural activation have been shown in eccentric actions when compared with concentric efforts creating a much greater force-to-neural activation ratio (40). Evidence surrounding muscle damage (loss of force production, increased soreness, and myocellular protein accumulation in the serum [e.g., creatine kinase, myoglobin, etc.] as well as Z-disk streaming) are routinely reported to a greater extent

when eccentric actions are completed (34,35). Finally, some evidence also indicates that a greater contribution from eccentric actions may better facilitate phenotypic adaptations such as increased strength and hypertrophy (38).

Eccentric training has led to increases in hypertrophy for both concentric-only strength and eccentric-only strength. Differences due exist, however, mainly from methodological design, subject history, specific load used, and equipment. Taken together, all of this evidence suggests that increasing the incorporation of eccentric efforts into resistance training programs for fitness, athletic, and clinical populations may aid in training outcomes. Eccentric resistance training incorporating submaximal, maximal (100% one repetition maximum [1RM]), or supramaximal (typically 105–120% 1RM) training loads has been shown to stimulate greater increases in maximal muscle strength in traditional activities involving both concentric and eccentric actions (17,21,22,33,39), compared with conventional types of strength training (6), or even using very light loads (3).

KEY WORDS:

eccentric; strength; hypertrophy; rehabilitation

Table 1
Eccentric emphasized exercises—Upper and lower body

Exercise	Eccentric duration	Emphasis	Sets and reps	Suggested eccentric technique
TRX row	3–5 s	Upper body	3–5 sets × 6–8 reps	2/1; superslow
Pull-ups (Figures 6–8)	3–5 s	Upper body. Can focus on eccentric only or perform concentric with eccentric emphasis	3–5 sets × 8–10 reps with concentric; 3–5 sets × 6–8 reps with eccentric only	Superslow
				^a Can use heavier loading and decrease eccentric duration (i.e., 85% 1RM for 4 s)
				^a Body weight and strength dependent
Glute-ham raise (Figures 3–5)	3–5 s	Lower body. Focus on eccentric only or perform normal concentric reps with eccentric emphasis with prescribed duration	3–5 sets × 8–10 reps with concentric; 3–5 sets × 10–12 reps with eccentric only	Slow
				^a Body weight and strength dependent. Can also use plates or bands
Manual glute-ham raise	3–5 s	Lower body. Can focus on eccentric only	3–5 sets × 10–12 reps with eccentric only	Supramax; slow
		^a Requires a partner		^a Supramax was chosen for this exercise because of the overall difficulty
				^b Body weight and strength dependent. Can also use plates or bands
Single-leg Romanian deadlift or good mornings (barbell or dumbbell) (Figures 1–2)	3–5 s	Lower body. Can focus on eccentric only or perform normal concentric reps with eccentric emphasis with prescribed duration	3–5 sets × 8–10 reps with concentric; 3–5 sets × 10–12 reps with eccentric only	Two-movement technique
Glute-bridge and hip thrust (body weight, plates, or barbell) (Figures 9–13)	3–5 s	Lower body. Can focus on eccentric only or perform normal concentric reps with eccentric emphasis with prescribed duration	3–5 sets × 8–10 reps with concentric; 3–5 sets × 6–8 reps with eccentric only	Supramax; slow
^a Can also perform single-leg movements				^a The use of plates, or loaded barbell can be used for supramax in addition to slow techniques
Half-kneel-bottom-up press-eccentric only	3–5 s	Upper body. Mainly focused on eccentric only while also incorporating half-kneeling position and additional core and hip stability	3–5 sets × 6–8 reps	2/1 technique; slow; supramax
		^a Can be used for concentric portion and eccentrically emphasized or eccentric only		^a Can be used as a mix of all

Table 2
Eccentric training techniques

Technique	How to perform	Eccentric duration	Sets and reps	Example exercises
2/1 technique	Lift the weight concentrically using 2 limbs (both arms for upper body, both legs for lower body)	5 s	70–80% 1RM of your selected exercises	Rowing, various biceps and triceps exercises that can be performed using the triceps rope, dumbbells, free weight, and machines
	Return weight eccentrically with 1 limb		60-s rest	See Table 1
Two-movement technique	Use a compound movement (i.e., bench press and power clean) and the eccentric portion of an isolation movement	5 s	4–5 sets × 5	Power clean/reverse curl
			90–110% 1RM of the weight typically used for your selected exercises	Close-grip bench/triceps extension
			For example, use 90–110% 1RM of your reverse curl or triceps extension. 60-s rest	DB bench/flyes, DB Squat/single-leg DB squat
Slow/superslow	Execute a superslow eccentric phase while concentrically lifting the bar explosively	Varies depending on the load	60–85% of your maximum 60-s rest	Various single-arm and single-leg exercises (i.e., triceps pushdowns, dumbbell split squat)
		Lower % 1RM yields a longer eccentric duration (i.e., 60% 10–12 s)		
Negative (supramax)	Performing the eccentric-only portion of an exercise	The eccentric action is load dependent	Set of 1 rep	Close-grip bench, bicep curls
	^a Requires a spotter		110–130% of your maximum	
			8–10 s if the load is 110–120%	
			4–6 s, 6–8 seconds if the load is 120–130%	



Figure 1. Starting position of single-leg stiff-legged deadlift. Athlete should strive to stay arched as much as possible while driving the back leg up with hip extended and use a slight knee bend in the front leg. There should be little hip rotation.

Current and recent evidence does indicate that eccentric muscle contractions are important in practically all sports that involve jumping, running, or throwing as a critical part of the stretch-shortening cycle (44). Studies show a relationship between improved eccentric strength and improved athletic performance exists. For example, in fast movement (i.e., sprinting), preactivation of muscles is observed between the onset of electromyographic signal and the subsequent limb movement (45). In addition, preactivation of muscle immediately enhances sensitivity of muscle spindles, leading to improved regulation of reflex potentiation and

stiffness throughout the subsequent eccentric phase (24), and that in jumping exercises, high and fast muscle activation during the eccentric phase of the takeoff improves performance (25). In addition, evidence suggests that in the long jump, the maximal stretch in fibers of leg extensor muscles is achieved in a very short time (i.e., 15 milliseconds) after touchdown, leading to greater eccentric force enhancement than the concentrically generated force immediately before the kickoff (41).

In addition, although both concentric and isometric muscle contractions elicit a hypertrophy response, numerous studies have reported that eccentric

actions may have the greatest effect on skeletal muscle growth (15,21,22,32,37). Importantly, some studies go 1 step further and indicate that the speed of the eccentric action may preferentially impact hypertrophic changes (11,42). Farthing and Chilibeck (12) examined the effect of isokinetic eccentric and concentric training at 2 velocities (fast, 180° and (slow, 30°) on muscle hypertrophy where they trained 1 arm eccentrically for 8 weeks followed by concentric training of the opposite arm for 8 weeks. Ten subjects served as nontraining controls. Subjects were tested before and after training for elbow flexor muscle thickness by sonography and isokinetic strength. The results indicated that eccentric training resulted in greater hypertrophy than concentric training. The fast eccentric training group (180°) resulted in greater hypertrophy than concentric training group (180°) training and concentric (30°) training. However, the slow-velocity (eccentric, 30°) training group resulted in greater hypertrophy than the concentric group (180°) training. It is important to note that the hypertrophic superiority of eccentric training is largely attributed to a greater time under tension. It is postulated this is because of a reversal of the size principle of recruitment, resulting in fast-twitch fibers being recruited first (42). In addition, eccentric training has been shown to lead to increased hypertrophy for both concentric-only strength and eccentric-only strength (4,11,17,20,22). Thus, from a hypertrophy perspective, it seems that movement speed during the eccentric portion of a repetition (rep) may play a role in determining how the involved muscle responds.

Eccentric training is mainly incorporated in an indirect manner by strength and conditioning and fitness professionals; as a result, it is often underused and undervalued, and it is our contention misunderstood. Many techniques of eccentric training are available for incorporation into a training program along with the use of nontraditional exercises for able-bodied clinical and athletic populations. This article examines the scientific basis of eccentric training



Figure 2. Finish position of single-leg stiff-legged deadlift.

and extends this science by emphasizing the delivery of practical recommendations for all potential applications. In addition, suggestions for progressions are provided depending on training abilities and experience and further highlighted using case study scenarios.

BENEFITS OF ECCENTRICS TRAINING

Incorporating eccentric training and programming into a resistance training program can facilitate numerous benefits that extend well beyond simple increases in strength and hypertrophy for populations ranging from athletes desiring peak performance to clinical patients involved in physical rehabilitation. With eccentric exercise,

greater force output is produced during a maximal eccentric action primarily because of the ability to use higher external loads. Research focusing on the effects of overload training (100–120% 1RM) during the eccentric phase of a movement has routinely demonstrated a greater ability to develop maximal strength.

Research by Doan et al. (9) reported that applying a supramaximal load ($\geq 105\%$ of 1RM) on the eccentric phase of the lift elicited increases in 1RM concentric strength by 5–15 lbs. These abilities to increase strength have been shown to be greater when compared with concentric resistance training using lighter loads (17,21,22,33,39). In addition, a number of other adaptations have been reported

in the literature in support of eccentric training and include heightened neural adaptations in response to eccentric training when compared with concentric training (22). These neural adaptations likely include spinal and cortical mechanisms (i.e., larger excitability and greater involvement of brain areas) and are areas in need of greater research (19). In addition, the energy cost of eccentric exercise is comparably low, despite the high muscle force being generated. This makes eccentrics an appealing strategy for those wishing to gain additional strength and hypertrophy because of the fact that more volume can be performed without excessive fatigue. Exercise-induced hypertrophy from eccentric exercise is likely manifested by greater muscular tension under load. This is a situation that has been mechanistically explained to represent a reversal of the size principle of motor unit recruitment, resulting in fast-twitch motor units being preferentially recruited earlier in the process (42). Finally, and as a mechanistic link to reports of greater hypertrophy, eccentric exercise is also linked to more robust increases in protein synthesis (31) as well as a larger rise in IGF-1 mRNA expression (42) when compared with concentric muscle actions.

Scientific literature indicates that eccentric training sessions elicit greater muscle damage compared with concentric training as represented by a loss of force production and increases in soreness as well as increased concentrations of serum-based proteins of myofibrillar origin (34,35). The response to damage from eccentric training is thought to be associated with a mechanical disturbance of the actomyosin bond versus ATP-dependent detachment, leading to greater stress and strain on the contractile apparatus compared with other muscle actions, increasing the susceptibility to muscle damage (16).

Other interesting findings related to muscle damage include indications that the degree of eccentric-induced muscle damage is greater in upper-limb musculature when compared with lower limb (23,36).



Figure 3. Starting position of glute/ham raise: Athletes should place your feet against the footplate in between the rollers as they lie facedown. The knees should be just behind the pad. Incorporating the eccentric emphasized technique(s), the athletes should start from the top of the movement. Keep your body straight and stay braced with the core. Slowly move down focusing on the eccentric portion while keeping the upper body straight and continue until you are fully extended.

It also seems that fusiform muscles (i.e., biceps brachii) are more susceptible to eccentric-induced damage than penniform muscles (i.e., rectus femoris) because of pennate muscles having short fascicles that attach obliquely to a central tendon running the length of the muscle (23). Finally, evidence also indicates that a fiber-type specific response to muscle damage may occur whereby type II muscle fibers seem to be more vulnerable to damage during eccentric exercise than type I muscle fibers (30,43). Whether these intramuscular factors will eventually result in altered eccentric

prescriptions primarily in clinical populations to avoid (or promote) damage and its ensuing repair and remodeling phases remains to be seen, but the scientific foundation is present for such considerations to be entertained.

As mentioned previously, incorporating eccentric training not only benefits healthy adults and athletic populations, but these benefits also extend to a number of clinical populations. For example, the aging process results in a progressive and continual reduction in muscle strength. For this reason alone, incorporation of eccentric

training could be considered in an elderly population for its known ability to improve muscle strength and power while also reducing their risk for falls and potential fracture risk (26,27). With respect to increases in power, eccentric exercise training serves an important part in all aspects of sports and is critical during the stretch-shortening cycle (44) and has been shown to be an effective modality in increasing (explosive) muscle strength, muscle cross-sectional area, leading to increased sarcomere length. Recent evidence suggests that eccentric and over-speed training modalities are effective in improving components of muscular power, and eccentric training induces specific training adaptations relating to muscular force. It was found that eccentric training with over-speed stimuli was more effective than traditional resistance training in increasing peak power in the countermovement jump (8).

Other clinical populations can benefit from incorporating eccentric training, particularly if the patient exhibits a low level of strength and is just beginning a resistance training or rehabilitation program. For example, research involving patients with stroke and chronic obstructive pulmonary disease has demonstrated a significant preservation of eccentric strength when compared with age-matched healthy controls (10,29). Additionally, increases in collagen synthesis and improvements in overall bodily function (13) regularly occur as part of a comprehensive rehabilitation program.

Physical rehabilitation populations can also derive benefits from eccentric training, starting first with the known cross-education effect or the transfer of strength gains unilaterally from 1 limb/side to the other (11). Protocols using cross education have been shown to successfully improve quadriceps strength in the limbs of healthy uninjured participants, although the exact mechanism is still not yet fully explained. Recent evidence examined the effect of eccentric exercise on quadriceps strength and activation gains in the unexercised limb. Eighteen healthy



Figure 4. Mid-position of glute/ham raise.



Figure 5. Finish position of glute/ham raise.



Figure 6. Starting position of eccentric pull-up using a supinated grip. The athletes can also use various grip positions such as double overhand, neutral, narrow, or wide.

individuals were randomly assigned to an eccentric training group or a control group. Quadriceps strength and activation measured pre-, mid-, and postintervention. Eccentric training participants exercised their dominant limb with a dynamometer in eccentric mode at $60^\circ \cdot s^{-1}$, 3 times per week for 8 weeks and found greater eccentric strength in the unexercised limbs in eccentric training participants between trials. It was concluded that exercising with eccentric actions resulted in mode-specific and velocity-specific improvements in quadriceps strength in the unexercised limb, suggesting that strength gains may have occurred because of enhanced neural activity (28).

INCORPORATING ECCENTRICS INTO YOUR PROGRAM

A variety of eccentric training techniques are available along with the use of a number of nontraditional exercises for able-bodied clinical and athletic populations. Although several eccentric techniques exist that strength and conditioning and fitness professionals can use, 4 categories of eccentric techniques are most commonly used. These 4 techniques are highlighted in the following section.

2/1 TECHNIQUE

The 2/1 technique for emphasizing the eccentric component involves lifting the weight through its concentric range of motion with 2 limbs, while moving the weight back through the eccentric phase with 1 limb. It should be emphasized that the load should be heavy enough to pull through the concentric phase as quick as possible but heavy enough to challenge the individual throughout the eccentric portion. Specifically, the load during the eccentric phase should be twice as high as during the concentric phase, and an approximate load of 70% of bilateral concentric 1RM is considered to be a general starting point. Sets of 3–5 reps per limb are performed (6–10 total reps per set), with a rest interval of 60 seconds. Tables 1 and 2 provide examples of several exercises that can be modified to accentuate the eccentric phase using any of the techniques highlighted throughout this



Figure 7. Mid-position of eccentric pull-up.

article. Finally, past experiences of using this technique indicate that a wide variety of populations can benefit from its use.

TWO-MOVEMENT TECHNIQUE

The 2-movement technique is slightly more technical as compared with the 2/1 eccentric technique. With the 2-movement technique, it is recommended that the concentric portion should be a compound (multijoint) exercise coupled with an isolation exercise for the eccentric portion of the lift. It is our contention through personal experience and coaching that this technique should be practiced among more highly trained individuals. The volume and load parameters should consist of 90–

110% of your maximal load while incorporating 4–5 sets of 5 reps with an eccentric duration of 5 seconds. Rest periods should be 1–2 minutes in between sets. Sample exercises using this technique (i.e., power clean/reverse curl, close-grip bench/triceps extension, etc.) and basic prescription recommendations are provided in Table 2.

SLOW/SUPERSLOW

This technique is relatively simple. The lifter executes an exaggerated slow-speed eccentric phase while concentrically lifting the bar explosively. This is perhaps one of the more common eccentrically emphasized techniques in comparison with other techniques, and as a result, it has been used to a greater extent. Again,

we have attempted to provide details regarding this technique in Table 2. It should be emphasized that the eccentric duration varies depending on the load used. For example, a lower % 1RM yields a longer eccentric duration (i.e., 60% 10–12 seconds), whereas a heavier load (i.e., 85%) would likely yield approximate 4-second eccentric action duration. A load ranging from 60 to 85% 1RM is commonly used with eccentric action durations ranging from 2 to 15 seconds, depending on load assignment, type of movement, size of muscle group, etc. A rest period of 60 seconds is commonly used, which could be further modified depending on other details found within the overall exercise prescription.

NEGATIVE (SUPRAMAX)

This type of training primarily refers to the eccentric action and is mainly used as an eccentrically emphasized training technique. Although an effective technique, 1 drawback is that it requires at least 1 spotter, and depending on the exercise, load, and number of eccentric reps to be completed, 2 or 3 spotters may be needed. For example, when performing a bench press, 1–2 spotters are recommended. There should be no actual concentric lift with this type of technique, which commonly results in the spotter concentrically lifting the bar to the starting position after the lifter performs the eccentric rep. Therefore, the lifter should focus their efforts on eccentric control throughout the supramaximal technique. As indicated in Table 2, sets of 1 rep should be used with 110–130% of concentric 1RM. However, the time of the eccentric action is load dependent with 110 and 130% of 1RM. For example, an 8- to 10-second eccentric action can be expected if the load is 110–120% concentric 1RM. Furthermore, the lifter may increase the load percentage (125–130% concentric 1RM) which will decrease the overall duration of the eccentric phase to somewhere around 4–5 seconds in duration. When performing this specific technique, it is recommended that 3–10 sets of singular reps be completed at a load of 110–120% 1RM. We recommend



Figure 8. Finish position of eccentric pull-up.

starting conservatively with this technique, as it places a large demand on the nervous system and therefore can elicit rapid periods of overreaching and potentially overtraining. As a result, the individual should take a longer rest interval when using this technique and closely evaluate recovery, soreness, etc., before completing a subsequent workout using this technique. Provided that a muscle is not fully fatigued during concentric training (46), the use of heavy negatives (supramax) may elicit greater motor unit fatigue and thus provide an additional hypertrophic stimulus. The greatest improvements using supramaximal eccentrics (110–120% 1RM) have been reported by Brandenburg and Docherty (1) who reported an increase in elbow extensor

strength of 24% compared with 15% using standard resistance training after 10 weeks of training 2–3 times per week. Similar results were also reported by Doan et al. (9) who applied a supramaximal load ($\geq 105\%$ of 1RM) on the eccentric phase of the lift and elicited increases in 1RM concentric strength.

SCENARIOS

The following section is included in the hopes that it will help facilitate a broader understanding of how eccentric techniques can be used and hopefully stimulate additional thought by the reader to further apply the different eccentric techniques. Both scenarios are intended to build on the information outlined in Tables 1 and 2.

SCENARIO 1

A 240-lb football player has a severe hamstring strain. To facilitate recovery and strength, it is recommended that the individual incorporates eccentric training into his program. His goals are to restore range of motion and strength and to use specific hamstring exercises to assist in this process. Once the initial inflammation phase has been resolved (i.e., 1–4 weeks), he can begin to primarily use open kinetic chain and non-weight-bearing exercises. Once the athlete has tolerated the non-weight-bearing exercises, Comfort et al. (7) have suggested to implement low-velocity eccentric activities such as stiff-leg deadlifts, eccentric hamstring-lowering exercises, and split squats. Based on the recommendations from Comfort et al. (7), the next phase involves higher velocity eccentric exercises that include plyometric and sport-specific activities designed to increase hamstring torque and lower-extremity power. Examples include squat jumps, split jumps, bounding, and depth jumps. Finally, sports-related progressions should complete the program. Comfort et al. (7) suggest progressing from unidirectional linear movements to bidirectional and then multidirectional movements. These examples may include progressions from 2-leg jumps, single-leg hops, single-leg bounding, backward skips, lateral hops, lateral bounding, and zigzag hops and bounding. Furthermore, evidence from Brughelli and Cronin (2) proposes that incorporating eccentric exercise for reducing the frequency of hamstring strains should include the following: high force, maximal muscle elongation, high velocity, multijoint movements, closed-chain exercises, and unilateral exercises. These include eccentric lunge drops, eccentric single- and double-leg deadlifts, and even a split stance “good morning” exercise with the load positioned in front compared with a posterior load on the back. It should be noted that we have provided similar eccentric emphasized exercises for the lower body (Table 1) that can also be used in this scenario example for the specific



Figure 9. Starting position of barbell hip thrust. The bar should be positioned in the crease of the hip with the hands holding the bar into position throughout the movement, so that the bar does not move forward or backward.

eccentric action duration with the recommended set and rep scheme.

SCENARIO 2

An advanced 28-year-old female lifter with 10 years of training experience wants to incorporate some eccentric emphasized training into her training program to assist in further development of strength and hypertrophy. She has competed in strength sports throughout high school and college and continues to compete recreationally for the past 6 years while recently completing 3

bodybuilding competitions in the past 2 years. With this scenario, multiple eccentric-focused resistance training techniques can be performed using exercises available in most commercial gyms.

2/1 technique. The 2/1 technique is an ideal eccentric technique for this type of scenario. For example, using bilateral machines (i.e., leg press or chest press) while raising the load with both limbs and lowering with only 1 limb will limit fatigue and allow the lifter to complete more



Figure 10. Top position of barbell hip thrust. At the top, the hips should be fully extended, with the shins vertical. The athletes should complete the lift by contracting the glute hard and pushing the hips forward. The low back should not be overextended. At the top of the movement, your torso should be parallel to the ground.

eccentric actions. Both of these examples can also be completed with dumbbells, but care and caution need to be paid toward muscular failure with weights overhead. Additionally, eccentric 1-arm push-ups can be completed using the 2/1 technique by pressing up with both arms and lowering with 1 arm.

Cluster sets with eccentric emphasis. Cluster sets involve a series of reps interspersed by a very short (i.e., 5–30 seconds) rest interval (14). A well-known modern-day example of this training style is a “rest-pause” set. A partner or spotter helps raise the weight to the starting position. From here, the lifter begins each series of reps with an eccentric action and completes the set (after concentric failure or as the last rep performed) with an eccentric action to a safe stopping point. With the technique, the lifter can accumulate additional eccentric actions over the course of a multiseries cluster set.

Forced eccentrics (surpamaximal technique). These are primarily completed in a fatigued state with lighter loads. For example, as one reaches concentric failure at the end of a drop set, the spotter helps lift the weight and provides an additional load during the eccentric portion so that the eccentric tempo is relatively normal or even slower. In the current bodybuilding culture, this is often referred to as “isotension,” where isometric contractions are performed with additional tension provided by a spotter.

CONCLUSIONS

Eccentric actions are a distinct phase of nearly every muscular contraction that are represented by a combination of several unique factors, which ultimately impact how the involved musculature responds. A number of eccentric training strategies exist that can allow for a wide variety of applications across nearly all populations. Although eccentrically dominated movements may not be needed in all situations, it is our contention that nearly all populations can indeed derive benefit. Toward this aim, the approach taken throughout this article was to highlight a number of different eccentric strategies along with



Figure 11. Top position with leg elevated of barbell hip thrust. Athlete should strive to keep the lifted leg perpendicular to ground through movement for balance and added core stability.



Figure 12. Middle position with leg elevated of barbell hip thrust (downward motion).



Figure 13. Finish position of barbell hip thrust.

examples and potential prescriptive scenarios on implementation to encourage the reader to incorporate and explore other means in which eccentric training can be incorporated into their athlete's or client's programs. From this article, we hope to better highlight many ways how eccentrics can be incorporated into the training and therapy programs of active athletic and clinical populations.

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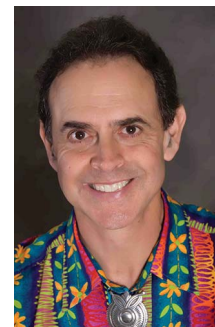
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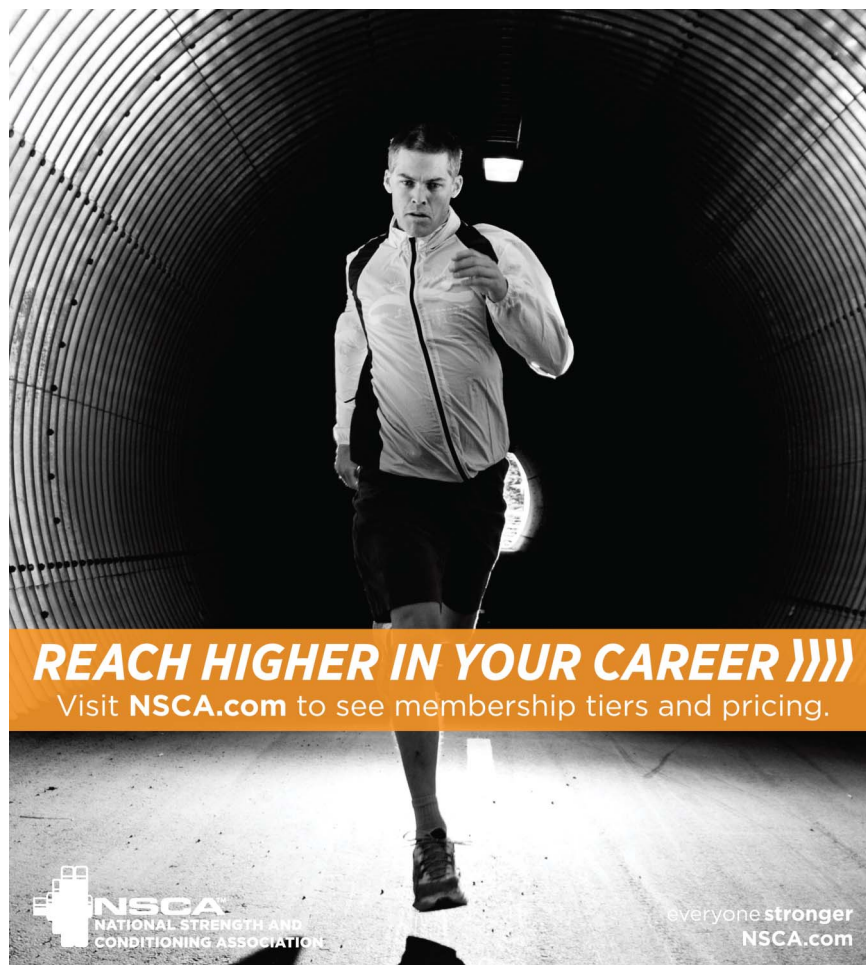


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