

Focus on Eccentric Training

Add a new dimension to your clients' programs with a training method that is effective and efficient.

Since the typical client's number-one excuse for not exercising is usually "lack of time," what personal trainer would not be happy to find a more efficient form of exercise to incorporate into clients' programs? Eccentric training might be one way to respond to clients' excuses. Research suggests that this training mode may be the most efficient form of exercise, yielding greater overall strength gains, with less effort, than other modes.

Finding ways to integrate eccentric training into sessions may help your clients:

- Perform more work while exerting less effort.
- Accomplish more in each workout by reducing the time spent per exercise.
- Reduce overall strength training time, allowing more time for flexibility and cardiovascular training in the same workout period.

The Mechanics

Let's take a step back to Muscle Mechanics 101. Exercise, in general, is a finely tuned combination of concentric, isometric and eccentric contractions. Each of these contraction types acts in concert with the other types, both within the individual muscle and between the agonists and antagonists, to produce movement around a joint. In the concentric phase of a contraction, tension is generated while the muscle shortens; in the isometric phase (the transition phase between the concentric and eccentric phases), tension is generated, yet muscle length remains the same; and in the eccentric phase, tension is generated as the muscle lengthens (Friden & Leiber 1992; Luciano, Vander & Sherman 1978). For example, with a biceps curl, lifting the weight is the concentric phase of the exercise; holding the weight at the top of the lift is the isometric phase; and lowering the weight is the eccentric phase.

The Benefits

What are the advantages of eccentric training? A significant body of research suggests that when compared to other modes of training, eccentric training encourages more strength gains at a lower energy expenditure, or VO_2 max, and requires less time for recovery.

Strength Gains. According to research conducted by Komi and Buskirk (1972), when compared to concentric and isometric exercise, eccentric exercise elicits a greater increase in maximum tension, not only in eccentric contractions, but also in concentric and isometric contractions. This finding was supported by Ellenbecker and associates (1988), who found that an eccentrically trained limb exhibited gains in both concentric and eccentric strength, whereas a concentrically trained limb showed gains only in concentric strength.

Some research suggests that adding eccentric exercise to a program may also encourage more strength gains in the muscle tendon unit and its associated connective tissue than concentric exercise alone. As Friden and associates (1983) explain, eccentric exercise enhances the coordination and reorganization of contractile proteins and, since the muscle tendon complex functions as a unit, these benefits would be transferred to the tendon tissue.

Lower VO₂ Max. Eccentric training is associated with a lower energy expenditure than concentric exercise. Research has demonstrated that at a given intensity level, the VO₂ max for eccentric exercise is approximately 30 percent of that for its concentric counterpart (Dean 1988). This benefit is of special interest if you have clients with cardiovascular conditions, since eccentric exercise should allow these clients to perform more work with comparatively less stress to the cardiovascular system.

The association of eccentric training with both greater strength development and lower VO₂ max makes this form of exercise especially beneficial for injury prevention, as well as for training clients in postrehab.

Shorter Recovery Period. Eccentrically trained muscles recover faster (Ebbeling & Clarkson 1990; Friden et al. 1983) and are, therefore, able to handle repeated bouts of exercise sooner and more readily than their concentrically trained counterparts. In fact, the adaptation response may occur even before full recovery.

Finally, if none of these benefits is enough to persuade you to integrate eccentric training into your clients' programs, think of eccentric exercise as simply an alternative training methodology—something different that may be helpful for nudging a client off a plateau.

The Controversy

As with any training modality, eccentric training engenders some controversy. Some trainers may hesitate to incorporate eccentric training into clients' programs because this mode of training:

- has been tagged as the culprit in delayed onset muscle soreness (DOMS)
- is closely related to the mechanism of many overuse injuries

Let's take a look at these two issues.

DOMS. Why would you want your clients to participate in an activity that is known to induce soreness? The answer to this question can be found in the

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conclusions of many research studies. Faulkner and associates (1993) suggest that the increased probability of DOMS after eccentric training is due in part to the greater-than-average forces developed during this phase. When the researchers compared contraction forces, they found that those generated by maximum eccentric activity were the highest; those generated by maximum isometric activity were some 20 to 30 percent lower; and those generated by maximum concentric activity were the lowest of all. Researchers theorize that the increased tension developed during eccentric exercise reflects an increased strain on the cross-bridge attachments as they are pulled beyond overlap. This "cross-bridge strain" theory helps explain the relationship between eccentric exercise and DOMS: The strain induced by the eccentric load results in structural and ensuing metabolic damage at the cellular level. Of course, it is this damage that triggers the adaptation response that leads to strength gains.

In short, eccentrically trained muscle tissue is stronger than concentrically trained muscle tissue. In addition, as mentioned previously, it adapts faster and recovers more rapidly. These benefits may provide enough motivation for incorporating eccentric training into your clients' workouts despite the increased risk of DOMS. Since it is *unaccustomed* eccentric activity that induces DOMS, using this training mode with fit individuals who exercise regularly, and applying appropriate progression, should substantially reduce the amount and severity of any soreness.

Overuse Injury. Eccentric forces are involved in all forms of activity. In fact, all functional patterns of movement, including such everyday activities as walking or running down a flight of stairs, depend on repetitive and sometimes high-speed eccentric muscle demands. In general, repetitive activity, faulty muscle recruitment patterns and training errors—when combined with inadequate eccentric strength—are the factors that predispose an individual to soft tissue injury (Clarkson, Nosaka & Braun 1992). Concern that eccentrically based training may predispose tissue to injury and that this predisposition may outweigh the benefits of this type of training has been negated by researchers Curwin and Stanish (1984), who suggest that, on the contrary, since eccentric forces play such an integral role in both daily living and sports, the best tactic for *preventing* injury is to train the muscles the way they are used—with progressive training in an eccentric mode.

What implications does the research have for your clients? One of the most popular phrases in the fitness industry today is "functional core training." Whether your clients are marathon runners, active teens, middle-aged weekend warriors, or seniors who want to regain or retain functional movement, eccentric training should be a part of their fitness regimen!

Adding an Eccentric Component

The following recommendations for developing and progressing an eccentric training program are intended for the

average population; however, the suggestions can be modified to include all populations, from professional triathletes to senior citizens. One caution: It *is* possible to get too much of a good thing. The point is to *integrate* these exercises into your current program, not to perform eccentric exercise to the exclusion of other forms.

The main design variables of an eccentric training program relate to the application of the load and the amount of time required as rest between sets. Eccentric activity is *decelerating* activity. As explained earlier, with eccentric activity, the muscle lengthens as tension is generated. The faster this lengthening phase of the movement is, the greater is the force required for deceleration, or, in other words, the greater the eccentric load. For this reason, speed of movement and the number of decelerations, or stops, incorporated during the movement are load variables. Since the recovery period for eccentric activity is comparatively faster than that required for concentric activity, the rest period between sets can be reduced from the generally recommended 30-120 seconds (Westcott 1981) to 30-60 seconds (Ebbeling & Clarkson 1990; Friden et al. 1983). Thus the length of the rest period becomes another design variable.

The design of an eccentric program can be summarized in four main points. With an eccentric training program, you:

1. Emphasize the eccentric phase of exercise.
2. Vary the speed of exercise during the eccentric phase.
3. Incorporate periodic stops or decelerations during the eccentric phase.
4. Reduce the rest period from 30-120 seconds to 30-60 seconds.

Progression is accomplished by changing any of the load variables (points 2 to 4 above), altering the position of the body and/or the equipment used, and incorporating more functional movement patterns. As with traditional programming, progression is appropriate

only after your client can successfully complete all the desired repetitions with perfect form.

To more clearly illustrate these points, let's look at the low row. (See "Suggested Progressions for the Low Row.") You can see by the chart that progression is achieved by altering the variables of body position, equipment or modality, load and speed. For example, you might start an eccentric training program by performing the low row in a seated position; doing one to three sets of eight to 12 reps with light resistance; and taking one to two seconds for the concentric phase of the exercise, six seconds for the eccentric phase, and 30 to 60 seconds of rest between sets. When the client can perform three sets of 12 reps with perfect form, you can gradually increase the speed of the eccentric phase from six seconds to four seconds, and incorporate one to four stops. Later, you can add resistance, vary the equipment and change the body position, while continuing to vary the speed of the eccentric phase and incorporate stops.

Designing an Eccentric Training Program for Core Strength

Only you can decide which specific exercises are suitable for your client. You can use the eccentric component of virtually any exercise to focus on this type of training. As examples, let's look at some basic exercises suitable for a general population. We have already discussed progression for the low row. Now let's consider the push-up, lateral raise, abdominal curl and squat.

Push-Up. The chart on this page illustrates a sample progression for the push-up, beginning with a standing push-up against a wall, using body weight only; and gradually increasing the speed of the eccentric phase, adding resistance and varying the body position.

Lateral Raise. Progression for the lateral raise is similar to that for the low row. Begin with light resistance, taking two seconds for the concentric phase and six seconds for the eccentric phase.

Progress by gradually increasing the speed of the eccentric phase and incorporating controlled stops, or decelerations, once the client can complete all the reps with perfect form. By changing the equipment and the position of the body, you can integrate more functional movement patterns and add challenges that require greater neuromuscular control and coordination. For example, at an advanced stage, the client might perform alternating right and left raises while standing on one leg on a balance board, with eyes shut.

Abdominal Curl. To focus on eccentric training, emphasize the curl-down phase of the movement. To progress, increase the number of stops on the way down from one to four. Once control is established, gradually increase the speed of lowering, and hence the speed of deceleration required on the stops. Add some resistance and incorporate a stability ball or balance board for more challenge.

Squat. A squat performed to emphasize eccentric loading, sometimes referred to as a "drop squat," is somewhat different from a traditional squat. Begin with a two-leg squat and no weight. Lower slowly into a quarter squat and hold until the knee stabilizes, with each knee pointing in the same direction as the middle toe. Then press back up to standing. When the client can complete all reps with a stable knee, gradually increase the speed of the "drop," or lowering phase. Once the speed is at a maximum for your client, add resistance. Progress to incorporate greater neuromuscular patterning by performing the exercise with the eyes shut, or using a balance board or stability ball. Progression could also be achieved by performing the squat on one leg, and then incorporating the same progressions as for the two-leg version.

Individualizing the Program

Clients can start at any point along the progression continuum, depending on their specific needs, experience and

fitness level. You can incorporate more sport- or activity-specific movement patterns into the program as your client progresses, by employing proprioceptive neuromuscular facilitation exercises. For example, a client who is a baseball player would derive more benefit from a diagonal shoulder and arm movement pattern (simulating the throwing action) than from a lateral raise.

As you can see, eccentric training has numerous benefits and possibilities. But remember, although eccentric training is an integral part of a strength training program, it is only a *part*. As with any stimulus, too much eccentric exercise may eventually lead to

fewer strength gains and possible plateaus. This mode of training is just one of the many tools you can employ to provide your clients with a well-rounded program.

Pam Pedlow, MHK, has worked in the fitness industry since 1980. She recently completed her master's degree in human kinetics (sports medicine) at the University of British Columbia, where she studied the effect of eccentric exercise on shoulder rehabilitation and the benefits of this training method in postrehabilitation conditioning.

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SUGGESTED PROGRESSIONS FOR THE LOW ROW

The exercises may be introduced at any point along the progression, depending on the strength and technique of the individual client. Each step in the progression should begin with an eccentric phase of about 6 seconds, and gradually progress to 4 seconds. The same progression technique may be applied to the high row.

BODY POSITION	MODALITY	LOAD	SPEED
seated	light elastic resistance	8-12 reps/1-3 sets 30-60 seconds rest	concentric: 1-2 seconds eccentric: starting at 6 seconds, and gradually progressing to 4 seconds
seated	light elastic resistance	8-12 reps/1-3 sets 30-60 seconds rest	Incorporate 1-4 stops. concentric: 1-2 seconds eccentric: 6-4 seconds
seated	medium elastic resistance	Follow the same pattern as for light elastic resistance.	
seated	heavy elastic resistance	Follow the same pattern as for light elastic resistance.	
seated	cables or weight stack	Follow the same pattern as for light elastic resistance.	
supported, bent over (opposing hand & knee on bench; repeat sequence with hand support only)	free weights & bench	8-12 reps/1-3 sets 30-60 seconds rest	concentric: 1-2 seconds eccentric: 6-4 seconds
supported, bent over	free weights & bench	8-12 reps/1-3 sets 30-60 seconds rest	Incorporate 1-4 stops. concentric: 1-2 seconds eccentric: 6-4 seconds
supported, bent over	free weights & stability ball	8-12 reps/1-3 sets 30-60 seconds rest	concentric: 1-2 seconds eccentric: 6-4 seconds
supported, bent over	free weights & stability ball	8-12 reps/1-3 sets 30-60 seconds rest	Incorporate 1-4 stops. concentric: 1-2 seconds eccentric: 6-4 seconds
unsupported, bent over	free weights	8-12 reps/1-3 sets 30-60 seconds rest	concentric: 1-2 seconds eccentric: 6-4 seconds
unsupported, bent over	free weights	8-12 reps/1-3 sets 30-60 seconds rest	Incorporate 1-4 stops. concentric: 1-2 seconds eccentric: 6-4 seconds

SUGGESTED PROGRESSIONS FOR THE PUSH-UP

The exercises may be introduced at any point along the progression depending on the strength and technique of the individual client.

BODY POSITION	MODALITY	LOAD	SPEED
standing	wall	body weight/10-15 reps 1-3 sets 30-60 seconds rest	concentric: 1-2 seconds eccentric: 6-4 seconds
standing	wall/light elastic resistance (wrapped around the back & held in the hands)	body weight/10-15 reps 1-3 sets 30-60 seconds rest	concentric: 1-2 seconds eccentric: 6-4 seconds
standing	wall/medium elastic resistance	body weight/10-15 reps 1-3 sets 30-60 seconds rest	concentric: 1-2 seconds eccentric: 6-4 seconds
standing	wall/heavy elastic resistance	body weight/10-15 reps 1-3 sets 30-60 seconds rest	concentric: 1-2 seconds eccentric: 6-4 seconds
incline (hands on a raised platform)	weight bench	Follow the standing pattern above through all stages.	
hands on the floor		Follow the standing pattern above through all stages.	
decline (hands on floor, feet on a raised platform)	platform for feet	Follow the standing pattern above through all stages.	
decline (as above, with hands on an unstable surface)	platform for feet, small medicine balls for hands	Follow the standing pattern above through all stages.	

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