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Functional Eccentric Training, Part 1

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Any discussion of functional training should start with a review of the S.A.I.D. principle—Specific Adaptation to Imposed Demand. SAID is the guiding principle of exercise physiology and program design. This means that exercises and programs need to be designed to produce the specific results desired.

One of the most important aspects of specificity to consider is which types of muscular contractions are dominant in any specific functional outcome desired. For example downhill skiing requires significant eccentric loading of the lower body—particularly when skiing through moguls (bumps). So if we do NOT include eccentric exercise in a ski conditioning program it will not prepare people well for skiing!

Skiing is not the only activity that requires eccentric loading—in fact many sports and activities require eccentric strength including:

- Walking down stairs or down a hill
- Landing from any jump
- The landing phase of walking or running
- Squatting down to lower an object or pick something up off the floor
- Any activity where a person is on their feet running with sudden changes in direction, sudden decelerations or stops
- Decelerating the arm when throwing or punching

If you think about this list for a moment you will realize that eccentric loading is heavily required in most activities and virtually all sports! However, most training programs do not include any meaningful eccentric component capable of stimulating increased functional eccentric strength and endurance.

There are several known methods for producing improvements in eccentric function, but in order to employ them effectively a trainer must understand the unique physiology of eccentric loading along with the considerations for training specific populations such as athletes, rehabilitation patients, senior citizens along with the typical health club member.

To understand eccentric loading it is important to understand concentric and isometric muscle contractions. Concentric contractions are used whenever a muscle is shortening against some type of resistance and occur whenever you are projecting force externally such as:

- Lifting any object against gravity
- Performing an exercise on a machine where the weight stack is moving up
- Throwing anything
- Jumping up, sideways or forward
- The push off phase of running.

Isometric contractions occur when a muscle contracts with no movement and occur whenever you are stabilizing or preventing movement such as:

- Rotator cuff muscles of the shoulder contracting isometrically to hold the head of the humerus into the glenoid fossa while larger muscles like pectoralis major move the arm.
- Torso musculature contracting isometrically to maintain the core in rigid alignment during most movements including lifting, jumping, throwing, etc.

Characteristics and Benefits of Eccentric Loading

During many movements the muscles act like springs and use eccentric contractions to store kinetic energy which is then used during concentric contractions—this process is ubiquitous and is known as the Stretch Shortening Cycle or SSC. For example during the landing phase of walking and running the muscles are loaded eccentrically storing energy which is used immediately during the push-off phase. In fact **up to 50% of all the energy needed to accelerate/lift the body can be reclaimed from the eccentric/muscle lengthening phase of the stride!**

Another important concept to understand is that **muscles are capable of producing much more force eccentrically compared to concentrically or isometrically**. During eccentric contraction force production comes from both the contractile elements in the muscle fibers AND from the viscoelastic components

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of the connective tissue (primarily tendons)! However during concentric and isometric contractions the force production only comes from the contractile elements.

The other interesting fact about eccentric force production is that it increases as the velocity (speed) of movement increases (up to a point). Whereas during concentric loading the opposite is true and force production decreases quickly with increased movement velocity.

The take away message here is that just lowering a weight slowly during the eccentric portion of a typical resistance training exercise will not result in any significant improvement in eccentric strength, which is true for two reasons. First, as mentioned, force production during an eccentric contraction increases with faster movement and decreases with a slower movement. Doing a slow negative does not necessarily provide any meaningful force or overload relative to the eccentric capability of a given muscle. Second, muscles have the potential to produce considerably more force during the eccentric phase of an exercise doing a resistance training exercise with a level of resistance selected to be somewhere between 70% and 100% of 1RM for the concentric portion of the exercise. There will not be sufficient overload to produce meaningful gains in the eccentric strength of a muscle.

Another unique aspect of eccentric training is that **eccentric training can help shift a muscle's length/ tension curve out so that after appropriate eccentric training a muscle can produce more force at longer lengths**. This is one of the reasons eccentric training can help prevent injury. Furthermore, eccentric training has proven to be very effective for many different types of tendonitis—it helps realign and strengthen tendons in ways that concentric and isometric training do not.

In fact researchers believe that eccentric training actually causes a more optimal alignment of the contractile elements within a muscle fiber to allow greater production of force **meaning eccentric training produces unique structural changes to muscle**. In addition **eccentric training causes hypertrophy of tendons and connective tissue increasing the tendons strength, resistance to injury, and ability to store energy during movement**.

A comparison of eccentric and concentric exercise shows that eccentric training causes more rapid increases in muscle size and strength than concentric training, and that strength from eccentric training carries over to concentric training but NOT the other way around! **Eccentric training also requires a much lower level of oxygen consumption and cardiovascular stress and a lower rate of perceived exertion for any given level of force production. As such, eccentric exercise has been proven to be ideal for seniors and those with decreased cardiovascular capacity because it quickly and safely builds muscles and decreases fall risk significantly without overtaxing their cardiovascular systems!**

Another area of extensive benefit from eccentric training is treatment of ACL tears. In fact, several well done studies have proven that **properly designed eccentric training for ACL rehab is well tolerated and greatly accelerates increases in muscle mass, strength and in hopping ability compared to other forms of rehabilitation.** Research has also shown significant health benefits from a single thirty minute weekly bout of eccentric exercise done for eight weeks including:

- Significant improvements in Resting Energy Expenditure
- Increased Fat Utilization
- Improved Blood Lipid Profiles
- Decreased Insulin Resistance!

Next month, Part 2!

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