

The Stretch Reflex

Many people refer to the stretch reflex as the key to explosive training. How it is applied, however, is frequently misunderstood. This article takes an in-depth look at this action and how you can better utilize it in any or all aspects of your training.



The need for variety in the training program has been well established. This includes not only the need to modify and change the exercises being used but also how the exercises are executed and how the training regimes are used. When you use different rates of speed in weight training exercises, you can develop greater strength and muscle mass than when using only one rate.

Because bodybuilders and athletes are using increasingly heavy weights with high training volume, the speed of the movement is becoming slower. This is effective in maintaining maximum tension on the muscle through the full range of motion. However, using less resistance and increasing the speed of execution is also effective for muscle mass and strength, especially for the faster contracting (fast twitch) muscle fibers.

Learning how to use the stretch reflex when doing certain exercises can bring about even greater development of the fast twitch muscle fibers with a quick, high intensity muscle contraction. Keep in mind that there are basically four types of muscle fibers. This includes the slow twitch (ST) fibers, which are slow contracting and slow to fatigue. They are efficient in sustaining prolonged low intensity activity and are used extensively in bodybuilding, powerlifting, and endurance sports.

The fast twitch muscle fibers are sub-divided into several sub-classes and include fibers that are fast contracting and resistant to fatigue (FRF), fast contracting but more easily fatigued (FEF), and fast contracting fast fatiguing white fibers (FFF). Near-maximal and explosive resistance training produces greater hypertrophy of the fast twitch muscle fibers than the slow twitch muscle fibers.

At the same time, maximal muscle power output and the potential for explosive movement is determined mainly by the proportion of fast twitch fibers. For example, weightlifters and sprinters who must do more explosive movements have a considerably higher proportion of fast twitch fibers than bodybuilders, powerlifters, and endurance athletes. High intensity is not necessarily dependent upon the use of near-maximal or maximal loads but more to the degree to which the relevant muscle fibers are recruited during the effort. The terms “fast twitch” and “slow twitch” do not necessarily mean that fast movements recruit exclusively fast twitch fibers and slow movements recruit exclusively slow twitch fibers. The fibers involved are determined by the force that is produced.

For example, the maximum force generated during rapid acceleration of a 220-pound bench press can easily exceed the maximum force produced during a slowly accelerated 330-pound bench press. Small loads accelerated rapidly and heavy loads accelerated slowly both involve fast twitch fibers. However, the explosive movements rely heavily on the action of the fast twitch fibers. Also, accelerated movements recruit the muscle stretch (myotatic) reflex, which can elicit a faster and more powerful contraction. The pre-stretch principle is well known in sports and in the plyometric method in explosive training.

Fast twitch fibers are the main contributors to force production in ballistic motions while slow twitch fibers make their major contribution during very slow movements. Fast twitch fiber action can be impaired by the growth of slow twitch fibers because they appear to have a dampening effect on fast twitch contractions during quick or fast movements. Thus, even though heavy resistance training serves as a powerful stimulus for the development and hypertrophy of both slow twitch and fast twitch fibers, fast twitch fiber development requires special training.

Training the fast twitch fibers also includes the storage and release of elastic energy by the connective tissues in the muscle/tendon complex and should not be ignored by bodybuilders, powerlifters, power athletes, and endurance athletes. This is done by involving the stretch reflex, which entails accumulation of energy in the muscle-tendon complex prior to a quick explosive contraction and accelerates the weight or object held. After this, the weight or object moves on its own momentum followed by some muscle involvement until the movement stops.

When using the stretch reflex, the muscles do not react in the same manner as during a slow movement. During slow movements, the main muscles involved in performing the movement as well as their antagonists undergo contraction to control the movement via feedback over the full range of motion. To use the stretch reflex to get a more explosive contraction, you must program it in advance. This is needed so that the execution is safe and under control throughout the entire range of motion.

The bench press can be used to illustrate how the stretch reflex is used to elicit a more powerful muscle contraction. Begin the exercise with the arms straight, fully extended above the chest, and holding a barbell. Lower the barbell at a normal rate of speed, and as you approach the bottom position, before touching the chest, quickly change direction to accelerate the barbell upward. In essence, you blast out of the bottom position and then allow the barbell to continue the movement on its own inertia. Later, use the muscles to completely extend the arms. Pause after completion and then repeat for up to ten repetitions.

During the exercise, it is important that you inhale and hold the breath as you lower the barbell and execute the explosive change and acceleration phase in the bottom position. Exhale after the barbell has passed the most difficult portion of the lift or when the arms are extended. Holding the breath is needed during the explosive movements to stabilize the trunk for safety and assure effective execution.

When the bench press is executed using the stretch reflex, there is much greater force created in the initial pushing phase. The reason for this is that you use the energy accumulated on the down movement to execute the switch and upward acceleration of the barbell. Keep in mind that as you lower the barbell, the triceps, pectorals, and anterior deltoids undergo an eccentric contraction during which the muscles lengthen and become tenser. This muscle tension is used to stop the downward movement, switch to a brief isometric movement when the movement stops going down, and then change to the concentric contraction with which you accelerate the barbell upward. The eccentric contraction is most important for eliciting the stretch reflex and for controlling the barbell on the down phase.

The stretch reflex allows you to use the strength of the muscles involved as well as the energy accumulated on the down phase to enable you to generate even more power using mainly the fast twitch fibers. If you pause in the bottom position, as often occurs in a slow movement, the energy gained in the eccentric contraction will be dissipated in the form of heat. As a result, you will have to generate additional concentric strength to push the barbell back up.

The quick switch from the eccentric to the isometric to the concentric contraction is analogous to bouncing a super ball or other resilient ball. When you toss the ball downward and it makes contact with the ground, the ball undergoes deformation, which compresses the air or material on the inside, creating greater pressure. This is analogous to the muscle developing greater tension during the eccentric contraction as the weight is being lowered. The built up pressure inside the ball then returns the ball to its original or slightly elongated shape, and it leaves the ground (rebounds) upward to almost the same height without additional force being added. This equates to the release of energy stored in the eccentric contraction.

When using the stretch reflex, the same muscles are involved in the down phase as in the up phase. The ability of the muscles to undergo a stretch and accumulate energy to produce a forceful and fast contraction in the shortening phase is known as muscle resiliency. This is the key to all speed and power movements (i.e. movements that involve acceleration).

Phil Murphy, a former lineman for the then Los Angeles Rams football team in the early 80s, is a great example of what can be accomplished with explosive training using the stretch reflex. Phil, who was already extremely strong,

was brought to me for quickness and explosive training. He weighed 352 pounds and stood between 6'4" and 6'5". After approximately seven weeks of training, Phil lost 25 pounds of mostly fat and posted 255 pounds of lean muscle mass at a weight of 325. This is more muscle than I have ever seen on any other athlete. In testing done by the team, he was equal to, if not superior, to all the other linemen (who weighed around 280) in the 10- and 20-yard dashes and in the agility test. He was so powerful that he was able to leap up onto a three-foot table from a push-up position.

Exercises that use the stretch reflex are ballistic in nature and are perfectly safe and effective. However, they can't be performed on exercise machines because they do not allow you to begin the movement with a pre-stretch. If you try speed or explosive movements on a typical exercise machine, the weight stack, just as a free weight, develops momentum during the lowering and raising phases. When you quickly change directions, the momentum of the weights keeps them moving in sometimes the opposite direction from which they should be going. This, in turn, may bind the cable and the cable may leave the pulley or even break because of the great tension built up on the quick switch.

To ensure that the movements are done safely, it is important to have the necessary eccentric strength to control the weights on the down phase and generate the tension needed to make the quick switch and utilize the stretch reflex. To provide safety, use about 50–75 percent of the usual training weight used for a typical set. The lighter weight allows you to make a quicker switch in directions.

If the weights are extremely heavy, you will have co-contraction of the agonist and antagonist muscles and you will not be able to make a quick switch or quickly accelerate the weights. The key to utilizing the stretch reflex is to generate maximum tension in the eccentric contraction with relative relaxation of the opposing muscles, except as needed to keep the joint stable. If the opposing muscles are strongly contracted, they will not allow you to make a quick switch.

However, the weights should not be too light in order to prevent excessive momentum, which may keep the weights moving beyond the normal range of motion of the joint. When the weight is light and moving fast, it may be difficult for the muscles to stop the movement. Because of this, you can use medicine balls with light weights so they can be released to dissipate the momentum. However, with sufficient weight, the amount of momentum developed will allow the barbell to stop before full extension of the limbs. In most cases, you will have to contract the muscles to ensure reaching the end range of motion.

The stretch reflex can be incorporated in many different exercises, especially those that involve the extensor muscles which usually contain a greater proportion of fast twitch fibers. For example, it can be used in a squat and overhead press (which, in many cases, becomes an overhead jerk or push-press), triceps press, and others.

In the squat, as in the other exercises, different down positions can be used from which to execute the quick switch. For example, stop before reaching the thigh level position and then leap upward. In this case, you may do the squat to approximately a 135-degree knee joint angle and then quickly change directions to return to the standing position. In some cases, you may even leave the ground if there is sufficient power generated. In all cases, however, the descent should be smooth and under control while the return is executed quickly—as though you were shot out of a cannon.

Understand that using the stretch reflex does not mean a bouncing rebound. There is no bouncing as you approach the position for the quick reversal. You merely make a quick change from the down movement to the up movement. You do not give the muscles a chance to lose the tension generated as when you relax or hold the down position even momentarily.

When doing exercises involving the stretch reflex, stop after a complete repetition. Doing this gives you a chance to mentally and physically prepare for the next repetition. Keep in mind that you must think out the movements in advance so that as you execute the exercise, you will be prepared for the quick switch and will be able to execute it in a timely and explosive manner.

Regardless of whether you use the stretch reflex, you should always think in terms of starting an exercise with the

muscles placed on stretch before doing the overcoming work. For example, starting an exercise with the barbell on the chest in the bench press or when using an exercise machine requires considerably more energy and can overtax your joint stability.

Use of the stretch reflex when executing exercises is used to a great extent in the training of athletes. Almost all sports require greater speed and explosive movements as opposed to slow movements, which involve maximum strength or strength endurance. Bodybuilders, powerlifters, and endurance athletes need this type of training for only a portion of the exercises done. For example, do one or two sets using the stretch reflex with ample rest in between the sets. Slower execution sets for strength endurance and muscle mass can then complete the total sets used.

To get the most out of the stretch reflex, the muscles and nervous system should be fresh. Thus, speed and explosive exercises should always be done at the beginning of training after you have undergone a vigorous warm up to prepare the muscles for this work. When fatigue sets in, do not use the stretch reflex. At this time, the eccentric contraction is not as strong as needed, and you may not be able to control the weight either on the down or up phases. The greater the levels of fatigue, the less the muscle resiliency and the more prone you become to injury.

When the stretch reflex is used, it can bring about additional gains in strength and more muscle mass because of the greater development of the fast twitch fibers. However, this is only one technique for training. It is not meant to replace the other types of exercise execution. Keep in mind that variety is most important in developing muscle strength and mass. Incorporating the stretch reflex in some of the exercises is a very effective, if not the most effective, method for maximally developing the size of the fast twitch fibers.

For more information, read *Build a Better Athlete and Explosive Running*.

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