Section 1

Isometric Training
Muscular Contraction
The Resistance Band
The Jumping Process
The Running Process

ISOMETRIC TRAINING

The word ISOMETRIC is defined as follows: óIsoô means equal or the same, and ómetricô means length. Combining these two definitions we get óequal or the same lengthô. Isometrics, as it pertains to muscle training, involves tensing muscles against other muscles or against an immovable object while the length of the muscle remains unchanged. For isometric training to be effective, this muscular tension must be maintained over a certain period of time. Therefore, isometric training is best defined as follows:

The sustained contraction of a muscle over a certain period of time where the length of the muscle remains unchanged.

The following are a few examples of an isometric contraction:

Example 1. Take a 20 pound weight and perform a biceps curl. Hold a position halfway between the repetition for 10 seconds. The length of your biceps muscle doesnõt change during this time. A force is still being applied. See Figure 1-1 below:

Figure 1-1.

Example 2. Push against a steel pole for 10 seconds. The pole doesnõt move and neither does the length of the muscles in your arms pushing against it. A force is still being applied. See Figure 1-2 below:

Figure 1-2.

Isometric training has been around for a long time, and so it is nothing new. Many extraordinary results in muscle strength have been achieved in a very short period of time with this type of training. However, because of the number of new training products and techniques on the market today, its use by athletes is often overlooked.

MUSCULAR CONTRACTION

In order for you to appreciate the value of isometric training, it will be necessary to briefly discuss some basic anatomical principles of muscular contraction. To start with, all skeletal muscles consist of three main fiber types. These fiber types are listed below:

1) Slow twitch fibers - Responsible for the endurance and strength of a muscle.
2) Fast twitch fibers - Responsible for the speed and strength of a muscle.
3) Intermediate twitch fibers - Possess qualities of both slow and fast twitch fibers.

In most muscles, these fibers are intermingled. However, there is usually a predominance of one or the other. For example, in postural muscles of the spine, the slow twitch fibers dominate. This is because slow twitch fibers can undergo extensive repetitive contractions without fatigue. In non-postural limb muscles like the arms and legs, the fast twitch fibers dominate. This allows for powerful forces to be generated over a short period of time.

All of these fiber types are arranged into groups known as *motor units*. A motor unit is defined as one motor neuron and all the muscle fibers it supplies. There are many motor units within the overall muscle. When a muscle begins to contract, an action potential is carried down the motor neuron across the motor endplate to the muscle fibers it supplies. Initially, only some of the motor units become active. As the demand on the muscle increases, more and more motor units are recruited to help support this demand. As the demand on the muscle decreases, the number of motor units also decreases. This is a general description of muscular contraction.

With isometric training, a muscle opposes some form of resistance and is contracted to a certain length and then held for a certain period of time, usually 10 seconds or more. There are no repetitions required here as in weight training.

The biggest advantage to this type of training is twofold. *First,* by forcing your muscles to hold a position for a certain length of time, your body starts to recruit more and more motor units to help maintain this contraction. Motor units that are rarely exercised within a muscle are now brought into use, perhaps for the first time. *Second*, the motor units that are recruited are forced to hold their contraction continuously, time after time, until your muscles achieve a state of maximum intensity safely and effectively. The end result is that the entire muscle matures very quickly.

THE RESISTANCE BAND

One of the most popular forms of exercise training today deals with what is known as resistance training. Essentially most forms of training deal with some type of resistance aid (weights, etc.) but the way the term *resistance training* is used today means to utilize things such as rubber bands or flexible pieces of metal to provide you with a simulated form of weight training. One of the *new* and more *popular* types of resistance training aids is what is known as the resistance band or exercise band. See Figure 1-3 on the next page:

Figure 1-3. The resistance or exercise band.

This is an outstanding product that has a very unique physical property known as a *hyper-elastic potential.* This means that the more you stretch the band the more resistance you will have to apply. The amount of resistance found within an elastic band is therefore a function of its length when stretched. When used properly, the resistance band is the ideal speed training device.

Hereós a very basic idea of how and why it works: Imagine first that you are performing a biceps curl, much like that shown in Figure 1-1 on page 2, except that instead of holding a weight, you are holding one end of a resistance band with the other end either attached to the floor or perhaps secured under your foot. Since we are using an isometric contraction, this position with the elbow flexed at about 90 degrees is held for 10-15 seconds without moving it.

While holding this position, imagine the band is already stretched and exerting a significant amount of force back into your biceps muscle. For some, this may be a 40 lb equivalent force, for others, perhaps more. After a few seconds, your biceps muscle will naturally start to weaken. When this happens, your body will begin to recruit more and more motor units to help keep your arm and elbow in this fixed position.

Eventually, and rather quickly if the resistance is high enough, you get to the point where you can no longer hold the band still and maintain the same amount of force efficiently. The muscle has become over-stimulated This causes your arm to give out or start to shake a little, since the over-stimulated muscle weakens and your coordination dissipates. This is one of the desired states for your muscles to be in to train them for speed and quickness.

These movements in your elbow and arm, however small and in whichever direction, instantaneously alters the amount of force that the resistance bands supply. Unlike weights, which always have the same amount of resistance, the bandós resistance is variable and changes as its length changes. Even small changes in distance, whether greater or less than the starting position, will affect the amount of resistance your muscles exert.

Your muscles constantly perceive these small changes in resistance and alter their typical recruitment pattern of motor units to try and maintain the held position. This new pattern is considerably different than that observed while undergoing a similar exercise with a 40 lb dumbbell, because its resistance is not subject to a change in position.

This is a great benefit to athletes since with each new recruitment pattern of motor units, a muscleǿs weakness and lack of coordination on a much deeper level than normally experienced, is instantly exposed, forcing the over-stimulated muscle fibers to immediately get stronger and with more precision than before. Furthermore, the mass of the muscle typically does not significantly increase with this type of training, which, if it did, could potentially offset these gains.

So, whenever you are able to increase a muscleǿs strength and coordination without adding any additional body weight, your speed, quickness and athletic performance will automatically increase. This again is just one of the reasons how and why this type of training works.

Imagine now applying this strategy in not only conventional ways, as in the biceps example here, but also in ways and positions you may have never thought of before. When you do this to your muscles, you will immediately expose and then eliminate greater weaknesses in them leading to a vastly improved athletic performance.

Therefore, throughout this entire program, we will be *using the resistance band with an isometric training strategy to increase the strength, coordination and contraction rate within specific muscles located in your lower extremities* - all of which play important roles in the jumping process.

THE JUMPING PROCESS

Jumping in sports, especially basketball, can occur off of one foot as in performing a lay-up or break-away slam dunk, or with both feet as in rebounding.

Jumping off of one foot is also common with certain track and field events like the high jump, long jump and triple jump, while jumping off of two feet is common in volleyball where athletes need to jump straight up to block a shot or spike the ball.

The muscles involved in jumping off of one foot when compared to those used in jumping off of both feet are, as one might expect, similar, but there are a few noteworthy differences. Letǿs take a closer look at the muscles involved with each.

Jumping off of one foot. Jumping off of one foot typically requires a bit of running or sprinting first to generate the necessary momentum to carry you higher and/or farther. Since most athletes are familiar with performing the lay-up in basketball, which typically involves some running, letǿs use that as our model in identifying the muscles involved with jumping off of one foot.

As you may already be aware, right hand players jump off the ground off with their left foot when shooting a lay-up with their right hand and left hand players jump off the ground with their right foot when shooting a lay-up with their left hand. Therefore, and more specifically, we will use the right hand player performing a lay-up as our model in identifying the muscles involved with jumping off of one foot.

Right hand basketball players first run a certain distance and then plant their left foot firmly on the ground before jumping and shooting a lay-up. This is the last contact the left foot makes with the ground before jumping. With the left foot firmly planted on the ground, the left knee and left hip are initially slightly bent or flexed prior to the jump. The right thigh and leg initially trail the left leg a this point. See Figure 1-4a. As your momentum carries you forward, the trailing right thigh and leg quickly start to flex forward and upward. The left hip and thigh remain slightly flexed. See Figure 1-4b. As the right thigh passes in front of the left thigh, it continues on its path upward to create more momentum. The right arm is flexed upward toward the basket. This occurs at the same time the left hip is extending, the left knee is extending and the left ankle is plantar-flexing. See Figure 1-4c.

Figure 1-4a. Left foot planted on the ground. Left knee and hip are slightly flexed.

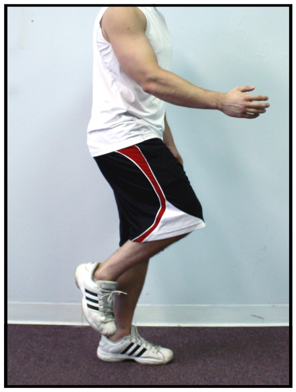

Figure 1-4b. Right thigh is starting to flex forward to create momentum.

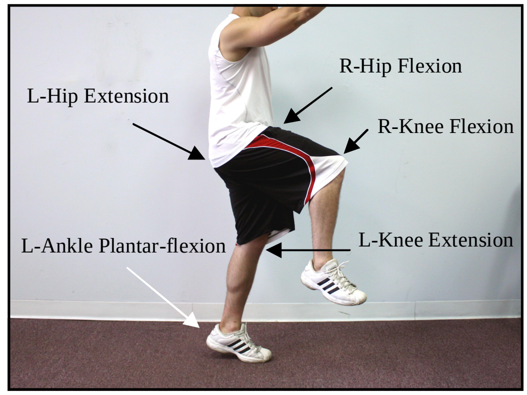

Figure 1-4c. Right thigh is flexed upward. Left knee and hip are extended and left ankle is plantar-flexed.

Summary: The muscles involved in jumping off of one (left) foot in our example above are: right hip flexors, right knee flexors, left hip extensors, left knee extensors, and left ankle plantar-flexors. See Section 4 for a picture of these muscle groups.

Jumping off of both feet. Jumping off of both feet uses similar muscles, bilaterally, except the hip flexors do not help with your upward momentum and the knee flexors may only recoil the knees slightly *after* you have left the ground. The jumping position starts out with both knees and both hips flexed. See Figure 1-5a. As the motion starts, both knees and both hips begin to extend. The arms and forearms also begin to flex. See Figure 1-5b. As the motion continues, both knees and both hips are fully extended and both ankles are plantar-flexed. The arms and forearms continue to flex upward to help create momentum. See Figure 1-5c.

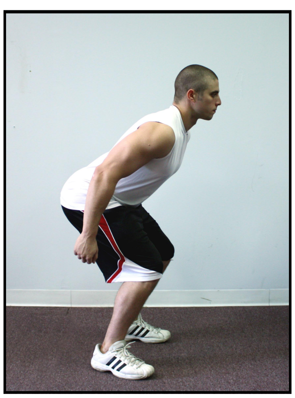

Figure 1-5a. Left & right knees and hips flexed. Left & right ankles in neutral position.

Figure 1-5b. Left & right knees and hips start to extend. Arms & forearms start to flex.

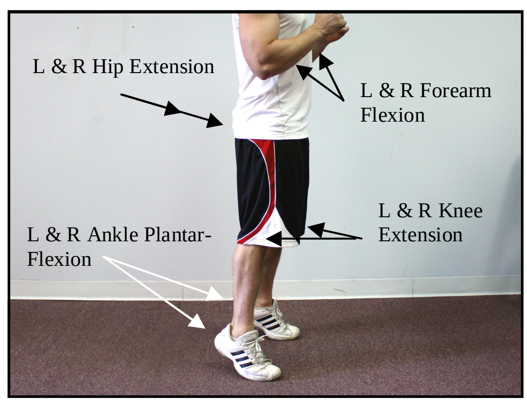

Figure 1-5c. Left & right knees and hips extended. Left & right ankles plantar-flexed. Left & right arms and forearms flexed.

Summary: the muscles involved in jumping off of both feet are: left & right hip extensors, left & right knee extensors, and the left & right ankle plantar-flexors, See Section 4 for a picture of these muscle groups. The left and right arm and forearm flexors are also involved but not illustrated.

THE RUNNING PROCESS

The *Running Process* consists of three main phases: 1) the push phase, 2) the swing phase and 3) the return phase. These three phases constitute a complete leg sequence for each leg during the entire time one is running. For example, the right leg will sequence as follows:

Push phase > Swing phase > Return phase > Push phase > Swing Phase > Return Phase etc.

The left leg follows a similar pattern however, the phases of running for the left leg are not in synch with the phases of running for the right leg.

The Push Phase. The push phase is perhaps the most popular of the three phases since it is typically associated with the start of a race however, like the other two phases, it is involved throughout the entire time one is running. It begins when the thigh of the foot touching the ground is perpendicular to the ground, and ends when the toes of this same foot are barely touching the ground behind you. Figures 1-6a, 1-6b, 1-6c and 1-6d show the stages of the push phase shortly after the start of a race for the *right* leg. See below:

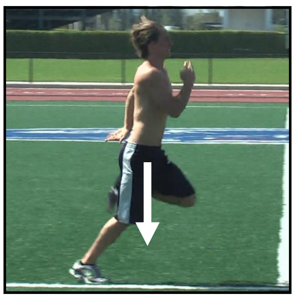

Figure 1-6a. Start of the push phase. Right thigh is perpendicular to the ground.

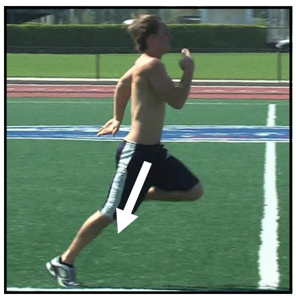

Figure 1-6b. Middle of the push phase. Right thigh and leg are extending.

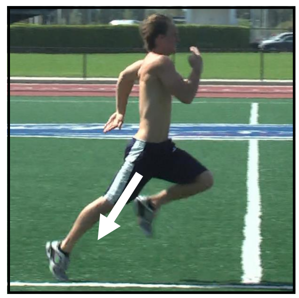

Figure 1-6c. Continuation of push phase. Right thigh and leg near complete extension.

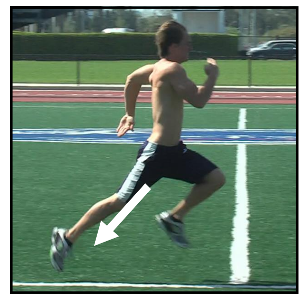

Figure 1-6d. End of push phase. Right thigh and leg fully extended. Right foot makes last contact with ground.

The muscles involved in the push phase are the knee extensors, hip extensors and the ankle plantar-flexors. See Section 4 for a picture of these muscle groups.

The Swing Phase. The swing phase begins when the toes of the foot that finished the push phase have just left the ground behind you and ends when this same foot strikes the ground in front of you. The distance covered by the swing phase is called your *stride*. Improving your stride is not very difficult however, it is perhaps one of the greatest oversights athletes make. Improving this phase of running can make a big difference in your running speed. Figures 1-7a, 1-7b, 1-7c and 1-7d below show the basic stages of the swing phase for the *right* leg:

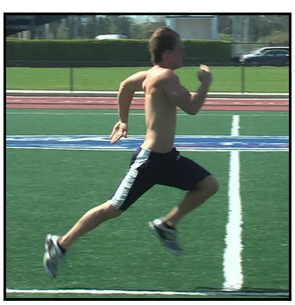

Figure 1-7a. Start of the swing phase. Right foot has just left the ground.

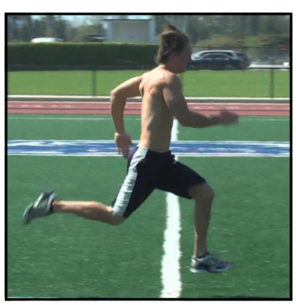

Figure 1-7b. Middle of swing phase. Right thigh is being pulled forward.

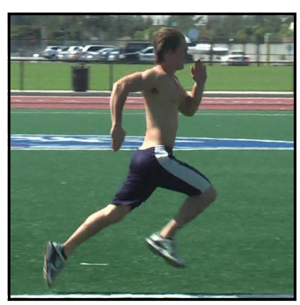

Figure 1-7c. Continuation of swing phase. Right thigh is now flexed in front of runner.

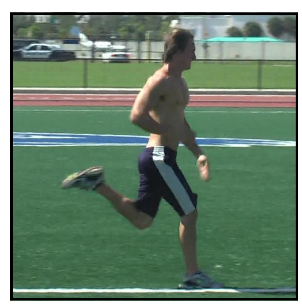

Figure 1-7d. End of swing phase. Right foot strikes the ground in front of runner.

The muscles involved in the swing phase are the hip flexors, knee flexors and knee extensors. See Section 4 for a picture of these muscle groups.

The Return Phase. The return phase begins once the foot strikes the ground in front of you and your thigh is still flexed, and ends when the knee and thigh of the same foot are perpendicular to the ground directly beneath you. This is the shortest of all the phases and it too is often overlooked by a lot of athletes. Improving this phase of running can also make a big difference in your running speed. Figures 1-8a, 1-8b, 1-8c and 1-8d below show the basic stages of the return phase for the *right* leg:

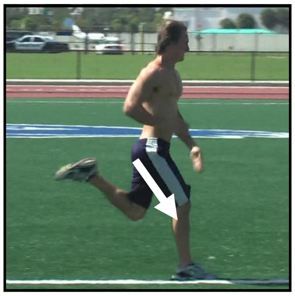

Figure 1-8a. Start of return phase. Right foot on the ground; right thigh (arrow) is flexed on the hip.

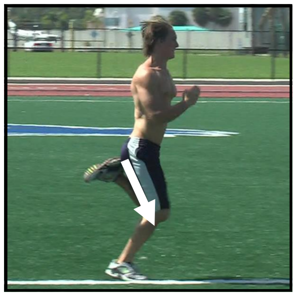

Figure 1-8b. Middle of return phase. Right thigh (arrow) flexed but being pulled underneath runner.

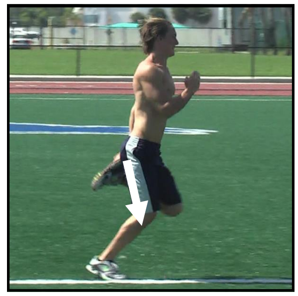

Figure 1-8c. Continuation of return phase. Right thigh (arrow) almost perpendicular to ground beneath runner.

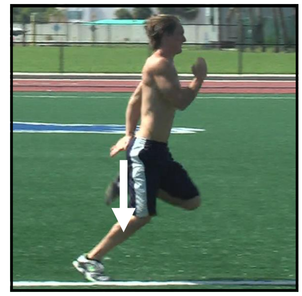

Figure 1-8d. End of return phase. Right thigh (arrow) perpendicular to ground; push phase set to repeat.

The primary muscle groups involved in the return phase are the hip extensors and to a lesser extent, the knee flexors. Note: the hamstring muscles have two functions: 1) hip extension and 2) knee flexion. See Section 4 for a picture of these muscle groups.

This completes the basic motions of the three phases of running. Many athletes have different styles of running that best suits their needs however, the muscles involved all remain the same.