Leg Strength for Sport Performance  
by Vern Gambetta

The legs are the primary source of power in many sports. In the great majority of situations they function as part of a closed kinetic chain which means that one leg is always in contact with the ground. Without functional leg strength the athlete can not have speed, strength, power, or suppleness to perform. We must think of the legs as a functional unit of the whole kinetic chain. "Function is a miraculous and complex combination of systems that are linked and react with each other. In order to understand function as a whole, the parts and components of function must be appreciated." (Gary Gray) The leg muscles work together to reduce and produce force in the most effective manner for the required activity.

In order to functionally strengthen the muscles of the legs for sport performance we must select exercises that meet the following functional criteria:

- The exercise should be multi-joint. If the muscle group crosses the knee and the hip then the exercise should work the muscles at both the knee and the hip. If the muscle group crosses the knee and ankle then the exercise intended to work that muscle should work at the knee and ankle. It is preferable to select exercises that work the ankle, knee and the hip together as a functional unit.
- The exercises should be closed kinetic chain which means that the foot should be in contact with the ground supporting the body weight. This utilizes gravity and ground reaction forces. It allows for the legs to move forward & back, right & left as well as rotate.
- It should incorporate all three planes of motion. Movement occurs in the sagittal, frontal and transverse planes therefore it is important to train the muscles to work effectively in all three planes. This means involving movements that incorporate rotational, forward/back as well as side to side movement.
- The exercise should be over the greatest range of motion possible. Limiting the range of motion only serves to narrow the players performance spectrum. The athlete should perform the exercise to the greatest range that can be controlled.
- It should incorporate speed of movement. The speed of movement is relative to the exercise and the stage of training or rehab. The goal is to use a rate of speed that is safe, that the athlete is able to control. Rather than limiting speed, find a rate of speed that can be controlled.
- The exercise should be of high proprioceptive demand. It should challenge the joint and muscle receptors to provide feedback regarding joint and limb position and reposition them accordingly. The proprioceptors assist the system to generate movement in a form that it is appropriate to the demands placed upon the system. If exercises are of low proprioceptive demand then the body will quickly adapt and will not be prepared for greater demands called for in the game. For example if you do all your work at half speed then try to go full speed for the game it will not work.

Traditional training programs that utilize exercises like the leg extension and leg curl fail to take into account these functional criteria. These exercises may actually contribute to the problems they are designed to solve. The knee extension is commonly used to strengthen the
quads to help with patellar femoral problems when in actuality it increases shear force at the knee which causes more problems. The hamstring curl is used to help prevent hamstring pulls. In fact it may predispose the athlete to pulled hamstrings because of the imbalanced muscle development that results from doing the exercise. Programs that use these exercises are training muscles not movements. To be functional you must train movements not muscles. The functional goal is to prepare the legs to use ground reaction forces in an effective manner.

The choice is between joint isolation exercises and kinetic chain exercises. Joint isolation exercises create an incorrect motor program which causes confusion to the muscles. Using joint isolation exercises the muscles are asked to do one thing in training when they function the exact opposite in performance. Kinetic chain exercises on the other hand works the muscles in integrated movements as part of the whole kinetic chain. In addition the exercises must prevent injury as well as enhance performance. These isolated single joint leg exercises do neither, in fact they do little to improve performance and may predispose the athlete to injury by creating incorrect motor programs and imbalanced muscular development.

What are the alternatives? All the multi-joint movements of the legs can be trained with a few very simple exercises. These exercises have many variations that allow the exercises to be more movement or sport specific. Movement seldom occurs with both legs applying force together at the same time. Forces as high as three to five times body weight on one leg are not uncommon. Therefore it is important to train the legs one at a time where possible. Single leg movements, movements which alternate the use of the legs or movement that is off of one leg onto the other leg offer a myriad of possibilities for exercise selection for both rehab and conditioning.

The traditional approach to developing leg strength has been to overload the legs with heavy back squats. This approach has it's advantages and disadvantages. Although the squat is the cornerstone in any functional leg strength program, it must be put into focus so that it is accomplishing the desired goal. The heavy back squat is only one method of squatting. There are several factors that must be considered when using the heavy back squat:

1. It is not as functional for sports that involve running, jumping or throwing because performance occurs off one leg. The squat distributes the load to both legs. However it is a good exercise to develop basic leg strength and muscular size as preparation for more specific functional work to follow.
2. The squat excessively loads the spine. The amount of weight necessary to overload the legs enough to elicit a training effect is often more weight than the spine can safely tolerate. This presents problems for the developmental (younger) athlete and the older athlete.

It is important to understand that there are many variations of the squat that will make it more functional and address the previous considerations.

Performance of exercise on one leg allows a greater training effect without adding external resistance. For example a 70 kg athlete performing an exercise on one leg will have a
resistance of 70 kg on that one leg. It allows greater speed because there is little or no external load to slow the movement. There is better control of the rhythm of exercise. It affords little stress on the spine. Single leg work also allows for better intra- workout recovery, this also makes better use of your training time. In other words while one leg is working the other leg is resting. Single leg work allows each leg to perform the same volume of work with the same intensity. In bilateral work it is common to see the athlete subtly shift the load to one side or the other. This is especially true if there is any abnormal curvature of the spine, a significant leg length difference or an abnormal foot type. Most importantly it allows extra work to be done on the weak leg to achieve balanced development. Balance and proprioception are optimally challenged.

How often can you work the legs? Because the legs are weight bearing muscles it is not advisable to work the legs with the same frequency as the trunk and the upper extremities. It also depends on how much other activity that you are doing besides leg strength work. Weight lifters, who do not do any additional movements besides weight training movements to tax their legs, do some leg work virtually every day. On the other hand the athlete who uses the legs extensively should probably train the legs two to three sessions in a seven day cycle. If you do choose to work the legs more often, for whatever the reason, it would be advisable to only use two to three exercises in a session and emphasize a particular movement. For example one day emphasize squatting movements, the next day emphasizing lung or step-up movements. This must be carefully correlated with the other training activities so as not put additional stress on the legs because, as I mentioned previously, the legs will not recover as quickly due to their weight bearing function in daily activity.

How about overload? How much weight should I use? Try body weight and the force of gravity first. Yes that is right your own body weight before you add additional external loading in the form of weight. The principle is body weight before external resistance. A corollary before using external resistance use variations that raise the proprioceptive demand. Adding mass and overcoming external resistance necessary for football or a thrower in track is not necessary in many other sports - therefore bodyweight exercises can go a long way toward developing the leg strength necessary to prepare. It offers the additional advantage of being able to be done anywhere. It has been my experience that when using bodyweight for resistance the optimum repetition range is 20 to 30 reps which must be done at a rate of one rep per second for squatting movements and as close to that rate as possible for the other movements. This adds a high speed eccentric component which causes residual soreness, but provides a very positive training effect.