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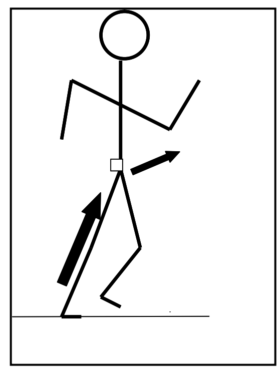
Creating Efficient Horizontal Propulsion

Despite what most runners and their coaches believe, technique plays an enormous role is sustained fast running. Most runners' subscribe to one of two basic paradigms of propulsion. Unfortunately, both are flawed. One creates more upward propulsion than forward and the other isolates a relatively small, weak muscle group instead of harnessing a number of muscles to work together to produce propulsion.

Upward Thrust Method

One challenge for runners is creating propulsion as close to purely horizontal as possible. Excessive vertical displacement increases the energy cost of running dramatically. The most common method runners use to develop propulsion is the upward thrust. At toe off, the knee is straightened forcefully, thrusting the body up and forward. This technique wastes a tremendous amount of energy, leads to local muscular fatigue in the quadriceps, and slows turnover.

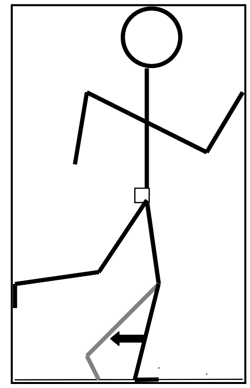


As indicated by the large black arrow in the illustration, the direction of the force created by extending the knee is slightly forward, but mostly upward. The slight increase in stride length is more than made up for by decreases in turnover rate caused by the extended flight time during each stride, resulting in slower running speed and increased energy cost. This up and down method of running, employed to some degree by most runners, is extremely inefficient. If an athlete's quadriceps fatigue during long runs even at easy pace, he probably subscribes to the upward thrust paradigm.

The quadriceps muscles work in the vertical plane. On flat ground, the quadriceps should only contract at the moment foot-strike to hold the body up. The quadriceps should minimize knee bend at foot-strike, but should not create propulsion. The quadriceps should only be propulsive in uphill running.

Pull Through Method

A somewhat less common error of propulsion is the pull through. This runner avoids the upward thrust push-off, instead creating propulsion by bending the knee and pulling his body forward with the hamstring muscles. This running style is reasonably energy



efficient: it does minimize vertical displacement and landing impact. The problem with this running style is the demand that it places on the hamstring muscles.

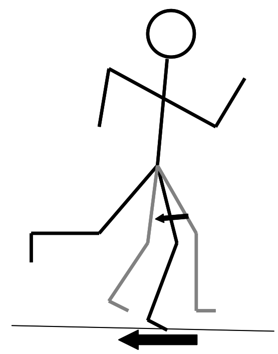
The hamstring muscles are relatively small and weak. When they are almost exclusively responsible for propulsion, they fatigue easily. Using larger muscles, with the hamstrings, enables a runner to take advantage of the benefits of the energy-efficient (horizontal) style, but prevents local muscular fatigue in the hamstrings by spreading the workload over greater muscle mass.

If an athlete suffers from hamstring fatigue or cramping during long or hard runs, while the rest of the body feels fairly comfortable, he probably uses pull-through propulsion. Learning to engage more muscle for propulsion while maintaining the horizontal movement will increase speed and endurance.

<u>Foot Drag</u>

The two common errors of creating propulsion for running involve movement at the knee. Optimal technique for creating propulsion when running on flat ground requires a constant knee angle through the propulsive phases of the stride cycle.

I (Ken) call the recommended technique the foot-drag movement. It involves pivoting the leg backward from the hip with the entire leg as a fixed unit.



The knee should be slightly bent, but the knee angle should not change from just before foot-strike, through the period of contact with the ground, to the follow-through. ***Through the entire propulsion phase, the knee angle should be slightly bent and constant***. This technique accomplishes a number of goals of efficient, fast, sustained running.

First, the foot-drag movement creates almost perfectly horizontal propulsion. Vertical displacement, and all the problems associated with it, can be minimized. Newton's Law states that "every action has an equal and opposite reaction". It follows that, in order to create horizontal propulsion, we must pull straight back against the ground instead of pushing down into the ground. The foot-drag movement accomplishes this goal.

The foot-drag movement also takes advantage of the attachment points of the muscles on the back of the hips and thighs and spreads the work of propulsion among a much larger muscle mass than other methods of propulsion. Using greater muscle mass to accomplish a certain amount of work decreases the relative intensity of the work for each muscle. If more muscles are doing the same amount of work, each muscle is working more easily.

The hamstring muscles are unusual in that they cross two major joints. The hamstrings attach above the hip, cross both the hip and the knee joints, and attach below the knee. Due to this unique attachment, they serve two major functions: extending the hip joint and flexing the knee joint. The gluteus maximus muscles, on the other hand, cross only one major joint, the hip. The glute muscles only major action is hip extension.

The pull-through method of propulsion creates nearly horizontal propulsion, but it fails to engage the largest and strongest muscle in the body, the glutes. Which do you think would be stronger, your hamstring muscles, or your hamstring muscles plus your glutes? That answer is obvious. If knee flexion is the primary producer of propulsion, the hamstrings have to create the force by themselves. By using hip extension instead of knee flexion to create propulsion, the hamstrings work in conjunction with the glutes, therefore each muscle is required to produce less force. Obviously, this minimizes fatigue.

Pull-through runners frequently have extremely tight hip-flexors, preventing correct hip extension. Stretching these muscles will enable you to incorporate better technique for developing propulsion, allowing you to create high levels of horizontal propulsion without local muscular fatigue.

Developing a stride which uses hip extension as the primary method of propulsion will enable runners to move more horizontally and to use large muscle groups to do the work. This will allow you to run farther and faster that ever before.

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