Warming Up Cooling Down and Stretching

Preparing for a workout and recovering afterward deserve a lot more attention than many believe.

By Mort Malkin, M.D.

Warm-ups in fitness and sports are performed in accordance with each person's own idea of the purpose of warming up. Cooling down is generally given little attention. Stretching varies widely from person to person, each going through a "routine."

Yet, there are fundamental principles based on human anatomy and physiology to use for guidance in warming up, cooling down and stretching. The purposes of these three workout supplements are different, and should be examined one by one.

Warming up

Warming up should prepare the muscles that will be used in the workout. These muscles must be physically warm for good reason. When a muscle contracts, not all the individual fibers contract at once; some are kept in reserve. So, there is tension created among the contracting fibers and non-contracting fibers, and in the connective tissues between fibers. Warm tissues are more supple and less likely to suffer mini (or even maxi) tears.

Warming up muscle tissues and the associated connective tissues can be accomplished by internal or external means. Exercisers can raise total body temperature with a hot tub. They can use physical therapy interventions such as diathermy, ultra-sound or a whirlpool. They can have a massage therapist use rhythmic pressures to reach targeted muscle groups. Warming up must be performed close to workout time, and the apparatus and personnel should be onsite for theses external warm-up modes. (Many people have the misperception that the best way to increase blood flow to an area is by using hot packs. Actually, the application of external heat increases the blood flow to the skin, not deeper structures such as muscles and organs.)

Internal means of warming the muscles are far more convenient and, arguably, more effective. Internal warming is achieved by bringing warm blood to the muscles. The control of blood perfusion to muscles responds best to muscle contraction, and to the build up of metabolites from the biochemical energy cycles. The simplest way to warm up specific muscles is to make those muscles work at a light to moderate intensity for a few minutes.

Warm-up exercises are muscle-group-specific. It would be of little or no benefit to a runner to perform a series of hand and wrist exercises before a race. That may be an extreme example, but the principle holds true: Warm up with the same exercise that will be used in the workout, but at a slower pace. Three or four minutes should suffice.

How about stretching as a warm-up? Stretching has a purpose - after the workout and after the cool-down. Studies have shown that stretching before exercise does not prevent either soreness or injury. Indeed, stretching cold muscles can cause muscle fiber tears. There is no objection to first warming up, and then performing specific stretches for those muscles that will be employed in the workout.

Better yet, exercisers can perform a range-of-motion routine for the limbs and torso. Be careful they don't force the range to the point of pain or significant discomfort.

Preventing injury is largely a matter of proper biomechanics, effective training for the workout and not pushing past training thresholds

Cooling down

Cooling down (or warming down) is important after a workout. There are two reasons for a warm down. The first is more important, and concerns systemic circulation. When an exerciser has been moving at a strong pace for a time, heart rate and blood volume are elevated. Cardiac output during exercise is driven by 1) a high volume of blood return; 2) greater dilation of the chambers of the heart; and 3) stronger contraction of the myocardial muscle particularly of tale left ventricle.

The pulsation of the arteries completes the systolic blood pressure phase of the cardiac cycle throughout the arterial side of the circulatory system. The return of blood to the heart through the venous side of the system has no such primary pump. Return blood flow depends on venous pressure at 10 to 15 mmHg, a minimal force compared to arterial pressure of 8 to 120 mmHg.

During exercise, particularly lower-body exercise, the rhythmically contracting muscles act as pumps to speed up the venous blood flow hack to the heart. In weight-bearing exercises such as running, exercise walking and cross country skiing, gravity is a significant force that must be overcome so that the heart receives enough blood to send to the lungs for re-oxygenation and on to all the vital organs and other tissues. If a runner stops moving after a race, the heart would continue beating rapidly for at least another minute or two. Blood in the lower body, however, would not have any help from the exercising muscles in its

return to the heart. Only the normal venous pressure, a minimal force, would be available to combat the force of gravity. There would be less blood for the heart to pump to the brain, kidneys, lungs and on to the coronary arteries that supply the heart muscle itself. Warming down by continuing the exercise of the workout at a slower pace will continue to move venous blood upward from the lower body until the heart slows and a rest state is stabilized.

The second reason for the warm-down is to help remove the metabolites - lactic acid and other organic acids - that can build up. If the workout was a competition, race pace will build up a higher level of metabolites than a training workout. Most competitors, whatever the sport, perform at a slightly higher intensity and release more adrenaline. Both factors cause more oxygen use, a greater exhaustion of muscle glycogen and some usage of straight chain amino acids as an energy substrate. During competition, the athlete dips into anaerobic reserve a little, especially at the end of the competition. A continued, easy rhythmic contraction of the muscles after the workout will maintain circulation to "wash out" the metabolites.

Stretching

After a workout, muscles are tired and, even with a warm-down, will have an elevated level of metabolites. In this condition, muscles can easily go into spasm. It commonly happens in running, race walking and even fast exercise walking.

Stretching should occur after the warm-down and again later in the day to jog the memory of the muscles. How to stretch is more complex. There are many muscles in the body, and several in each of the muscle groups are the weight-bearing, power-producing muscles used in each particular sport or exercise. There is, however, a general principle to follow: Whatever motion of limb or torso results from the contraction of a particular muscle or muscle group, the opposite motion will lengthen that muscle.

An example relevant to running is the quadriceps group of muscles When the quads contract, they normally straighten the leg. In running, the knees are slightly bent. Thus, the quads must support the weight of the body. To understand the biomechanics of running in terms of quadricep power, have clients visualize the changing degree of the bend, from the beginning of the stride to the end. At the "support phase" of the stride, the knee starts at a sight bend. As that foot moves back under the body's center of gravity, the leg must bear increasing weight and so the knee bends more. At that point, the quads are trying to contract to support the body's full weight, but at the same time they are being, lengthened by the increased leg bend. This type of muscle contraction is called "eccentric." Many

successive, strong eccentric contractions, as in downhill running cover a distance of one mile or more, may result in Focal muscle cell damage and extreme soreness. From the middle of the support phase until the end of the stride at toe-off, the knee straightens under normal concentric contraction of the quads.

To stretch the quads, the muscle group must be held in a lengthened position for about 30 seconds. To lengthen the in muscle group, runners should place their limbs or torsos in a position opposite to that of muscle contraction. As contraction of the quads normally straightens the leg bending the leg will lengthen the muscle group. To accomplish this, exercisers can stand on one leg and bend the other one by lifting the foot up behind them and holding it in place by grasping the foot or ankle (Figure 1). Runners are often seen performing this quad stretch. The stretch can also be performed by lying face dawn on the ground, bending one leg back and holding it in the bent position, again by grasping the ankle or foot.

Figure 1.
Stretching the Quadriceps

Hamstring; stretches need a limb position opposite to the quad stretch. Hamstring contraction during exercise normally would bend the leg back and up during exercise. But if the exercise or sport is weight-bearing, the hams will exert a backward force on the entire leg. In this, they act in concert with the gluteal extensors. The effect is to move the whole body forward. Stretching (lengthening) the hams require bending the body at the waist with a fairly straight leg. A sitting or standing position can be used.

The calf muscles (gastrocnemius and soleus) also need stretching. When the calf muscles contract, they move the forefoot (toes and metatarsals) down. So, stretching the calves requires moving the forefoot up, or toward the knee. Clients call sit on the ground with their hands pulling the forefoot hack toward the knee but it is probably easier to do a "wall stretch" (Figure 2). Facing the wall, have clients

place one foot near the wall and extend the other two-and-a-half to three lengths back. Keeping the back heel on the ground, have them bend their front knee and move their hips forward. In effect, the toes of the front foot will be moved in the direction of tile knee, and the angulation oft he foot to lower leg will form less than a right angle.

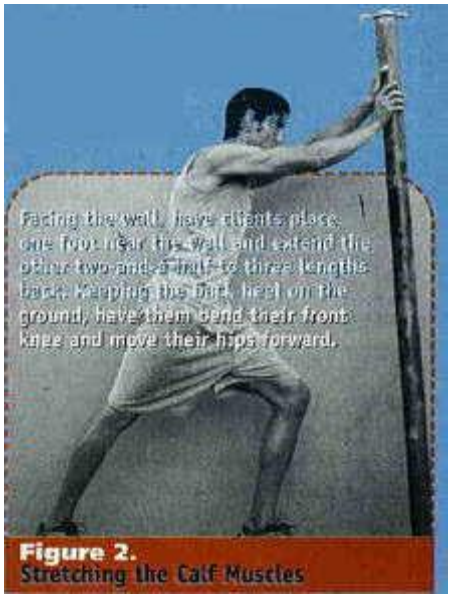

Figure 2.
Stretching the Calf Muscles

Running requires at least quad and calf stretches. Race walking and aerobic exercise walking require hamstring and calf stretches. Cross country skiing requires all three stretches.

The principles for all post-exercise stretches hold true regardless of the exercise. First, muscles normally shorten when they contract, and to stretch a muscle it must he lengthened. Second, whatever direction the body moves when the muscle contracts, exercisers must move the body in the opposite direction to stretch it.

These principles can be applied to any exercise and any muscle groups. Figure out which muscles are contracting when clients run, jump, turn or move different parts of the body repetitively in a workout. Then have them move to the opposite position for the muscle groups that they wish to stretch.

Be kind to muscles

Aerobic exercise requires sustained, rhythmic contractions of large muscle groups, preferably in a weight-bearing manner. The factor of distance (or time) is generally about 40 to 50 minutes. That requires perhaps 3,000 strong contractions - a significant amount of work. These muscle groups deserve a modicum of kindness. Proper warm-tip, warm-down and stretching are the least exercisers can do for

their muscles; if exercisers are kind to their muscles, their muscles will be kind to them.

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