

HOW MUSCLES MOVE—CONTRACTION AND RELAXATION

To understand this concept, you have to really understand the meaning of relaxation. If you think of it as a lethargic, sleepy state such as lying in a sauna or on a sunny beach, you're missing the point. Relaxation is a lack of restrictive tension that allows unimpaired movement in any direction. In the specific case of massage, it is a release of tension.

Muscles generate motion. They also restrict motion. Muscles are arranged in pairs of opposites, and a muscle does two things. First it contracts, and second, between contractions it relaxes so that it may be stretched to its full length. With each contraction, the several hundred or several thousand myofibrils making up the muscle fold over on themselves, shortening and thickening the total mass of the muscle.

As a muscle contracts, it pulls the bone of its attachment in the direction of the contraction. As it relaxes, its opposite muscle is allowed to pull the bone the other way. All skeletal motion is a repetition of this basic process.

There is no such thing as a muscle that pushes. All muscles pull. The pulling of certain muscle groups may produce a pushing action by the body against an outside object. But the muscles in themselves give motion through the shortening action.

In this alternate contraction and relaxation process, you find the fundamental difference between strength and power. Strength comes from the size of a muscle plus its ability to contract. Power is the degree of movement that this contraction achieves. If the relaxing muscle does not stretch to its fullest extent, or is slow to stretch, you have increased resistance, reduced power, and therefore reduced performance levels.

Everyone is familiar with the case of the "muscle-bound" person who possesses fantastic strength but can be outdone by someone with less strength but greater power. The same principle applies, in a much lesser degree, to a muscle that must undergo the rigors and repeated microtrauma of training and competition.

Any muscle that is consistently worked within the same range of motion will shorten as it gains strength. To protect ourselves against this shortening, we employ a daily routine of stretching exercises designed to extend muscles to their fullest. If we don't do this, our performance levels drop along with our mobility and resistance and we become prone to serious muscle injuries.

THE FRAGILITY OF OVERTIGHT MUSCLES

Muscle tightening can cause weakening and danger. During any sustained activity the intake of oxygen and the concurrent removal of waste products become insufficient for the needs of the muscle. Because the contraction process is a generated action and the relaxation process is not, it is the latter process that is the first to deteriorate.

When this happens, muscles do not stretch as completely or as quickly, and the contractors are forced to work harder to overcome the increased resistance. Result: both a loss of power and an increase in energy output necessary to maintain the same pace.

This you see as "the fade." Labored motion, dull reflexes, shortened range of movement. The lead into this has begun, of course, long before "the fade." It began with the very first step. The final stage of muscle tightening is muscle fatigue—the complete loss of power.

Muscle tightening and muscle fatigue are the natural results of maximum effort. They are inevitable but not unalterable. With massage you will start loose and stay loose, you will have fewer problems along the way to a full and maximum performance.

THE “ALL-OR-NONE RESPONSE”

The “All-or-none Response” is a major factor in muscle problems. What it basically amounts to is the straightforward fact that you cannot use an entire muscle “a little bit.” Muscles are arranged in bundles of fibers, each acting independently of its neighbors, and only the number of fibers required to perform an action are brought into play.

Fibers either contract to their fullest or do not contract at all. Maximum effort brings fibers into play that ordinarily do not get used. Fibers situated at the ends of the muscle have less elasticity making them more susceptible to each successive strain and overexertion. It also allows these spasms to go unnoticed until they reach the critical stage of causing discomfort, pain, or disablement. Once that has occurred, it is much more difficult to treat by massage.

This explains why, no matter how well conditioned we are, we develop problems following a particular grueling session of sports activity. A proper warm-up is essential, but it is not enough to reach all of the muscular structure used during such an activity. A warm-up is not a loosening or a stretching process. A warm-up is raising the temperature of muscles to their proper operating levels. Existing spasms are not eliminated but they are overcome.

Massage before an activity assures that the fibers of least use in every muscle to be used can receive proper attention and protection. Without it, we risk postplay charley horses and, muscle fatigue.

MUSCLE FATIGUE—THE END OF THE LINE

Prolonged and sharp contraction of a muscle leads to the well-known state of muscle fatigue associated with a loss of power. It results simply from the inability of the contractile and metabolic processes of the muscle fibers to continue supplying the level of work output. The nerve continues to work normally. The impulses pass normally through the neuromuscular junction into the muscle fiber. Normal action potential spreads over the fiber but the contraction becomes weaker as the nutrient source is downcut.

Interruption of blood supply to a fiber causes complete loss of power in one minute's time because the oxidation of glucose, the body's main energy supply, cannot take place. The same situation occurs when in tense effort of prolonged exertion has used fuel and oxygen faster than it could be supplied to the muscle tissue. At this point, the body shifts gears into a process called glycolysis, a type of alternate energy system that is better than nothing but nowhere near as effective as oxidation.

The scientific Law of Mass Action states that as the end products of a chemical reaction build up in the reacting medium, the rate of the reaction approaches zero. In plain words, you have to get rid of the ashes to make room for the coal or the fire goes out.

In the case of glycolysis, the ashes or end products convert to lactic acid, which in turn is absorbed by other cells of less active use. This spreads the fatigue over a wider area in an effort to prevent the total breakdown of the individually overworked portion of the body.

Once the contest is over, you repay the oxygen debt to the overexerted parts of the body by the heavy breathing that continues on after the exertion itself is ended. The chemical process, enriched once more by the presence of sufficient oxygen, reverses itself. Lactic acid breaks down into the component parts that convert themselves back into glucose, and the condition stabilizes. The body is like a self-rechargeable battery. Pushing yourself to this degree is a necessary part of muscle development and athletic ability. We push for our maximum and the longer we can go before reaching it, the more we can do, and the better we get.

THE FACTS OF FAT

Muscles are of necessity a vascular tissue. Fat is a nonvascular tissue, having no network of blood vessels of its own. Its presence in, between, and around muscle fibers increases resistance to motion, the blood and oxygen supply, and reduces the ability of muscles to perform their functions. Fat is a non-contractile tissue. Even a hundred pounds of fat cannot lift one ounce of weight one inch!

OXYGEN—THE INDISPENSABLE FACTOR

Oxygen is the fuel of combustion in muscular activity. Adequate oxygen delivery depends on many factors: inspired oxygen concentration, the pulmonary system (heart, lungs, blood vessels), and the micro-circulation with which massage is most concerned. It is at this point that the oxygen-carrying portion of the blood must leave the vessels, filter through the tissues to deposit nutrient, pick up by-products of combustion, and be reabsorbed into the venous system. This is the weak link in the circulatory chain. It is the “combat zone” where everything happens- or doesn’t happen. It is not superficial. It is the necessary link in the deepest part of our muscular structure. It is the point where massage gives that extra boost.

Insufficient oxygen and the accumulation of lactic acid, a by-product of combustion, cause muscles to weaken. Lactic acid is produced by metabolism when an insufficient amount of oxygen is present-anoxia. Lactic acid levels rise in direct proportion to the lack of oxygen, causing the muscle to lose its ability for complete performance.

From the time it leaves the heart, blood is forced through ever-narrowing channels- arteries, arterioles, and finally into a vast network of minute blood vessels called capillaries. The walls of the capillaries are dotted with permeable areas called stomata through which the oxygen-charged portion of the blood is discharged into the tissues.

The shape of the capillary network is elongated to run parallel to the long axis of the muscle fibers. The number and size of the capillaries and the interspace between them are determining factors as to how much oxygenated blood can be delivered to and how much metabolic waste can be discharged from any given area. This is the vital feeding and cleansing process for which our entire circulatory system is structured.

The meshes and interspaces are much wider apart in ligamentous tissue, fascia, and fibers of lesser use than in the belly of the muscle. So the junction where the muscle turns into tendon has a five or six to one ration for primary breakdown, as well as for the development of a spasm due to anoxia and lactic acid formation during strenuous activity. Richness is where muscle action is. Richness is not where the stress overload takes place. It is the combination of these two factors that is manifested as stress points in the body. Any pre-existing degree of tightening or spasm that causes fibers to lie more

closely or rigidly together further hinders the free flow of oxygen into and the removal of toxins from the muscle.

Training and conditioning increase the ability of the heart and lungs to oxygenate and pump blood and of the muscles to produce work. The fiber-spreading technique of massage- by creating a durable hyperemia that enlarges the capillaries and increases the interspace and by rendering tissue fibers more pliable-increases even more the ability of the muscle to receive and utilize fuel and efficiently cast off toxins.

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