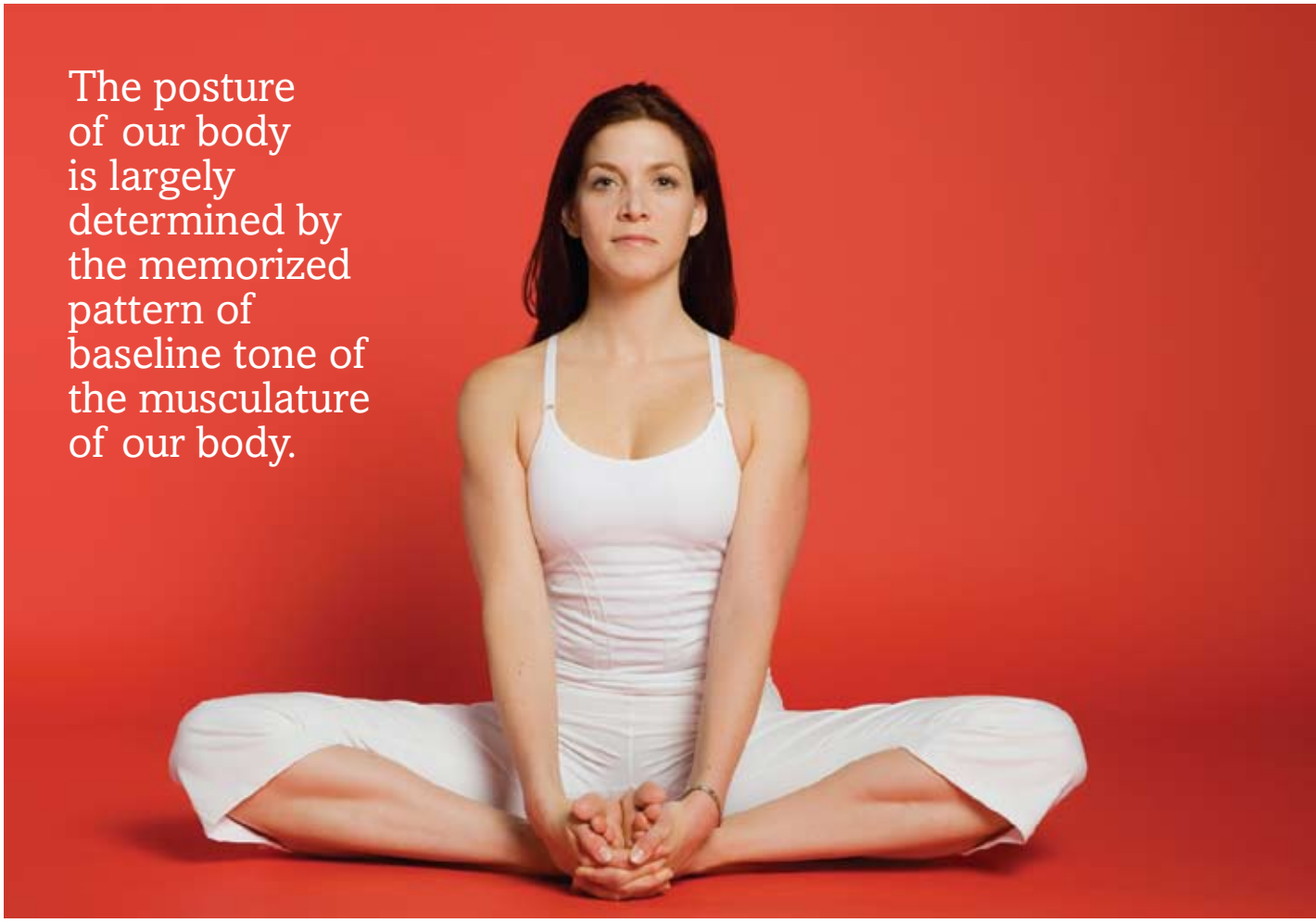

what is muscle memory?

The concept of muscle memory is vitally important in the world of massage and bodywork. Yet, there seems to be some controversy about what it is and how it works. To better understand this idea and its application to clinical work, let's explore the concept of muscle memory.

Practiced Repeatedly

Simply put, muscle memory describes the idea that the musculature of the body contracts in patterns, for both posture and motion of the body. And these patterns are memorized on some level, working without our conscious control. Hence, the term muscle memory.

There is little controversy surrounding the idea of memorized patterns of muscle contraction for movement. By practicing certain activities such as walking, swinging a tennis racquet, playing a piece of music on the piano, or driving a car while drinking a cappuccino and adjusting the radio dial, we learn to execute these complex and coordinated activities with little or no input from the part of the brain that controls voluntary, willed muscle contractions—the cerebral primary motor cortex.

Instead, once a movement pattern has been initially learned in the cerebral motor cortex, it is transferred to the basal ganglia, located deeper within the brain. Consequently, it's possible for people to execute complex coordinated movement patterns while paying little or no attention, perhaps even thinking of something else entirely. Thinking in these terms, the concept of muscle memory as it relates to movement seems fairly straightforward: memorized movement patterns are stored in and released from the basal ganglia of the brain.

The Controversy

More controversial and more relevant to the world of

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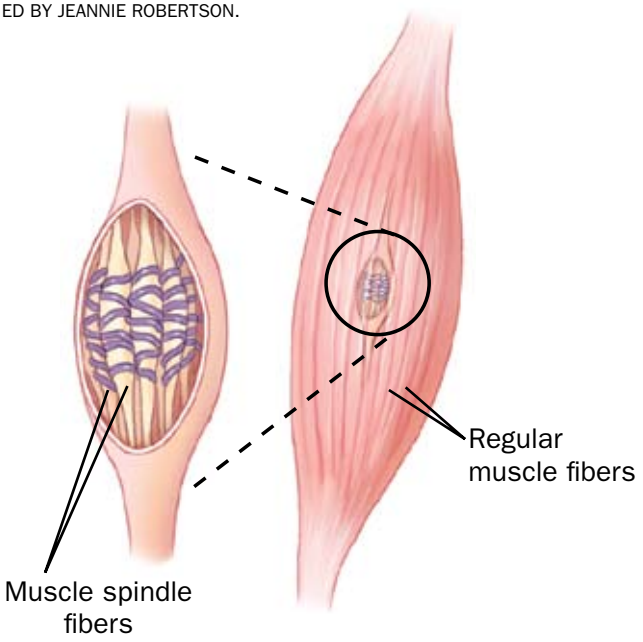

Figure 1. Muscle spindle fibers are a specialized type of muscle cell. They are located within a muscle and lie parallel to the regular muscle fibers.

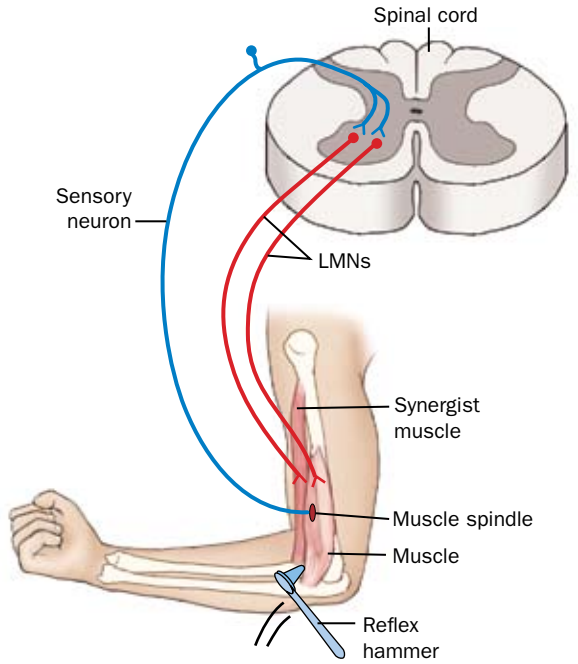

Figure 2. Cross section of the spinal cord and the muscle spindle stretch reflex. The muscle spindle reflex is triggered to occur when the muscle is either stretched too far or stretched too quickly, as when stretched too quickly by being hit with a reflex hammer as shown. This reflex causes lower motor neurons (LMNs) to direct the muscle and its synergists to contract.

massage and bodywork, however, is how the concept of muscle memory relates to posture. The posture of our body is largely determined by the memorized pattern of baseline tone of the musculature of our body. By exerting pull upon the bones and joints, resting baseline muscle tone determines the position, or posture, of our body. Indeed, when clients visit a massage therapist, the usual complaint is that their resting baseline tone of musculature is too tight. Musculoskeletally, the most common goal of massage therapy is to change the muscle memory of baseline resting tone of the tight muscles of our clients.

So, let's explore the idea of muscle memory in this context. The first misconception is the belief that postural muscle memory resides in muscle tissue itself. The muscular system is an amazingly complex and awe-inspiring system of the body, but it does not hold the key to its own memory. Certainly, adhesions present within musculature and its fascia can determine its ability to stretch, affecting its degree of passive tension and, in turn, the body's posture. But when we refer to actual muscle tone—or muscle contraction—the memory resides somewhere else.*

This idea can be easily understood by considering a person who has suffered a traumatic injury that severs the lower motor neurons (LMNs) that synapse with and control a muscle. In these cases, the muscle will become flaccidly paralyzed and have no ability to contract, unless electrical stimulation is applied from the outside. If the memory for the muscle contraction were actually within the muscle, however, it would be able to contract regardless of nerve function.

The Grand Master

If not in the muscle itself, where does muscle memory for baseline resting tone reside? Similar to the muscle memory for movement patterns, muscle memory for baseline resting tone resides in the nervous system, the grand master of all muscular function. However, this muscle memory isn't stored in the basal ganglia, but in a different region of the brain known as the gamma motor system.

The gamma motor system controls resting muscle tone via muscle spindle fibers. Muscle spindle fibers are specialized muscle cells that are sensitive to stretch. They are located within the belly of the muscle, lying parallel to the regular muscle fibers (Figure 1). When

*This rule is not true of myofascial trigger points (TrPs). The tone of the fibers of a TrP is due to local phenomena. For more on this, please see the "Body Mechanics" column in the Spring 2008 issue of **mtj**.

the muscle is either stretched too long or too quickly, the muscle spindle fibers are stimulated and send an impulse within sensory neurons into the spinal cord. These sensory neurons synapse with LMNs and cause them to send a signal for contraction to the regular muscle fibers of the muscle and its synergists (Figure 2).

When the muscle contracts toward its center, it is no longer stretched, preventing it from being overly stretched and torn. For this reason, the muscle spindle reflex, also known as the stretch reflex, is viewed as a protective reflex.

The critical aspect of this mechanism is that the sensitivity of the muscle spindle fibers can be set by specialized LMNs known as gamma LMNs. These in turn are controlled by gamma upper motor neurons (UMNs) that are located within the brain and operate subconsciously (Figure 3). When this gamma motor system of the brain orders the muscle spindle fibers to contract and shorten, they become less tolerant of being stretched and therefore more apt to trigger the muscle spindle stretch reflex. The stretch reflex will then cause the muscle to contract and tighten to match the tone of the spindle fibers within. On the other hand, if the gamma motor system does not contract the muscle spindle fibers they will be longer and more tolerant to being stretched—and less likely to trigger the stretch reflex.

As we move our bodies with normal daily activities, we inevitably stretch our muscles to some degree because when we order a muscle on one side of a joint to contract and shorten to cause movement, its antagonists on the other side of the joint must lengthen and stretch to allow this movement to occur. If and when this stretch exceeds the tolerance of the muscle spindle fibers, they will trigger the stretch reflex. Hence, resting muscle tone comes to mirror the tone of the muscle spindle fibers. In this manner, spindle tone determines the muscle memory of resting baseline muscle tone in our body.

Thus, when we are working on a client's tight muscle, what we are really trying to accomplish is to lower the gamma motor system activity so that the muscle spindle fibers will relax, allowing the regular fibers of the muscle to relax. We may be working directly on the muscle, but we do so to affect its gamma spindle activity in regions of the brain that act subconsciously. In effect, we are trying to alter the patterns of spindle tone that have already been set.

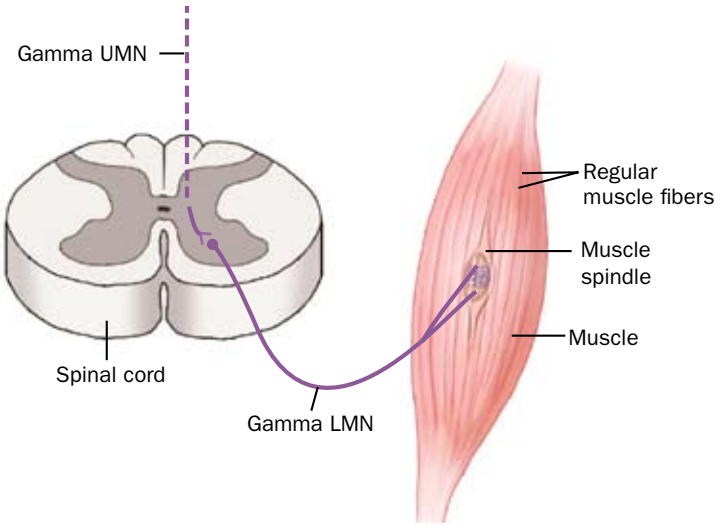

Figure 3. Cross section of the spinal cord and muscle spindle fibers within a muscle. The sensitivity of muscle spindle fibers to stretch is determined by gamma lower motor neurons (LMNs) that direct the muscle spindle fibers to contract and shorten. These gamma LMNs are controlled by gamma upper motor neurons (UMNs) that originate in the brain.

Whether this pattern has been in place for months, years or even decades is critically important. As a general rule it is the chronicity, not severity, of a tight muscle that is the primary factor that determines how long it takes to loosen it. Put simply, when it comes to changing muscle memory for tight muscles, the purpose of massage, as well as stretching, is to alter gamma motor activity of the brain so that we can change muscle spindle tone, and thereby change resting muscle tone. ■

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