

# Can Soft-Tissue Methods Affect the Muscle Spindle Cell?

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There is a strong probability that mechanical loading of [soft tissue](#) by manual and instrument-assisted methods can affect the muscle spindle cell. If this is true, then it will be another part of the puzzle that explains our results using soft-tissue techniques. But first, while we remember some things about spindle cells, I think a short review of the importance of these cells and their relationship to muscle function is warranted. There is much more information about spindle cell activity than can be expressed in this short article, but the following is some of the essential information.

The simplest way to understand the spindle effect is with the stretch reflex of the knee jerk. The percussion hammer stimulates the patellar tendon, stretching the thigh muscles (extrafusal fibers), which activates (stretches) the intrafusal fibers of the muscle spindles. Most spindle cells are located around the muscle belly. The muscle spindle then excites the 1a afferent back to the cord, stimulating the alpha motor neurons back to the muscle, causing a contraction of the quadriceps muscle. At the same time, the 1a afferent neurons also synapse in the posterior horn, stimulating inhibitory interneurons that depress activity in the alpha motor neurons to the antagonistic muscles to allow the agonist contraction.

Another afferent neuron stimulated by the muscle spindle is the secondary type II sensory fiber, the second of the two main groups of stretch receptors besides primary 1a. Type II keeps active even when the muscle has stopped changing its length. Since the type II firing rate is directly related to the muscle's instantaneous length or position, this information would indicate the position of one's leg once it has stopped moving. Type II does not respond to rate of length changes as do the Ia fibers. At the same time, the 1a and type II spindle sensory neurons, when they reach the spinal cord through second-order collaterals, inform the brain (particularly the cerebellum) of body movements and changes in muscle tone.

It is absolutely necessary that the cerebellum be continually informed of the ever-changing status of muscle tone. Muscle tone or tonus is defined as the normal state of balanced tension in the tissues of the body, especially the muscles; for example, a state of partial contraction present in a muscle in its passive state, as when the eye is in the physiological position of rest.<sup>1-2</sup> Tone is assessed clinically by the degree to which a muscle resists being lengthened.

The spindle sends feedback to the spinal cord, cerebellum, reticular activating system in the brain stem and the motor cortex. This feedback allows us to be aware of our limb position (proprioception), since the amount of stretch in a muscle indicates angular joint changes and detection of movement. Spindles also contribute to the presetting and regulation of muscle stiffness (tone).<sup>3</sup>

The brain relies on input from these receptors, as well as those in tendons and joints, to give it the

information it needs to direct smooth and coordinated muscle movements. They constantly supply the brain with necessary information concerning the ever-changing tone in muscles, in addition to the present position of muscles at any time during a movement.

The gamma motor neurons (also called gamma motoneurons) are located in the spinal cord, through which the CNS, after it receives feedback from the peripheral receptors, adjusts the stretch sensitivity of the spindle cell to help it maintain the proper required muscle tone. Posture and movement depend on the control and tone of muscles during movement; so the CNS, after receiving signaling from the periphery (joints, muscles, tendons, and fascia), uses the gamma neurons to regulate the ever-changing status of tone by maintaining the proper sensitivity of the intrafusal fibers of the spindle.

So, how does soft-tissue mechanical load fit into this picture? One theory uses the concept proposed by Johansson and Sojka,<sup>4</sup> whereby metabolites produced by muscle contractions stimulate group III and IV muscle afferents, which activate gamma-motoneurons projecting to both homonymous and heteronymous muscles. The gamma-motoneurons influence the stretch sensitivity and discharges of secondary and primary spindle afferents. Increased activity in the primary muscle spindle afferents will therefore enhance muscle stiffness and further production of metabolites.

In other words, overstimulation of the gamma motor system will increase muscle tone and muscle pain.<sup>5</sup> It has been proposed<sup>6</sup> that by stimulating the skin, muscles, ligaments and fascia over a joint, often by using Graston Technique instruments along with patient movement, a barrage of proprioceptive input will be created that will alter muscle reaction time and reset normal tone in the muscles.

Luigi Stecco, PT, and Carla Stecco, MD,<sup>7-8</sup> have concluded that the spindle cell is not really located in the muscle, but in the perimysium and endomysium, which cover every muscle fiber in our body. Also in the fascia are Ruffini and Pacini corpuscles. All of these receptors are activated by stretch and can only function correctly if they are embedded in tissue (fascia) that is capable of being stretched. Fascial restrictions, particularly those located in what Stecco classifies as "centers of coordination," most of which are located in the belly of muscles, will alter the function of spindle cells. Doing so will prevent them from contracting normally, especially when stimulated by the gamma neurons.

In a recent e-mail exchange with Siegfried Mense, MD, the world's leading expert on muscle pain and neurophysiology, he responded with the following when asked if fascial adhesions can have an adverse effect on spindle cells: "Structural disorders of the fascia can surely distort the information sent by the spindles to the CNS and thus can interfere with a proper coordinated movement." Proponents of [fascial manipulation](#) claim that by deep pressure and friction on what they call centers of coordination and centers of fusion points, the spindle cell can be freed from its restrictive state, allowing the distal muscle and joint to function normally.

It is evident that soft-tissue stimulation, both superficial and deep, should have an effect on the neurology that is embedded in this tissue. Exactly how it works is still the subject of debate, but the success of various soft-tissue treatment methods continually amazes the patient who suffers with myofascial abnormalities – and the clinician who treats them.

## References

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