Focal Muscle Vibration:
An Invaluable Clinical Tool for Relaxing Muscles and Predicting/Preventing Future Low Back Injury

By Tom Michaud, D.C.

Summary:

- *Oscillating a muscle at a very specific frequency/displacement can reduce muscle tension by as much as 50%.*
- *Focal muscle vibration can be used to identify reduced core proprioception, a proven predictor of low back injury.*
- *Core proprioception is easily returned with a series of specific strengthening exercises, and restoring proprioception not only prevents injury, it can markedly improve athletic performance.*

For more than 50 years, researchers have shown that vibrating a muscle at a specific frequency suppresses information from muscle spindles, and can reduce muscle tension by as much as 50% (1-3) (Fig. 1). Through trial and error, researchers determined that spindle activity, and hence muscle tone, is best reduced with motors that oscillate at 60 cps with 0.4 mm displacements. While invaluable for relaxing tight muscles, Kurt Claeys and his colleagues from Belgium (4,5) came up with a novel diagnostic use for muscle vibration. These authors published a series of papers showing that while standing with eyes closed, the muscle spindles in our calves and core muscles share information allowing us to balance properly.

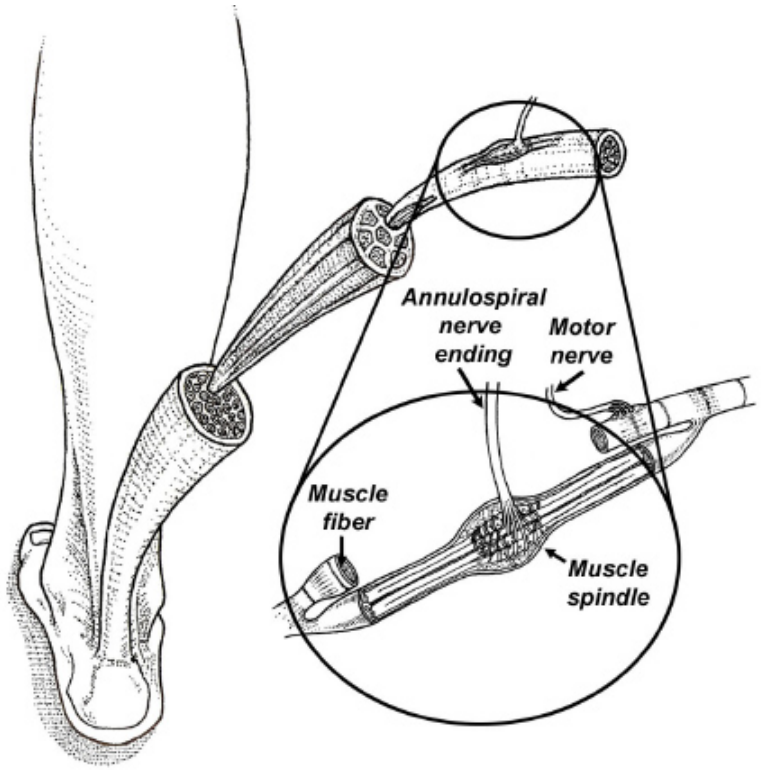
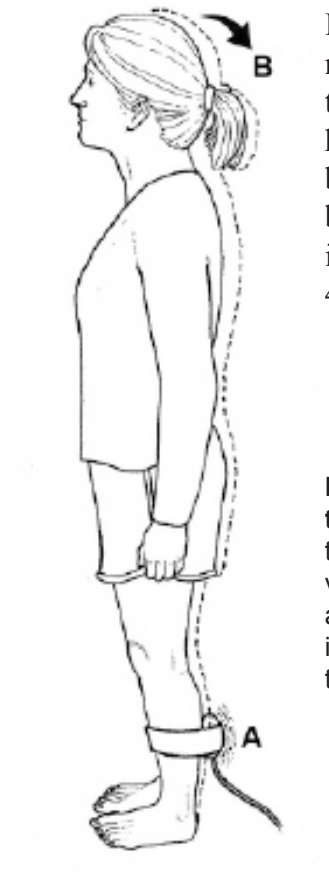


Fig. 1. Muscle spindles attach in parallel series along muscle fibers. Spindles supply sensory information along annulospiral nerve endings providing detailed information regarding muscle movement. When information from the annulospiral nerve endings is inhibited, muscle tone is greatly reduced.

Apparently, the calf muscles send information to the central nervous system regarding forward/backward sway while core proprioceptors give information regarding the position of the torso relative to the pelvis. The shared information regarding position sense is vital for injury-free activity, since muscle spindle input tells your central nervous system exactly where you are in space and what speed your joints and muscles are accelerating/decelerating. Of course, this information is vital for injury prevention as it allows for the smooth, controlled motion necessary to participate in most daily activities. Perfectly functioning proprioceptors are especially important in preventing sports-related injuries.

In their clever studies, the Belgian researchers decided to use muscle vibration to evaluate the sensitivity of an individual's core proprioceptors. To do this, Claeys et al. (4) placed vibrating motors on the soleus muscle while subjects stood on force platforms with their eyes closed. When these motors were turned on, the sudden vibration caused presynaptic inhibition of the muscle spindles, producing the false sensation that the soleus muscle was lengthening. In subjects with perfectly functioning core proprioceptors, the core muscles ignored the faulty information from the vibrating soleus muscles, and the subjects easily managed to balance with eyes-closed. Conversely, subjects with poor core proprioception immediately shifted their entire bodies back to counter the illusion that they were falling forward (Fig. 2). This simple test takes less than 20 seconds to perform and provides information regarding core proprioception that until recently, was impossible to obtain.

To determine if muscle vibration can distinguish between asymptomatic and chronic low back pain patients, Claeys et al. (4) performed the 20-second muscle vibration test on 106 nonspecific low back pain patients and 50 healthy controls. The researchers confirmed that the low back pain patients had significantly greater backward sway when their calves were vibrated, which the authors relate to reduced "lumbosacral proprioception." Claeys et al. (4) theorize that the low back pain patients were unable to process proprioceptive signals from their low back muscles and they were forced to become overreliant on calf proprioceptors. This study was fascinating in part because so few clinical tests can distinguish low back pain patients from non-low back pain patients. In fact, abnormal findings on expensive tests such as CTs and MRIs are so common they are considered normal variants, as they are not predictive of future injury.



In a follow-up study, Claeys et al. (5) again performed the 20-second vibration test on more than 100 asymptomatic subjects. In addition to evaluating vibration-induced sway, the authors also evaluated spinal posture along with various psychosocial behaviors known to correlate with the of future development of low back pain; e.g., fear avoidance behavior. The subjects were followed for 2 years and while posture and fear avoidance behavior in no way predicted the development of low back pain during that period, individuals who swayed excessively when their calf muscles were vibrated were almost 4-times more likely to hurt their backs over the 2-year follow-up period.

Fig. 2. Vibrating motors placed on the soleus muscle (A) give the illusion that the calf muscles are lengthening. Individuals with good core proprioception can sense the calf muscles are not lengthening and remain stationary. Conversely, subjects with poor core proprioception are overreliant on ankle spindles and respond to the vibrating motors by leaning backward (**B**). The posterior sway is apparent to both the doctor and the patient, especially when the vibrating motors are turned off.

As with differentiating low back from non-low back pain patients, this finding is significant since so few factors predict future injury. Interestingly, a 2022 research paper from Iran (6) suggests proprioceptive deficits confirmed with the focal muscle vibration test should not be considered to be an adaptive response to prior low back injury, and are more than likely causal for the development of low back pain.

What I like most about this diagnostic test is that it is an inexpensive test to perform, and when a proprioceptive deficit is discovered, it is easily fixed with a series of specific exercises. Over the past few years, I've had patients with impaired core proprioception perform a series of different exercises, including diaphragm and various lower extremity exercises. I've also used hip mobilization, spinal manipulation, and deep tissue massage of the erector spinae musculature to see what, if anything, can improve core proprioception.

While spinal mobilization and deep tissue massage will occasionally increase core proprioception, without doubt the most significant improvements in core proprioception occur when performing exercises that increase endurance in the lumbar paraspinal muscles. This makes sense because muscle spindles are extremely reliant upon adequate circulation to function properly, so exercises that effectively enhance blood flow will also increase core proprioception. My favorite exercises are reviewed in the following video link (X). The ability of these exercises to increase circulation to the core proprioceptors has been proven with near infrared spectroscopy. By performing these exercises five times per week, it is not uncommon to have a complete restoration of core proprioception in as little as eight weeks.

Inexpensively diagnosing and treating low back injuries has never been more important. In the US alone, the direct and indirect cost of treating low back pain is over $600 billion annually (7). To make matters worse, the prevalence of low back pain has increased by more than 50% since 1990, and is projected to continue to increase as people become more sedentary (8). Because it is inexpensive, can be performed in less than 20 seconds, and is a proven predictor of future back injury, focal muscle vibration should be used as a screening tool to identify individuals prone to future injury, and initiate a treatment protocol before the injury occurs. Because of its ability to reduce muscle tone by as much as 50%, focal muscle vibration can also be used on difficult to treat musculoskeletal conditions, such as adhesive capsulitis and ankle equinus.

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