

life. A similar “sharing the load” phenomena governs the way muscles should work as well, but MTPs interfere with this process.

Holding any muscle in a contracted state, even for 30 seconds at a time, involves shift-work or rotations within a small subpopulation of fibers. Some subsets of fibers work for a period of time and then stop, while others take their place. This trade-off of activity is a healthy way to prevent burnout within a muscle.

“When one or more MTPs are in a muscle,” says Ge, “the motor units are firing all of the time; they never stop. The normal shifting mechanism is lost, leading to premature development of muscle fatigue.”

Not only do latent MTPs (which don’t generally hurt) prevent muscles from sharing the workload, pain interferes with this process as well.<sup>4</sup> When healthy women were injected with a pain-producing substance in their upper trapezius, the shifting mechanism disappeared. However, the comparison group of FM patients showed more rapid muscle exhaustion, thought to be partly due to reduced capillary blood flow.

## Stiff Goings

What could be causing you to feel so stiff, even if you haven’t overdone it? Ge says, “Each tight muscle band (a bundle of muscle fibers) is in a state of contraction no matter whether you are active or at rest. Muscle fibers with MTPs are working all of the time and are always in a tensed state.”

MTP blood flow is reduced and adds to muscle fatigue by limiting the supply of energy nutrients. But MTPs also contribute to stiffness because when the muscle is vibrated, these areas lack fluidity like the rest of the muscle.<sup>5</sup> The drop in blood flow at the MTPs is due to too much sympathetic activity from the spinal cord nerves traveling to these muscle regions. Anything that increases the parasympathetic “calming” activity should

improve blood flow and reduce muscle stiffness.

But why do you wake up in the morning feeling like your muscles are made from dried leather? “Chronic pain from MTPs worsens sleep and poor sleep leads to sympathetic dominance over the parasympathetic system,” says Ge. “The sympathetic imbalance aggravates the muscle fibers containing MTPs, so that they fire all night long (e.g., calf cramps during sleep). The muscle fibers become so terribly taut and stiff by morning because they were busy working all night.”

“FM patients may experience some good days after a sound night of deep sleep when the parasympathetic system dominates,” says Ge. “Likewise, warm water or a hot shower activates the parasympathetic activity. This increases blood flow, reducing MTP activity and muscle stiffness.”

## Oxygen Debt

Near-infrared devices used to check your blood oxygenation are commonplace. Just place your finger in a small clip and the results are quickly generated. Adopting similar technology, a customized machine was engineered by **Guoqiang Yu, Ph.D.**, at the University of Kentucky, to assess blood flow and oxygen use in the exercising thigh of FM patients and matched healthy controls.<sup>6</sup>

The same fatiguing set of contractions was done by each group and a test ensured that all subjects per-

formed the same workload. As a muscle contracts, the hemoglobin in the blood releases its oxygen through the small capillaries and breathing replaces the oxygen used. The oxygen is taken up by the muscle mitochondria to make energy fuel for the exercising muscle.

Here is how the FM patients differed: the amount of oxygen consumed by the exercise (but same workload) was less and there was a time delay for the hemoglobin to fill back up with oxygen. It’s as though the muscles continued to use oxygen after the exercise stopped in the FM group. In other words, an oxygen debt occurred because there was not enough supplied during exercise.

Muscle biopsies in the same subjects were examined in a second study.<sup>7</sup> “The most pronounced difference in muscle between subjects with FM and healthy controls in this study was reduced capillary density in FM,” says Yu. In addition, a greater number of smaller-sized muscle fibers with decreased enzyme ability to use oxygen was found in the patients. All of these factors enhanced the exercise-induced fatigue in FM. **END**

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## Reducing Burnout

Use warm water to reduce MTP-related tension and increase muscle blood flow. The heat coupled with any daytime medications you take for discomfort should improve the shift-work processes within your muscles so they do not wear out as quickly. However, eliminating your MTPs will produce the best results.

What can you do about the reduced number of capillaries and oxygen debt in your muscles? Take lots of breaks during very mild aerobics to accommodate the lag in oxygen delivery. To build stronger muscles and more capillaries, try lots of repetitions with next to no resistance.