Wear, Tear, and Repair

"A condition called telegraphists' cramp, which affected the hand muscles required to operate a Morse code machine, was prevalent in the early 1900s. It was one of the first documented repetitive strain injuries," says **Mary F. Barbe, PhD, Professor of Anatomy and Cell Biology** at Temple.

Caused by repeated motion that damages tissues of the musculoskeletal and nervous systems, repetitive strain injuries (RSIs) spark persistent pain — usually in the neck, shoulders, forearms, wrists, and hands. "They can be debilitating," Barbe says.

RSIs are common among athletes. Computer and smartphone overuse can cause them, too. But Barbe studies "higher-load, higher-force tasks. Think construction workers, nurses moving patients, or hotel staff lifting mattresses and ending up with elbow tendinitis or a rotator cuff problem," she says.

High-force, high-repetition movements create microinjuries in muscle fibers. Muscle tissue responds by making small repairs. But over time, with repetition of the activity causing the injury, muscle tissue becomes replaced with connective tissue — weakening muscles and putting pressure on nerves, causing inflammation and pain. "With nerve injury, you develop hypersensitivity to normally innocuous stimuli," Barbe says.

"A lot of treatments fail. Rest doesn't work for everyone. Physical therapy doesn't work for everyone," says Barbe, who also holds an appointment as Professor in the Department of Physical Therapy. "Even surgery fails, because you can't just go in and pick out all the fibrosis."

RSIs have long been thought to be irreversible, but Barbe's research shows, for the first time, that it may be possible to undo the damage caused by fibrosis and restore muscle strength — offering hope for people who have been unable to work due to overuse injury.

The findings, published online in 2019 in *The FASEB Journal*, detail the results she's achieved in preventing and reversing RSI-related fibrosis with a drug called pamrevlumab, a compound recently approved by the U.S. Food and Drug Administration for the treatment of Duchenne muscular dystrophy. Barbe and colleagues, including Steven Popoff, PhD, the John Franklin Huber Chair and Professor of Anatomy and Cell Biology, found that the drug can halt — even reverse — the scarring process. Pamrevlumab is an antibody that inhibits connective tissue growth factor, a protein that contributes to fibrotic disease progression.

Pamrevlumab for RSI is a novel application. "It's being fast-tracked by the FDA for patients with idiopathic pulmonary fibrosis and kidney fibrosis — but would also be a good drug for people with overuse injury whose other treatments are not working. If we can reverse muscle fibrosis, workers could eventually return to their jobs," Barbe says.

Last year, in the *Journal of Orthopedic Research*, Barbe reported that pamrevlumab also relieved the irritative, compressive effects of carpal tunnel syndrome, a common RSI associated with weakness and functional decline.

She's also found that manual therapy — techniques including massage, stretching, and chiropractic intervention — is helpful. It breaks down fibrotic tissue, promoting repair and recovery. "Bodies are amazing things — sometimes we just need to help them along," she says.

Barbe has authored many book chapters and has won numerous teaching and research honors, including the 2018 research prize of the International Society for the Study of the Lumbar Spine — recognizing her collaboration with David Klyne, PhD, and Paul Hodges, PhD (University of Queensland, Australia), for findings regarding contributors to low back pain.

Barbe also collaborates with Michael Ruggieri, PhD, Professor of Anatomy and Cell Biology at Temple, to develop techniques to reinnervate the bladder and urethral sphincters. "Functional reinnervation of the bladder is possible — and would be a great boon to patients who've suffered spinal root injury," she says.

Barbe's research has been supported by the National Institutes of Health for 18 years. A native of Virginia and North Carolina, she is a fellow of the American Association of Anatomists and the American Society for Bone and Mineral Research — and is currently Vice President of Advances in Mineral Metabolism, an international association.

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