

Unique Skeletal Muscle Design Contributes to Spine Stability

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The novel design of a deep muscle along the spinal column called the multifidus muscle may in fact be key to spinal support and a healthy back, according to researchers at the University of California, San Diego School of Medicine. Their findings about the potentially important "scaffolding" role of this poorly understood muscle has been published on line in advance of the January issue of the *Journal of Bone and Joint Surgery*.

"The multifidus muscle was formerly thought to be relatively unimportant based on its fairly small size," said Richard L. Lieber, Ph.D., Professor and Vice Chair of UC San Diego's Department of Orthopedic Surgery and Director of the National Center for Skeletal Muscle Rehabilitation Research, based at UC San Diego. Lieber is also Senior Research Career Scientist at the Veterans Affairs San Diego Health System. "Our research shows that it's actually the strongest muscle in the back because of its unique design. It's like a long, skinny pencil packed with millions of tiny fibers."

The researchers discovered that the multifidus has a unique packing design consisting of short fibers arranged within rods, and that these fibers are stiffer than any other in the body. Using laser diffraction methods that they developed to measure muscle internal properties during back surgery, they demonstrated that the multifidus' unique design serves a critical function as a stabilizer of the lumbar spine. These findings could have implications for surgery, according to Steven R. Garfin, M.D., Professor and Chair of UCSD's Department of Orthopaedic Surgery.

"It is important to identify what each individual muscle does, and this is just a start, showing that the multifidus contributes significantly to spinal stabilization," said Garfin. "The more we know about what muscles do, the better we can devise therapeutic interventions such as physical therapy to target specific muscles."

Garfin explained that currently surgery to treat spinal disorders could actually disrupt the multifidus muscle, which could lead to decreased stabilization and lower back pain. Minimally invasive spine surgery techniques strive to minimize surgical trauma to these muscles in order to best preserve their function.

The lower back, or lumbar spine, can be vulnerable to many pain-causing injuries or disorders because the lumbar vertebrae carry the most body weight and are subject to the most force and stress along the spine. Muscular instability is a risk factor in many injuries and consequent chronic lower back pain, according to Lieber.

"The multifidus back muscle keeps us vertical and takes pressure off the discs," said Lieber. "When muscle function is poor due to back problems, support is lost."

He explained that many muscles get weaker as they are extended. But the researchers discovered that, unlike all other muscles, the multifidus actually becomes stronger as it lengthens, when the spine flexes.

"The length of the sarcomere-the structure within the muscle cell where filaments overlap to produce the movements required for muscle contraction-is shorter in the multifidus than in any other muscle cell," explained

study's first author Samuel R. Ward, P.T., Ph.D., Assistant Professor of Radiology at UC San Diego School of Medicine. "But as it gets longer, for instance as a person leans forward, the multifidus actually strengthens."

Contributing authors to the study include UCSD researchers Choll W. Kim, M.D., Ph.D., Carolyn M. Eng, B.S., Lionel J. Gottschalk, B.S.; and Akhito Tomiya, M.D., Ph.D. Tohoku University School of Medicine, Sendai, Japan. Research was supported by the Department of Veterans Affairs Rehabilitation, Research and Development; the National Institutes of Health and DePuy Spine of Raynham, MA.

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