ORLANDO, FL—Long missions in space have not been kind to astronauts’ backs, causing temporarily increased height, back pain, and a higher risk of disc herniation upon their return to Earth. Historically, the blame for these conditions was placed on microgravity’s effect on intervertebral discs, causing them to decompress and swell with more fluid and become vulnerable to herniation. However, researchers who won an “Outstanding Paper Award” at the 32nd Annual Meeting of the North American Spine Society (NASS) expand upon their previous research and suggest that the real culprit is the atrophy of small, yet stabilizing spine muscles, which could have implications for patients here on Earth.

The paper, “From the International Space Station to the Clinic: How Prolonged Unloading May Elevate Risk for Low Back Pain and Lumbar Instability,” is one of three winners of The Spine Journal’s 2017 Outstanding Paper Award that recognizes excellence in unpublished research in spine care (see sidebar). This paper won in the category of Medical/Interventional Science. Winning manuscripts will be published in a 2018 issue of The Spine Journal and receive a $10,000 prize.

“Surprisingly, our results show that lumbar flattening and atrophy of the spine’s multifidus muscles may be responsible for post-flight increases in height, pain, and risk of disc herniation, rather than disc swelling, as previously hypothesized,” said Jeffrey C. Lotz, PhD, one of study’s authors. “This research has prevention and treatment implications for earthbound patients who have deconditioned spines from inactive lifestyles or prolonged bedrest due to an injury or back pain.”

The paper describes a unique longitudinal study of crewmembers from the National Aeronautics and Space Administration (NASA) with six-month missions aboard the International Space Station (ISS). In space, astronauts do not use their backs to bend and lift things as on Earth, so they become very deconditioned. Spine imaging and health data were assessed from six NASA astronaut crewmembers at two time-points: before launch (“pre”) and one day following six months spaceflight on the ISS (“post”). Researchers followed up with each subject during a debriefing at one year post-flight, where they self-reported any low back symptoms or injuries within that year. Subjects included one female and five males (ages ranging from 46 to 55 years).

Additional 2017 “Outstanding Paper” Award Winners

**Outstanding Paper, Surgical Science**
“Objective measurement of function following lumbar spinal stenosis decompression reveals improved functional capacity with stagnant real-life physical activity”

**Authors:** Matthew Smuck, MD; Amir Muaremi, PhD; Patricia Zheng, MD; Justin Norden, MPhil; Aman Sinha, MPhil; Richard Hu, MD; Christy Tomkins-Lane, PhD

**Outstanding Paper, Value in Spine Care**
“Establishing benchmarks for the volume-outcome relationship for common lumbar spine surgical procedures”

**Authors:** Andrew J. Schoenfeld, MD; Daniel Sturgeon, MS; Camden B. Burns, MD; Tyler J Hunt, BS; Christopher Bono, MD

**Outstanding Paper, Runner Up**
“A minimum of 5-year follow-up after lumbar transforaminal epidural steroid injections in patients with lumbar radicular pain due to intervertebral disc herniation”

**Authors:** David J. Kennedy, MD, Patricia Zheng, MD, Matthew Smuck, MD, Zachary L. McCormick, MD, Lisa Huynh, MD, Byron J. Schneider, MD

(more)
The results surprised the researchers, who concluded that paraspinal muscle atrophy, specifically of the multifidus, was strongly associated with post-flight decreases in lumbar lordosis and intersegmental range of motion (ROM). Multifidus muscles attach directly to the lumbar vertebrae and act locally to provide the greatest active stiffness in both the sagittal and frontal planes.

Supine lumbar lordosis, which is the curve of a spine while laying down, decreased (flattened) by an average of 11% (p=0.019), which is significant. Active flexion-extension range of motion (FE ROM) decreased for the middle three lumbar discs (L2-L3: -22.1%, p=0.049; L3-L4: -17.3%, p=0.016; L4-L5: -30.3%, p=0.004). By contrast, no significant passive FE ROM changes in these discs were observed (p>0.05). Importantly, disc water content did not differ systematically from pre- to post-flight. Both multifidus and erector spinae muscles changed variably between subjects, with five of six subjects experiencing an average decrease of 20% for functional cross-sectional area (FCSA) and 8-9% for cross-sectional area (CSA) in both muscles. For all subjects, changes in multifidus FCSA strongly correlated with changes in lordosis (r²=0.86, p=0.008) and active FE ROM at L4-L5 (r²=0.94, p=0.007). Additionally, changes in multifidus FCSA/CSA correlated with changes in lordosis (r²=0.69, p=0.03).

The researchers also concluded that the risk for post-flight back pain symptoms may relate to pre-existing spinal pathology. Pre-flight, two of the six astronauts presented endplate irregularities with Type 2 Modic changes in the adjacent vertebral bone marrow, which have been linked to chronic low back pain in the general population. These same two astronauts described post-flight back pain symptoms. Weakening at the disc/vertebra junction could be exacerbated by microgravity-induced changes in vertebral bone quality and increased disc loading from lumbar flattening that together heighten risk of failure and injury at the disc-bone interface when reintroducing a relatively less stable lumbar spine to gravitational load.

The researchers intend to use these results to develop countermeasures targeting the multifidus muscles and new research on the role of muscular stability in relation to chronic low back pain and disc injury. The study authors are: Jeannie F. Bailey, PhD; Stephanie L. Miller, MS; Conor W. O'Neill, MD; Robert M. Healey, MBA; Dezba G. Couglin, PhD; and Jeffrey C. Lotz, PhD of Orthopedic Surgery, University of California, San Francisco, CA; Kristine Khieu; Douglas G. Chang, MD, PhD; and Alan R. Hargens, PhD of Orthopedic Surgery, University of California, San Diego, CA; and Jojo V. Sayson, PT, DMT of Ola Grimsby Institute, Bellevue, WA.

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More than 3,000 spine professionals will meet at the NASS 32nd Annual Meeting in Orlando, October 25-28, 2017 at the Orange County Convention Center to share the latest information, innovative techniques and procedures, best practices and new technologies in the spine field. NASS is a multidisciplinary medical organization dedicated to fostering the highest quality, evidenced-based and ethical spine care by promoting education, research and advocacy. NASS is comprised of more than 8,000 members from several disciplines, including orthopedic surgery, neurosurgery, psychiatry, neurology, radiology, anesthesiology, research and physical therapy. For more information, visit www.spine.org, NASS Facebook and NASS Twitter.

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