Spinal cord injury research: Bonus benefit to activity-based training

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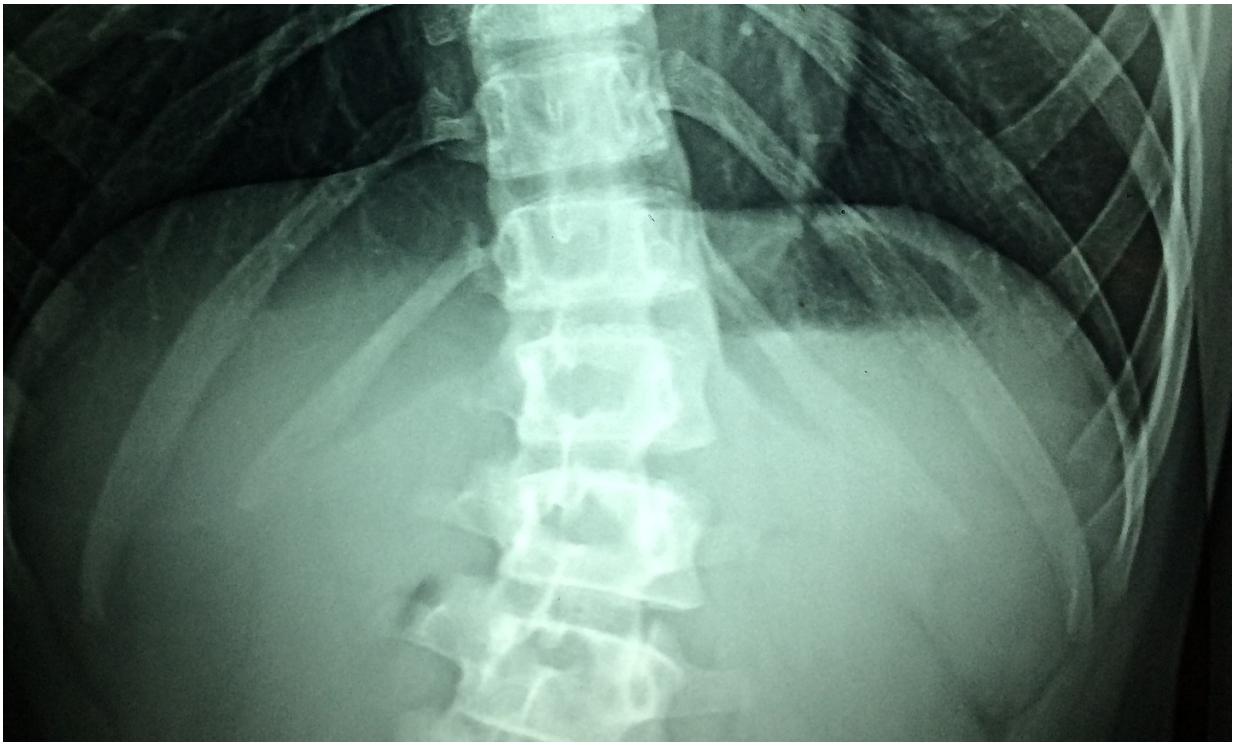

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Activity-based training has resulted in unexpected benefits for individuals with severe spinal cord injury (SCI). Researchers in the Kentucky Spinal Cord Injury Research Center (KSCIRC) at the University of Louisville have discovered that the training, designed to help individuals with SCI improve motor function, also leads to

improved bladder and bowel function and increased sexual desire.

Research participants receiving activity-based training conducted by KSCIRC at Frazier Rehab Institute initially reported improvements in bladder, bowel and sexual function anecdotally. Charles Hubscher, Ph.D., professor and researcher at KSCIRC, has documented those changes in research published today in the journal *PLOS ONE*.

For individuals with severe spinal cord injury, bladder and bowel dysfunction are among the most detrimental factors to their quality of life, even more than the loss of independent mobility.

"Patients with spinal cord injury say they are most concerned by the problems associated with bladder function," Hubscher said. "These issues contribute heavily to a decline in their quality of life and impacts overall health."

Bladder dysfunction associated with SCI results in numerous health complications, requiring lifelong management and urological care in the form of catheterization, drug and surgical interventions, peripheral electrical stimulation and urethral stents. All of these therapies bring with them serious side effects and none substantially improves the basic functions.

To document changes in bladder, bowel and sexual function resulting from activity-based therapy, Hubscher and his colleagues performed urological testing (urodynamics) and asked research participants with severe spinal cord injury (SCI) to complete surveys about their bladder and other functions. Eight of the participants received activity-based training, which includes locomotor training, stepping on a treadmill with their body weight supported, and stand training in a specially designed frame. Four participants did not receive training.

The active participants' functions following training were compared with their own condition prior to training and with individuals not receiving training. Following 80 daily sessions of locomotor training with or without stand training, the active individuals were found to store significantly more urine at safer pressures, reported fewer incidents of nighttime voiding and reduced general incontinence, as well as improved bowel functioning and increased sexual desire.

"Today's published research indicates that activity-based training strengthens the neural circuits that control urogenital and bowel functions," Hubscher said. "We hope to further validate those findings by determining if the improvements can lead to elimination of related medications and/or long-term reduction in the number of daily catheterizations. In addition, we are evaluating the effects of spinal cord epidural stimulation on those circuitries."

Susan Harkema, Ph.D., professor and associate director of KSCIRC and an author of the study, said the publication highlights the value of the research collaborations at UofL.

"This work showcases the exceptional environment for research at UofL, with basic scientists working in parallel with clinicians in rehabilitation and neurosurgery," Harkema said. "There are relatively few researchers addressing bladder, bowel and sexual function both in animals and humans in chronic spinal cord injury. Dr. Hubscher's work adds a unique and valuable aspect to our research."

Epidural Stimulation Research

Researchers at KSCIRC are investigating the use of spinal cord epidural stimulation (scES) to facilitate the ability of SCI patients to stand, voluntarily control leg movements, and improve other functions. Spinal cord epidural stimulation involves the delivery of electrical signals to

motor neurons in the spine by an implanted device.

In concert with this research, Hubscher is investigating the effects of scES on bladder, bowel and sexual function in SCI patients. Funded by a $3.5 million grant from the National Institutes of Health, Hubscher has begun work to map the lumbosacral spinal cord for multiple aspects of bladder function. This work will identify locations on the spine and device configurations for using scES to improve bladder storage and voiding efficiency.

The funding is through the NIH Common Fund program Stimulating Peripheral Activity to Relieve Conditions (SPARC), which aims to increase the understanding of nerve-organ interactions and neuromodulation to advance treatment of diseases and conditions for which conventional therapies fall short.

Hubscher's SPARC project has a three-year timeline and includes concurrent investigations in both animals and humans. His team will enlist six human research participants who have received scES devices and have completed the initial epidural stimulation study to assist with the development of device parameters, then test those parameters at home.

For the estimated 1,275,000 people in the United States who live with paralysis from SCI, therapies resulting from this research have the potential to increase their quality of life as well as reduce health-care costs.

More information: Charles H. Hubscher et al, Improvements in bladder, bowel and sexual outcomes following task-specific locomotor training in human spinal cord injury, *PLOS ONE* (2018). DOI: 10.1371/journal.pone.0190998

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