Medical Xpress

Continuing the quest for better stroke therapies

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Helping people recover from the debilitating effects of a stroke is an immensely complex challenge that requires deep knowledge of neurophysiology as well as effective therapy. Advancing such knowledge to improve therapeutic options and outcomes has been the primary focus of research by Sergei Adamovich, associate professor of biomedical engineering, since he joined the NJIT faculty more than a decade ago. It is work whose significance is underscored by substantial funding from sources such as the National Institutes of Health (NIH).

Most recently, the NIH awarded Adamovich and Rutgers colleague Eugene Tunik, Ph.D., PT, $1.3 million (with a $415,000 subcontract to NJIT) to continue this effort. Tunik is the director of the Laboratory for Movement Science at the Rutgers School of Health Related Professions, located in Newark.

The new funding has been awarded under the title "Planning and Updating in Frontoparietal Network for Grasping." With respect to its import for healing, the grant will enable Adamovich and Tunik to investigate brain networks linked to movement, especially hand and arm control. As much as we do know about the neural mechanisms of movement control, a great deal is still unknown, Adamovich says.

Building a baseline

Understanding how discrete parts of the brain interact to coordinate

hand and arm movements in healthy individuals is a critical starting point for developing better stroke-rehabilitation therapies. It's baseline knowledge of the brain's frontoparietal areas that the researchers say is ultimately essential for regaining movement impaired by a stroke-induced brain lesion or traumatic brain injury.

The research will employ techniques and equipment that include functional magnetic resonance imaging (fMRI) to map brain activity, noninvasive transcranial magnetic stimulation to induce responses in specific regions of the brain, and robotic/virtual-reality training systems that use the CyberGrasp hand exoskeleton and a library of therapeutic video games developed in Adamovich's laboratory at NJIT. Brain and muscle interaction will be mapped during various normal reaching and grasping activities with physical objects and tasks in virtual video environments.

In addition, areas of the brain under study will be stimulated in participating volunteers at Tunik's Rutgers laboratory to determine the role of those areas in controlling specific movements. "The activity of the neurons in the brain can be modulated electrically in our research using transcranial magnetic stimulation," Adamovich explains. "You apply a short magnetic pulse that passes through the skull and induces electrical currents on the surface of the brain. These currents interfere with normal brain activity. It's a technique widely used in both basic research and clinical applications—for example, in psychiatry to treat depression and other disorders. We will be applying it to movement impairment."

Next steps

The new research that Adamovich is initiating complements previous efforts that have led to the development of therapeutic stroke interventions now being assessed at a sub-acute rehabilitation facility

maintained by the St. Joseph's Healthcare System in Wayne, New Jersey. The robotically assisted exercises and game-like physical challenges in virtual reality yielded positive results when initially evaluated at NJIT with volunteers who were chronically impaired more than six months after a stroke. At the St. Joseph's facility, the goal is to see if the same interventions can help patients in a clinical setting regain hand and arm function almost immediately after they have experienced a stroke.

Adamovich looks ahead to gaining additional improvement from the neurophysiological research that is getting under way with healthy individuals. "Eventually, we want to learn how beneficial it might be to combine therapies we have already developed with non-invasive brain stimulation, a technique which, if applied correctly, has no known negative side effects," he says. "Exercising the arm and hand with appropriate stimulation of the brain either before or during an exercise session could improve the overall effectiveness of a therapy program.

"So we are investigating how, for example, a healthy person's reaching or grasping movement is organized in terms of which parts of the brain are participating, how they interact with each other, which part is responsible for which aspect of the movement. With this knowledge, we can be more efficient in designing protocols for stimulating the nodes of the neural network involved to improve the rehabilitation outcome."

Adamovich also cites the promising potential of delving into the question of why the same therapy program incorporating noninvasive stimulation may help some people and not others. "Greater understanding of the networks in the brain that control movement could make it possible to tailor therapy on an individual basis, to prescribe a 'recipe' of treatments that will produce the best outcome for a particular individual."

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