Open wide, and walk

Tongue stimulation gets brain to improve functions

By Harvey Black

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One possible treatment for people with neurological problems ranging from brain trauma to multiple sclerosis may lie on the tip of the tongue.

In experiments at the University of Wisconsin-Madison, neuroscientist Yuri Danilov and his colleagues have been studying for the past several years how electrical stimulation of the tongue can bring about dramatic improvements in people whose ability to balance, walk and stand has been damaged in ways that leave them virtually helpless without a walker or crutches.

Two major nerves - trigeminal nerve and cranial nerve - lie in the tip of the tongue. They wend their way to the back of the skull into the brain stem, which essentially performs a lot of unglamorous but essential housekeeping work, such as keeping us breathing, conscious, and our digestive system operating.

These nerves go to two important structures in the brain stem, the trigeminal nuclei complex and the solitary tract nucleus, Danilov explained.

"Stimulating these two major structures, we can reach any part of the brain," he said.

To reach the brain, a patient puts a small electronic device on the tongue, sending tens of millions of electrical impulses to the brain stem.

The sensation is like innumerable tiny droplets of water from a powerful showerhead. The technique is called cranial nerve non-invasive neuromodulation.

An hourlong session consists of 20 minutes of stimulation on the patient's tongue with the device, plus a number of exercises, including walking on a treadmill.

'Life-changing' treatment

Two weeks of these experimental sessions have made an enormous difference for Alan Eppenbaugh, 50, of Rockford, Ill., who was diagnosed with multiple sclerosis in 2000.

"It's life changing. I needed a walker when I started, and when I left I was walking on my own," he said.

In the month after his treatment, "I've learned to walk taller, and I can work a lot longer than I could," he said.

He added that he also is weaning himself off his medication.

Stuart Brandes, 69, of Monona also said the experimental approach has improved his life. Diagnosed 11 years ago with MS, Brandes underwent two weeks of training in Danilov's lab in April.

"My balance improved significantly, and my gait improved significantly as well. There were secondary improvements that were equally salutary," he said, noting that he found it much easier to bend over and put on his socks and shoes each morning. Uncontrolled muscle movements also were reduced.

Brandes continues to do several exercises that he learned in Danilov's lab to strengthen atrophied muscles.

But beyond those concrete changes, Brandes talked of his buoyed spirits.

"When you have MS you have a feeling of hopelessness," he said. "You see nothing except more misery. So maybe things don't have to get worse. It's the only thing that has offered me hope in these 11 years."

One sense for another

The concept is based on the thinking of the late Paul Bach-y-Rita of UW-Madison and involves substituting one sense for another, according to Kurt Kaczmarek, who works with Danilov at UW.

"That was part of another effort of Paul's to demonstrate brain plasticity, that the brain changes function as a result of working around injuries, such as stroke, traumatic injury, etc.," he said.

It was Bach-y-Rita who proposed using the tongue, which has a "fine sense of touch," Kaczmarek said.

Bach-y-Rita initially worked with vision, using a camera to transfer images to the tongue, whose projections reach through the brain stem to the area of the brain devoted to vision.

Maurice Ptito, a University of Montreal scientist, has been using this method to help blind people see.

"We were absolutely amazed by this," he said.

Blind people, via their tongues, were activating the same area of the brain as people who can see with their eyes, he said.

The blind, he said, can find objects accurately in space. When asked, they point to the location of the object whose picture is taken by the camera. They don't point to the tongue, which is being stimulated by electrical impulses.

Ptito has seen Danilov's work with neurologically damaged patients and is impressed by it.

"I think he has great results," he said.

Working on balance

The work with balance came about when Mitchell Tyler, a scientist who worked with Bach-y-Rita and now works with Danilov, developed an inner ear infection several years ago that severely damaged his sense of balance.

"For a week I couldn't tell where 'up' was," he says.

He proposed combining a device that measures orientation with the tongue stimulation to help people with such disorders. Tyler and Danilov worked together to understand the science and develop the technology that would correct balance problems.

"Basically, we're rewiring the brain," says Kaczmarek.

But the permanence of the rewiring remains a question.

Jim Haraughty, 50, of Madison was diagnosed with MS six years ago. Earlier this year he was treated in Danilov's lab and experienced "remarkable" effects. Previously he could not stand with his eyes closed. After the training, "I was able to stand on one leg with my eyes closed, and I could do that forever. I felt like an 18-year-old kid."

But in a July interview, he said those effects are starting to "drift away."

Indeed, the issue of permanence is a concern of Danilov, who said the results can be affected by things such as the degree of damage from disease or injury.

Patients may have to use the tongue stimulation device for years to keep themselves in "normal" shape, he said.

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