With Tiny Brain Implants, Just Thinking May Make It So

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Can a machine read a person's mind? A medical device company is about to find out.

The company, Cyberkinetics Inc., plans to implant a tiny chip in the brains of five paralyzed people in an effort to enable them to operate a computer by thought alone.

The Food and Drug Administration has given approval for a clinical trial of the implants, according to the company.

The implants, part of what Cyberkinetics calls its BrainGate system, could eventually help people with spinal cord injuries, strokes, Lou Gehrig's disease or other ailments to communicate better or even to operate lights and other devices through a kind of neural remote control.

"You can substitute brain control for hand control, basically," said Dr. John P. Donoghue, chairman of the neuroscience department at Brown University and a founder of Cyberkinetics, which hopes to begin the trial as early as next month.

The melding of man and machine has long been a staple of science fiction. Indeed, the participants in Cyberkinetics's clinical trial, who have not yet been chosen, will have a cable sticking out of their heads to connect them to computers, making them look something like characters in "The Matrix."

But in real life, several research groups have already implanted devices in monkeys that allow them to control cursors on computer screens or move robot arms using their brainpower alone, setting the stage for the trial in people.

"Among many people in the field, there's a feeling now that the time is here for moving the technology to test in humans," said Dr. Richard A. Andersen, professor of neuroscience at the California Institute of Technology, who is working on his own device for the brain. Still, for the trial, there is trepidation mixed with anticipation.

"A disaster at this early stage could set the whole field back," said Dr. Dawn M. Taylor, a research associate at Case Western Reserve University and the Cleveland Veterans Affairs Medical Center, who is testing similar systems in monkeys.

Devices have long been implanted in the brains of patients with Parkinson's disease to deliver pulses of electricity that reduce tremors and rigidity.

But systems like BrainGate do not deliver current.

Instead, they listen to the electrical signals produced by the brain's neurons as they work. The aim is to discern a pattern of neuronal activity indicating the intention to initiate a particular physical movement.

In typical monkey trials of neural implants, the animals, which are not paralyzed, are trained to perform a task, like moving a cursor with a joystick, while a tiny subset of their neurons is monitored.

After different patterns of neuronal signals are matched with different body movements, cursor control is shifted to their brains.

In some studies, the monkeys eventually appeared to realize that they no longer had to move their arms to perform the tasks.

In a sense, this is a form of mind reading, scientists say. But in addition to passively letting its thoughts be read, the brain also learns to control the cursor actively, just as it acquires any new skill.

The quadriplegics in the trial will not be able to move their arms to train the system, making things a little harder. Instead, they must imagine moving their arms.

Researchers have already shown that this can be done. Dr. Philip Kennedy, a neurologist in Atlanta who started Neural Signals Inc., implanted electrodes into several severely disabled people starting in 1996, and at least one could type through this method, though only three words a minute.

Some other implants have been tested briefly on people undergoing brain surgery for other reasons. Dr. Jonathan R. Wolpaw of the New York State Department of Health has developed a system that does not require implants but uses electroencephalography to pick up brain waves using sensors attached to the scalp.

Though Cyberkinetics is not the first to try neural control in people, it seems the most intent on bringing a product to market, perhaps by 2007 or 2008, said its chief executive, Timothy R. Surgenor.

Started in 2001 and based in Foxborough, Mass., the company has raised $9 million for the project.

Cyberkinetics argues that its system will perform better than other systems tested on people so far. Devices that use sensors outside the skull do not pick up signals as clearly as electrodes under the skull. And though Dr. Kennedy implanted two electrodes per patient, the Cyberkinetics chip has 100 electrodes. That means more neurons can be monitored, providing clearer information, the company says.

To implant the chip, a small hole will be cut in the

patient's skull, above the ear. The chip, which measures about 2 millimeters (or just under one-tenth of an inch) square, will be placed on the surface of the brain at the motor cortex, which controls movement.

The electrodes, which are like spikes protruding from the chip's surface, will extend into the brain to a depth of 1 millimeter.

The surgery will be performed at Rhode Island Hospital by Dr. Gerhard Friehs, an associate professor of neuroscience at Brown and a co-founder of Cyberkinetics, who performed the operations on the monkeys. Another neurosurgeon without connection to the company will monitor the procedure to ensure that financial interests do not dictate proceeding with surgery if it is not safe.

Technicians from Cyberkinetics will later visit the participants, whose identities will not be disclosed at first, several times a week at their homes to test the system for an hour or two a day. The trial will last about a year, and then the chips will be removed in a second operation.

Some scientists question whether the benefits will outweigh the risks.

One reason is that the signals from the chip are carried out of the body by wires coming through the skull. When the system is to be used, a cable will be connected to the wires.

The cable will carry the signals to a cart full of electronic equipment that will analyze them and convey the results to the computer. The opening in the skin is permanent and poses a risk of infection.

"We don't like to hang around with wires coming out of our head," Dr. Kennedy said. His system used brain implants that transmitted signals by radio, so no break in the skin was required.

Some experts also question Cyberkinetics's requirement that participants in the trial be able to talk. Such people, the experts say, can control computers through other options, like speech recognition systems or head or eye movements.

"If you are only talking about moving a cursor up and down on the screen, you don't need to get into the brain to do that," said Dr. Miguel Nicolelis, professor of neurobiology at Duke.

In contrast, Dr. Nicolelis said, the system he is developing will control a robot arm, making three-dimensional movements that will be too complex to do without a neural implant. Dr. Kennedy performed his experiments on people who could not talk and had virtually no other means of communicating.

Mr. Surgenor of Cyberkinetics, however, said that having participants who could talk would speed development of the system.

"We need the feedback of what they are imagining when it doesn't work and what they are imagining when it works," he said.

Dr. Jon Mukand of the Sargent Rehabilitation Center in Warwick, R.I., who will be the principal investigator of the trial and will select the participants, said the system had been proved safe in tests on 18 monkeys.

Infections were rare and treatable, Dr. Mukand said, and the incidence should be even lower in people, who understand the risk.

Dr. Donoghue of Cyberkinetics said the prototypes for many medical devices, including pacemakers and cochlear implants, had involved wires coming out of the body.

One uncertainty is whether the implants will move around over time or cause scarring. Either could lead to loss of the neuron signal.

Another question is whether the system, if it does work, will prove superior to more mundane methods like voice recognition or even Dr. Wolpaw's electroencephalography system.

Cyberkinetics said it expected that its system would be faster than other methods, perhaps allowing people to type 20 to 30 words a minute, as fast as a healthy person could type on a BlackBerry hand-held computer.

Marcie Roth, executive director of the National Spinal Cord Injury Association, said the needs of paralyzed people varied. A system like BrainGate "could be fantastically useful for some people," she said.

Cyberkinetics said that it did not intend to sell the current version of BrainGate, but that it hoped eventually to offer an improved model. It would use miniaturized electronics and would be fully implanted in the brain, transmitting information without wires. The price is likely to be in the tens of thousands of dollars, the company said.

Eventually, the system may come in a form that does not have to be calibrated by technicians each time it is turned on. It would always be ready to use, as if it were a part of the body.

"You don't wake up and turn on your hand," Mr. Surgenor said.

http://www.nytimes.com/2004/04/13/health/13BRAI.html?ex=1082878578&ei=1&en=01947190ac6c1314