

Caltech study could help disabled

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Author: Elise **Kleeman**

PASADENA - The monkeys in Richard Andersen's laboratory at Caltech practice mind control. Without so much as twitching a muscle, they can drag a cursor across a computer screen or flex a robotic arm.

All it takes is a few tiny receptors in their brains, a bank of computers - and the insights of Andersen, a neuroscientist who this month was admitted into the prestigious Institute of Medicine.

Over the course of his years of research, Andersen has worked to expand scientists' understanding of how the brain functions. Now he stands poised to apply what he's learned toward giving new freedom to people trapped in unresponsive bodies.

Next year, pending approval from the Food and Drug Administration, Andersen plans to implant a small group of quadriplegics with devices that will give them - like the monkeys in his lab - new control over their worlds.

Such patients normally are not be able to move their limbs, and many cannot speak or breathe on their own.

If all goes well, Andersen said, "we would have them communicate through the computer, so they could do things like computer games, typing, e-mail, controlling their environment."

Such is the promise of the burgeoning field of neuroprosthetics.

Scientists have been working toward this sci-fi fantasy of plugging directly into the human brain for about the past 40 years.

In that time, Andersen said, "there have been big success stories, like the cochlear prosthetics" that have restored hearing for many by carrying sound information directly to the auditory nerve.

"But even though this has been going on for a long time, it seems like recently it's just taken off," he said. "I think in part it's because there have been advances in engineering ... and it's very multidisciplinary, so it requires not just physiology labs but clinicians, engineers, theorists."

Andersen's lab does most of its work in the brain's parietal lobe, a sort of "central station," where sensory signals and higher-level cognitive information go in, and decisions and goals go out.

"I think originally I was interested in (that area) because patients with lesions there from strokes and traumatic accidents have this very unusual set of deficits that are very interesting," he said.

Such patients ignore a part of the space around them, and also have problems making coordinated movements.

In healthy brains, however, the parietal cortex - located about an inch above each ear - can be harnessed as a window into how monkeys, and hopefully humans, plan movement.

"It's like listening to a group of people," Andersen said of recording the electrical firings in a parietal lobe's neurons. "Each one is saying one little bit of a paragraph, and you're putting them all together, so you can't just listen to one to get the whole story."

But it takes surprisingly few brain cells, only about 40 or 50 amidst millions and millions, Andersen said, to capture a snapshot of the subject's intentions.

The electric chatter is collected by a tiny array of electrodes, each one like a fine needle in a matchhead-sized pin cushion.

These electrodes are implanted onto the brain's surface at a precise location and are connected to wires running through a hole in the skull to a bank of amplifiers, converters and computers.

Shrinking the hulking size of many of these components is one of the many remaining challenges for the researchers.

Among them, "one of the main issues is longevity of the device," said Igor Fineman, a Huntington Hospital neurosurgeon who works with Andersen to perform the surgeries.

Because the brain's chemistry is like sea water, it slowly corrodes materials.

More challenging is the fact that, over time, the signal from the neurons tend to fade, Fineman said, because of scarring, or as the neurons shift away from the foreign intrusion.

For now, the neuroprosthetics can last from several months to years. Hopefully, Andersen said, one day they will continue to function for a patient's lifetime.

Fineman and Andersen won't be the first to implant neuroprosthetics into humans - the Massachusetts-based company Cybernetics has already tested similar technology on a small number of patients.

For their trials, they collect signals from a different region of the brain that more directly controls movement, called the motor cortex.

Connecting directly to the parietal cortex could have some advantages, however, Andersen said, including faster reaction times.

"I think in the long run, the field will target different parts of the brain to get different kinds of signals, so there will not be any particular area that's superior to all others," Andersen said. "After all, we have all those other areas for a reason."