New prosthetic hand restores sense of touch

WASHINGTON – To feel what you touch — that's the holy grail for artificial limbs. In a step toward that goal, European researchers have created a robotic hand that allows an amputee to feel differences between a bottle, a baseball and a mandarin orange.

The patient only got to experiment with the bulky prototype for a week, and it's far from the bionics of science fiction movies. But the research released Wednesday does form part of a major effort to create more lifelike, and usable, prosthetics.

"It was just amazing," said Dennis Aabo Sorensen of Aalborg, Denmark, who lost his left hand in a fireworks accident a decade ago and volunteered to pilot-test the new prosthetic. "It was the closest I have had to feeling like a normal hand."

This isn't the first time scientists have tried to give some sense of touch to artificial hands; a few other pilot projects have been reported in the U.S. and Europe. But this newest experiment, published in the journal Science Translational Medicine, shows Sorensen could not only tell differences in the shape and hardness of objects, but could also quickly react and adjust his grasp.

"It was interesting to see how fast he was able to master this," said neuroengineer Silvestro Micera of Switzerland's Ecole Polytechnique Federale de Lausanne, who led the Swiss and Italian research team. "He was able to use this information immediately in a quite sophisticated way."

Scientists have made great strides in recent years improving the dexterity of prosthetics. But the sense of touch has been a much more difficult challenge, and is one reason that many patients don't use their prosthetic hands as much as they'd like.

Consider: Grab something and your own hand naturally grasps with just enough force to hang on. Users of prosthetic hands have

to carefully watch every motion, judging by eye instead of touch how tightly to squeeze. The results can be clumsy, with dropped dishes or crushed objects.

“You always have to look and see what’s going on, so that’s what is so much different from this new hand that I tried,” Sorensen, 36, said in a telephone interview.

First, doctors at Rome’s Gemelli Hospital implanted tiny electrodes inside two nerves — the ulnar and median nerves — in the stump of Sorensen’s arm.

Those nerves normally would allow for certain sensations in a hand. When researchers zapped them with a weak electrical signal, Sorensen said it felt like his missing fingers were moving, showing the nerves still could relay information. Meanwhile, Micera’s team put sensors on two fingers of a robotic hand, to detect information about what the artificial fingers touched.

For one week, cords snaked from a bandage on Sorensen’s arm to the artificial hand, and the electrodes zapped the nerves in proportion to what the sensors detected. They essentially created a loop that let the robotic hand rapidly communicate with Sorensen’s brain.

“It is really putting the brain back in control of the system,” said biomedical engineer Dustin Tyler of Case Western Reserve University, who wasn’t involved with the European work but leads a team in Ohio that recently created and tested a similar touch-enabled hand. “That’s an important step.”

Added neurobiologist Andrew Schwartz of the University of Pittsburgh: “It shows with a few sensors and some pretty elementary technology, that they can recover a fair amount of functionality.”

To be sure Sorensen used touch, and didn’t cheat by looking or hearing telltale sounds, he wore a blindfold and headphones as Micera’s team handed him different objects.

“Suddenly I could tell if it was a hard object,” Sorensen recalled, describing sensations that changed along with his grip. “The response, the feedback from the arm to my nerves and to my brain, they came very strong.”

Micera cautioned that it will take several years of additional research to create a first-generation artificial hand that can feel, and looks more like a traditional prosthetic. First, they have to prove these nerve implants can last; for safety reasons, Sorensen’s were surgically removed after the experiment.

But a lot of work is under way.

In Ohio, Tyler’s team recently issued video showing a blindfolded man gently pulling stems from cherries without crushing them, thanks to similar implanted nerve stimulators and a sensor-equipped prosthetic hand. The main difference, said Switzerland’s Micera, is in how the nerve electrodes are implanted. The European approach puts them inside the nerve rather than around it for better control, but that’s more invasive and some researchers worry it could damage the nerve over time.

In Pittsburgh, Schwartz’s team is about to test another approach — a brain-controlled robotic hand for the paralyzed that would “feel” through electrodes implanted in a brain region known as the sensory cortex.

Whatever the approach, touch is a complex sense and these are all basic first steps involving how someone grasps, not more sophisticated sensations such as texture or temperature.

“There is definitely tremendous value to having a sense of touch, a sense of feeling from the hand,” said Tyler. “What that feeling is, how we use it — that’s yet to come.”