A Burst of Technology, Helping the Blind to See

By PAM BELLUCK
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Blindness first began creeping up on Barbara Campbell when she was a teenager, and by her late 30s, her eye disease had stolen what was left of her sight.

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Béatrice de Géa for The New York Times

Barbara Campbell is part of a worldwide experiment testing whether electrodes implanted in the eye can restore sight.

Reliant on a talking computer for reading and a cane for navigating New York City, where she lives and works, Ms. Campbell, now 56, would have been thrilled to see something. Anything.

Now, as part of a striking experiment, she can. So far, she can detect burners on her stove when making a grilled cheese, her mirror frame, and whether her computer monitor is on.

She is beginning an intensive three-year research project involving electrodes surgically implanted in her eye, a camera on the bridge of her nose and a video processor strapped to her waist.

The project, involving patients in the United States, Mexico and Europe, is part of a burst of recent research aimed at one of science's most-sought-after holy grails: making the blind see.

Some of the 37 other participants further along in the project can distinguish shapes from cups, tell grass from sidewalk, sort white socks from dark, distinguish doors and windows, identify large letters of the alphabet, and see where people are, albeit not details about them.

Multimedia

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An Artificial Retina

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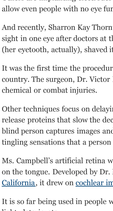

SCIENCE
Ways of Seeing
After losing her eyesight during adolescence to retinitis pigmentosa, Barbara Campbell recently received an artificial retina -- an experimental technology that might restore her vision.

Linda Morfoot, 65, of Long Beach, Calif., blind for 12 years, says she can now toss a ball into a basketball hoop, follow her nine grandchildren as they run around her living room and "see where the preacher is" in church.

"For someone who's been totally blind, this is really remarkable," said Andrew P. Mariani, a program director at the National Eye Institute. "They're able to get some sort of vision."

Scientists involved in the project, the artificial retina, say they have plans to develop the technology to allow people to read, write and recognize faces.

Advances in technology, genetics, brain science and biology are making a goal that long seemed out of reach -- restoring sight -- more feasible.

"For a long time, scientists and clinicians were very conservative, but you have to at some point get out of the laboratory and focus on getting clinical trials in actual humans," said Timothy J. Schoen, director of science and preclinical development for the Foundation Fighting Blindness. Now "there's a real push," he said, because "we've got a lot of blind people walking around, and we've got to try to help them."

More than 3.3 million Americans 40 and over, or about one in 28, are blind or have vision so poor that even with glasses, medicine or surgery, everyday tasks are difficult, according to the National Eye Institute, a federal agency. That number is expected to double in the next 30 years. Worldwide, about 160 million people are similarly affected.

"With an aging population, it's obviously going to be an increasing problem," said Michael D. Oberdorfer, who runs the visual neuroscience program for the National Eye Institute, which finances several sight-restoration projects, including the artificial retina. Wide-ranging research is important, he said, because different methods could help different causes of blindness.

The approaches include gene therapy, which has produced improved vision in people who are blind from one rare congenital disease, Stem cell research is considered promising, although far from producing results, and other studies involve a light-responding protein and retinal transplants.

Others are implanting electrodes in monkeys' brains to see if directly stimulating visual areas might allow even people with no eye function to see.

And recently, Sharron Kay Thornton, 60, from Smithdale, Miss., blinded by a skin condition, regained sight in one eye after doctors at the University of Miami Miller School of Medicine extracted a tooth (her eyetooth, actually), shaved it down and used it as a base for a plastic lens replacing her cornea.

It was the first time the procedure, modified osteo-odonto-keratoprosthesis, was performed in this country. The surgeon, Dr. Victor L. Perez, said it could help people with severely scarred corneas from chemical or combat injuries.

Other techniques focus on delaying blindness, including one involving a capsule implanted in the eye to release proteins that slow the decay of light-responding cells. And with BrainPort, a camera worn by a blind person captures images and transmits signals to electrodes slipped onto the tongue, causing tingling sensations that a person can learn to decipher as the location and movement of objects.

Ms. Campbell's artificial retina works similarly, except it produces the sensation of sight, not tingling on the tongue. Developed by Dr. Mark S. Humayun, a retinal surgeon at the University of Southern California, it drew on cochlear implants for the deaf and is partly financed by a cochlear implant maker.

It is so far being used in people with retinitis pigmentosa, in which photoreceptor cells, which take in light, deteriorate.

Gerald J. Chader, chief scientific officer at the University of Southern California's Doheny Retinal Institute, where Dr. Humayun works, said it should also work for severe cases of age-related macular degeneration, the major cause of vision loss in older people.

With the artificial retina, a sheet of electrodes is implanted in the eye. The person wears glasses with a tiny camera, which captures images that the belt-pack video processor translates into patterns of light and dark, like the "pixelized image we see on a stadium scoreboard," said Jessy D. Dorn, a research scientist at Second Sight Medical Products, which produces the device, collaborating with the Department of Energy. (Other research teams are developing similar devices.)

The video processor directs each electrode to transmit signals representing an object's contours, brightness and contrast, which pulse along optic neurons into the brain.

Currently, "it's a very crude image," Dr. Dorn said, because the implant has only 60 electrodes; many people see flashes or patches of light.

Brian Mech, Second Sight's vice president for business development, said the company was seeking federal approval to market the 60-electrode version, which would cost up to $100,000 and might be covered by insurance. Also planned are 200- and 1,000-electrode versions; the higher number might provide enough resolution for reading. (Dr. Mech said a maximum electrode number would eventually be reached because if they are packed too densely, retinal tissue could be burned.)

"Every subject has received some sort of visual input," he said. "There are people who aren't extremely impressed with the results, and other people who are." Second Sight is studying what affects results, including whether practice or disease characteristics influence the brain's ability to relearn how to process visual signals.

People choose when to use the device by turning their camera on. Dean Lloyd, 68, a Palo Alto, Calif., lawyer, was "pretty disappointed" when he started in 2007, but since his implant was adjusted so more electrodes responded, is "a lot more excited about it," he said. He uses it constantly, seeing "borders and boundaries" and flashes from highly reflective objects, like glass, water or eyes.

With Ms. Morfoot's earlier 16-electrode version, which registers objects as horizontal lines, she climbed the Eiffel Tower and "could see all the lights of the city," she said. "I can see my hand when I'm writing. At Little League games, I can see where the catcher, batter and umpire are."

Kathy Blake, 58, of Fountain Valley, Calif., said she mainly wanted to help advance research. But she uses it to sort laundry, notice cars and people, and on the Fourth of July, to "see all the fireworks," she said.

Ms. Campbell, a vocational rehabilitation counselor for New York's Commission for the Blind and Visually Handicapped, has long been cheerfully self-sufficient, traveling widely from her fourth-floor walk-up, going to the theater, babysitting for her niece in North Carolina.

But little things rankle, like not knowing if clothes are stained and needing help shopping for greeting cards. Everything is a "gray haze -- like being in a cloud," she said. The device will not make her "see like I used to see," she said. "But it's going to be more than what I have. It's not just for me -- it's for so many other people that will follow me."

Ms. Campbell's "realistic view of her vision" and willingness to practice are a plus, said Aries Arditi, senior fellow in vision science at Lighthouse International, a nonprofit agency overseeing her weekly training, which includes practice moving her head so the camera captures images and interpreting light as objects.

"In 20 years, people will think it's primitive, like the difference between a Model T and a Ferrari," said Dr. Lucian Del Priore, an ophthalmology surgeon at New York-Presbyterian Hospital/Columbia University Medical Center, who implanted Ms. Campbell's electrodes. "But the fact is, the Model T came first."

Ms. Campbell would especially like to see colors, but, for now, any color would be random flashes, Dr. Arditi said.

But she saw circular lights at a restaurant, part of a light installation at an art exhibition. "There's a lot to learn," she said. Still, "I'm, like, really seeing this."

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