BIOMEDICAL / BIONICS Engineering, lay audience

FEATURE

Birth of the Bionic Eye

In 2012, electrodes will bring eyesight to the blind

By ELIZA STRICKLAND / JANUARY 2012

Photo: David Yellen

SEEING THE SIGHTS Barbara Campbell's retinal prosthesis sends 30 images per second to her optic nerve.

When light hits Barbara Campbell's eyes, it triggers no response in her retinas, and no signals flash up her optic nerves to her brain. A genetic disease killed off her retinas' photoreceptor cells, leaving her completely blind by her 30s. But where her body failed her, technology rescued her. In 2009, at the age of 56, Campbell had an array of electrodes implanted in each eye, and she now makes her way through the world more confidently, aided by bionic vision.

Her sight isn't fully restored, not by a long shot, but the darkness has been replaced with rough shapes and patterns of light and dark. "The building where I live has a large light at the entranceway outside," says Campbell, who lives in New York City. "I hadn't been able to see that light in 16 years. Now, when I'm walking down the block, I can look up and identify the building."

The devices in Campbell's eyes come from Second Sight Medical Products. After 13 years of product development, the company's Argus II Retinal Prosthesis System is now hitting the market. In 2011 the company won regulatory approval in Europe [PDF], and eye surgeons there are just beginning to perform the implants. This year the Los Angeles–based company hopes to get approval from the U.S. Food and Drug Administration as well. "I didn't think it would take this long," says CEO Robert Greenberg, "but it's finally real."

TOP TECH 2012 Special Report

The process that allows the blind to see starts with a pair of sunglasses, which sport a tiny video camera mounted in the bridge just above the nose. The camera captures an image and sends it down a wire to a visual processing unit hanging on the patient's belt. That VPU—which is a little larger than a smartphone—converts the world's complexities into a 60-pixel image in black and white, which it sends back to transponders on the glasses. From there the image goes wirelessly to antennas wrapped around the sides of the eyeballs, and from there to the 60-electrode arrays that are tacked to the delicate retinas.

The Argus II system can't help all blind people, only those with degeneration of the retina's photoreceptor cells. The electrodes take the place of those damaged photoreceptors and stimulate the cells that are attached to the optic nerve. So far, Second Sight has concentrated on patients with retinitis pigmentosa—the disease Campbell has—but the company's device may also help with macular degeneration. Greenberg says that about 200 000 people in the United States and Europe could benefit from the implants.

Campbell was a volunteer in the second round of clinical trials. Her doctor, Lucian Del Priore, explains that patients need training to get the technology's full benefits. At first the medical team directly stimulates the electrodes. Says Del Priore: "We electronically project an image of a square onto the retina, and say, 'What does that look like?' And the patient says, 'It looks like an amoeba.' " The technicians have to compensate for differences in the distance between each electrode and the retina, Del Priore explains. "The distances have to be balanced, like balancing your stereo system."

Once the training and the balancing are done, however, patients gain a crude kind of vision—enough to make out doorways, the crosswalk on a street, the brightness of a face turned toward them. "We're not providing normal vision," says Greenberg. "We're providing cues and clues to help people navigate the world."

Second Sight's engineers are already thinking about their next move. Greenberg says a device with more electrodes (and thus more pixels) is likely, but adds that patients' vision can also be improved by using software tricks in the visual processing unit. The company is already experimenting with color vision.

"We've produced blues and oranges and yellows repeatedly," Greenberg says. "Blues seem to be the most emotionally rewarding. Almost universally, patients say, 'Please, show me that again.' "

This article originally appeared in print as "Future Vision."