

Artificial Vision Offers Ray of Hope for Blind *August 27, 2003*

Connie Schoeman began losing her vision in 1957 and is now blind. But since doctors placed a thin strip of electronics onto the back of her right eye in March, she has seen spots of light and bright shapes.

The type of vision being experienced by Mrs. Schoeman, 76 years old, may be remembered one day as a giant step forward for the blind. After years of research and laboratory prototypes, artificial vision now is being extensively tested in humans for the first time. During the past two years, 26 people in the U.S. and Europe have received a variety of experimental implants, and more surgeries are planned.

By **Antonio Regalado** in New York and **Gautam Naik** in London

The vision produced by these devices -- designed to stimulate nerves in the optical system or brain -- is extremely crude and not a cure for blindness. Many vision specialists worry that the efforts could provide false hope to the 45 million people world-wide, including 1.3

million Americans, who are legally blind. Nevertheless, recent experiments suggest that within 10 years commercial electronic implants could help some blind people navigate and perform daily activities.

In weekly training sessions conducted recently at the University of Southern California's Doheny Eye Institute, Mrs. Schoeman used a camera connected to the "artificial retina" in her eye to distinguish a white plate from a plastic knife. "It just looks like a number of lights. If it's real skinny, I know it's the knife," says Mrs. Schoeman, who began losing her sight when she was 29 because of retinitis pigmentosa, a disease that progressively kills retina cells but leaves the rest of the visual system intact.

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In its simplest form, vision is produced when light entering the eye is turned into electrical signals that are carried by the optic nerve to the brain's visual cortex. When that circuit is broken, blindness results. The idea of artificial vision is to replace the broken circuit with electronics -- including pinhole cameras, computer chips and electrodes wired to the nervous system.

The bionic devices tested so far include both those attached to the back of the eye itself and those implanted directly in the brain. Patients with both types of implants describe seeing multiple points of light and, in some cases, crude outlines of objects.

One U.S. researcher, William Dobbelle, has recently reintroduced a brain implant, a form of which was first tested in the late 1960s ([see related article](#)). Although his approach has drawbacks -- it requires large electrical currents that could prove dangerous -- some patients have eagerly paid to have the surgery done. Many scientists believe that brain implants ultimately will produce highly useful vision, but only when they become far more sophisticated devices that can communicate with individual neurons within the brain, a prospect that remains distant.

Placing electrodes in the eye has proved easier. During the past decade, work on these retinal implants has attracted growing government funding and commercial interest. Such implants zap electrical signals to nerves on the back of the eye, which then carry them to the brain. However, since these devices take advantage of surviving parts of the eye they will help only the subset of blind people whose blindness is due to retinal disease, by some estimates about 30% of the blind. Moreover, scientists don't believe any implant could help those blind since birth, because their brains never have learned to recognize vision.

A half-dozen companies in the U.S., Japan and Europe now are developing vision implants. Optobionics Inc., a Naperville, Ill., start-up, has implanted 10 people with an artificial retina under safety tests approved by the Food and Drug Administration. Second Sight Medical Products Inc. of Sylmar, Calif., built the artificial retina that USC ophthalmologists surgically implanted into the eyes of Mrs. Schoeman and two other volunteers.

The National Institutes of Health is spending \$12.5 million over five years to support Second Sight and its academic partners. Entrepreneurs in Germany have recently launched two companies -- **Retina Implant AG of Tubingen** and IIP-Technologies GmbH, in Bonn. IIP now is recruiting 20 volunteers for tests of its artificial retina design in Germany and at a clinic in Vienna. The German government has spent roughly €10 million (about \$10.9 million) during the past several years to kick-start artificial-vision research in that country.

Artificial-vision researchers take inspiration from another device, the cochlear implant, which has successfully restored hearing to thousands of deaf people. But the human vision system is far more complicated than that of hearing. The eye perceives millions of distinct points of light. Light entering through the pupil is converted to electrical signals by anatomical rods and cones, the light-sensitive cells in the retina. Those electrical pulses are carried through the optic nerve to the brain, where they yield images of the world.

By contrast, the retinal implant in use at USC is designed to yield just 16 points of light, by way of a grid of electrodes surgically attached to the retina. Mark Humayun and Eugene de Juan, the ophthalmologists who pioneered the device, also implanted a small computer chip and battery behind Mrs. Schoeman's ear. The chip conveys signals from a camera mounted on a pair of glasses to the implant's electrodes. The electrodes stimulate the retina, which conveys the signal through the optic nerve to the brain.

Since the implant's electrodes fill in only for lost retina cells, the technique won't work for those born blind or who have lost their eyes. Dr. Humayun says he explained that to musician Stevie Wonder, who approached the USC team in 1999 after word of progress with vision implants stirred the hopes of the blind.

The simple images patients see are produced by turning on different combinations of the 16 electrodes. One of Dr. Humayun's patients is able to make out a foot-high letter U from a letter H from a few feet away after scanning the letters for about 15 seconds.

It's not yet certain what level of vision will prove useful for the blind. Researchers say that to produce a simple rendering of a face, more than 600 electrodes will be needed. (Researchers hope someday to create implants with 1,000 electrodes.)

The USC researchers now are performing tests on dogs of an implant with 60 electrodes. Second Sight founder Alfred Mann, who also runs a company selling cochlear implants, says he thinks the 60-electrode device could be on the market within five years.

Bob Greenberg, president and chief executive of Second Sight, says, "Our expectation is that even these crude devices may help with mobility -- to see a door or a chair. The kind of resolution we are seeing in the clinic suggests it may help with tasks of daily living."

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