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A Second Chance at Sight

The bionic dream is to one day be able to replace human parts with biomedical cellular reconstructed organs or electromechanical systems that will restore or enhance physical abilities to pre-damaged conditions. The Hollywood dream of bionic people is still science fiction.

However, real progress has been made in the area of stimulating sight for people whose blindness is caused by macular degeneration or retinitis pigmentosa. This column describes the new and emerging biomedical technology of partial-sight-restoring technology.

(These medical conditions mentioned above definitely sound scary. So I especially want to emphasize to my younger readers, who might be fledgling hypochondriacs, that these diseases generally affect people my age, not theirs!)

The eye implant described here is the product of 20 years of research

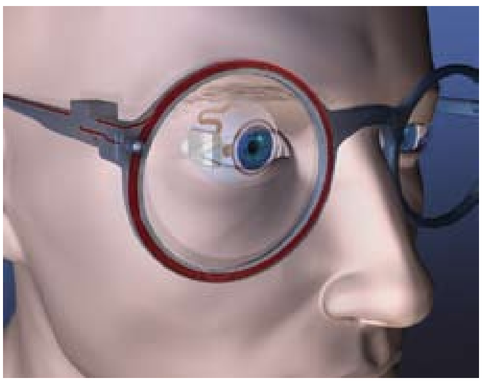

Photo 1—Eyeglass frames transmit video images to the implant's receiver coil.

and development. The Boston Retinal Research Project collaborators include many different types of engineers, scientists, and medical doctors from the Massachusetts Institute of Technology (MIT); the Massachusetts Eye and Ear Infirmary, which is a teaching hospital of Harvard Medical School; Cornell University; and the Boston VA Medical Center. The team now awaits FDA approval before they can start implanting their sight prosthesis in patients. They expect that their partial-sight-restoring prosthesis will be able to function, within the human body, without maintenance, for about 10 years.

The model now undergoing testing can only restore partial vision. Testing so far has supported the hypothesis that retinal stimulation of image-carrying electrical signals can create visual images in blind patients.

I think you will find the design and operation of this biomedical prosthesis fascinating. To simplify the discussion, imagine a patient whose eyesight can no longer benefit from corrective lenses in conventional eye glasses.

Once the hardware is surgically installed, stimulation of sight begins with a person wearing the Clark-Kent-looking (a.k.a., Superman) glasses shown in Photo 1. It is the frames—not the lens—of these glasses that play a major role in stimulating sight. These special frames contain a camera, transmitter coil, and battery power supply.

The frames transmit the camera's video images to the biomedical implant's outer ring receiver coil. Photo 2 shows the parts of the prosthesis that are surgically implanted. It consists of the gold ring receiver coil, microchip, and electrical circuitry. Although it doesn't appear so in the photograph, this implant is extremely thin. If you

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were to compare its thickness to a single strand of human hair, the hair would be extremely fat. The image processor of the implant contains 30,000 transistors encased in a titanium shell.

The implant receives the electrical power it needs to run its circuitry through resonant magnetic coupling between the eyeglass frame's transmitter coil and the receiver coil that surrounds the person's eyeball. Resonant magnetic coupling (WiTricity) is a recent MIT breakthrough that I discussed in last month's column.

The microchip in the prosthesis (Photo 3) receives video signals from the camera in the glasses. It transmits these electrical signals that represent pixels of light to still-working retina photoreceptor nerve cells that then pass the signals on through the optic nerve to the person's brain.

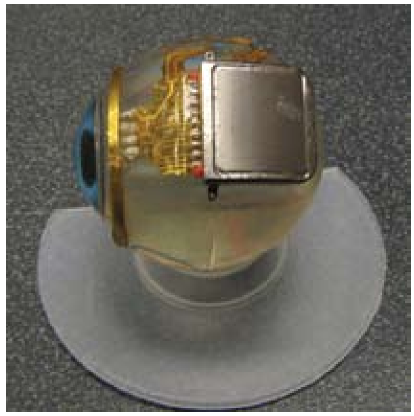
The prosthesis bypasses the damaged parts of the eye so the brain can receive the signals it needs to create the images that we see. The stimulating sight prosthesis is a bridge that connects the light rays

that normally enter a healthy eye directly to the retina cells that transmit converted light rays that are now electrical signals on to the optic nerve.

Keep in mind that this technology cannot restore normal sight. Like most new and emerging technologies it is currently a work in progress. But we can hope that in its present form it can provide enough stimulated sight for its recipients to recognize near objects so they can navigate the world better on their own.

Photo 2 (left)—Receiver coil, microchip, and electrical circuitry are surgically implanted in patient's eye.

Photo 3 (below)—Microchip on the partial sight-restoring prosthesis



Recalling the Facts

1. Define the term hypochondriac. Do you know anyone who fits that description?

2. Describe how the biomedical stimulated sight prosthesis discussed in this column works.