Optobionics' Artificial Silicone Retina

Christopher Pizza, 3/31/2003
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There are a number of diseases which affect the light sensing layers of the eye which greatly reduce the retina's ability to sense light signals. These diseases cause blindness and vision impairment in 10 million Americans, 1 million of which are considered legally blind. Researchers around the world are exploring ways of restoring sight to people with this retinal degeneration. Scientists are now experimenting with putting silicone chips into the human eye in place of this damaged tissue.

There are two important types of retinal degenerative diseases. The first is Retinitis Pigmentosa (RP), which is a general term for a number of diseases that affect the photoreceptor layer or "light sensing" cells of the retina. The second is Age-Related Macular Degeneration (AMD), which refers to a degenerative condition that occurs most frequently in the elderly. AMD and RP affect millions of people throughout the world. They are the most common causes of untreatable blindness in developed countries and, currently, there is no effective means of restoring vision.

Dr. Alan Chow, an ophthalmologist, and his brother Vincent Chow, an electrical engineer, combined their specialties in the early 1990's to create a company, Optobionics Corp. of Wheaton, Ill., and a microchip called the Artificial Silicon Retina. In cases where the retina fails, the nerves, behind the retina, which carry electrical impulses, still function. The damaged light receptors of the retina interrupt the connection between the eye and brain and cause blindness. The trick was to work around the damaged retina to stimulate those nerves.

The ASR™ microchip is a silicon chip, 2mm in diameter and 25 microns thick (less than the thickness of a human hair). It contains approximately 5,000 microscopic solar cells called microphotodiodes, each with its own stimulating electrode. These microphotodiodes are designed to convert the light energy from images into electrico-chemical impulses that stimulate the remaining functional cells of the retina in patients with AMD and RP types of conditions.

It is powered solely by incident light and does not require the use of external wires or batteries. When surgically implanted under the retina in a location known as the "subretinal space," the ASR chip is designed to produce visual signals similar to those produced by the photoreceptor layer. From their subretinal location, these artificial "photoelectric" signals from the ASR microchip are in a position to induce biological visual signals in the remaining functional retinal cells which may be processed and sent via the optic nerve to the brain.

The chip is implanted directly into the patients' eye. The surgeon starts by making three tiny incisions in the white part of the subject's eye. Each incision is no larger than the diameter of a needle. Through these incisions, the surgeon removes the gel in the middle of the eye and replaces it with saline. The surgeon then make an opening in the retina through which fluid is injected: the fluid lifts up a portion of the retina from the back of the eye and creates a small pocket in the "subretinal space" just wide enough to accommodate the ASR microchip. The surgeon then slides the implant into the subretinal space, much as one might slip a tiny coin into a pocket. Finally, the surgeon introduces air into the middle of the eye to gently push the retina back down over the implant. Over a period of one or two days, the air bubble is resorbed and replaced by fluids created within the eye. The procedure takes about 2 hours and is done on a hospital outpatient basis.

In January 2000, the US government's Food and Drug Administration (FDA) authorized Optobionics to implant their Artificial Silicone Retina microchip in up to ten retinitis pigmentosa patients in a two-year safety and feasibility study. In two-year clinical trials that began in June 2000, Optobionics implanted its microchip into the subretinal space of six patients with RP, to study its safety and feasibility in treating retinal vision loss. At this time Optobionics is correlating and assessing clinical data from all these patients: No patient has shown signs of implant rejection, infection, inflammation, erosion, retinal detachment, or migration of the implanted microchip.

The durability of the ASR chip in this location and the long-term safety, feasibility, and suitability of this procedure, however, are yet to be determined.

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