Photovoltaic Retinal Prosthesis for Restoring Sight to Patients Blinded by Retinal Injury or Degeneration

Principal Investigator: PALANKER, DANIEL V
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PUBLIC ABSTRACT

Ocular trauma can result in traumatic retinopathy, which, like retinal degeneration, leads to blindness due to loss of photoreceptors. Currently, there is no therapy for such conditions, and the loss of sight is permanent. Sight can be restored to some extent by patterned electrical stimulation of the remaining inner retinal neurons. Photovoltaic subretinal prosthesis directly converts light into pulsed electric current in each pixel, stimulating the nearby neurons. Visual information is projected onto retina by video goggles using pulsed near-infrared light. Testing of this technology in rats blinded by retinal degeneration demonstrated that their visual acuity was only twice lower than native acuity in the normally sighted animals. Modular design of these wireless arrays allows scalability to thousands of pixels, and combined with the ease of implantation, offers a promising approach to restoration of sight in patients blinded by retinal degenerative diseases.

We propose to advance this remarkably successful technology towards clinical testing, including the following: addition of the biocompatible protective coating for long-term implantation in human patients, fabrication of the video goggles with a camera, image processing software, and user interface for physicians and patients.

This technology will benefit patients with traumatic retinopathy and degenerative retinal diseases such as retinitis pigmentosa (RP) and age-related macular degeneration (AMD). RP is the leading cause of inherited blindness in the young population, and currently there is no effective treatment. AMD is the major cause of vision loss in people over 65 years in the United States. Development of wet-type AMD and associated vision loss can be slowed down pharmacologically, but there remains no cure, as there is no treatment for the dry form of AMD. As the life expectancy increases, the age-related vision loss is becoming a critical issue. The National Eye Institute estimates nearly 3 million people in the United States will have moderate to severe vision loss due to retinal degenerative diseases by 2020.

If successful, photovoltaic retinal prosthesis with 70 um pixels is expected to provide visual acuity close to 20/200, and after the described preparations to the clinical use, will be commercialized in collaboration with an industrial partner. Additional development of the three-dimensional version of the implant might allow twice smaller pixels, corresponding to the visual acuity level of 20/100.

Such level of vision will allow independent ambulation, reading of large fonts, face recognition, enabling independent and productive life to the Service Members, Veterans and their family members.

The clinical trials are expected to begin within a year after completion of the proposed research and development program.