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Intraocular Microdisplay Projection for Vision Restoration After Corneal Blindness

Principal Investigator: YU, CHARLES
Institution Receiving Award: STANFORD UNIVERSITY
Program: VRP
Proposal Number: VR180058
Award Number: W81XWH-19-1-0542
Funding Mechanism: Investigator-Initiated Research Award
Partnering Awards:
Award Amount: $797,013.00

View Technical Abstract

PUBLIC ABSTRACT

The cornea is the front clear window into the eye through which light must pass in order for the eye to see. Because of its location at the front of the eye, it is the structure most exposed to military-relevant trauma such as blast, chemical, and thermal injury. About 36% of eye injuries in Operation Iraqi and Enduring Freedom involved the cornea. Future beam weapons such as infrared and UV lasers and microwaves will be primarily absorbed by the cornea when hitting the eye.

When the cornea is injured and blood vessels grow onto the cornea, there is currently no effective treatment because corneal transplantation (replacing the cornea with a cornea from a deceased donor) does not work in this situation due to the high risk of rejection. Plastic button placements into the cornea have been performed but these are exposed to the external environment and are at high risk of infection and other complications such as falling out. In addition to disease, there are thousands of patients who suffer corneal injuries in work-related accidents. Due to the industrial nature of many ocular chemical and thermal burns, corneal injury disproportionately affects those in the prime of their life. Lastly, 12.7 million people around the world are unable to obtain corneas for transplantation due to a shortage of donors.

Building on the most recent developments in state-of-the-art high-resolution small-display technology, we have created a tiny projector (like a movie projector) that can be implanted into the patient's eye (intraocular). The device can wirelessly receive video data and power from a camera and processor positioned upon the frame of a pair of glasses. A lens focuses the image onto the retina. This in effect will place a miniature movie projector inside the eye, so that the patient will be able to see a projected image even with a completely scarred cornea or even if the eyes are closed. This design is superior to currently used devices because it is completely covered and not exposed to infection and it does not require cornea tissue to be collected from donors. The risks of our implant are that it may become dislocated or there may be leakage of liquid around the cable. Both of these can be fixed with further surgery. We have demonstrated prototypes of this device and discussed our published findings that this is a feasible technology. In this study, we propose to test this type of device in animals.

Our first aim is to build 15 of these projectors. We have already demonstrated our ability to produce fully functional projector implants, so this aim is just to build more of them. Our second aim is to perform the implantation surgery on 15 rabbits. We will check these animals every week for complications to determine the long-term safety of this implant. Also, every month we will use a method of measuring the brainwaves (VEP) of the rabbits after showing them specific pictures to figure out how well they are seeing. The brainwaves will increase if they are seeing, whereas they will not change if the rabbits are not seeing. This is a well-established way of checking animal (and baby) vision. At the end of 6 months, we will remove the eyes from the rabbits and examine them carefully to see if there were any complications.

This project will provide the needed information to establish a new type of sight restoration devices. It will pave the way for clinical trials to allow for the use of such a device to restore vision in humans, which could benefit thousands of Veterans and millions of civilians. A device could be available for use by patients within 5 years. In the future, this type of device could also enhance normal vision and provide Soldiers with super-normal visual abilities such as night vision.

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About Us

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