Layer-by-Layer Bioprinting of Stem Cells for Retinal Tissue Regeneration

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Institution Receiving Award: CALIFORNIA, UNIVERSITY OF, SAN DIEGO
Program: VRP
Proposal Number: MR130388
Award Number: W81XWH-14-1-0522
Funding Mechanism: Vision Research Program - Hypothesis Development Award
Partnering Awards: Award Amount: $250,000.00

PUBLIC ABSTRACT

Eye damage is a pervading illness in today's society, and more specifically accounts for the fourth most prevalent injury in military combat today. From 2002 through 2007, 13% of the U.S. soldiers endured significant combat ocular trauma in Operations Iraqi and Enduring Freedom. Retinal detachment is among the most common impairments leading to vision loss. Current research aims to regenerate the diseased retina by injecting a variety of cell types, with the hope that they would integrate within the host retina and restore vision. Unfortunately, these initial studies have shown that a simple injection technique gives rise to poorly localized tissue grafts.

We propose to develop a 3D printing technique coupled with retinal stem cell to create a multilayer tissue construct that could be implanted for retinal regeneration. Our research will address two focus areas in the Fiscal Year 2013 Vision Research Program Hypothesis Development Award: (1) mitigation and treatment of traumatic injuries, war-related injuries, and diseases to ocular structures and the visual system and (2) vision restoration following traumatic injury. As an emerging and disruptive technology, 3D bioprinting offers a revolutionary approach to retinal regeneration. We aim to print retinal stem cells and biomaterials in an anatomically correct fashion, providing a distinct advantage over current treatments.

Our ultimate goal is to develop artificial retina tissues to eliminate the current dependency on retina donor tissue and provide a new strategy for restoring vision. Three-dimensional bioprinting, which uses biomaterials, cells, proteins, and other biological compounds as building blocks to fabricate 3D structures, offers novel approaches that can accelerate the realization of anatomically correct tissue constructs for transplantation. The proposed research will benefit Service Members, Veterans, and/or their family members by providing a novel therapeutic approach for retinal repair and regeneration.