Joint Department of

BIOMEDICAL ENGINEERING

UNC CHAPEL HILL | NC STATE UNIVERSITY

B M E S e m i n a r S e r i e s P r e s e n t s

"Microfabricated Drug Delivery Devices for Single Injection Vaccination"

Kevin J. McHugh, PhD
Postdoctoral Fellow
Langer Lab
Massachusetts Institute of Technology

Kevin McHugh is a Ruth L. Kirschstein Postdoctoral Fellow in Dr. Robert Langer's laboratory at the Massachusetts Institute of Technology (MIT). His current research focuses on the development of microfabricated parenteral and intradermal delivery platforms for the controlled release of therapeutics and diagnostic agents. His other research interests include the use of quantum dots for disease characterization, non-invasive imaging for studying in vivo release kinetics, and organ-on-a-chip microfluidic devices for drug evaluation, disease modeling, and tissue engineering. Prior to working at MIT, Kevin received his B.S. in Biomedical Engineering from Case Western Reserve University in 2009 and Ph.D. in Biomedical Engineering from Boston University in 2014. As an undergraduate, Kevin worked in the laboratory of Dr. James M. Anderson evaluating the foreign body reaction to novel polymers designed for tissue engineering and drug delivery applications. Then, as a graduate student, Kevin worked in Dr. Magali Saint-Geniez's laboratory at Harvard Medical School where he designed a nanoporous retinal tissue engineering scaffold and developed a computational model for predicting the progression of age-related macular degeneration.

ABSTRACT

Each year 1.5 million deaths are caused by vaccine-preventable diseases worldwide. Many of these deaths are centralized in the developing world where healthcare access is limited due to poor infrastructure. Despite their status among the most effective and cost-effective therapeutics, vaccines typically require that multiple doses be administered over the course of months. To overcome this challenge, we have developed a microparticle platform that mimics the timing and kinetics of traditional vaccination schedules to confer immunity after a single injection. Microfabrication, soft lithography, and polymer sintering were used to create microparticles consisting of a polymer shell surrounding a vaccine-filled core. By varying the properties of the polymeric shell such as molecular weight, end group, and copolymer ratio, we are able to modulate release timing from as little as one week to greater than three months. Using this approach, we have achieved immune responses from a single injection of particles that were non-inferior to multiple injections of soluble antigen administered over time using both model and clinically-relevant vaccines. Ultimately, we hope to use this platform to administer the complete set of childhood vaccines in a single injection at birth in order to improve vaccination rates and eliminate vaccine-preventable infectious disease.

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