MedicalXpress

Microfluidic devices advance 3-D tissue engineering

October 6 2010

A research team, co-headed by Dr. Woo Lee and Dr. Hongjun Wang of Stevens Institute of Technology, has published a paper describing a new method that generates three-dimensional (3D) tissue models for studying bacterial infection of orthopedic implants.

Dr. Joung-Hyun Lee of Stevens, and Dr. Jeffrey Kaplan of the New Jersey Dental School, are co-authors of the research. Their paper, appearing in the journal *Tissue Engineering*, demonstrates a physiologically relevant approach for studying infection prevention strategies and emulating antibiotic delivery using 3D bone tissues cultured in microfluidic devices.

With over 1 million hip and knee replacement procedures being performed in the United States every year, orthopedic implants have become relatively common. Despite advances in implant design, hospitals have been unable to address bacterial infection, the leading cause of failure in orthopedic implants. A significant barrier to successfully developing infection-fighting drugs or biomaterials has been the inadequacy of laboratory equipment to create clinically relevant environment with traditional in vitro methods.

The researchers seeded 0.02 mL microfluidic channels with osteoblasts and inoculated the channels with Staphylococcus epidermis bacteria, a common pathogen in orthopedic infections. Nutrient solutions were pumped through the channels at a concentration and flow rate mimicking conditions within the human body. Bone tissue cells and bacteria within

the channels were imaged with a microscope and effluent was analyzed for bacteria count.

Microfluidic devices, together with finely-tuned dynamic flow settings, have the potential to provide realistic bone tissue models in clinical scenarios. As opposed to the static 2D Petri dish surfaces, microfluidic channels present a realistic environment for cells to grow and adhere in three dimensions. Dynamic fluid motion through the channels—with solutions potentially carrying antibiotics or other novel drugs—further mimics real-world conditions previously unrealizable in a lab setting.

More information: The researchers' published paper is a preliminary demonstration of dynamic microfluidic cell cultures and work continues in the lab to establish successful applications of the technology and processes. The article can be found online.

Provided by Stevens Institute of Technology