Biofabrication of 3-Dimentional Polymeric Hydrogels for Tissue Regeneration Scaffolds and Delivery Devices

Chowdhury, Naisha (School: Pleasant View School)

A key component of regenerative medicine is providing material scaffolds to function as supporting structures as well as delivery systems of therapeutic molecules or cells. Scaffolds and delivery cells can bioprinted. However, bioprinting is currently limited by a lack of suitable and advanced bioinks. The purpose of this research is to design a bioink which can be used to create hydrogels which have added properties of biodegradability and drug delivery. These hydrogels can be used for tissue-specific regenerative systems and can be printed into shape-specific scaffolds through various biofabrication methods. Double network gels were created from the crosslinking of PEG with PLLA-PEG-PLLA micelles. Hydrophobic drugs, Tetracycline and Prednisone, were encapsulated in the PLLA-PEG-PLLA micelles. Layered hydrogels were then created using different ratios of the micelle and PEG mix. The hydrogels have controlled mechanical strengths and can be fabricated into shape-specific implants and implant coatings using three-dimensional printing. The micelles encapsulated the drugs so these micelles can be used in hydrogels for scaffolds. The development of responsive hydrogels can serve as a platform for fabricating tissue regeneration scaffolds with sensing or programmable capabilities. Customized hydrogels provide the release of therapeutics in a controlled spatiotemporal manner to facilitate regeneration of tissues. With the addition of controlled degradability and drug delivery capability, these hydrogels can be specifically tailored for various implant applications.

Awards Won: