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Colloidal gels: A new class of biomaterials for tissue regeneration

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Abstract

Traditionally, scaffold materials for musculoskeletal tissue engineering are either hydrogel-based or solid-based (e.g., polymeric, ceramic, or metallic). We have developed an entirely new class of biomaterials for tissue regeneration based on colloidal gel technology. Colloidal gels are paste-like, shear thinning materials made of nanoparticles that interact through electrostatic forces, van der Waals attraction, and steric hindrance. These materials are thus malleable, they 'set' after placement, and they may facilitate resorption, tissue integration, and rapid tissue remodeling. Thus, colloidal gels possess unique advantages to traditional scaffolds as hydrogels are prone to leaking from the defect site prior to polymerization and because solid scaffolds cannot be molded into an irregularly-shaped defect. Although these materials can be utilized by any application where a moldable material is desirable, our team is exploring their use in cranial defects. We established proof-of-concept of these materials first by exploring oppositely charged poly(D,L-lactic-co-glycolic acid) (PLGA) nanoparticles, where shear thinning and recovery properties were observed. Additionally, the PLGA particles were implanted in rat cranial defects, where enhanced cranial defect regeneration was observed. We are now investigating natural materials, found within the extracellular matrix of tissues that have been modified to perform as colloidal gels. Currently, we are characterizing the shear thinning and recovery properties of different colloidal gel component ratios. In addition, we are also exploring the use of colloids in traditional hydrogels to allow for surgical placement prior to polymerization.

Biography

Emily Beck is a National Science Foundation Pre-Doctoral Fellow and a Bioengineering Ph.D. student at the University of Kansas.