Docket #: S19-552

Collagen-Based Hydrogels for Cell and Growth Factor Delivery

Collagen-based hydrogels behave similarly to the native tissue microenvironment, thus are widely used as scaffolds for encapsulating cells or molecules like growth factors. Collagen solution is an injectable liquid until it crosslinks at 37 C and physiological pH. However, dilution or leakage of the hydrogel once injected into the body can be problematic for regenerative medicine applications. Moreover, low viscosity and structural instability can limit its use as a bioink in 3D bioprinting. To improve the viscosity, stability, and mechanical properties of the collagen matrix, the inventors incorporated alginate and calcium sulfate (CaSO4). This novel alg/col hydrogel is shear-thinning and injectable through commercially available needles. The storage modulus and viscosity of these hydrogels can be tuned by altering the collagen content or CaSO4. Human mesenchymal stem cells (hMSCs) have >90% post-injection viability over 7 days and significant proliferative capacity. The encapsulated stem cells are functional and retain the ability to differentiate.

Applications

- Delivery of cells and/or growth factors for regenerative medicine purposes, including:
- Minimally-invasive surgeries
- Treating rotator-cuff injury using athroscopy
- Treating osteonecrosis
- As a bioink in 3D bioprinting of cellular constructs

Advantages

- Injectable through commercially available needles
- Highly stable and resistant to dilution or leakage

- Compared to pure alginate hydrogel, alg/col hydrogel has improved biocompatibility, cell-interactive ligands, and bioresorbability
- Preparation of the hydrogel does not require specific processing steps or instrument
- Precursor solutions of the alg/col hydrogel can be stored, mixed with patient cells, and used in the operation room

Publications

- Moeinzadeh, SM., et al. In-situ stable injectable collagen-based hydrogels for cell and growth factor delivery. *Materialia* 2021; 15: 100954
- Park, Youngbum, et al. "Dual delivery of BMP-2 and IGF-1 through injectable hydrogel promotes cranial bone defect healing." *Tissue Engineering ja* (2022).

Patents

- Published Application: 20220054639
- Issued: 12,133,893 (USA)

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