Docket #: S20-146

In situ forming gel constructs for ocular tissue regeneration

Researchers at Stanford University have engineered chemically crosslinked in situ-forming gels that can mimic corneal stroma. Corneal injury, which affects millions worldwide, can be effectively treated by corneal transplantation but have limited effectivity and accessibility due to the global shortage of donor corneas, and the risk of surgical complication. The inventors have engineered hydrogels, biocompatible, naturally occurring polymers, for the sutureless replacement of damaged cornea tissue which aims to improve vision in patients. Compared to other biomaterials developed for tissue regeneration, these hydrogels are bio-orthogonally crosslinked, eliminating the need for photo-initiators or reactive side products that would otherwise limit their clinical use. The researchers demonstrate desirable biocompatibility, gelation times, and optical and morphological properties in vitro, in vivo, and ex vivo. They show in corneal wound animal models that gel application enabled regeneration of corneal cells and decreased scarring, with complete restoration in corneal curvature.

Stage of Development
The inventors have demonstrated the utility of the biomaterial for cornea repair and regeneration in vivo using rabbits as an animal model, and are working towards characterizing its functional effects on vision.

Applications

- Regenerative medicine
- Tissue engineering
- Wound healing

Advantages

- More easily administered compared to transplantation, which requires meticulous dissection and suture placement
- Addresses donor corneal supply issues for cornea transplantation
- May decrease infection and rejection in patients who require transplants
- Does not require initiators or catalysts which would limit their clinical use

Publications

- Chen F, Le P, Fernandes-Cunha GM, Heilshorn SC, Myung D. 2020a. Bio-orthogonally crosslinked hyaluronate-collagen hydrogel for suture-free corneal defect repair. Biomaterials 255:120176.
- Chen F, Le P, Lai K, Fernandes-Cunha GM, Myung D. 2020b. Simultaneous Interpenetrating Polymer Network of Collagen and Hyaluronic Acid as an In Situ-Forming Corneal Defect Filler. Chem Mater 32:5208–5216.

Patents

- Published Application: WO2021222612
- Published Application: 20230263943
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