Title: Novel Adhesive and 3D-Printable Biomaterials for Corneal Tissue Engineering

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Abstract

3D-bioprinting enhances tissue engineering, allowing the precise control and creation of cornea-mimicking structures to address the global shortage of donor corneas(*1*). The emerged technology created a need for new and tailorable 3D-printable bioinks. Non-biocompatibility, weak wet adhesion, poor mechanical strength, need for UV-light or harmful crosslinkers are major challenges of currently available options.

We have modified the previously reported hyaluronan-based adhesive bioink (*2*) with multiple catechol derivatives. Degree of modification was determined with both ^{1}HNMR and UV-Vis spectroscopy. Mechanical characterization involved rheological measurements to assess viscosity, shear thinning, and storage (G') and loss (G'') moduli of hydrogels, along with compression testing for self-healing capability and tensile testing for adhesion of synthesized materials. Finally, we printed grids through a 32G needle to characterise printability.

NMR proved successful modification of hyaluronic acid without compromising the cell-friendly crosslinking method. Crosslinked bioink remains soft but could be handled and showed shear thinning behaviour critical for extrusion printing and good shape fidelity. We could see differences of printability between the catechol derivatives. Additionally, tissue glued together with the ink could carry loads and could be stretched multiple times of its own length.

Developed materials fill demands of next generation bioinks with excellent printability, stability and biocompatibility. They are elastic and adhere to surfaces and tissue. The hydrazone crosslinking method is dynamic; the structure heals itself after subjected to deforming stress. These adhesive bioinks show promise for soft tissue engineering applications and have unique adhesive properties.

References
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