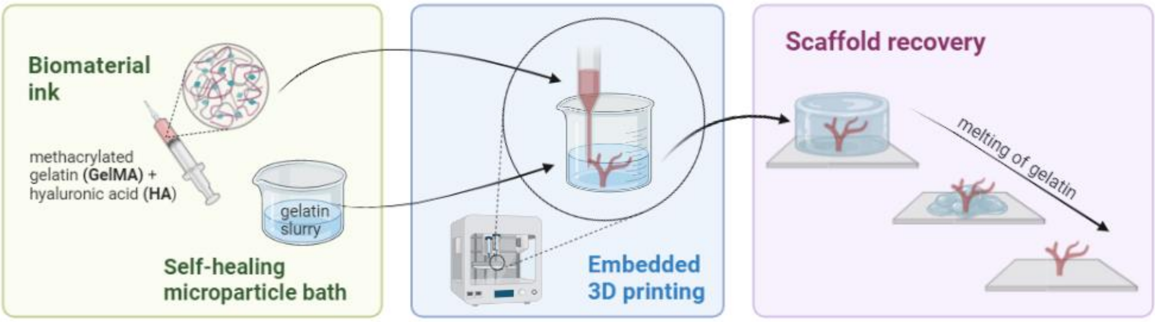
Embedded printing of branched vascular channels – FRESH approach

Lack of functioning vasculature system within a tissue model can remain a significant barrier for the practical application of such constructs, especially *in vivo*. Therefore, the project is guided by a hypothesis that the vascularization of the artificial tissue can be overcome by developing new 3D-printing strategies using methacrylated gelatin (GelMA) and hyaluronic acid (HA) biomaterial inks. Conventional extrusion bioprinting requires a high viscosity bioink to improve the printability and high stiffness to support itself to keep shape fidelity, which subsequently has negative effects on cell viability, migration, or functioning. Nevertheless, low viscosity inks cannot be printed as standalone structures. In cases as such a support bath that offers temporary and omnidirectional support can stabilize the soft and overhanging material, preventing structure collapse before solidification. As such a new method called freeform reversible embedding of suspended hydrogels (FRESH) can be an alternative way to create vascular channels.In this project a support bath consisting of a gelatin slurry will be used to support the creation of vascular branched scaffolds from gelatin-hyaluronic acid hydrogels. Light curable biomaterial ink will be used to 3D print vessels, by the extrusion of the material in a vertical manner. Following the photocuring, gelatin termo-reversible bath will be dissolved, revealing the printed vessel-structure. In this project you will focuse on the optimization of a crosslinking method employing visible light photo-crosslinking and investigation of inks and hydrogels rheological behavior, to determine the most promising formulation for FRESH printing. The last step will cover the fabrication of 3D hydrogel scaffolds (in the form of tubes) and their characterization. Quantitative characterization of embedded printing will be performed using cross-sectional images of the printed structure before and after the removal of suspension bath.Hopefully, the resulting hydrogels may become promising materials to obtain vessel-like structures with branched organization, which is not possible using conventional 3D printing techniques.



Abstract of the Master thesis project' created in Biorender.com

Related literature:

- https://doi.org/10.1021/acsami.0c05096
- https://doi.org/10.1016/j.tibtech.2019.12.020
- https://doi.org/10.1016/j.procir.2022.06.064

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