On Chip High Definiton 3D Bioprinting of Microvascular Structures

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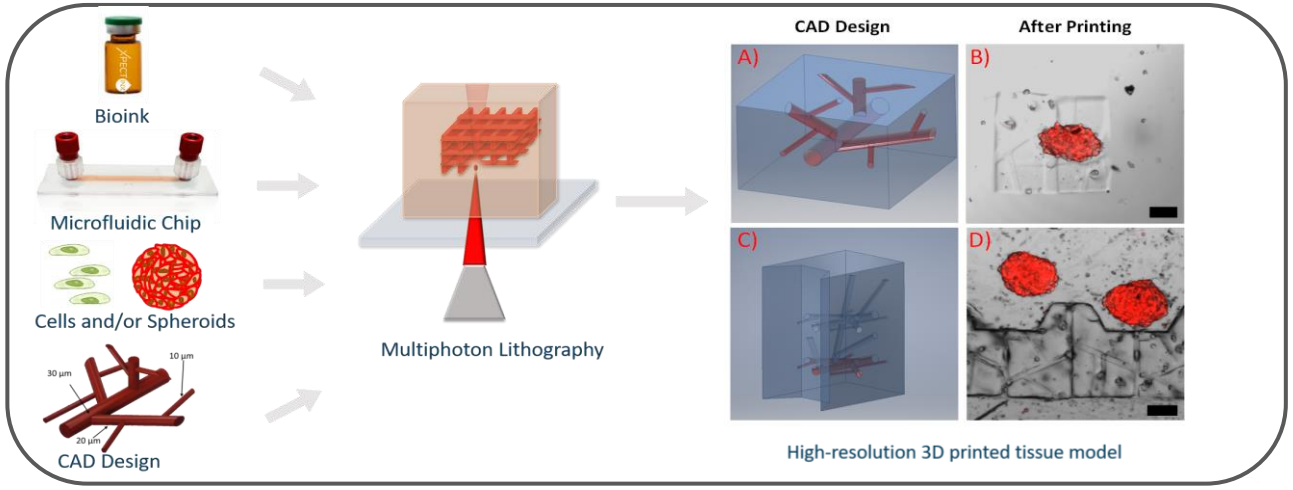
Introduction

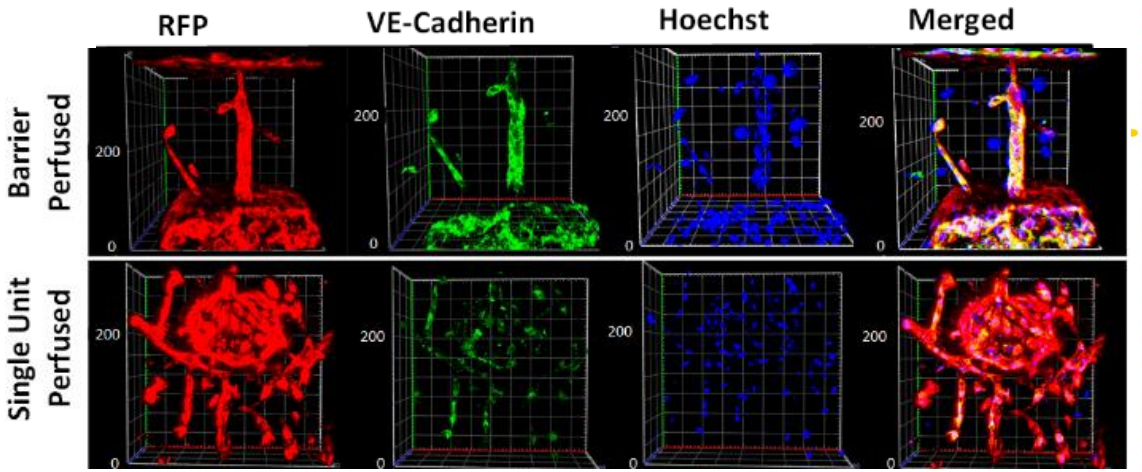
One of the central challenges in tissue engineering is the lack of vascularization in the fabricated organ-on-a-chip models. Most of the traditional approaches can offer promising strategies to form vascularized tissue models but they often lack the resolution to produce channels in the microvascular range (under 30 µm). The present work focuses on the high-resolution bioprinting of a biocompatible extracellular matrix mimic hydrogel in the presence of cells to produce microvascular structures directly on-chip using two-photon polymerization.

Materials and Methods

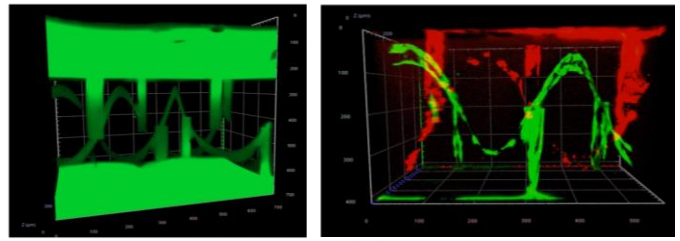
Red-fluorescent protein labelled human umbilical vein endothelial cells (HUVEC) spheroids with adipose derived stem cells (AST/TERT1) were 3D printed to fabricate microvascular structures using a biocompatible hydrogel bioink. The cell migration and alignment was followed over 5 days via laser scanning confocal microscopy in static and perfused culture and the intercellular junctions were immuno-stained using an anti-VE-Cadherin stain.



Results



An intertwined spiral structure was 3D printed and ASC-GFP spheroids were seeded on one side while RFP-labelled HUVECs spheroids were seeded on the opposite side of the chip to create two separate compartments for the generation of vascular structures with a high degree of precision.



Conclusion

We have established and optimized the high-resolution bioprinting of small diameter microcirculation networks based biocompatible bioinks directly on a chip in the presence of endothelial cell spheroids an/or supporting cells to facilitate the fabrication on vascularized organ and tissue models.

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