# Towards Vascularized Tissue blocks Using a Suspension Bioprinted Blood Vessel

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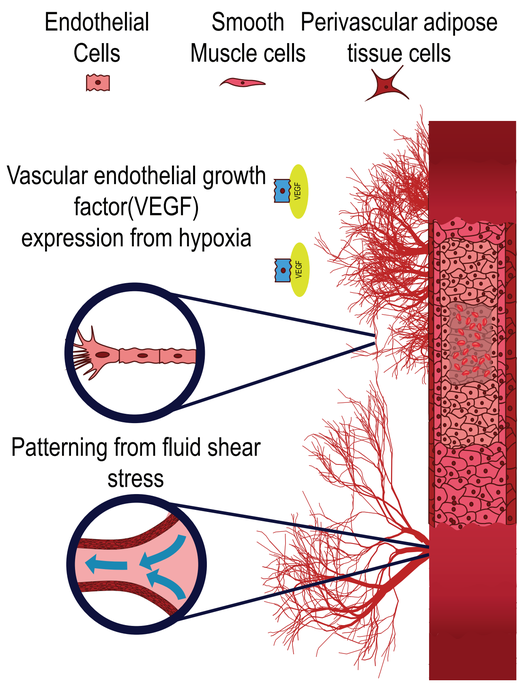
## The Challenge

Cell composition of a vessel

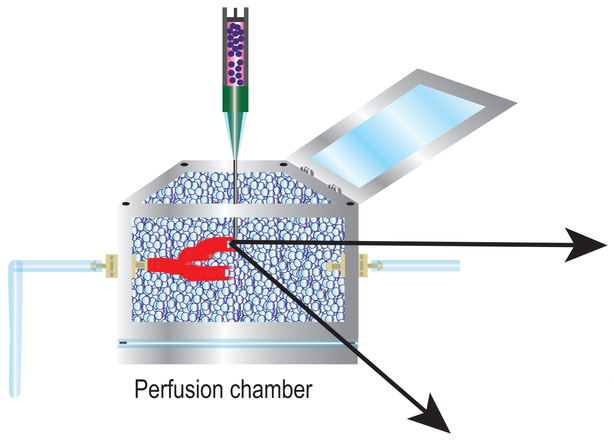



Artificial tissue constructs are being developed in order to address the need for organ transplants and accurate disease models. The current artificial tissue construct upscaling has been hindered by the lack of controlled vascularization. Without vasculature, the tissue constructs cannot receive nutrients essential for their survival, but also lack the stimuli that determine the tissue's biophysical properties i.e. cell fate determination, cell to cell junctions, and cell orientation. Contemporary biofabrication methods, have not yet managed to combine the high resolution necessary (<20μm for the fine features of the capillary vessels) with the ability to intervene to the construct at different time points, in order to mimic the natural process of angiogenesis.

## Our Approach

Liquid-like hydrogel suspensions have offered the ability to print structurally complex designs which do not need support structures. We focus on the effect of the interstitial space between the microparticles forming the embedding bath, as well as the interaction of spheroids with the material comprising the hydrogel suspension. a)Approach illustration b) spheroid compaction over time c) Size distribution of achieved microgel suspensions and indicative pictures.d) Bright-field microscopy images of the particles comprising the embedding baths.

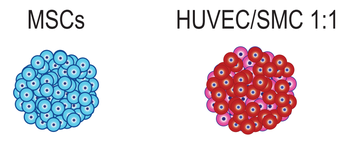
**a)** Spheroid ink embedded bioprinting



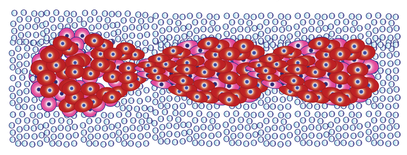

For suspension printing:

$\langle F \rangle_{particle} < \langle F \rangle_{spheroid}$

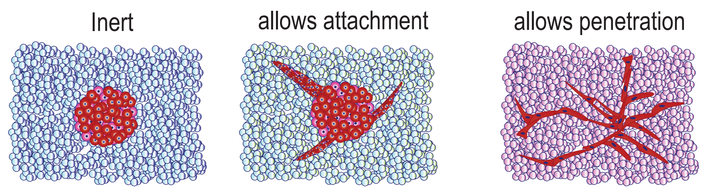
Spheroid cell composition variation



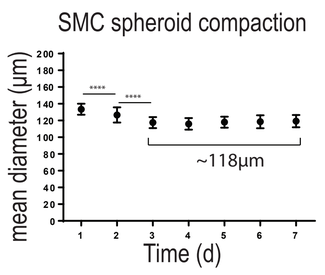

Spheroids in proximity fuse

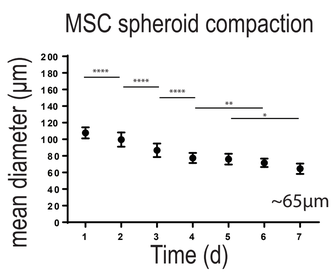


Different embedding bath materials mitigate a different response from the spheroids

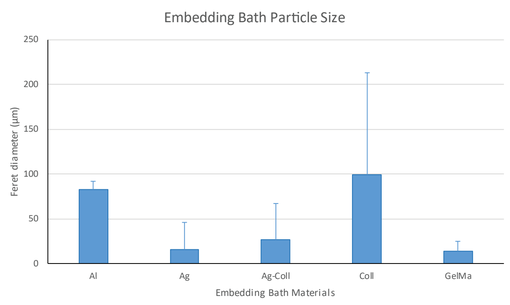



**b)** Spheroid size distribution

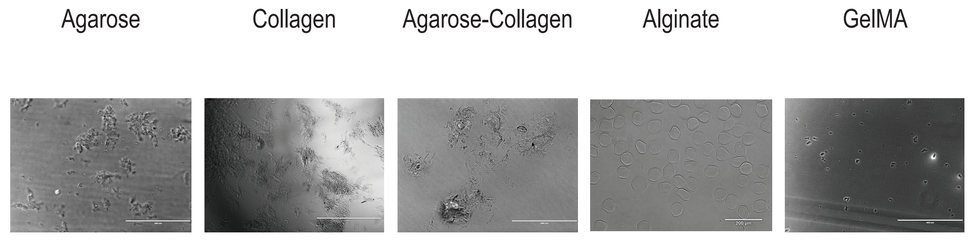


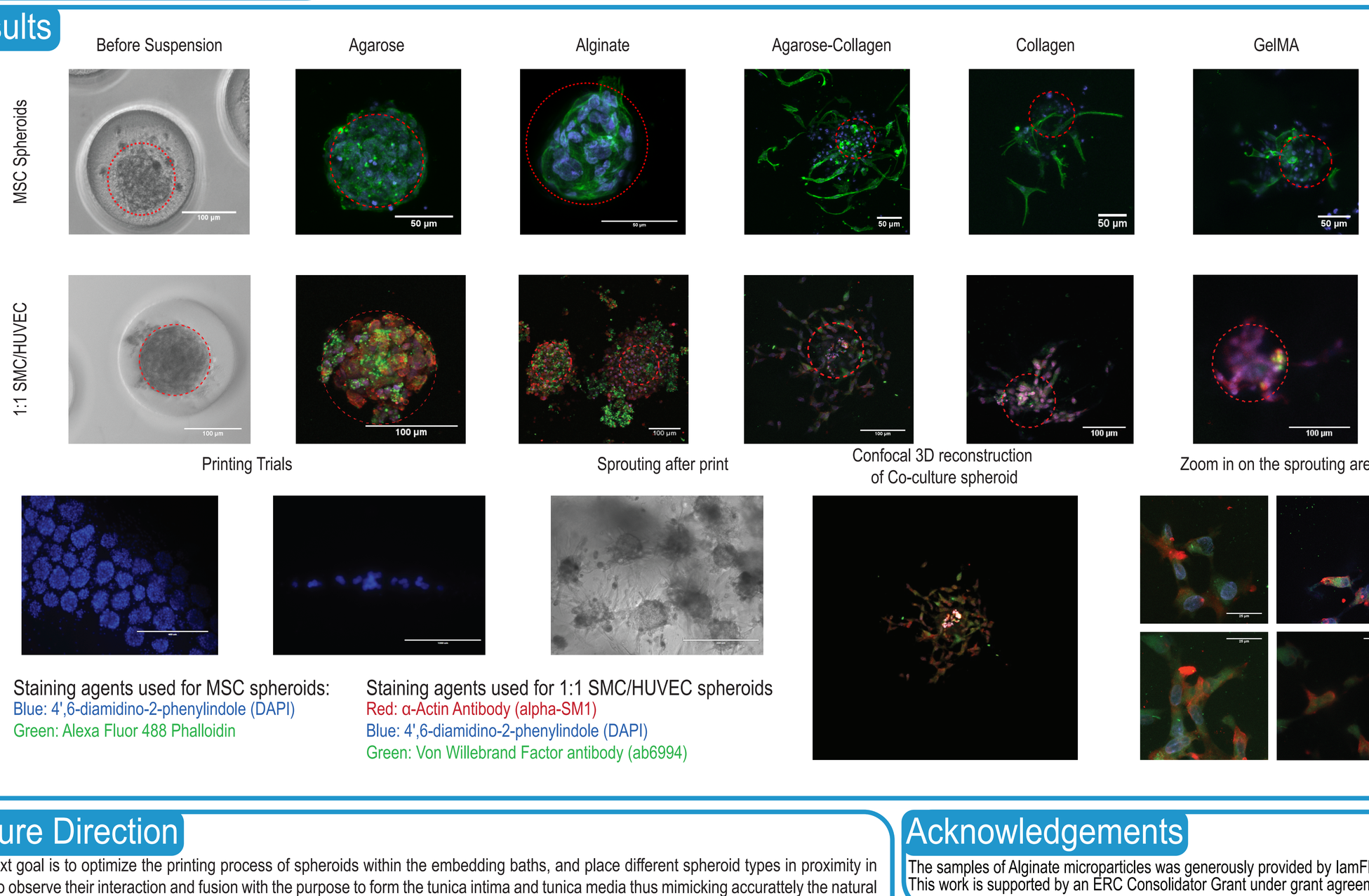

**c)** Embedding bath size distribution




**d)** Brightfield image of embedding bath particles




## Results




Staining agents used for MSC spheroids:
Blue: 4',6-diamidino-2-phenylindole (DAPI)
Green: Alexa Fluor 488 Phalloidin

Staining agents used for 1:1 SMC/HUVEC spheroids
Red: α-Actin Antibody (alpha-SM1)
Blue: 4',6-diamidino-2-phenylindole (DAPI)
Green: Von Willebrand Factor antibody (ab6994)

## Future Direction

Our next goal is to optimize the printing process of spheroids within the embedding baths, and place different spheroid types in proximity in order to observe their interaction and fusion with the purpose to form the tunica intima and tunica media thus mimicking accurattely the natural tissue architecture. Finally we will perfuse the artificial blood vessel in order to modulate the angiogenic sprouting.

## Acknowledgements

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