Human-Derived Hydrogels to Support Stem Cell-Derived Microphysiological Systems

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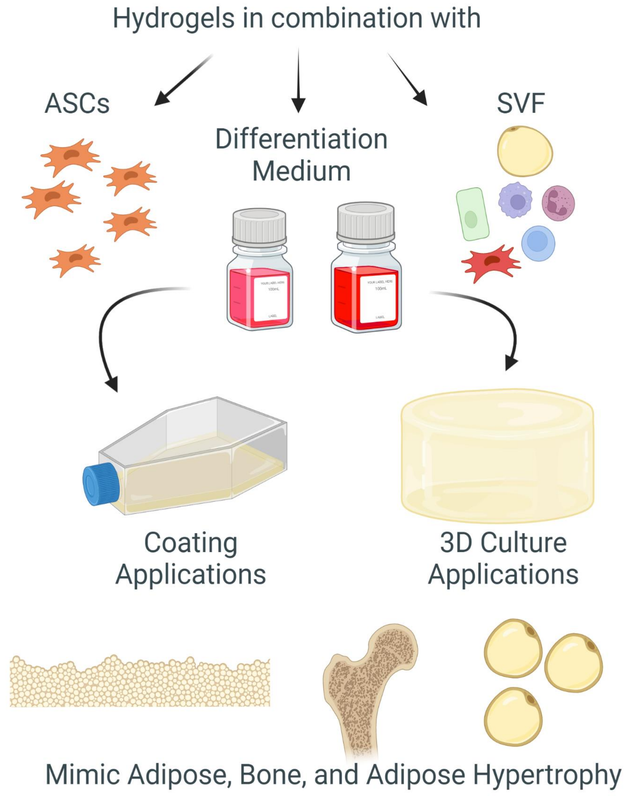
Introduction

Hydrogels are three-dimensional scaffolds used as alternatives to *in vivo* models for the understanding of human disease. They can also serve as scaffolds, delivery system for cells and drugs, and as a 3D tissue system for drug screening. Here we are presenting ObaGel®, ObaGel®-Coating, and ObaGel®-ECM, demonstrating unique biocompatibility as alternatives to current murine-derived and synthetic recombinant hydrogels. Furthermore, an Adipose hypertrophy model is demonstrated.

Concept

Hydrogels in combination with



Methods

Thermoregulated hydrogels were developed from human decellularized tissues through a series of processes optimized by Obatala Sciences. The human scaffolds were characterized for biological properties using rheology, electron microscopy, and cellular proliferation, differentiation, and adipogenic hypertrophy studies.

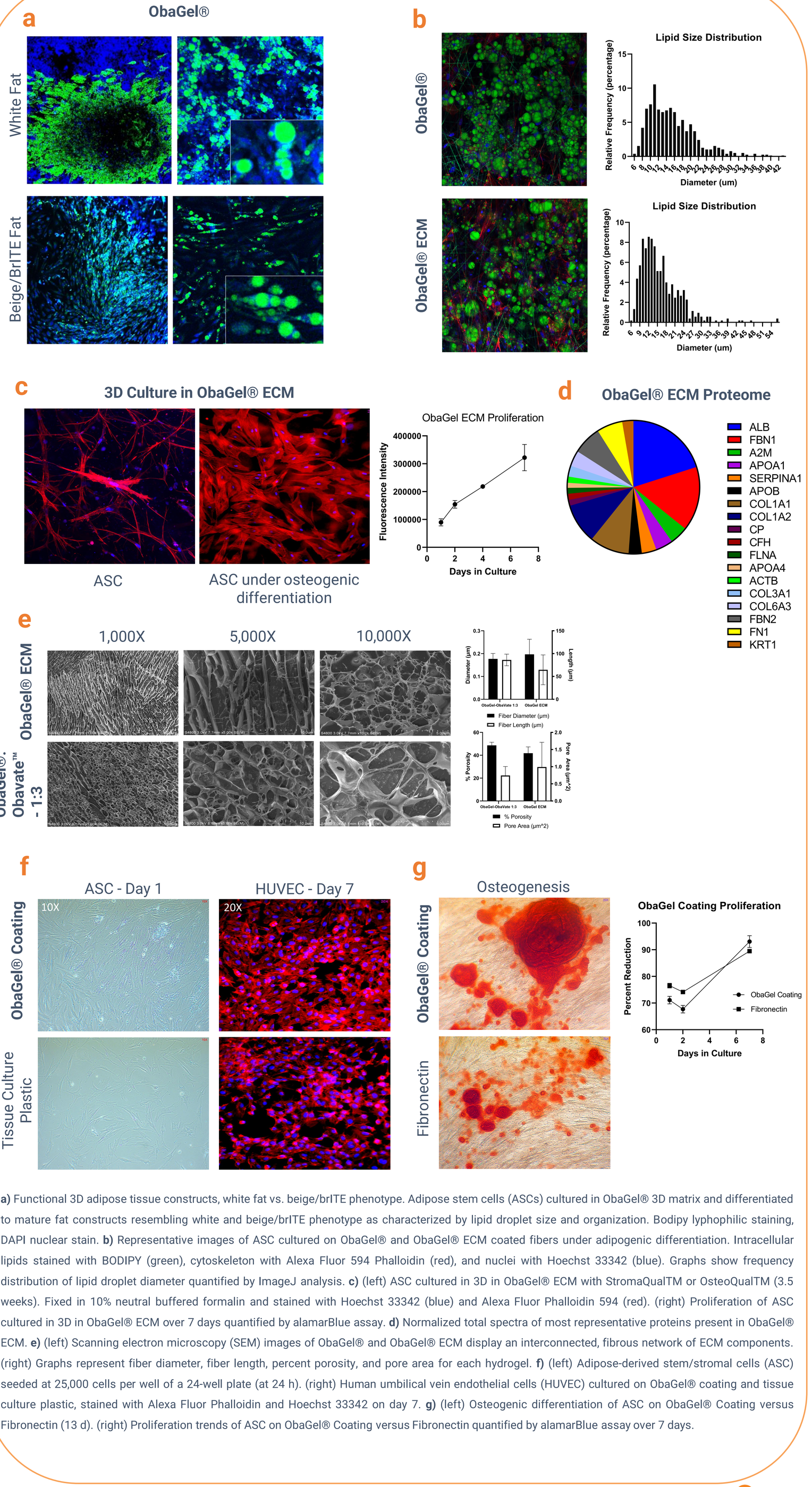
Conclusions and Future Directions

This study provides the characterization of hydrogels suitable for 3D and coating applications including microfluidic organ-on-a-chip devices and bioprinting. As derivatives of human tissue, ObaGel®, ObaGel®-Coating, and ObaGel®-ECM can support the development of 3D models that not only recapitulate normal human tissue and human disorders such as adipose hypertrophy as MPS, also to be employed in regenerative medicine.

References

Belgodere, J.A., Lassiter, H.R. et al. (2023), Biomechanical and Biological Characterization of XGel, a Human-Derived Hydrogel for Stem Cell Expansion and Tissue Engineering. Adv. Biology 2200332.

Results



a) Functional 3D adipose tissue constructs, white fat vs. beige/brITE phenotype. Adipose stem cells (ASCs) cultured in ObaGel® 3D matrix and differentiated to mature fat constructs resembling white and beige/brITE phenotype as characterized by lipid droplet size and organization. Bodipy lyphophilic staining, DAPI nuclear stain. **b)** Representative images of ASC cultured on ObaGel® and ObaGel® ECM coated fibers under adipogenic differentiation. Intracellular lipids stained with BODIPY (green), cytoskeleton with Alexa Fluor 594 Phalloidin (red), and nuclei with Hoechst 33342 (blue). Graphs show frequency distribution of lipid droplet diameter quantified by ImageJ analysis. **c)** (left) ASC cultured in 3D in ObaGel® ECM with StromaQualTM or OsteoQualTM (3.5 weeks). Fixed in 10% neutral buffered formalin and stained with Hoechst 33342 (blue) and Alexa Fluor Phalloidin 594 (red). (right) Proliferation of ASC cultured in 3D in ObaGel® ECM over 7 days quantified by alamarBlue assay. **d)** Normalized total spectra of most representative proteins present in ObaGel® ECM. **e)** (left) Scanning electron microscopy (SEM) images of ObaGel® and ObaGel® ECM display an interconnected, fibrous network of ECM components. (right) Graphs represent fiber diameter, fiber length, percent porosity, and pore area for each hydrogel. **f)** (left) Adipose-derived stem/stromal cells (ASC) seeded at 25,000 cells per well of a 24-well plate (at 24 h). (right) Human umbilical vein endothelial cells (HUVEC) cultured on ObaGel® coating and tissue culture plastic, stained with Alexa Fluor Phalloidin and Hoechst 33342 on day 7. **g)** (left) Osteogenic differentiation of ASC on ObaGel® Coating versus Fibronectin (13 d). (right) Proliferation trends of ASC on ObaGel® Coating versus Fibronectin quantified by alamarBlue assay over 7 days.

This work has been supported in part by the National Institutes of Health R21 and by the NSF Phase I SBIR funding mechanisms.

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