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Research Interests

The microvascular network plays a dominant role in cardiovascular health and disease, performing the mechanical function of oxygen and nutrient delivery and metabolic waste removal. It is also a highly adaptable system, capable of structural remodeling in response to mechanical and biochemical stimuli. The adaptive capability of biological structures provides a unique engineering challenge.

A central research thrust is to understand vascular adaptation to environmental conditions and in vascular diseases, aiming at development of new preventative technologies. Research is focused on arteriolar network remodeling as a function of mechanical stresses, vascular pattern formation, and engineering of wound prevention and repair. Techniques to carry out this work include immunofluorescence visualization of arteriolar remodeling and contractile cell lineage, three-dimensional reconstruction of vascular networks, intravital microscopy measurements of blood flow and pressure, vessel dimensions, and vascular reactivity, gene expression profiling, integrated device design and prototyping for fluid transport in skin flaps and skin ulcer studies, effects of magnetic fields on blood vessel tone and growth, nano-patterning and stretch-mediated control of smooth muscle phenotype, continuum mechanical study of network hemodynamics, and discrete cell-based computer simulation of vascular adaptation. The computational systems biology or "digital biology" modeling is one of the only multicellular systems approaches to this type of tissue assembly problem.

Recent Publications

Nickerson MM, Song J, Meisner JK, Bajikar S, Burke CW, Shuptrine CW, Owens GK, Skalak TC, Price RJ
Bone Marrow-Derived Cell-Specific Chemokine (C-C motif) Receptor-2 Expression is Required for Arteriolar Remodeling.

Morris CE, Skalak TC
Acute exposure to a moderate strength static magnetic field reduces edema formation in rats.

Morris CE, Skalak TC
Chronic static magnetic field exposure alters microvessel enlargement resulting from surgical intervention.

Murfee WL, Rehorn MR, Peirce SM, Skalak TC
Perivascular cells along venules upregulate NG2 expression during microvascular remodeling.

O'Neill TJ, Wamhoff BR, Owens GK, Skalak TC
Mobilization of bone marrow-derived cells enhances the angiogenic response to hypoxia without transdifferentiation into endothelial cells.

More Publications