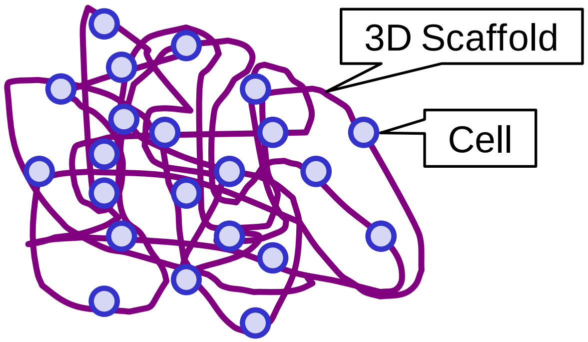
Measuring Cell Adhesion and Proliferation in Polymer Scaffolds by X-Ray Microcomputed Tomography

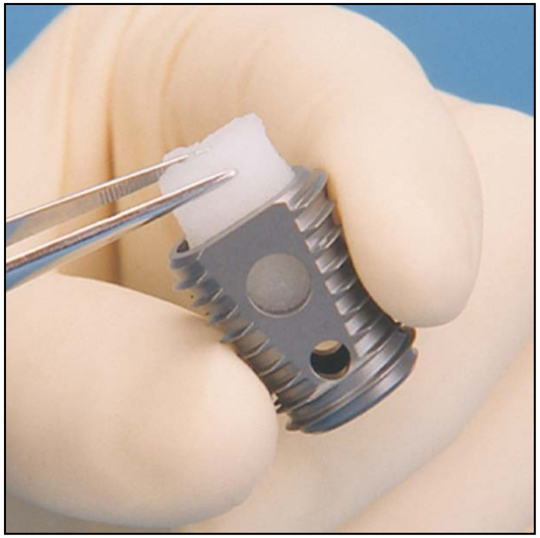
Carl G. Simon, Jr., Ph.D.

National Institute of Standards and Technology
United States Department of Commerce
Polymers Division • Biomaterials Group

Need: Method to Quantify Cell Distribution Polymer Scaffolds in 3D



Scaffold use constitutes a central dogma in the field of tissue engineering

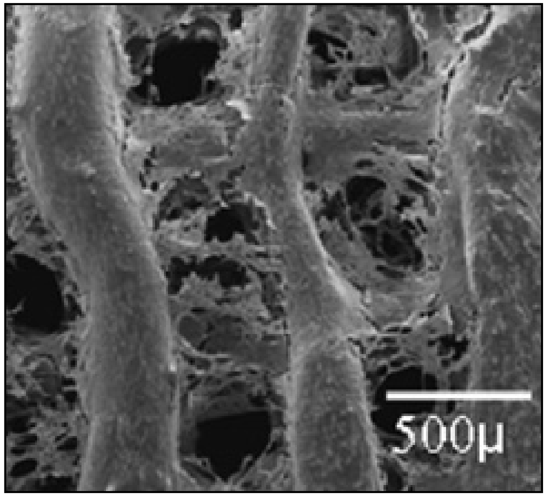


Tissue engineering devices are commonly 3D scaffolds: Medtronic's Infuse bone graft, $2.6 billion in 2006, half the orthobiologics market

Why is there a need?

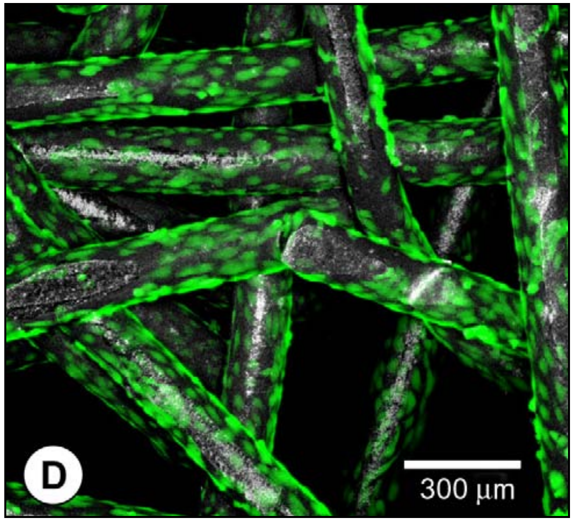
- To evaluate scaffold performance
- To quantify cell & tissue formation in the scaffold in 3D
- To determine optimal scaffold composition/properties for tissue regeneration

Scanning Electron Microscopy



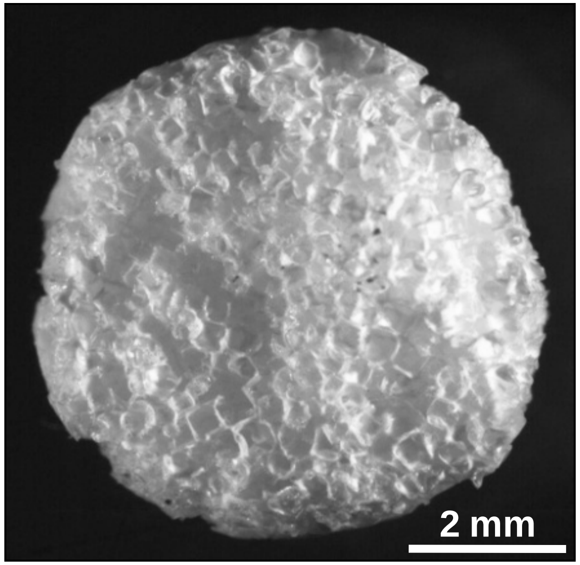
Shor et al., Biomaterials 28 (2007) 5291

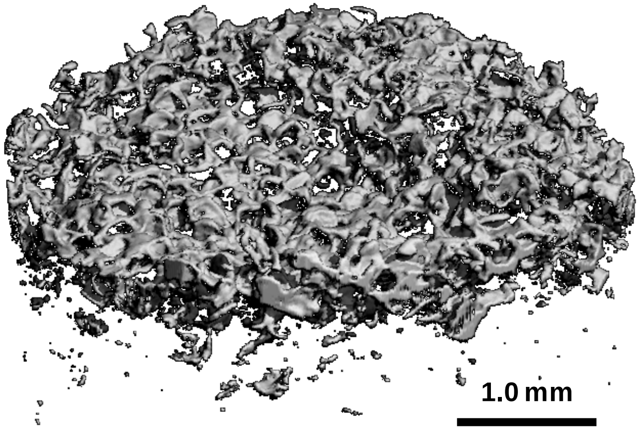
Confocal Fluorescence Microscopy



Santos et al., Biomaterials 29 (2008) 4306

Goal: Use X-ray microcomputed tomography (μCT) to measure cell distribution in 3D tissue scaffolds





X-ray Microcomputed Tomography

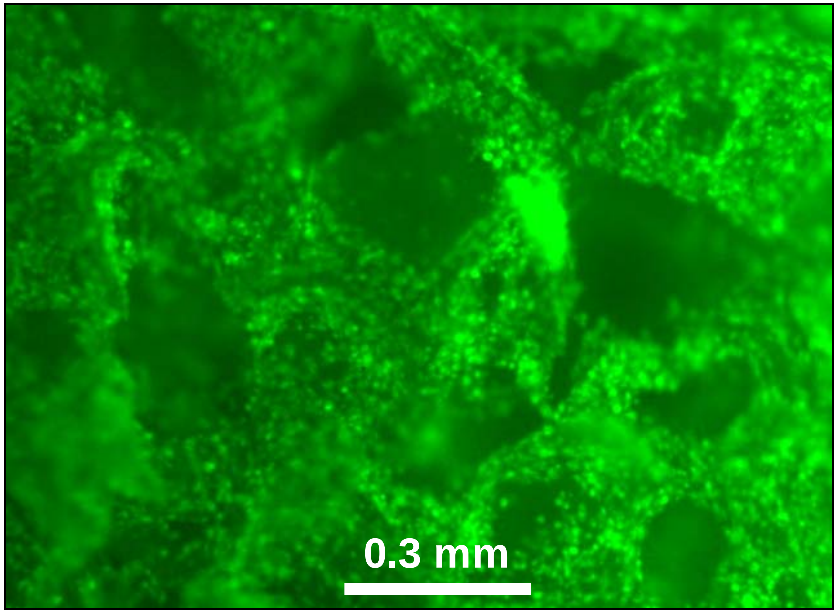
X-ray Microcomputed Tomography

- Uses X-rays for 3D imaging of materials that scatter X-rays
- Cells are stained with osmium tetroxide (OsO_4) to make them radiopaque

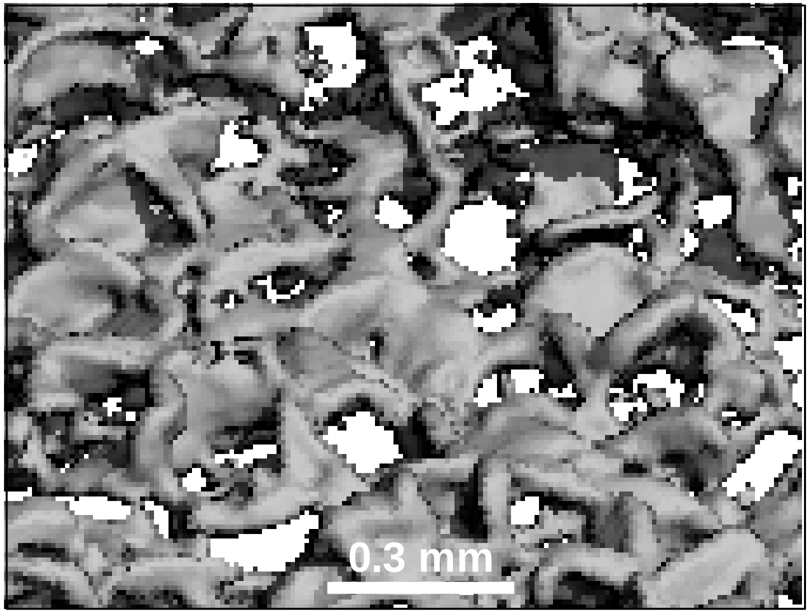
Disadvantages: hard, lower resolution

Advantages: 3D imaging, quantitative, can see “thru” scaffolds

Comparison of Fluorescence Microscopy & µCT



Fluorescence Microscopy



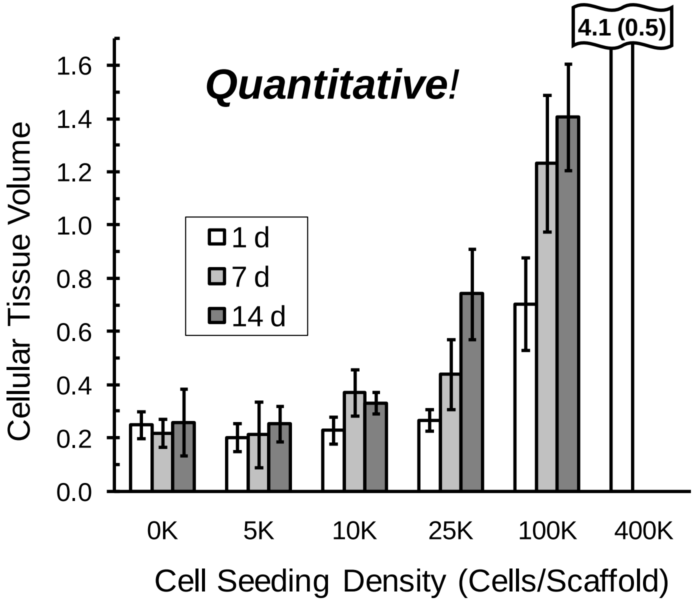
X-ray Microcomputed Tomography

Disadvantages

- µCT is lower resolution than fluorescence microscopy and less sensitive than biochemical assays (DNA)

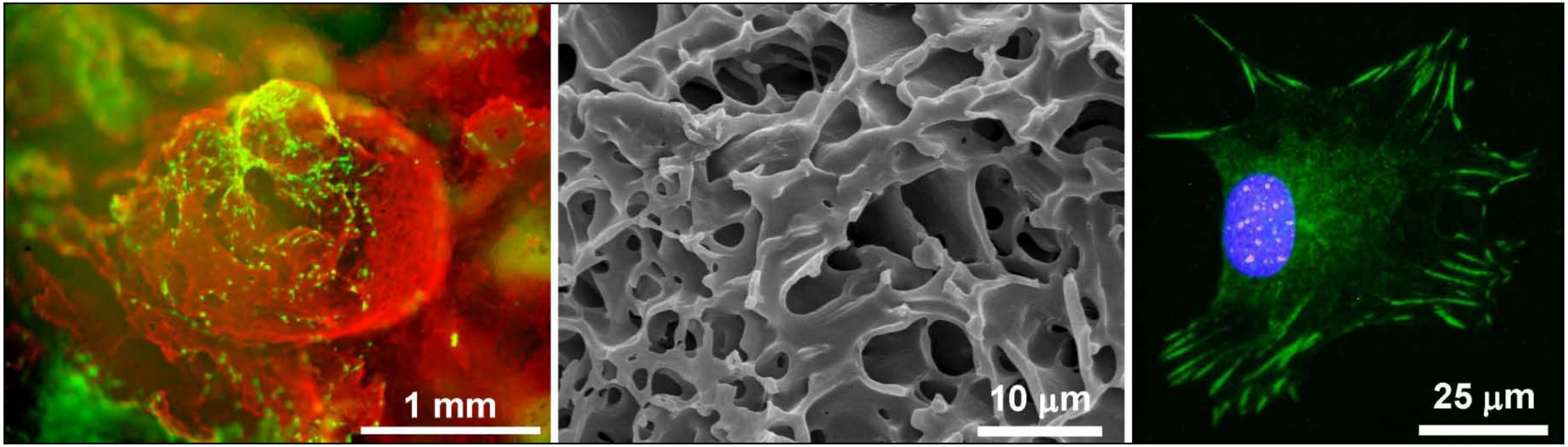
Advantages

- µCT enables imaging through the opaque scaffold
- µCT portrays the 3D nature of cells on scaffolds
- µCT is quantitative



Collaborative Opportunities

- Please come visit me at my poster if you have interest in:
    - Measuring effect of 3D tissue scaffold properties on cell response
    - Stem cell fate in 3D scaffolds
    - Bone tissue engineering
    - Combinatorial methods for screening scaffolds
- *Post-Doctoral Research Opportunities*
    - NIST-NRC: $63K/yr., 2 yrs., benefits, Feb 1 & Aug 1, US citizens only
    - NIST/NIH-NRC: $55K/yr., 2 yrs., benefits, Aug 1, open to foreign nationals
- *Undergraduate (SURF):* 11-weeks, $4K stipend, travel, housing, Feb 15



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Reference

Dorsey SM, Lin-Gibson S, Simon Jr CG (2009) Biomaterials 30, 2967 (highlighted as a Leading Opinion article)

Contact Information

Carl G. Simon, Jr., Ph.D.
3D Tissue Scaffolds Project Leader
Polymers Division
National Institute of Standards and Technology
100 Bureau Drive
Gaithersburg, MD 20899-8543
carl.simon@nist.gov
Tel.: 301-975-8574
Fax: 301-975-4977
http://www.nist.gov/msel/polymers/biomaterials/3dtissuescaffolds.cfm