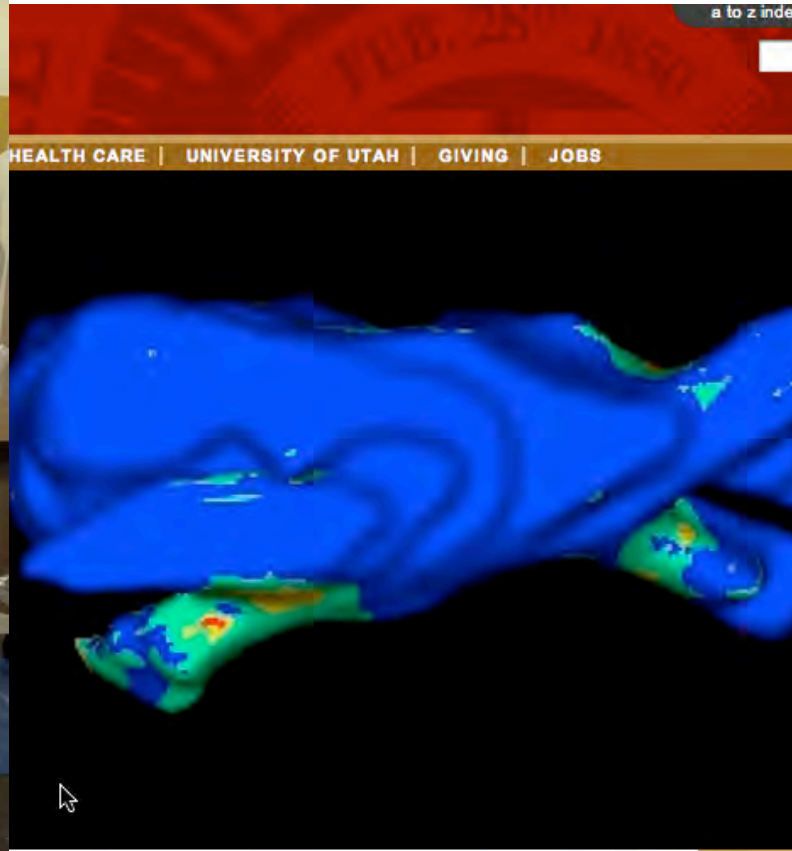


Imaging Based Analysis of Patients with Atrial Fibrillation

Rob MacLeod, University of Utah
CARMA Center, SCI Institute, CVRTI
Bioengineering Department

What is Atrial Fibrillation? = Afib = AF

Comprehensive Arrhythmia Research and Management



CARMA CENTER

CARMA CENTER



News

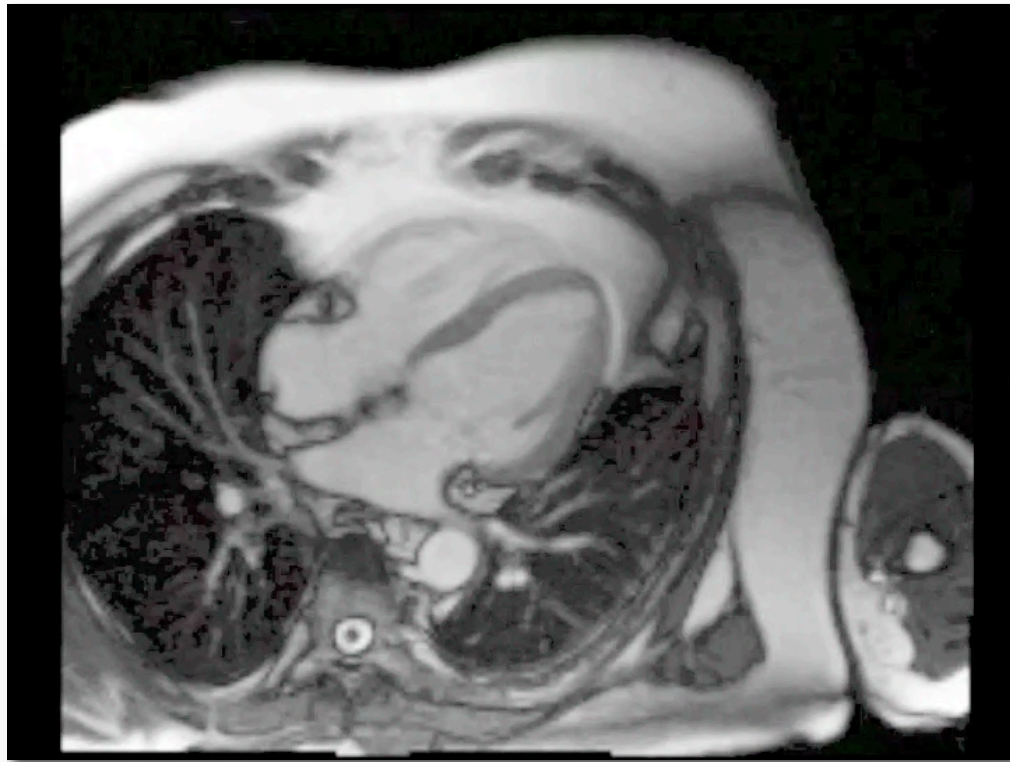
- North America's First Integrated EP MRI Lab
- Novel Imaging Technique Holds Promise for Predicting
- Ep-Web TFP



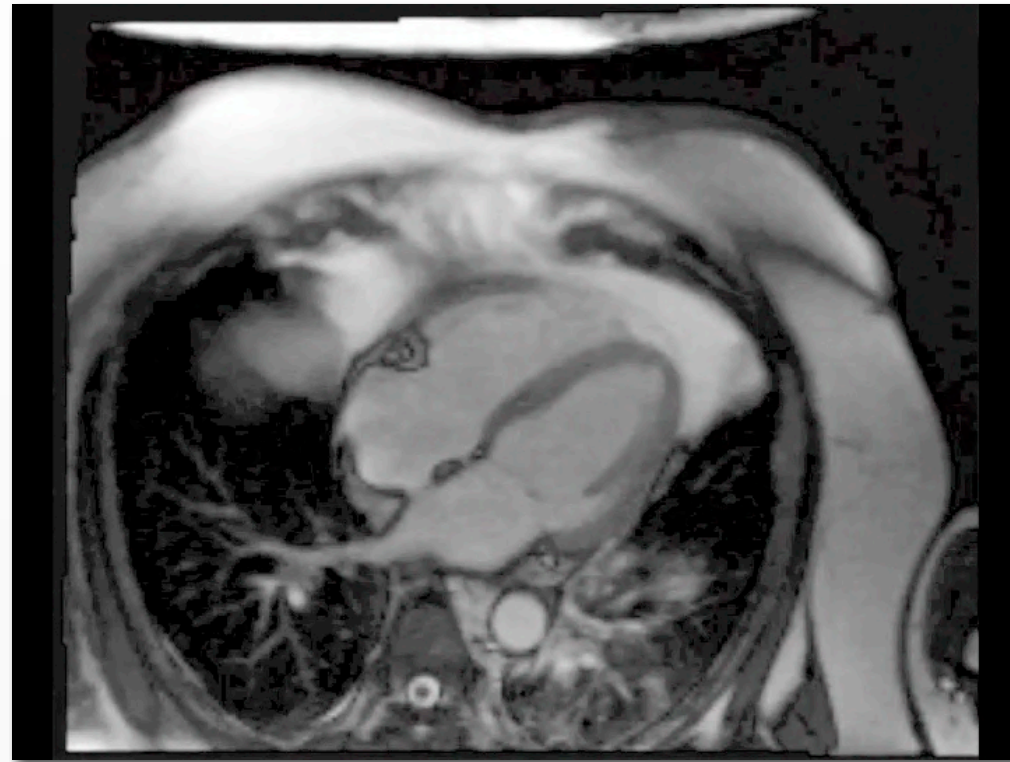
Atrial Fibrillation Illustrated



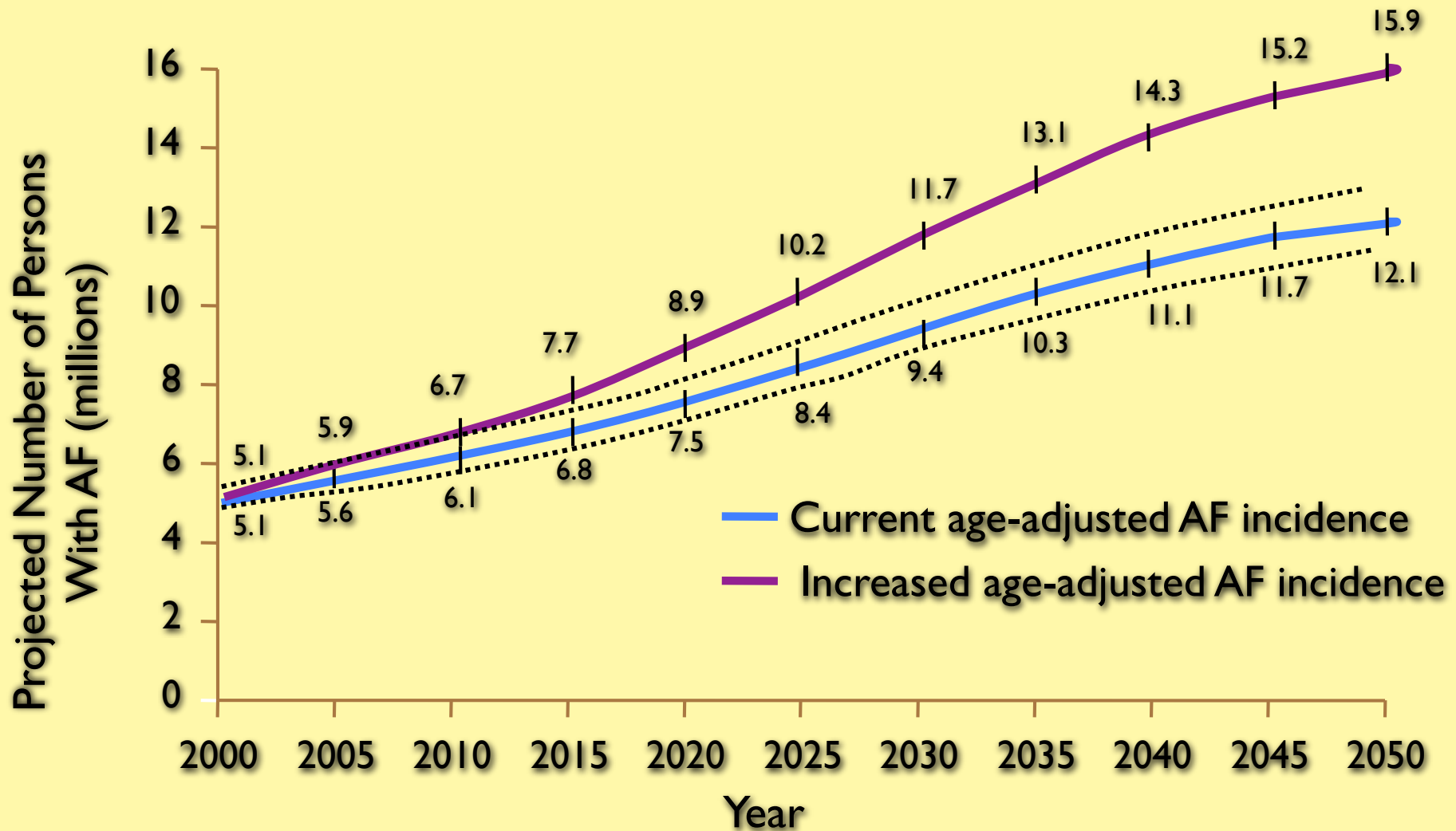
Normal Contraction



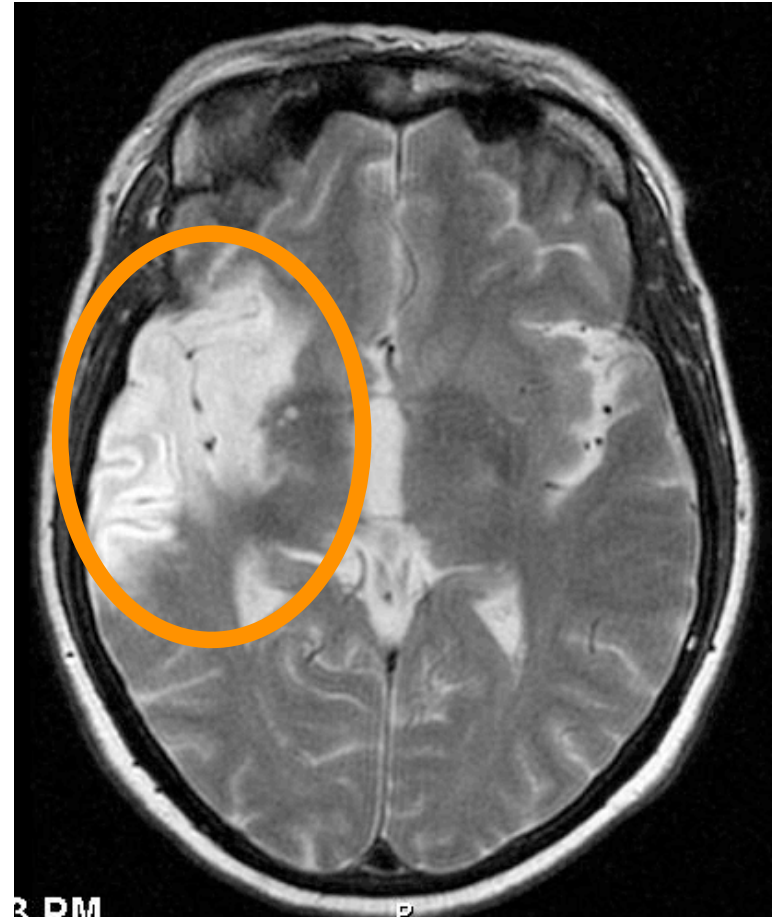
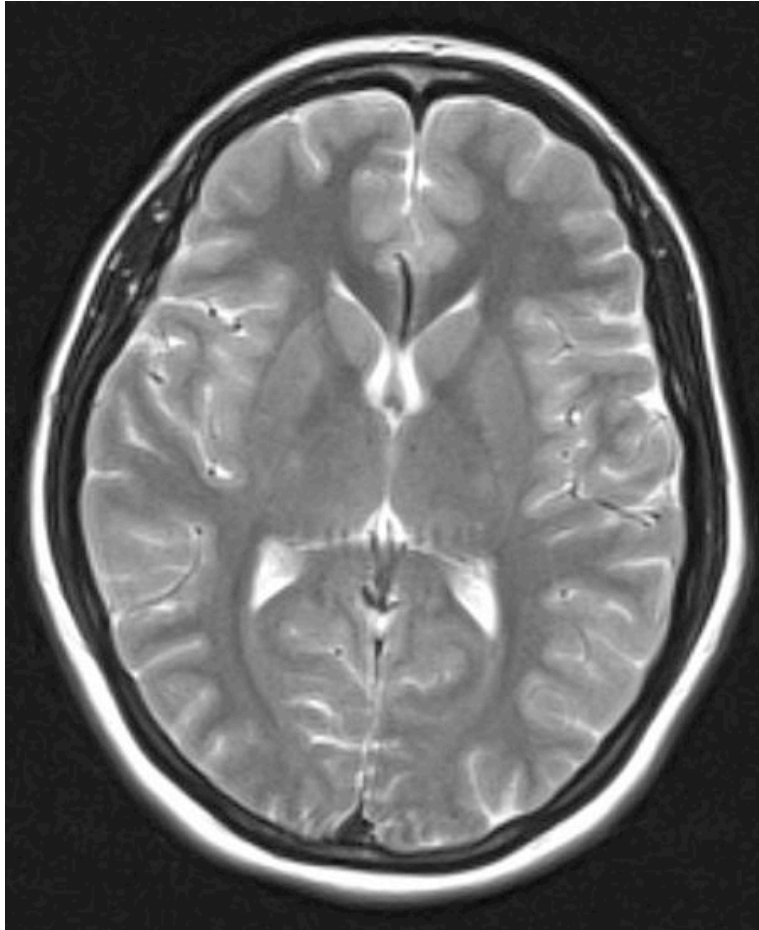
Atrial Fibrillation



AF Prevalence



20% of Strokes



\$20 billion/year

The CARMA Mantra

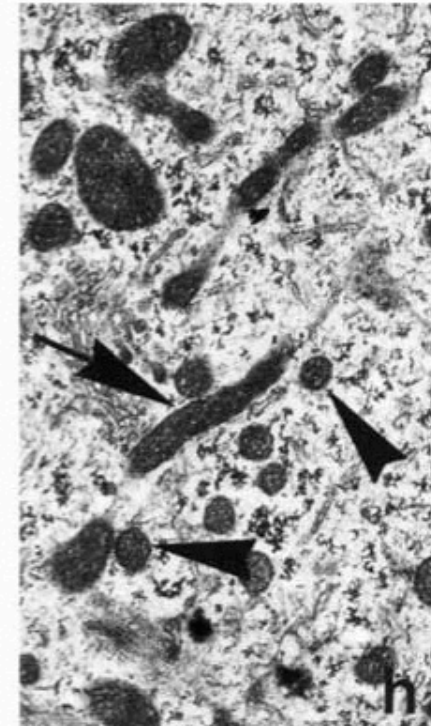
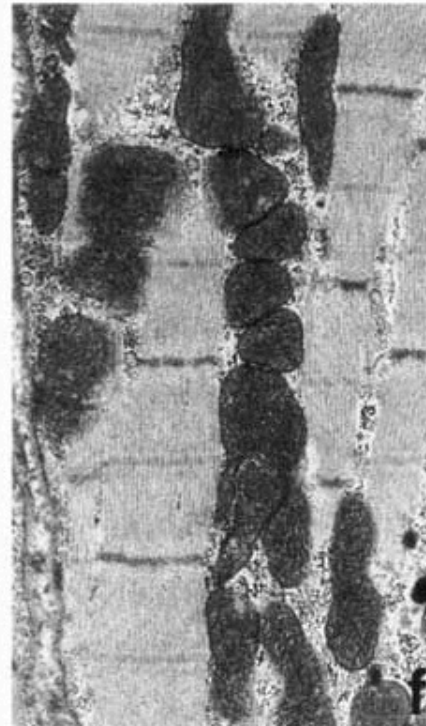
“AF is a heart tissue disease”

Normal

Early stage

Mid stage

Late stage

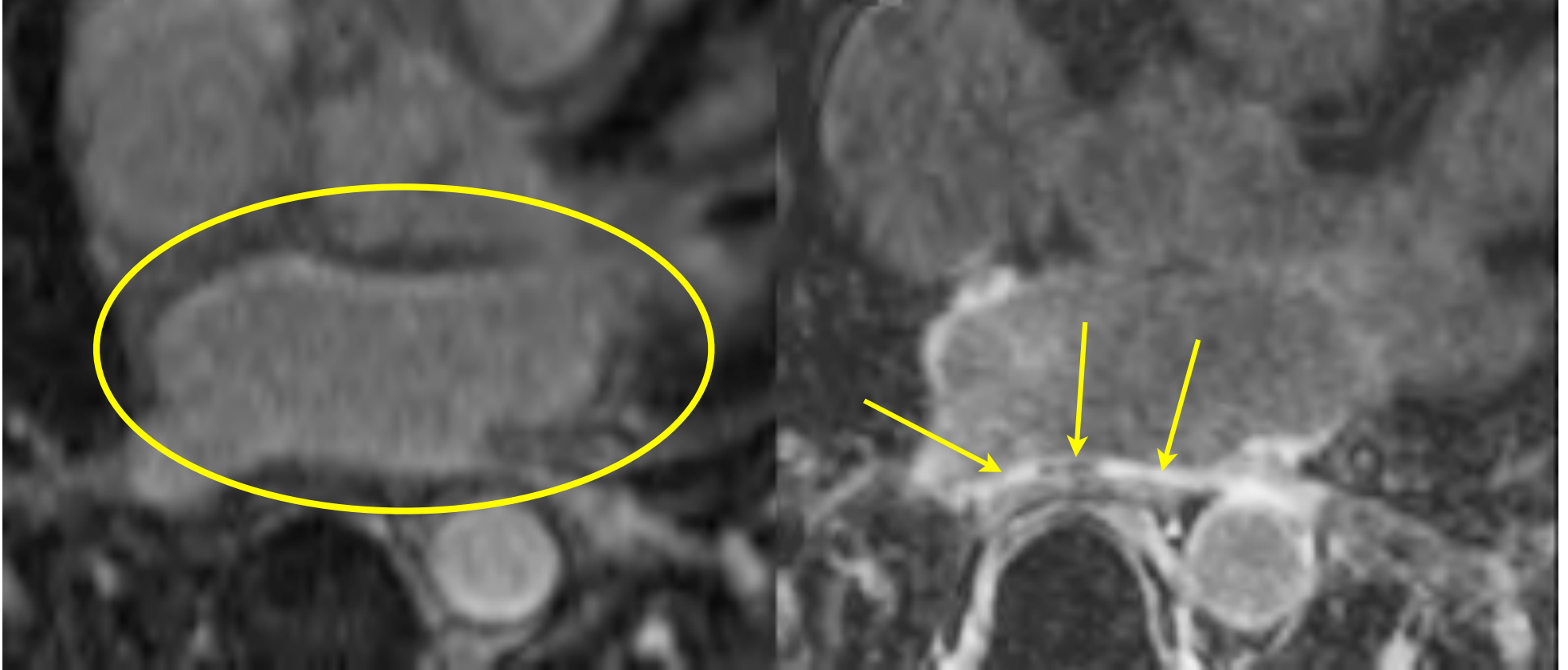


Ausma J, Alessie M ...J mol Cell Cardiol. 2001: 2083.

Structure Matters



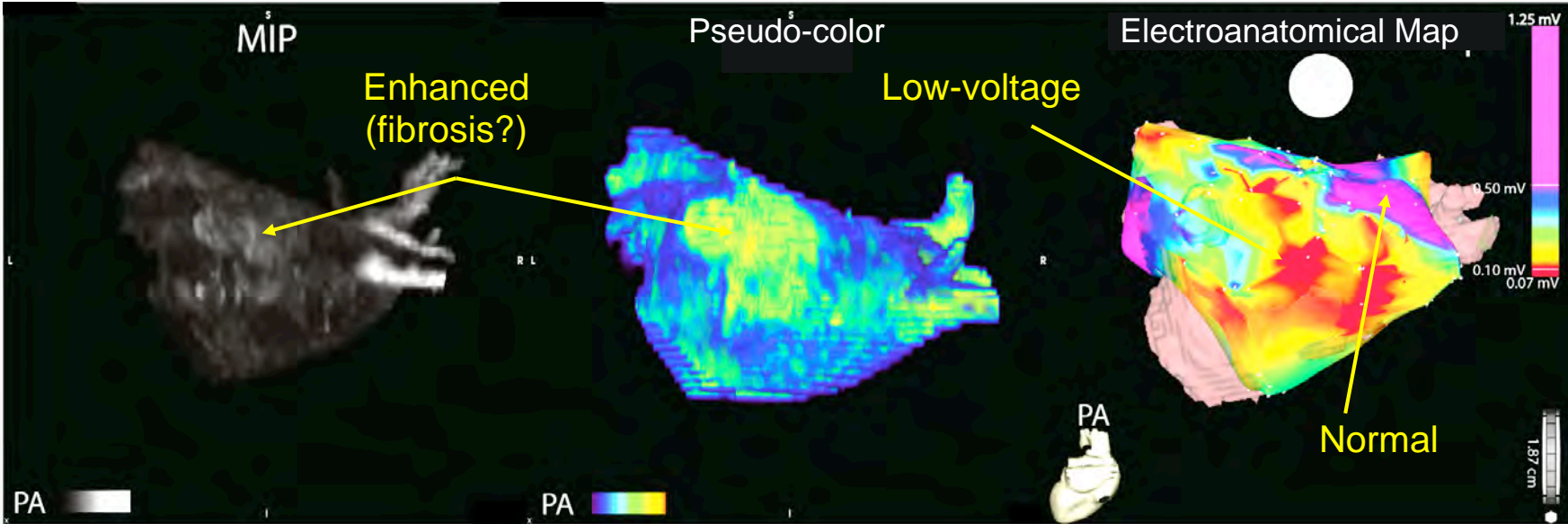
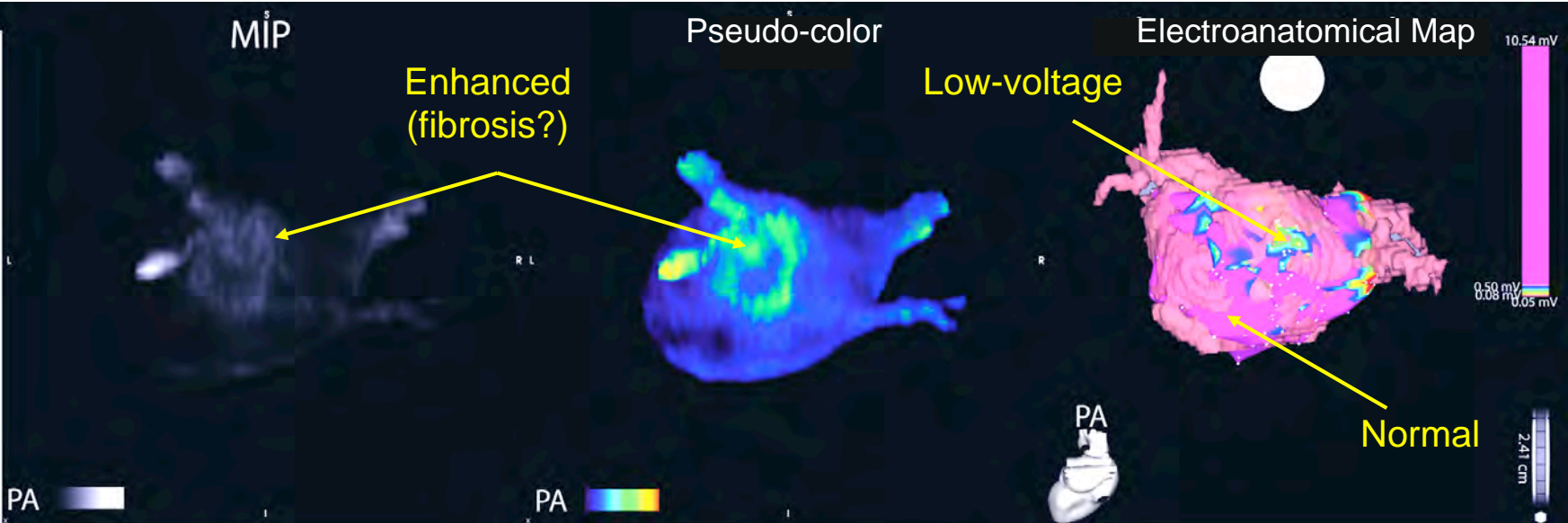
Late Gadolinium Enhancement



Pre-treatment

3 month Post

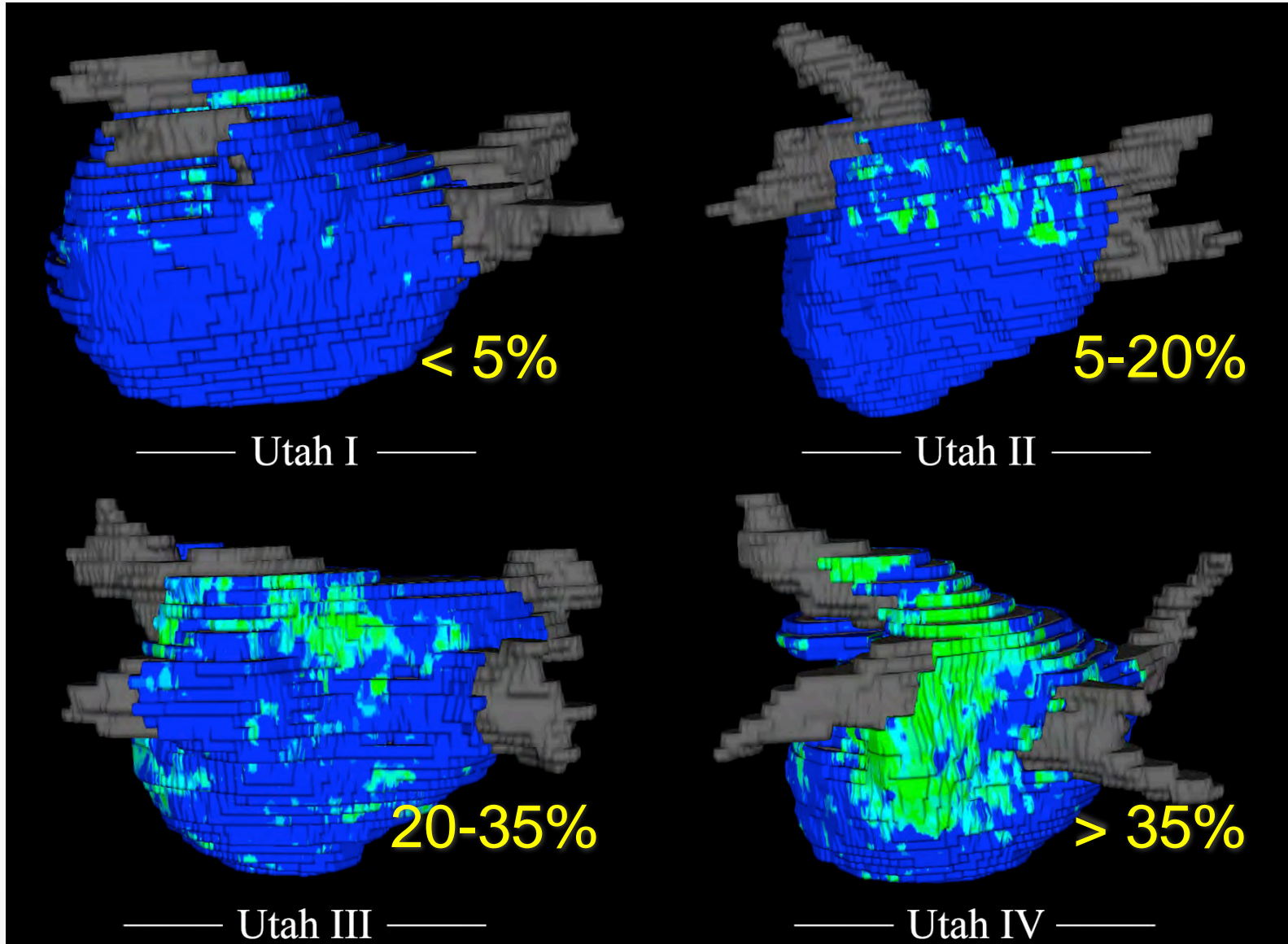
CARMA Started Here



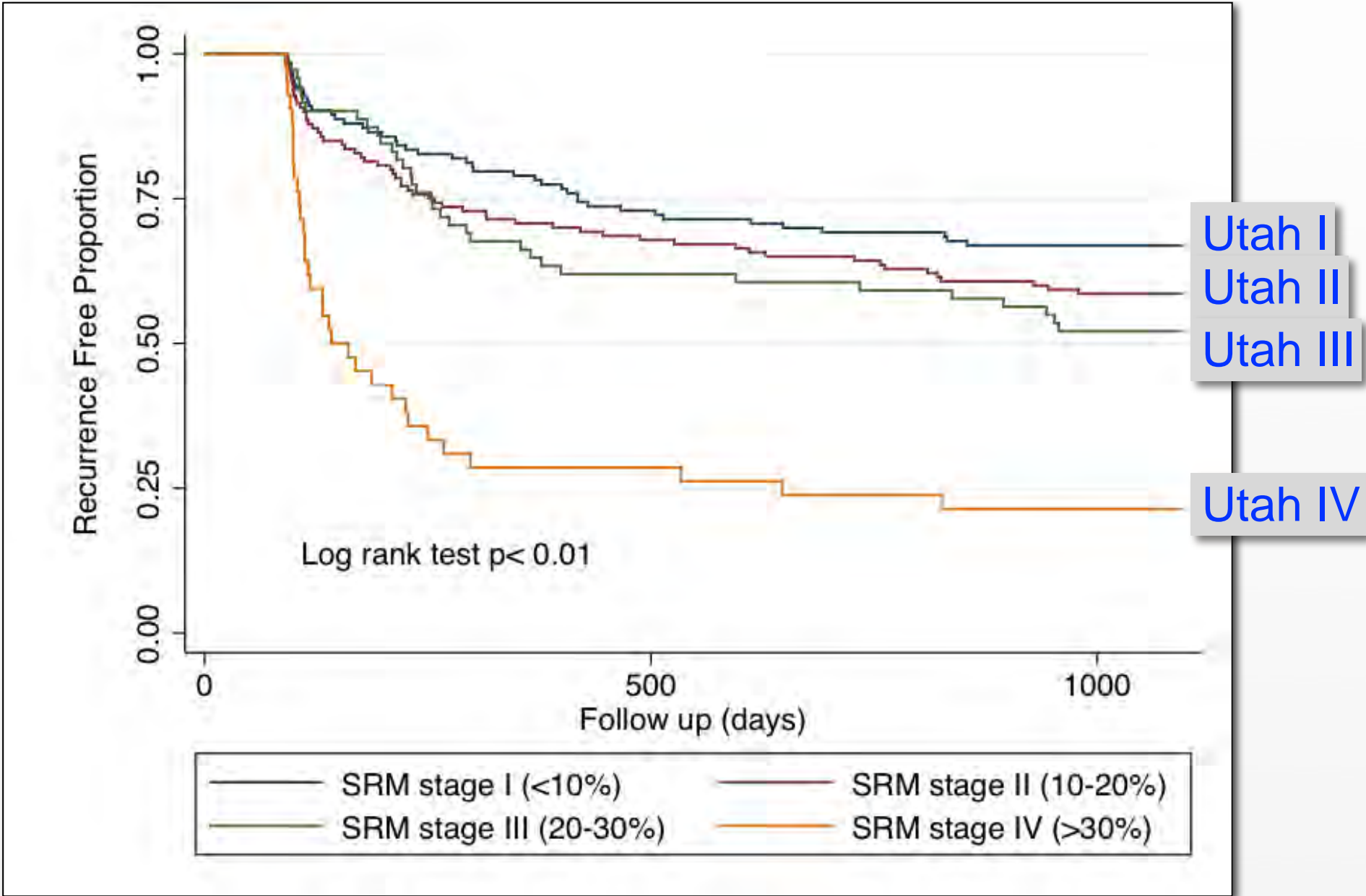
Utah Scoring Scheme: 2011



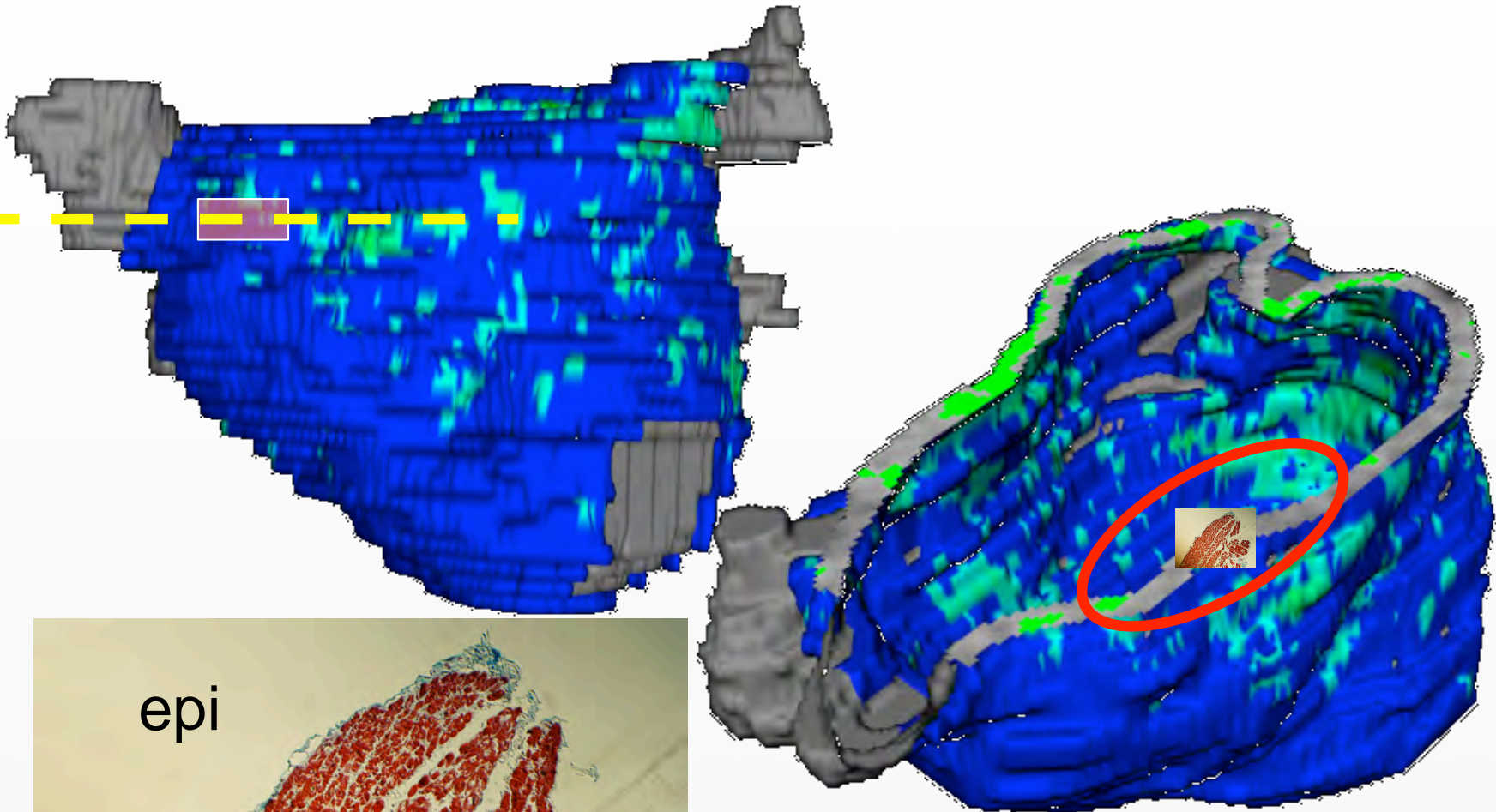
Nazem Akoum



Utah Score Predicts Outcome



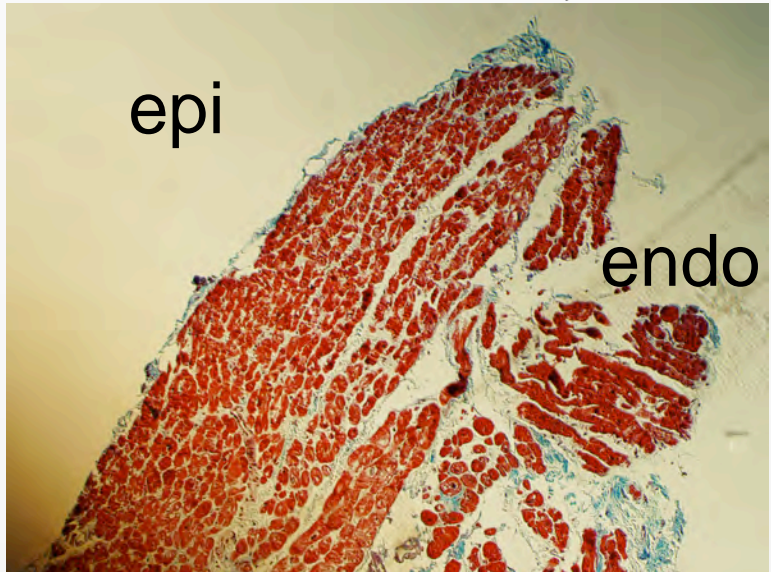
MRI & Fibrosis: Blue is Normal



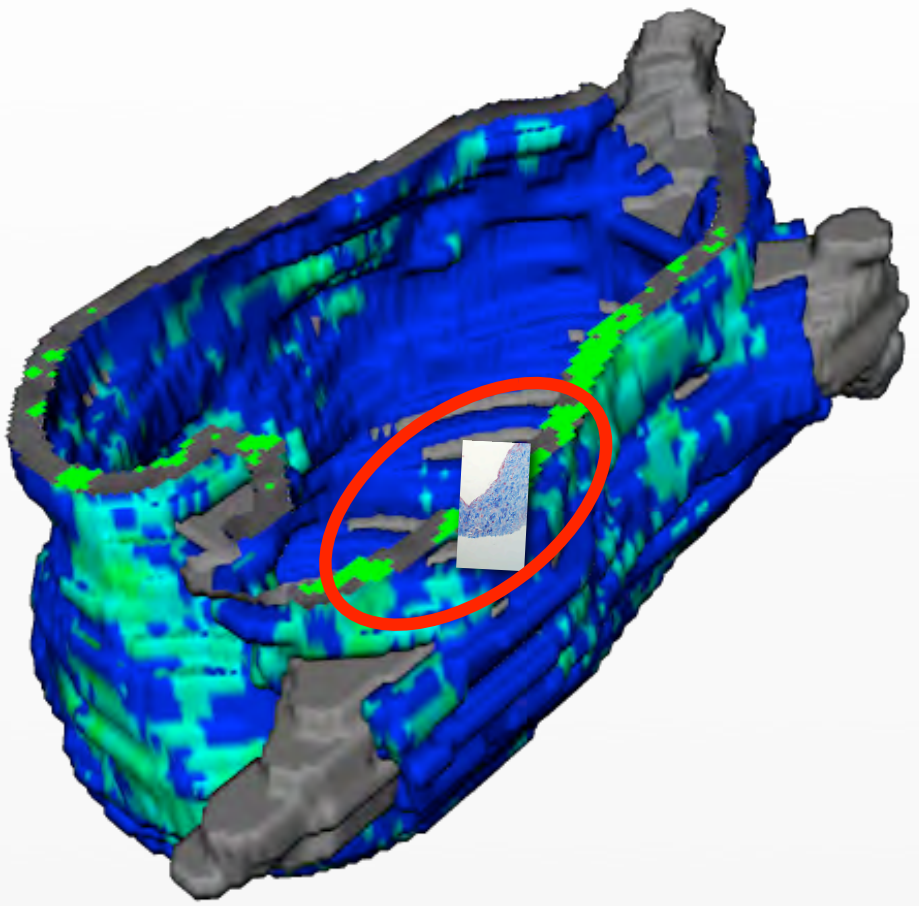
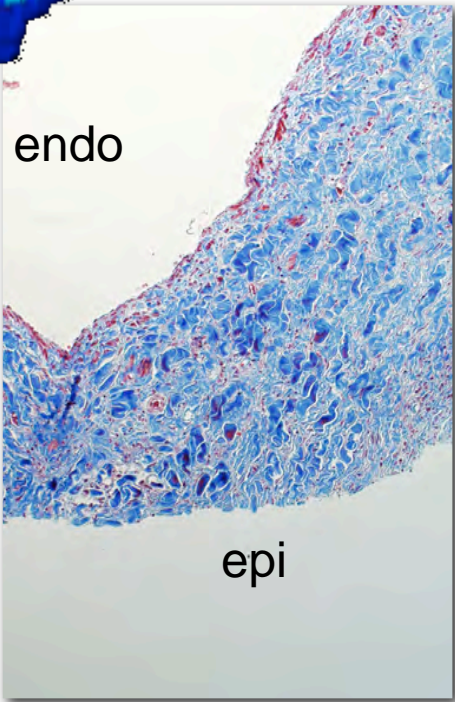
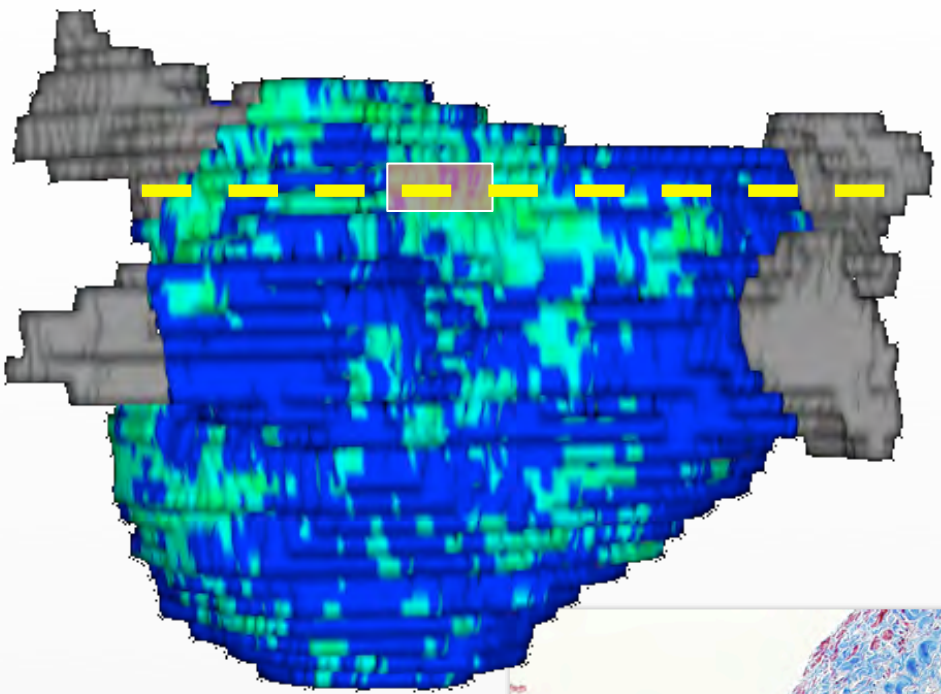
Chris McGann



Amit Patel



MRI & Fibrosis: Green is Fibrosis

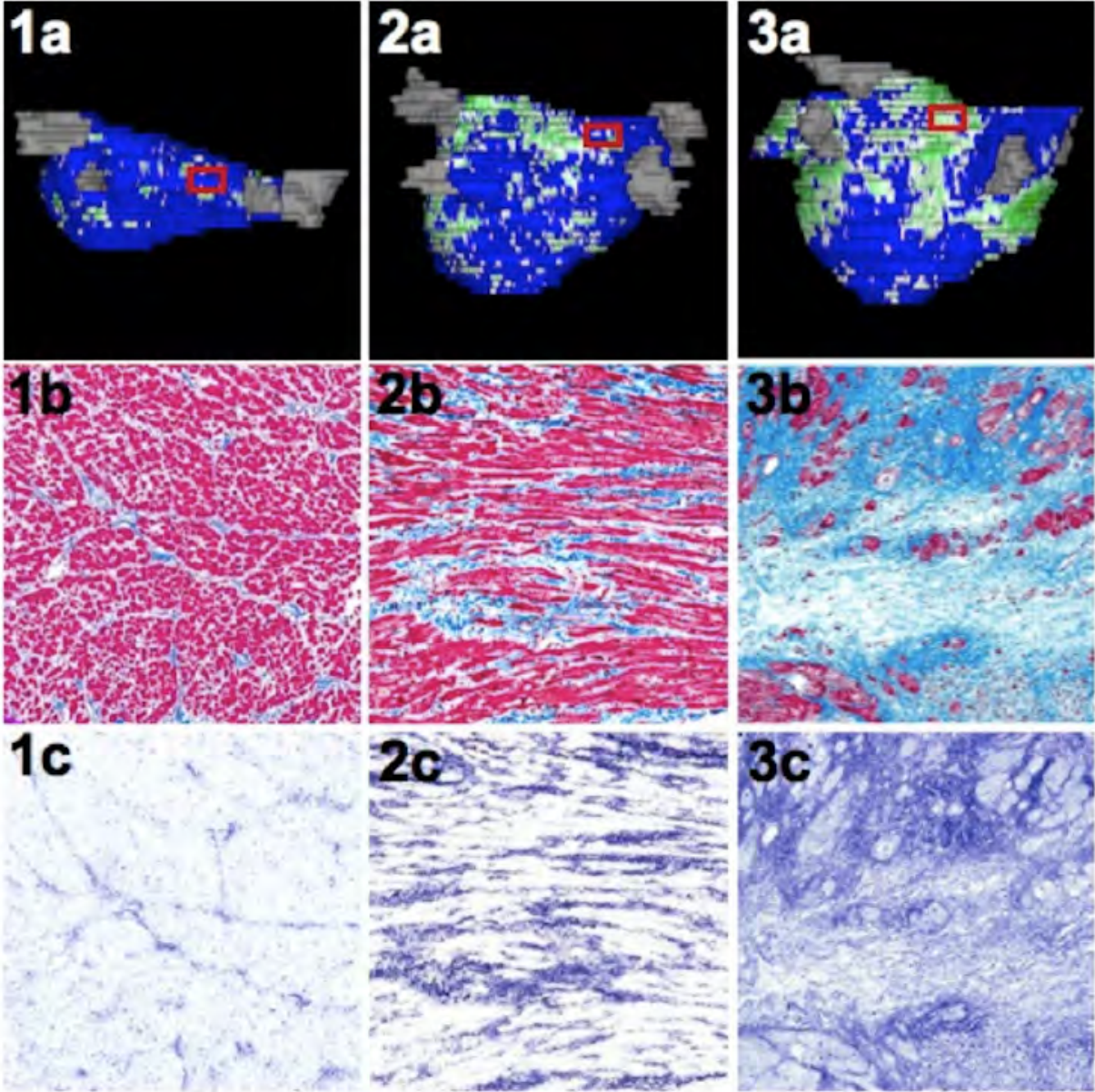


Histology Summary

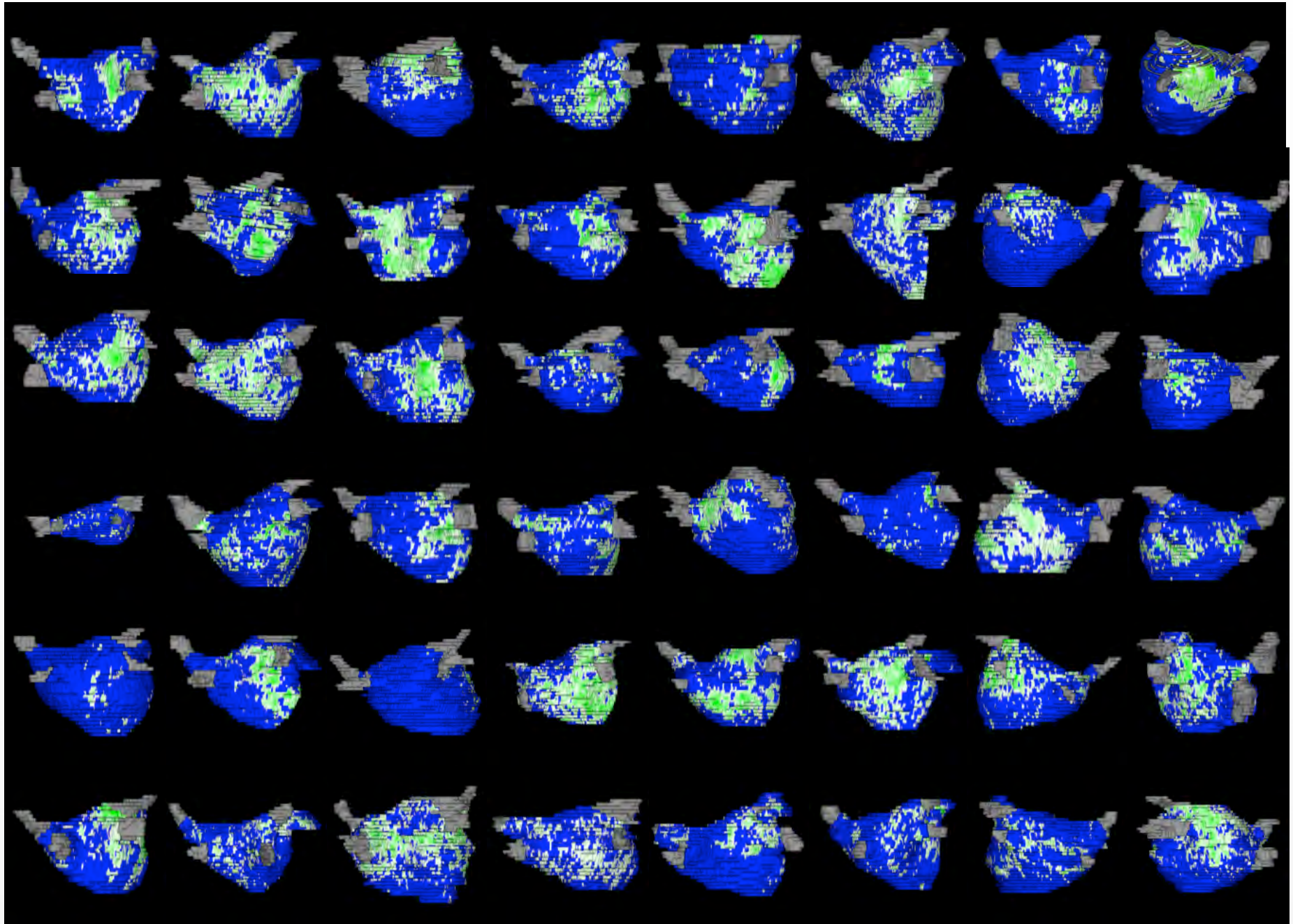
Control

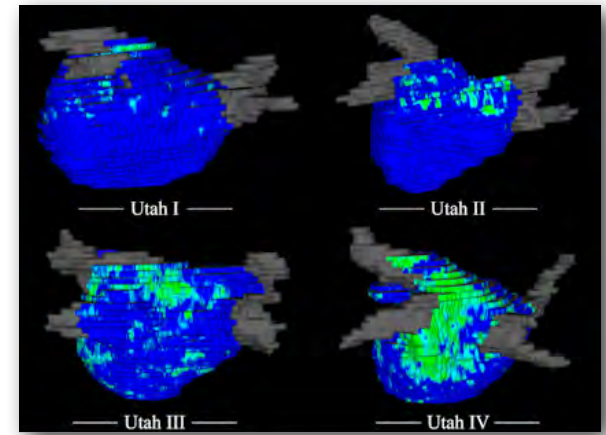
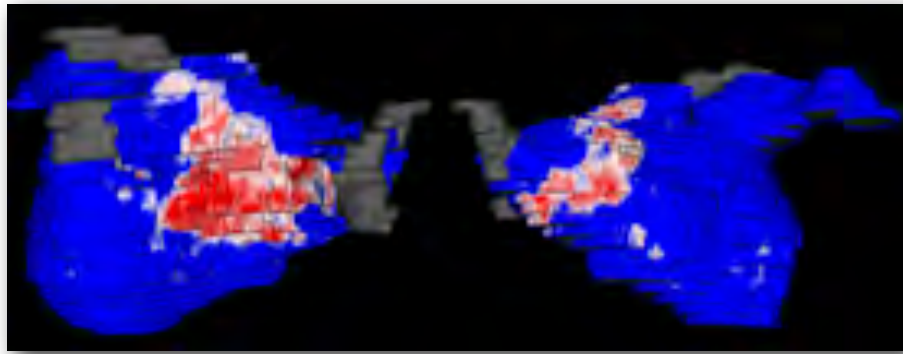
AF-mix

AF-fibrosis

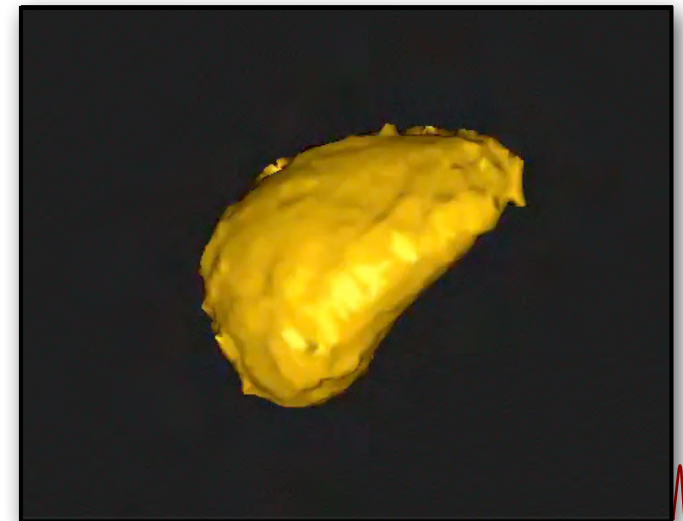
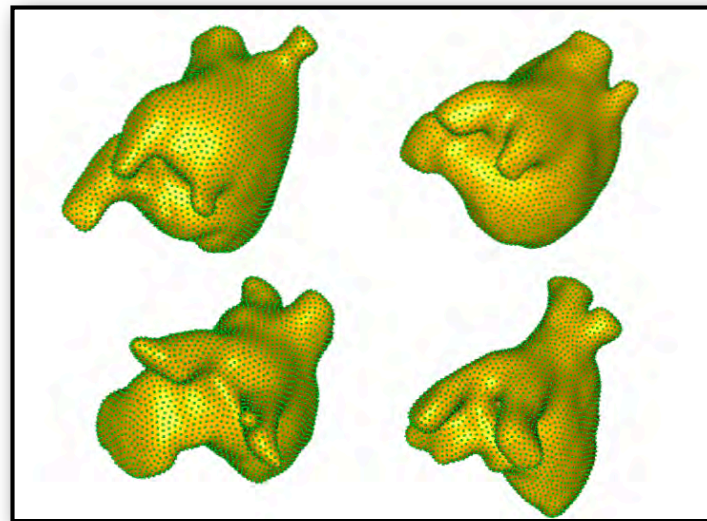
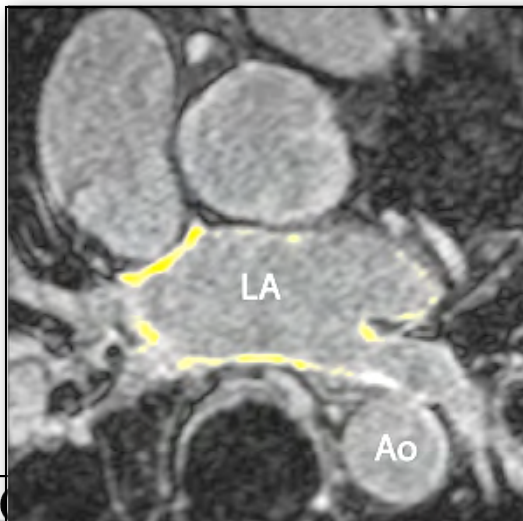


Fibrosis Analysis

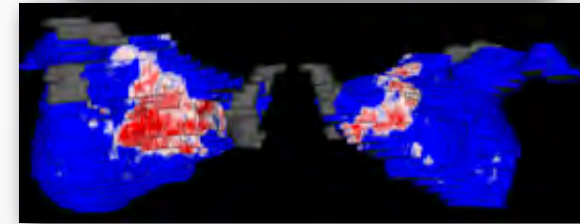
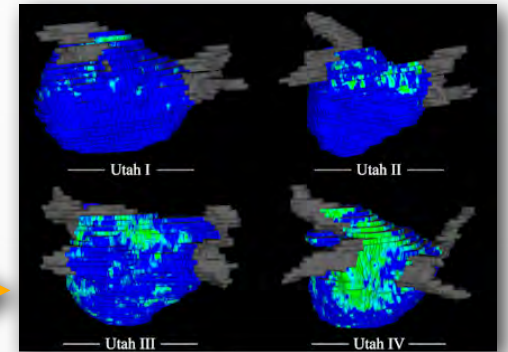
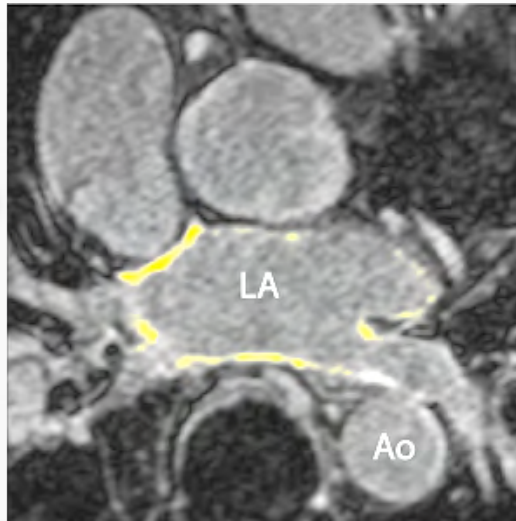




What Role Does Image Segmentation Play?



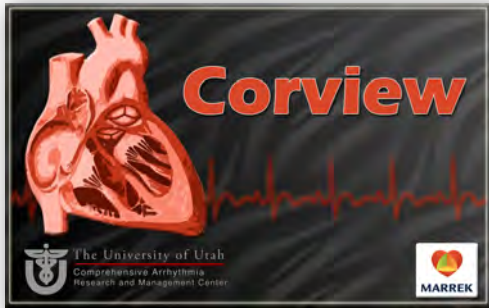
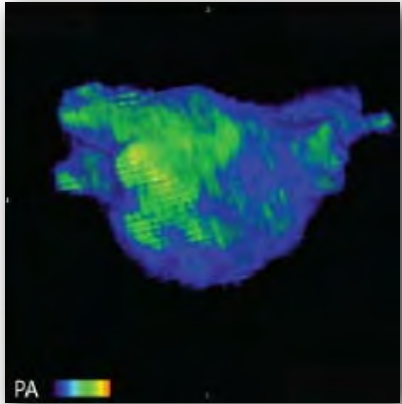
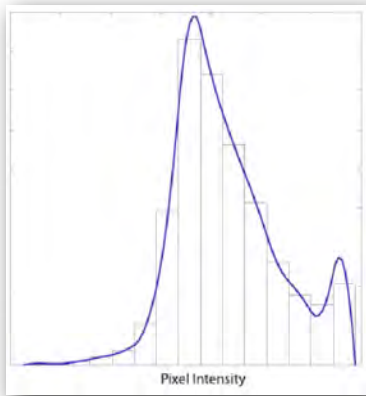
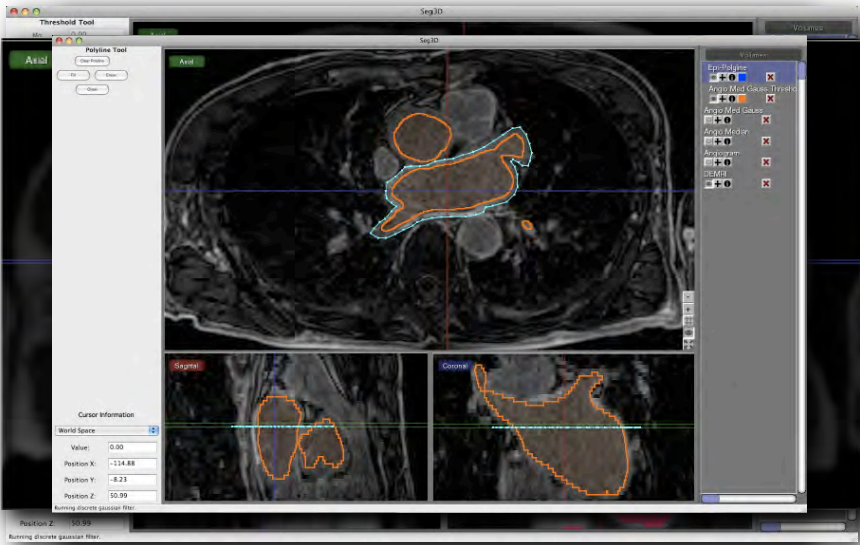
The CARMA AF Workflow



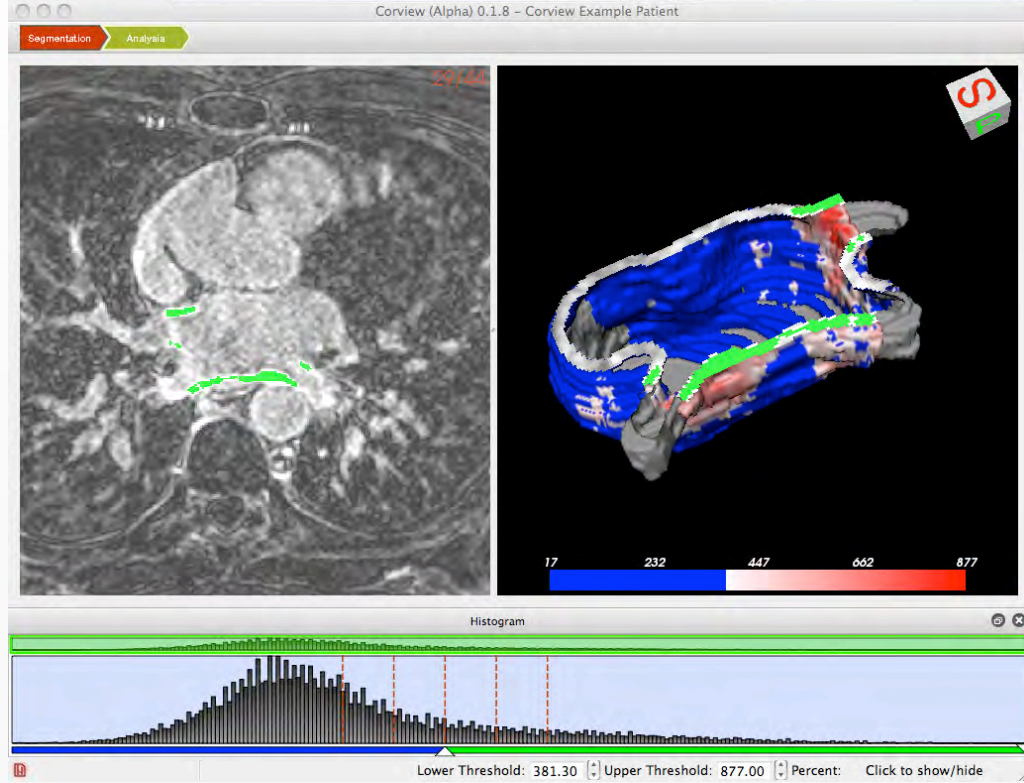
Automated Segmentation



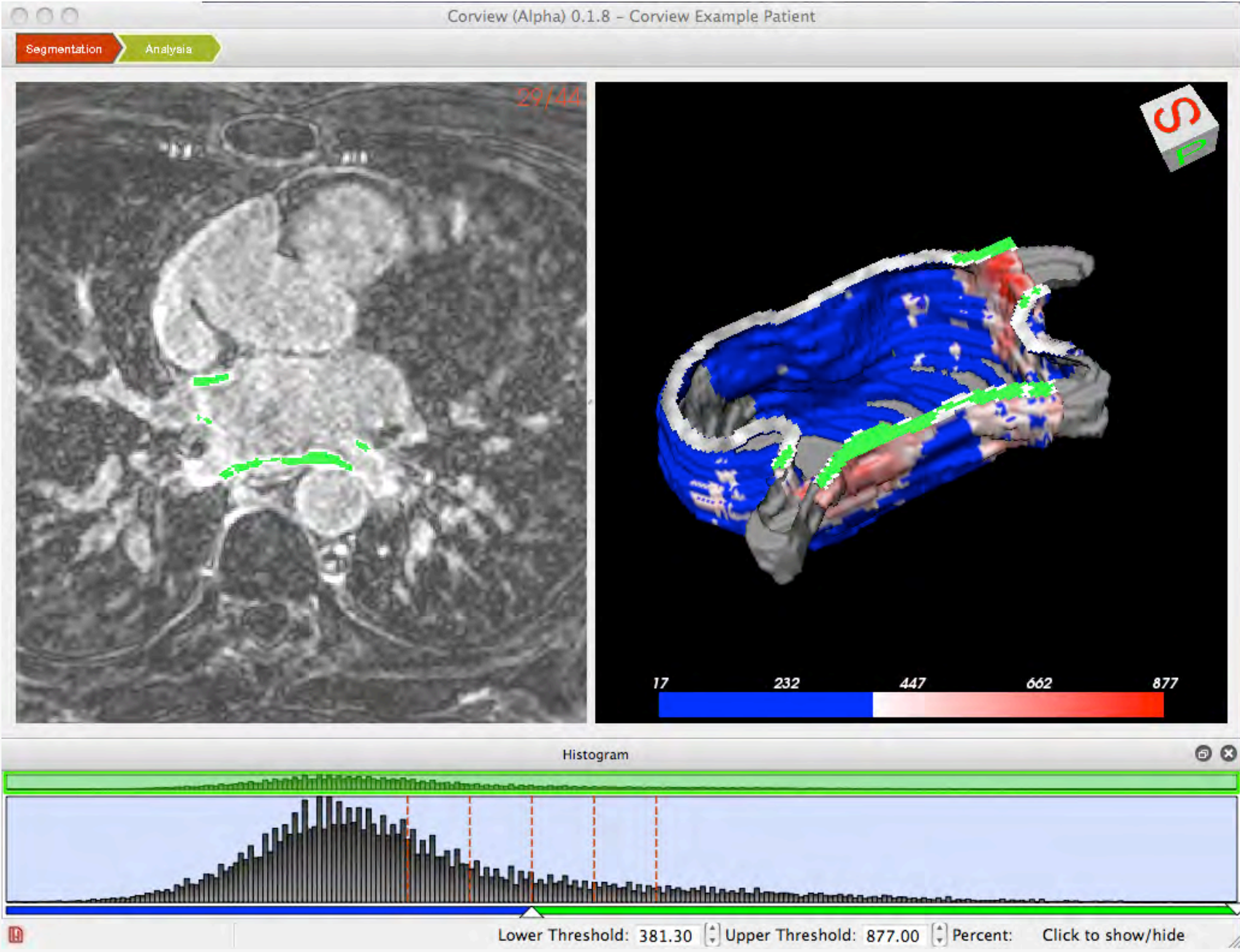
Workflow Past



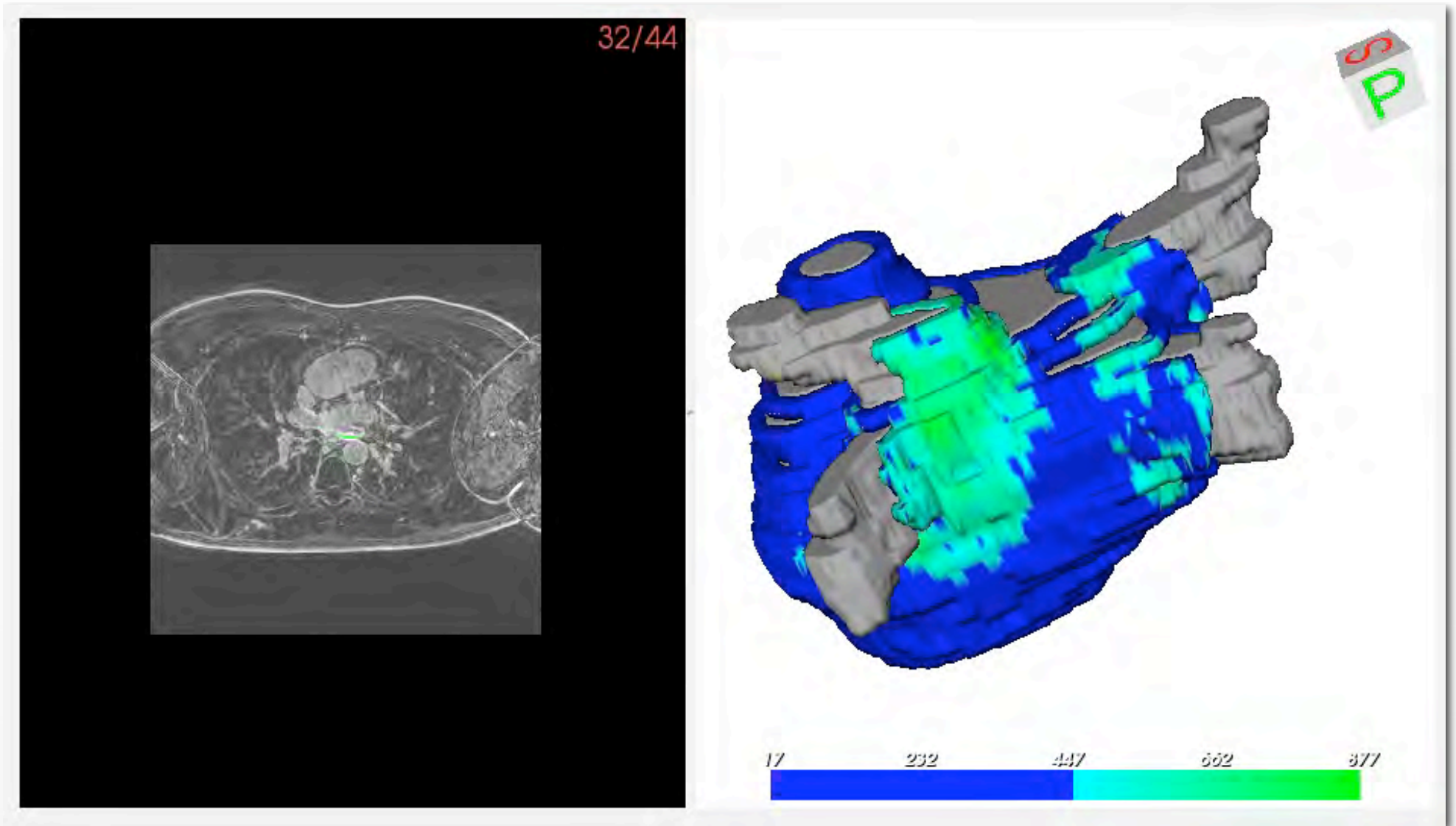
The New Workflow



Corview in Action



Corview in Action



Role of Shape Analysis in AF

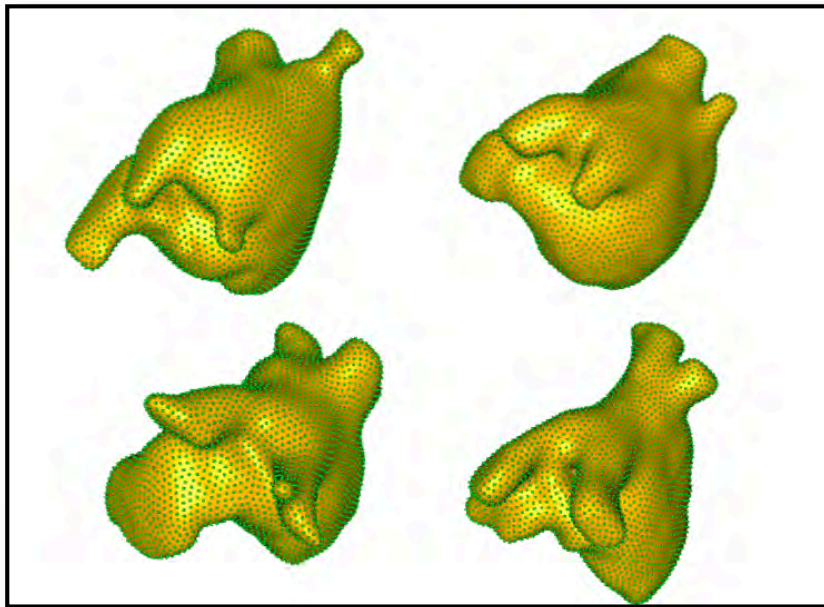
Shape Analysis



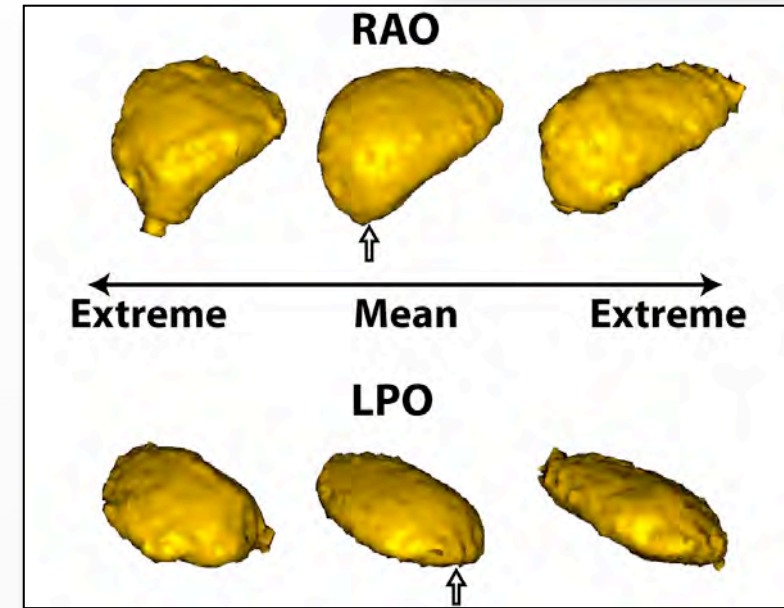
Greg Gardner



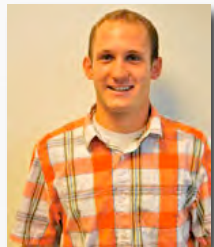
Josh Cates



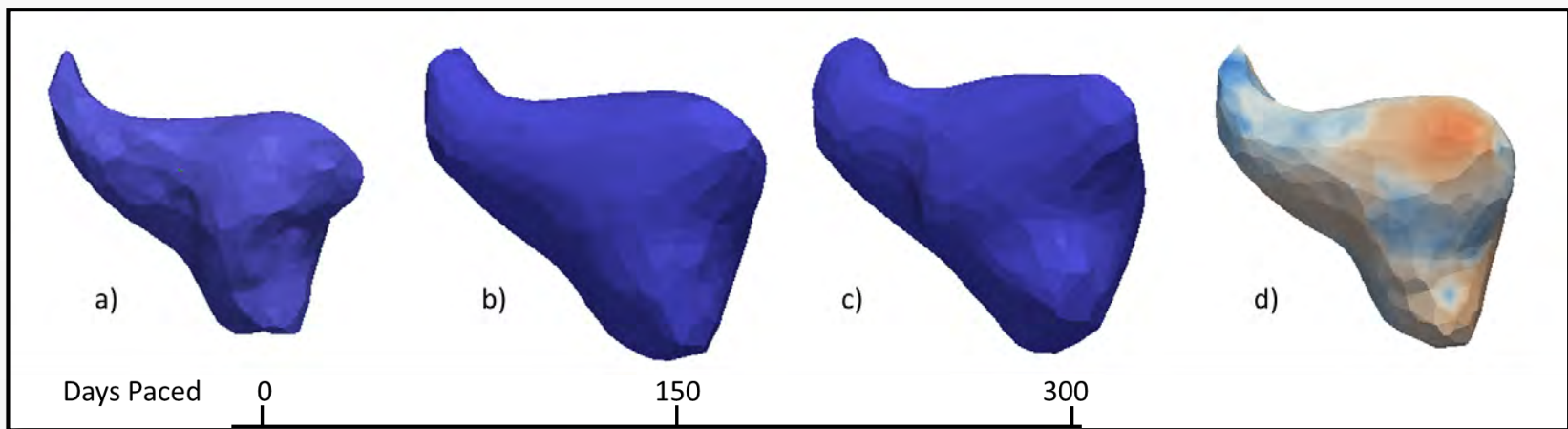
LA Shape



LAA Shape



Jason Jenson



LA Shape Change over Time

Registration



Greg Gardner



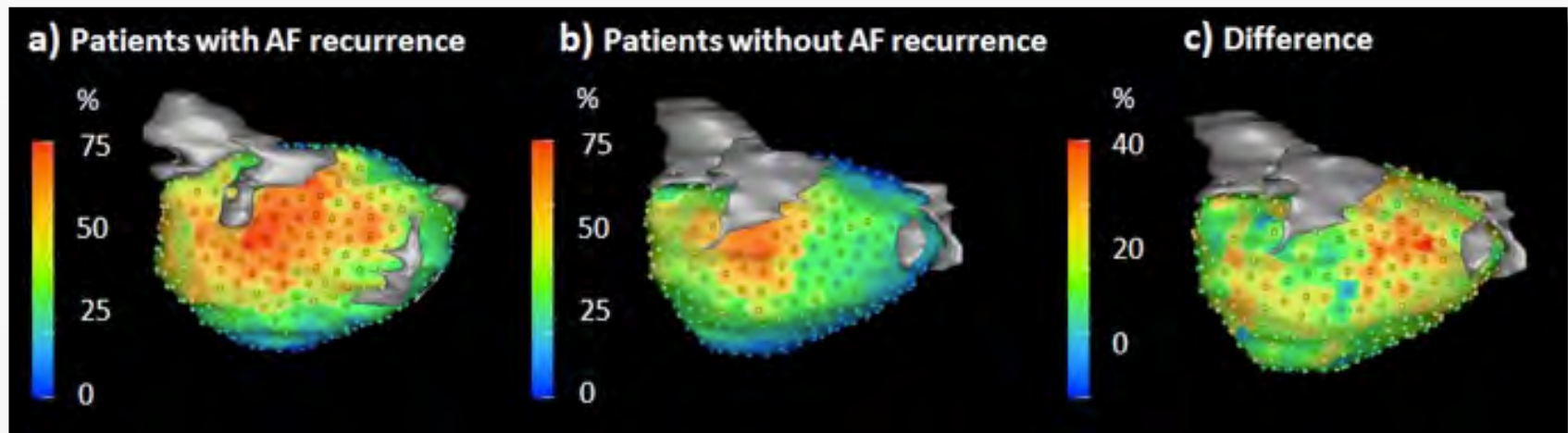
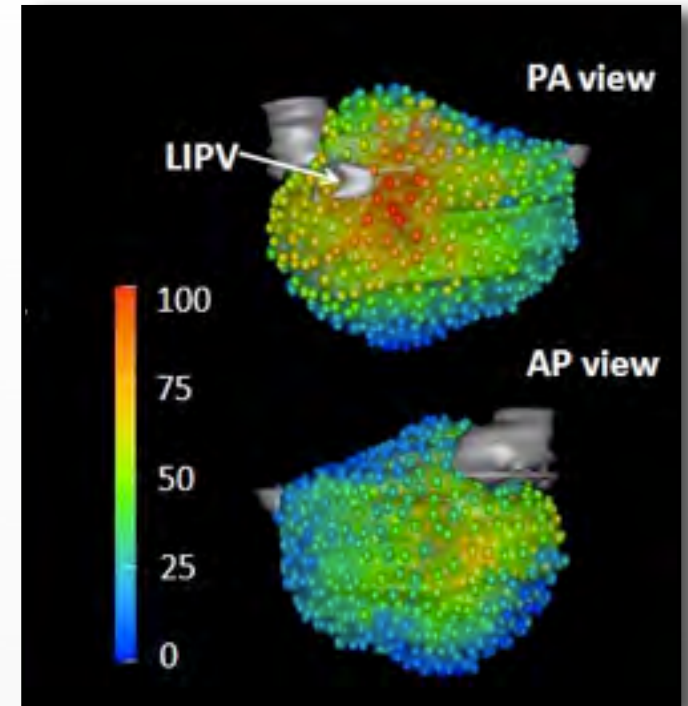
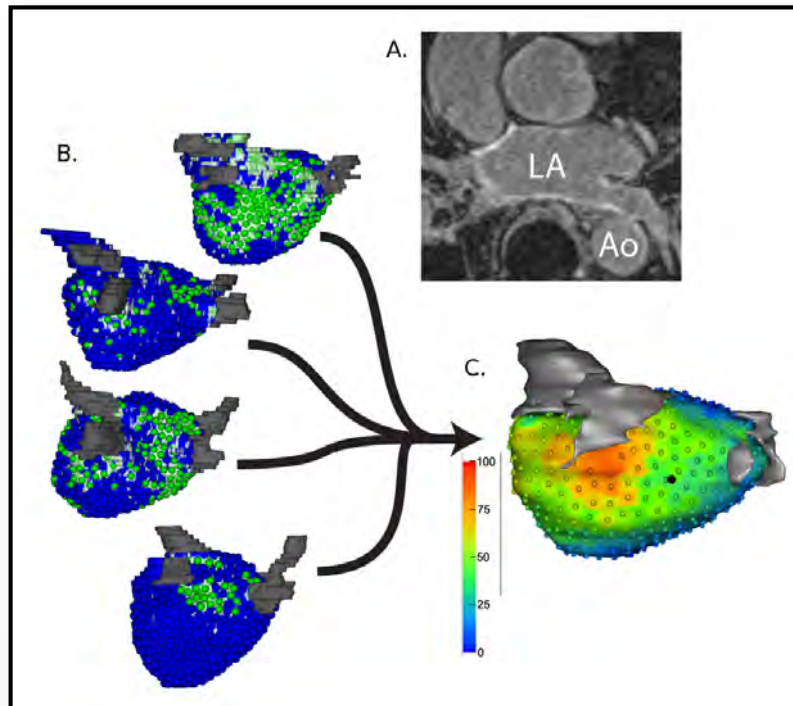
Koji Higuchi



Alan Morris



Josh Cates



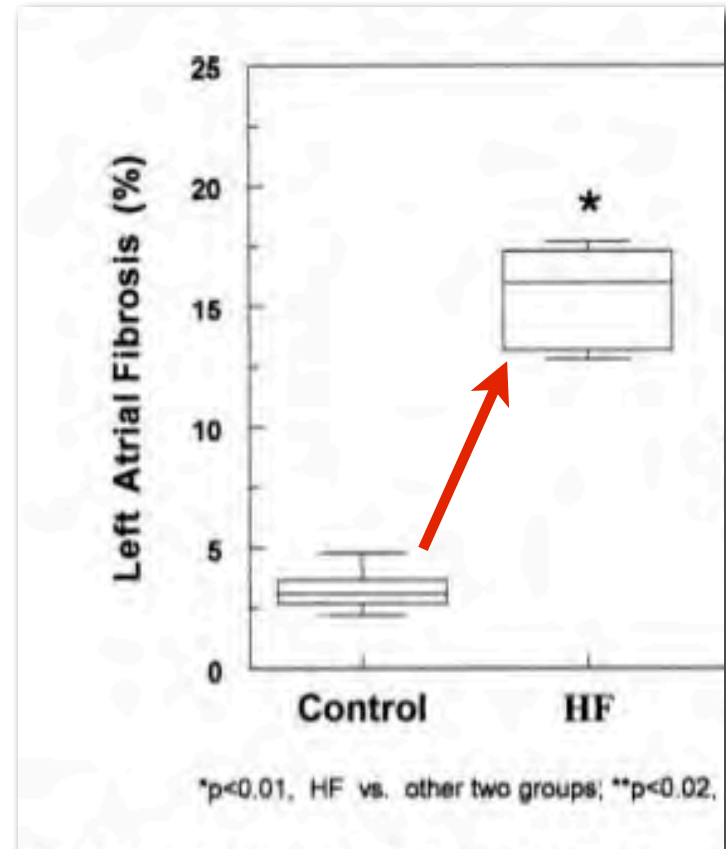
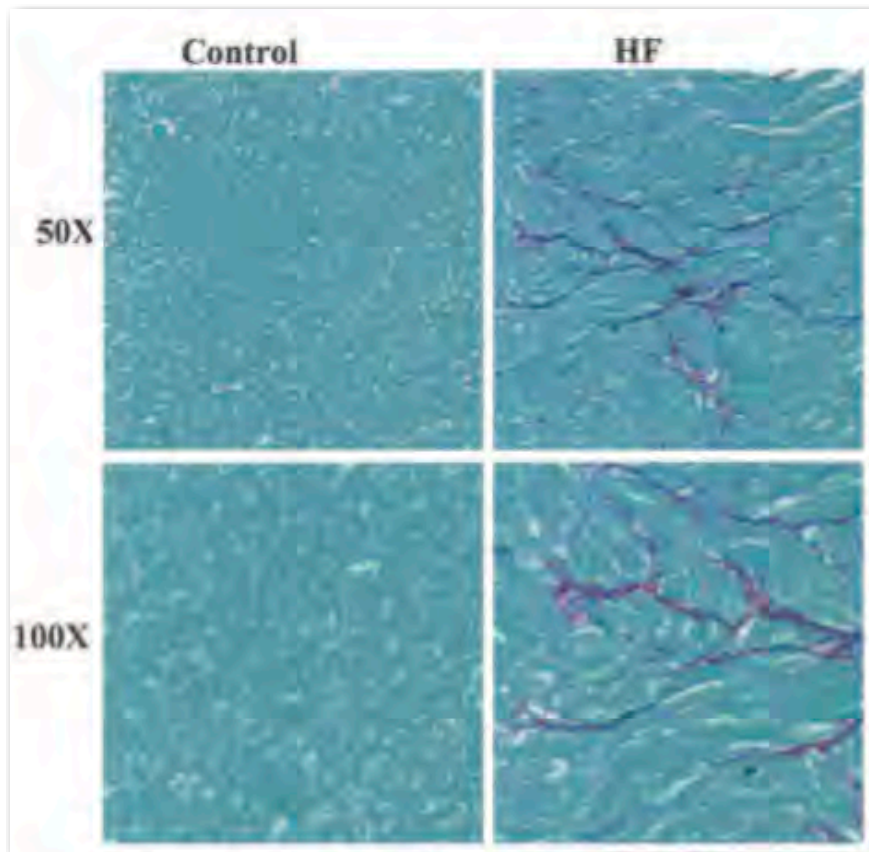
Simulation: What Causes AFib?

Substrate

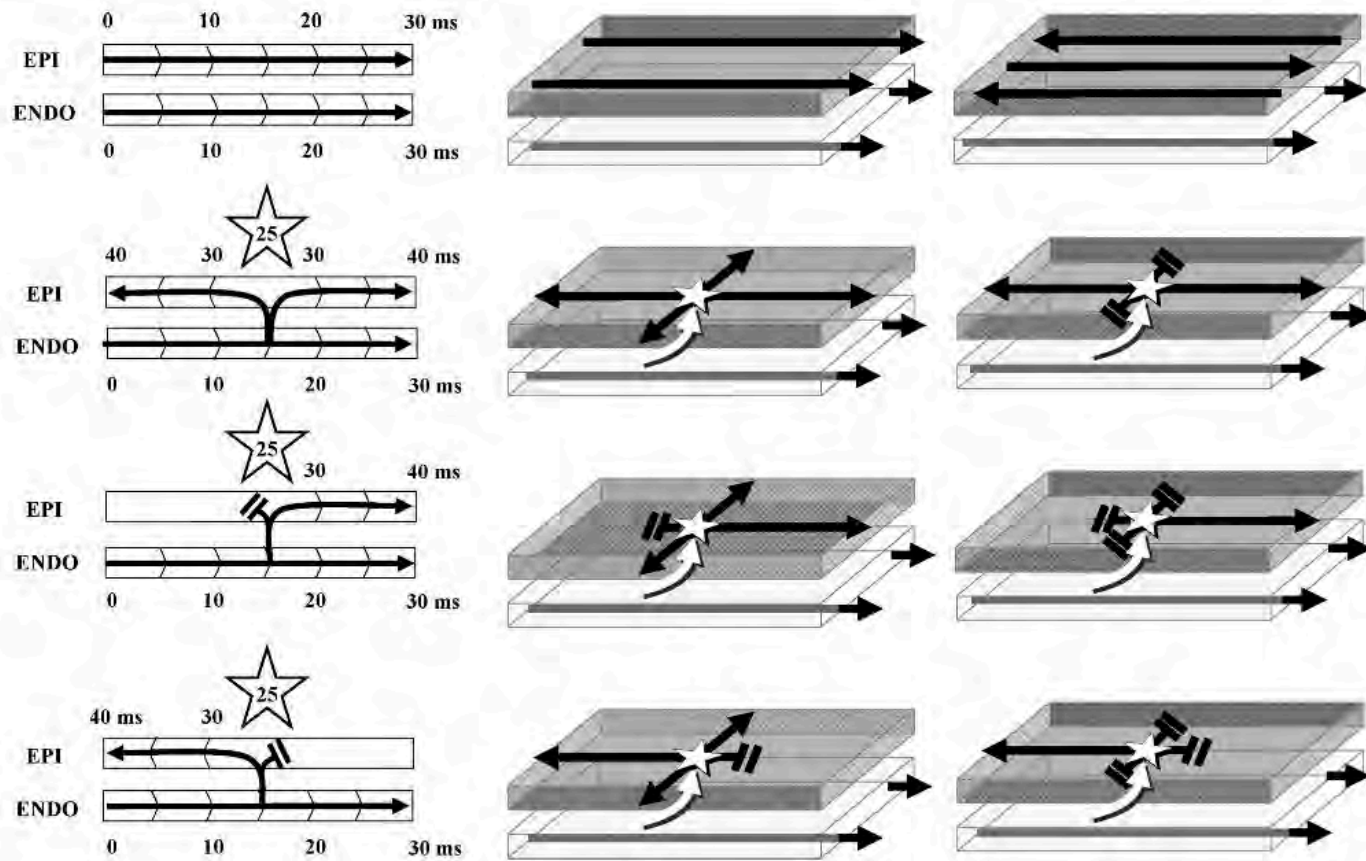
+

Trigger

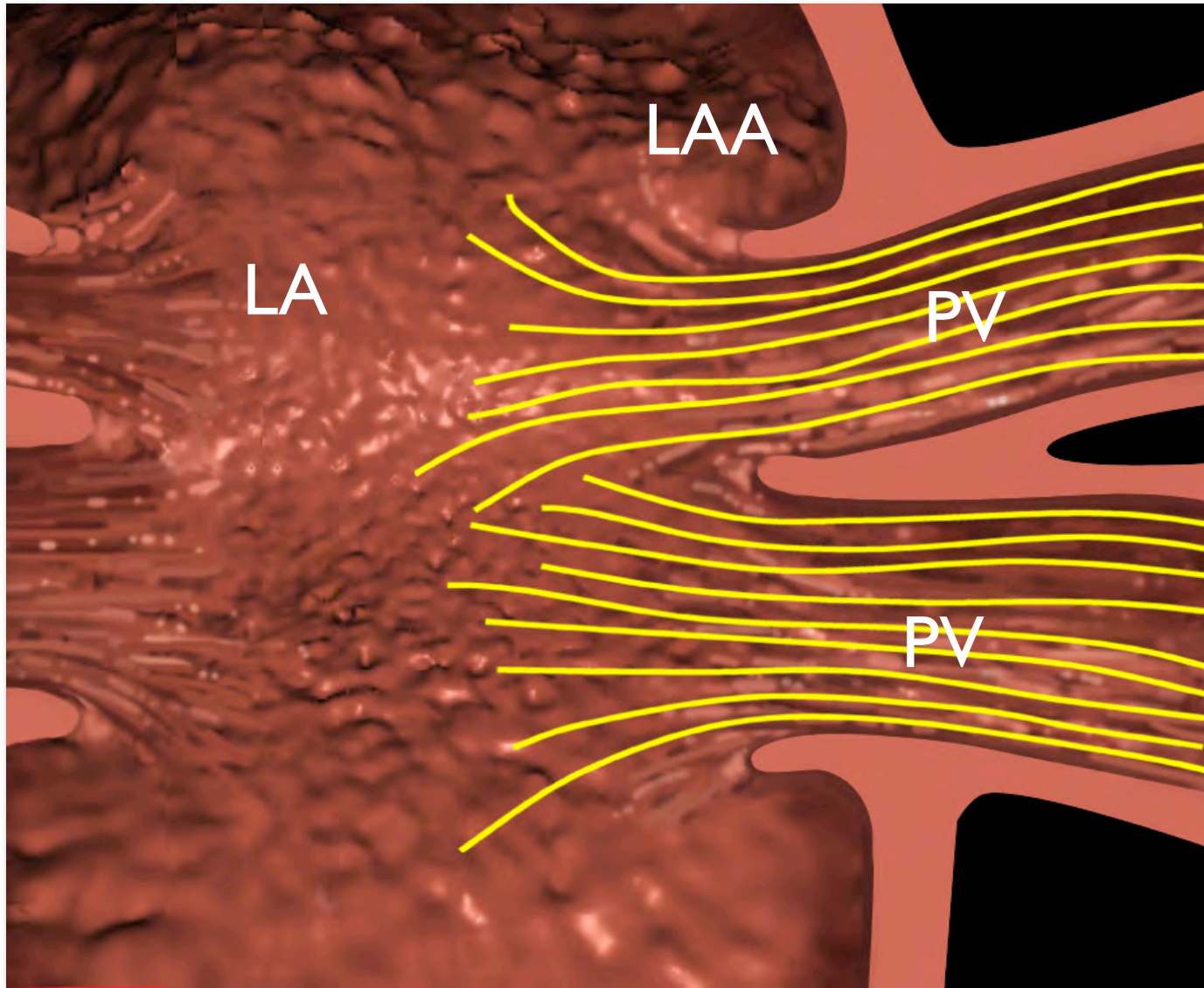
Substrate:Fibrosis



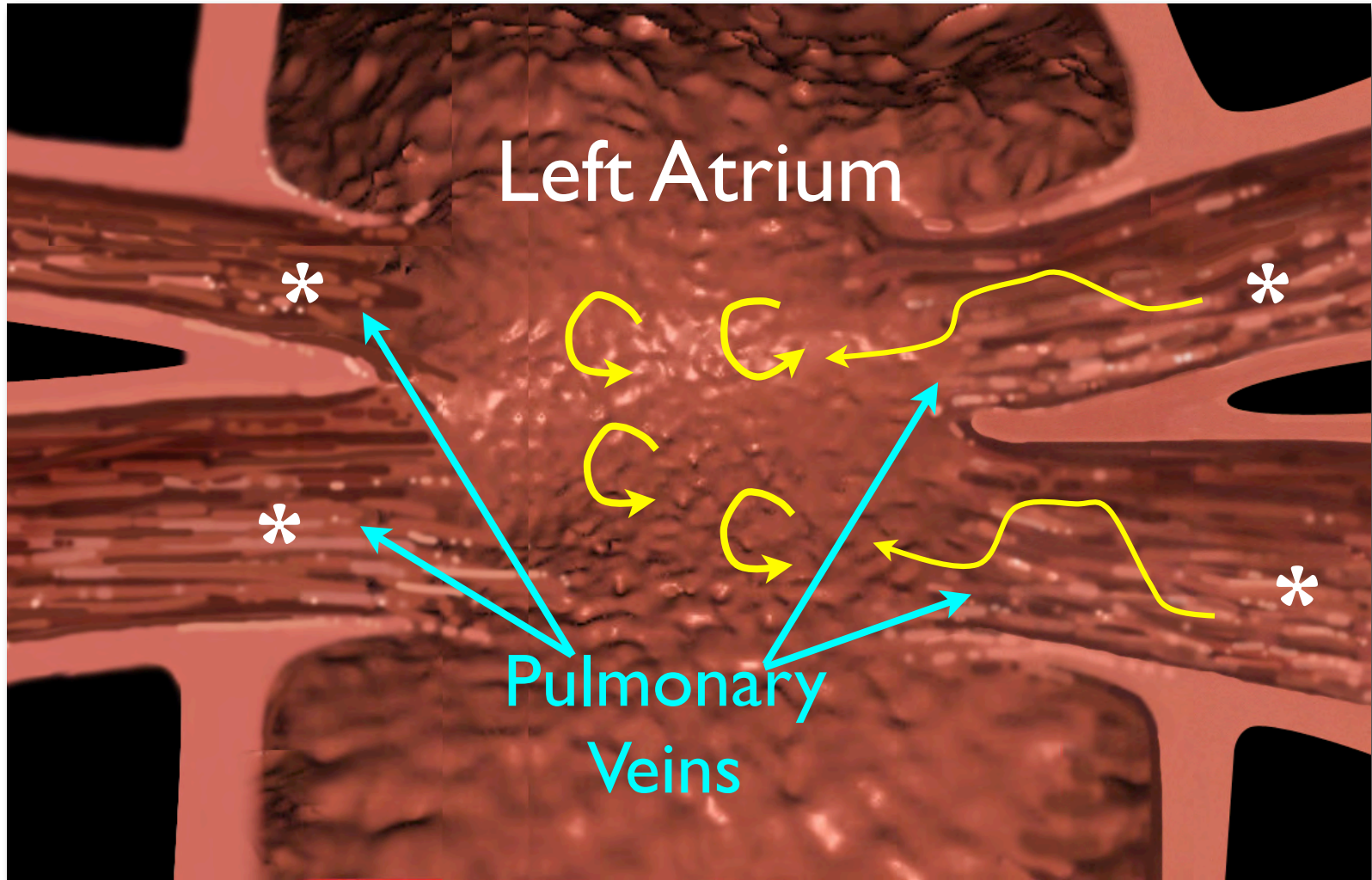
Complex Propagation



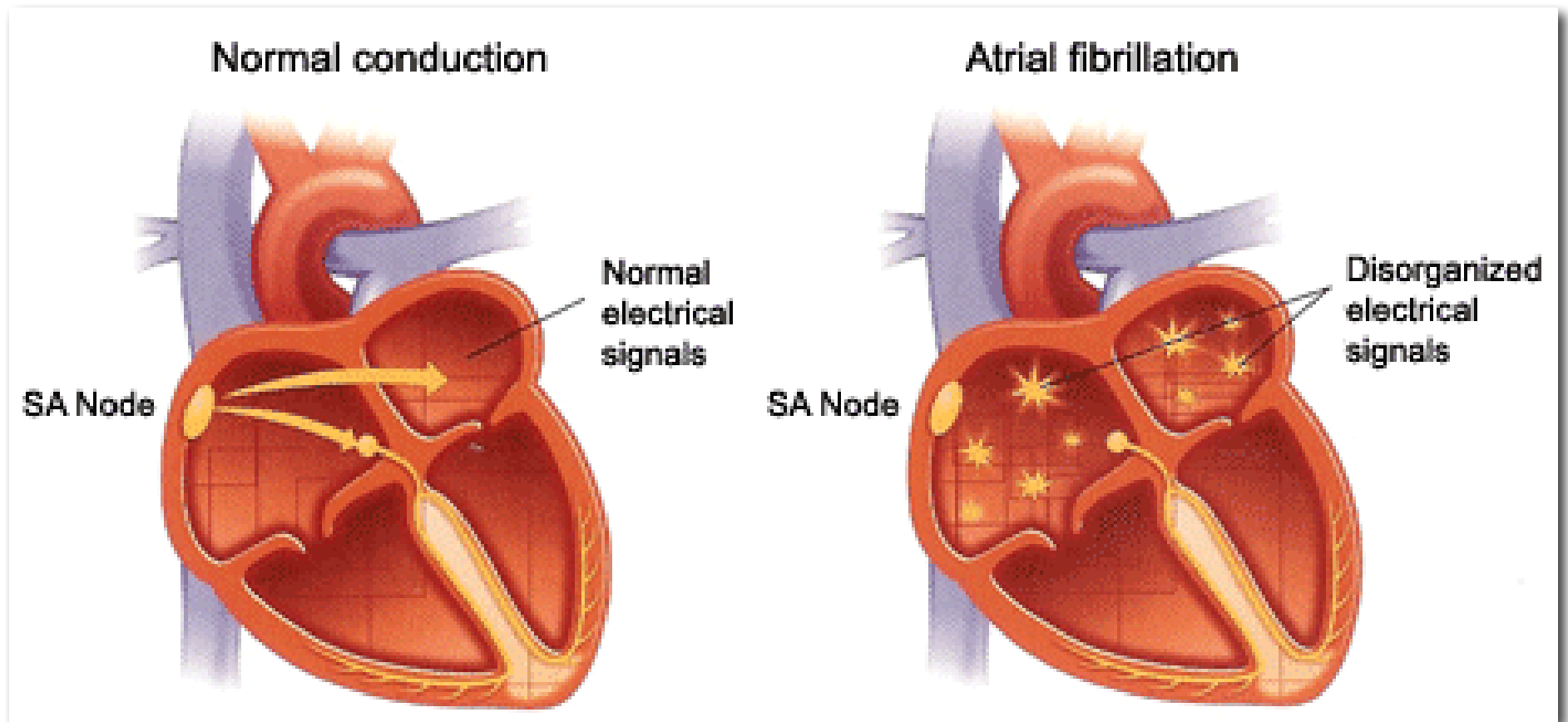
Substrate: Extension of muscle sleeves



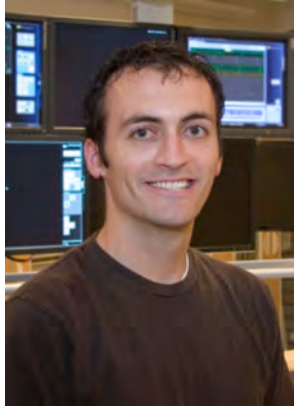
Triggers



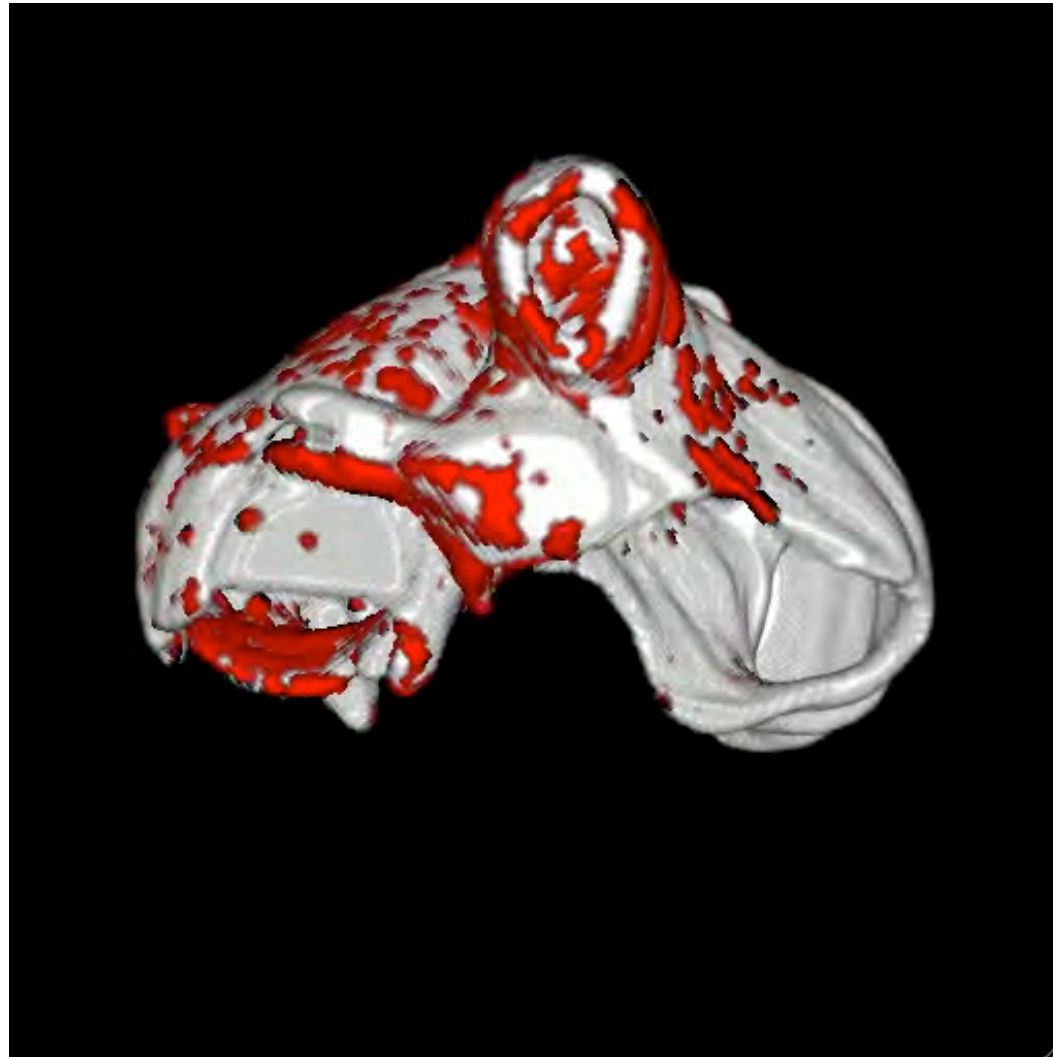
Clinical Result



Patient Specific Models of AF



Josh Blauer



Natalia
Trayanova

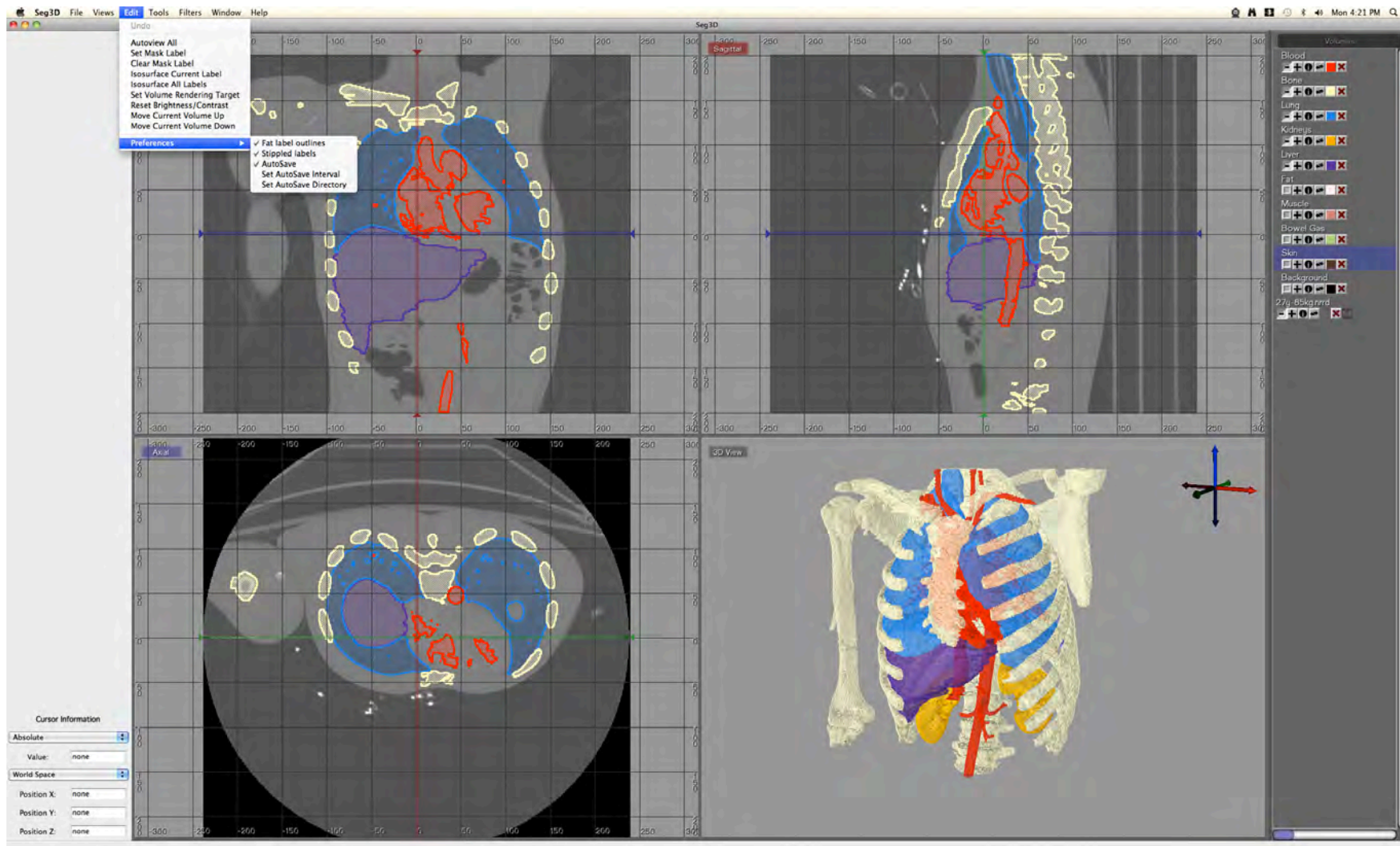


Kathleen
McDowell

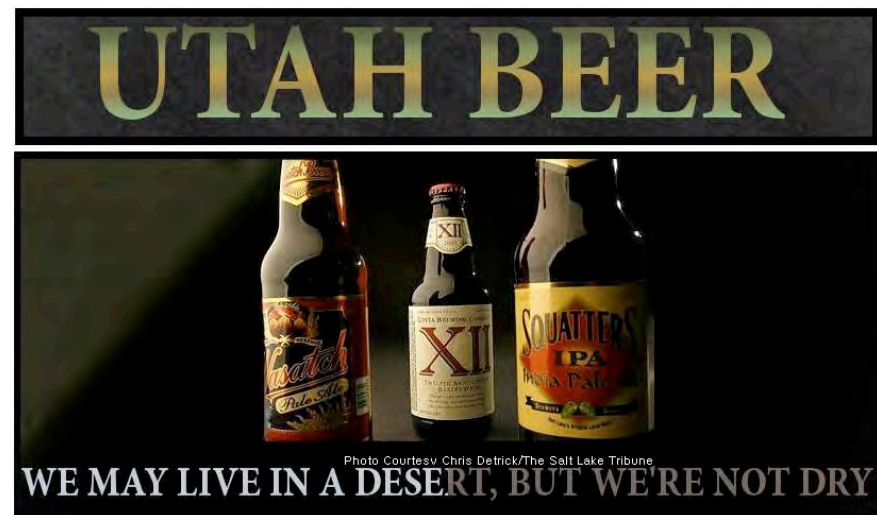
Segmentation



Goal: Identifying Structures



Segmentation in the Real World



Seg3D - 3D Segmentation



Seg3D 2.0

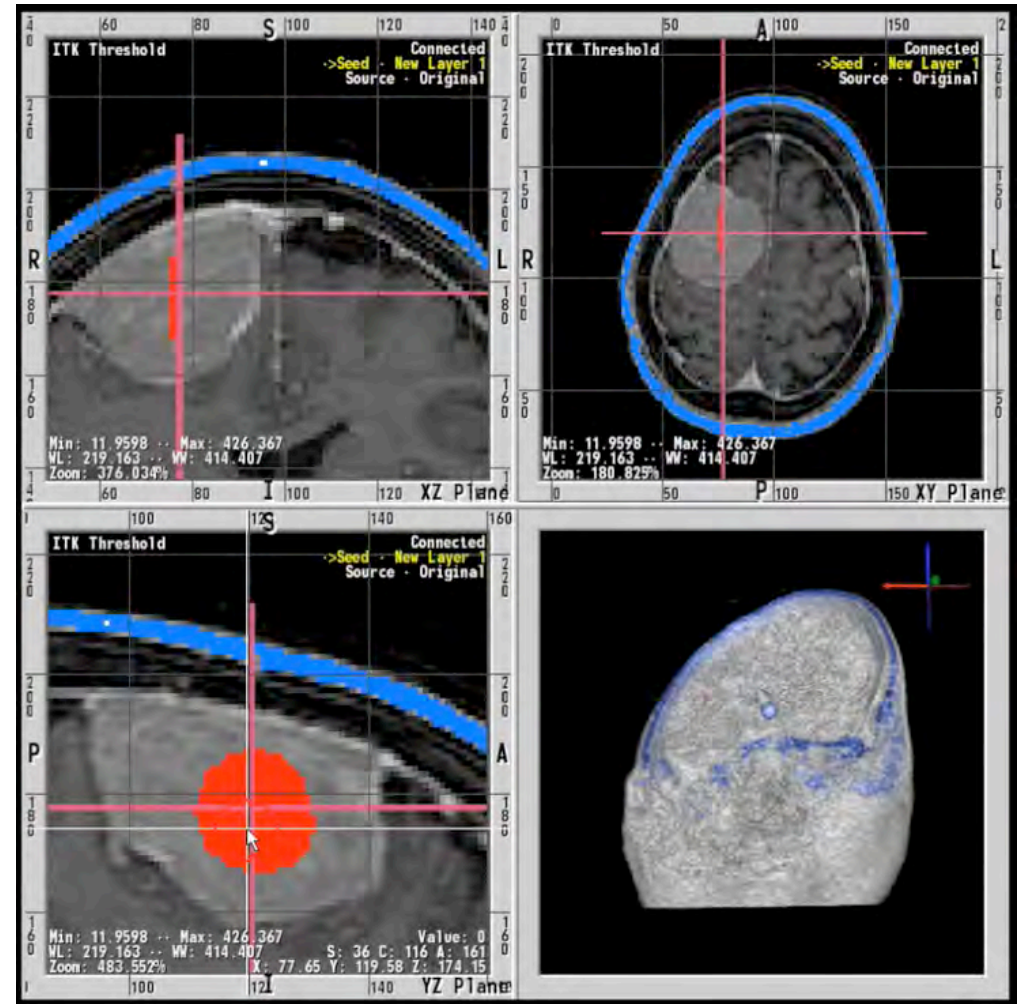
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McKay Davis, Josh Cates, Ross Whitaker, Steve Parker, David Weinstein, Marty Cole, Michael Callahan, J. Davison de St. Germain, Yarden Linnat, Allen Sanderson, Darby Van Uiter, Jenny Simpson, Gordon Kindmann, Chris Moulding, Ted Dustman, Rob MacLeod, John McCorquodale, Keming Zhang, Kurt Zimmerman, Kostadin Damevski, Alexei Samsonov, Erik Kuehne, Peter-Pike Sloan, Oleg Portniaguine, James Bigler, Wayne Witzel, Bryan Worthen, David Hart, Chris Butson, Sascha Moehrs, Lisa Durbeck, John Schmidt, Richard Coffey, Jesse Hall, Nick Benson, Randy Jones, Rob Van Uiter, Kai Li, Yesim Seringagoglu, Lorena Kreda, Alireza Ghodrati, Saeed Babaeizadeh, Jeroen Stinstra, Erik Anderson, Jason Shepherd, Kristen Zygmunt, Jianrong Shu, Ayla Khan, Wes Christiansen, Ramón Casero, Nathan Galli, Erik Jorgensen, Chems Touati.

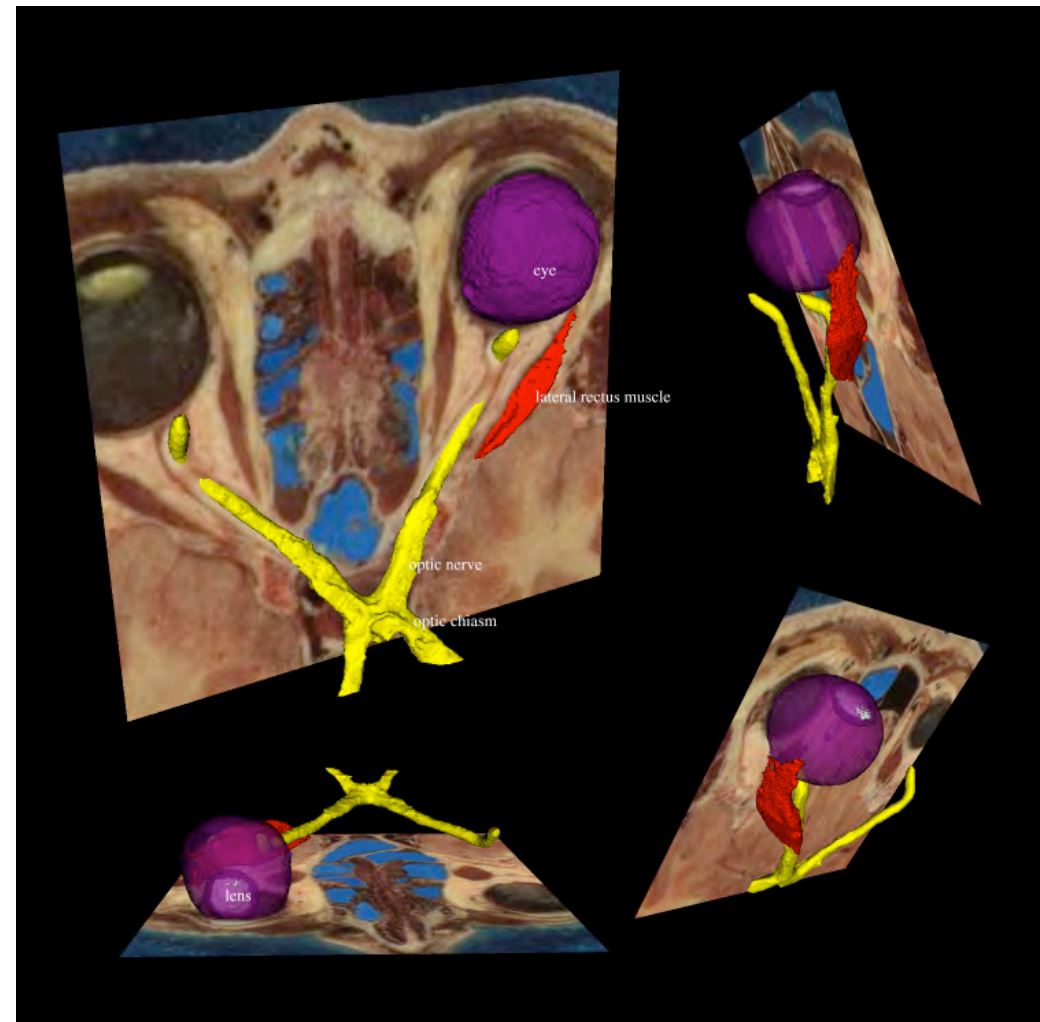
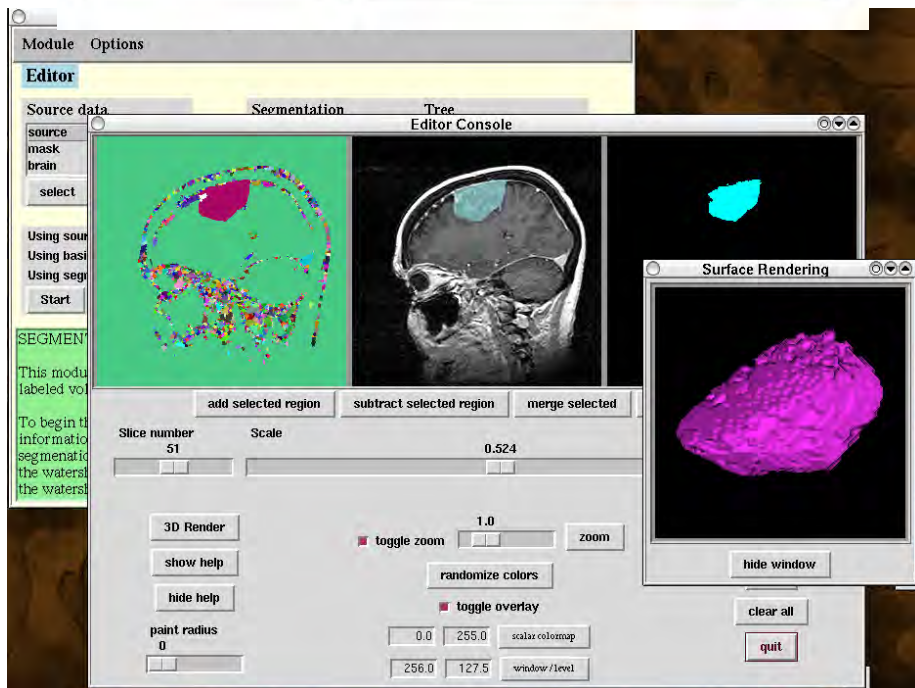
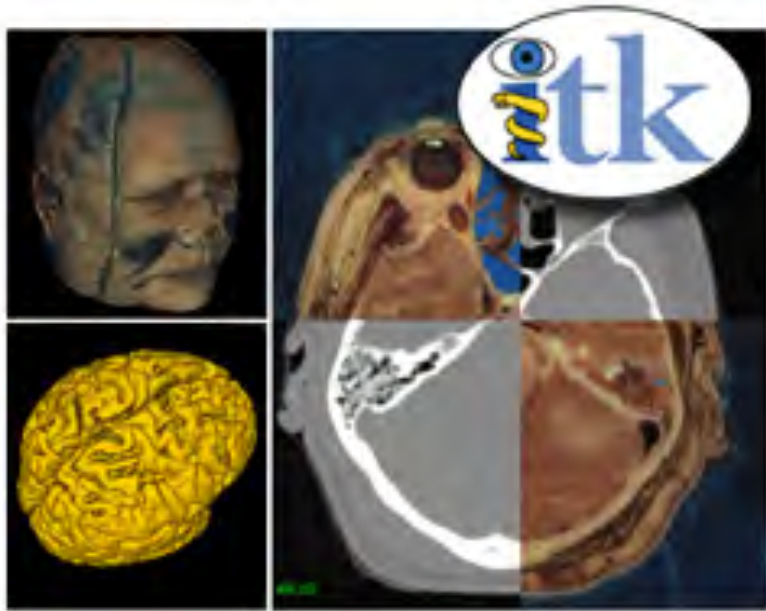
Stinstra, Erik Anderson, Nathan Galli, Erik Jorgensen, Chems Touati.

www.seg3d.org



ITK: Insight Toolkit

www.itk.org



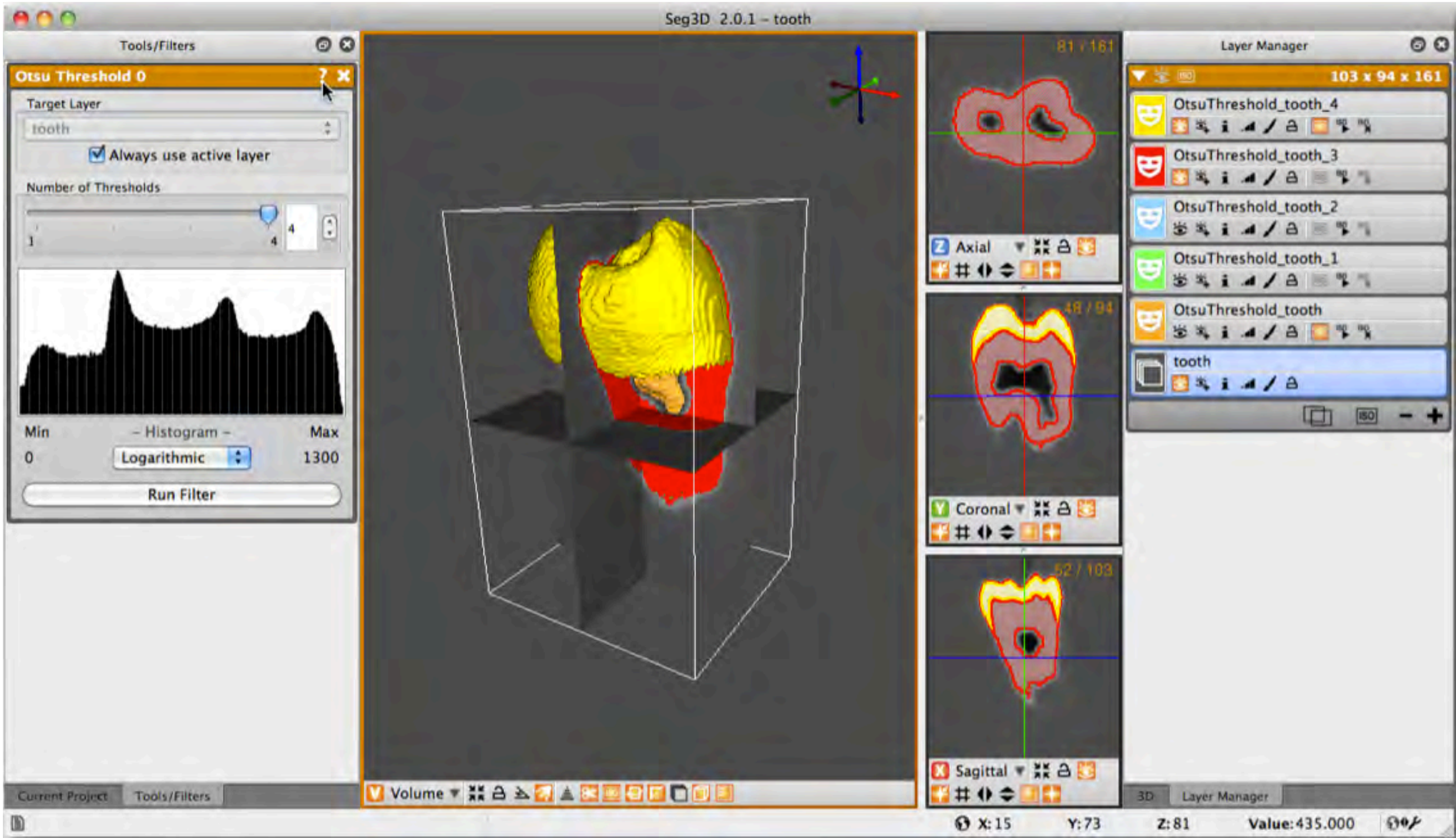
Seg3D: Introduction



Seg3D: In Action



Seg3D: Layers



Seg3D: Measurements

The screenshot displays the Seg3D ALPHA 2.1.0 software interface, which is used for 3D medical image segmentation and measurement. The interface is divided into several panels:

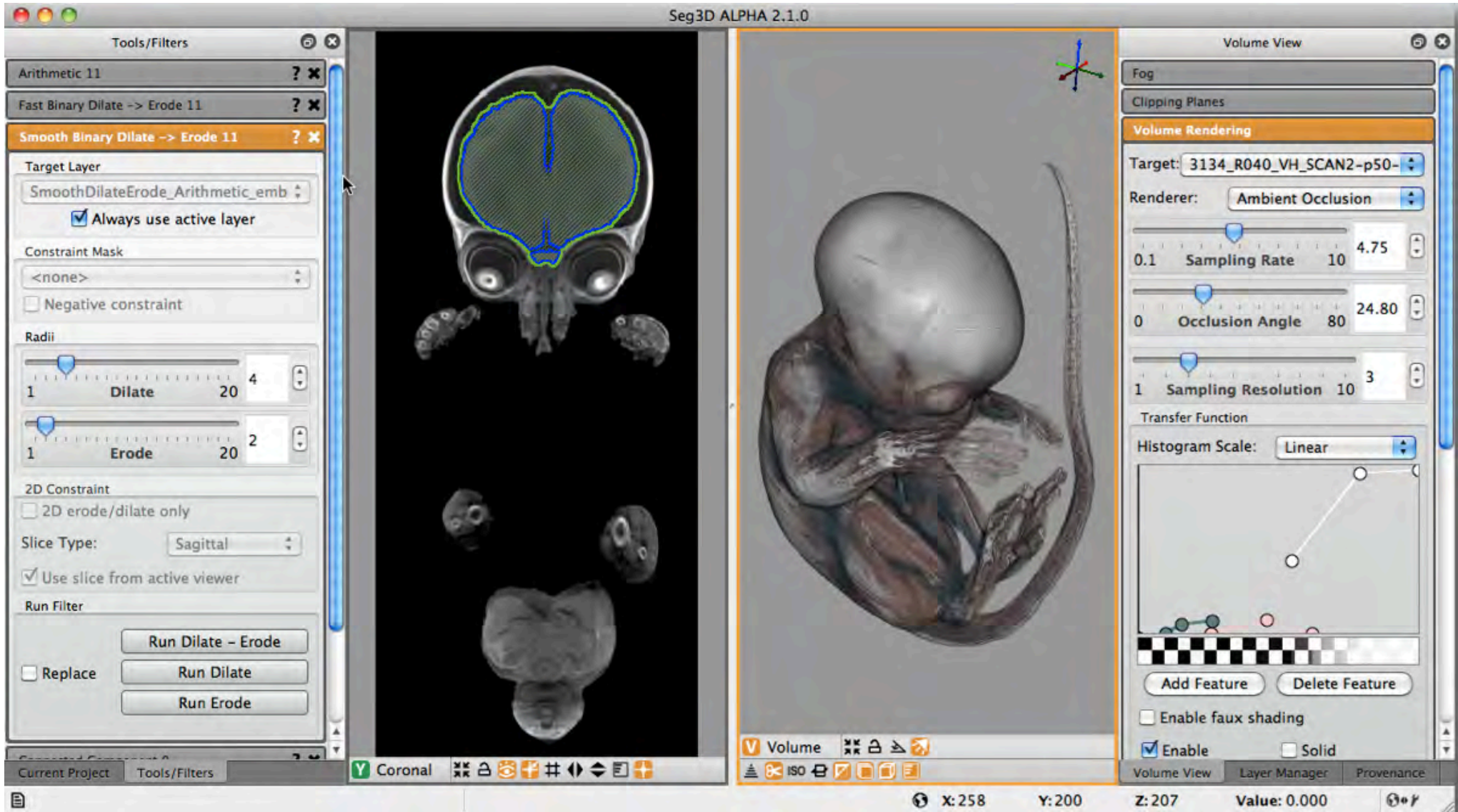
- Tools/Filters:** Located on the left, it includes a "Connected Component 0" panel and a "Measure 0" panel. The "Measure 0" panel contains a table of measurements:

Measurements	Length	Note
M0	15.056	Interocular

Below the table, there is a "Note:" field containing the text "Interocular". At the bottom of this panel, there are options for "Units" (Index, World) and "Label" (ID, Note).

- Main View:** The central area shows two views of a 3D medical image. The left view is a Coronal slice showing a yellow mesh overlay on the brain, with a measurement line and the value "15.056" indicating the interocular distance. The right view is a Sagittal slice showing a yellow mesh overlay on the brain and a green mesh overlay on the lungs. A measurement line and the value "15.056" are also present in this view.
- Layer Manager:** Located on the right, it displays a list of layers and their properties. The current layer is "ISO" with dimensions "277 x 530 x 706". The layers listed are: MaskLayer_1, embryo_brain, embryo_lungs_1, embryo_lungs, and embryo_kidneys. Below the list, there are sliders for "Max" (255, 235.46) and "Min" (255, 37.96), and a checkbox for "Adjust Min/Max". A "Reset Brightness/Contrast" button is also present.
- Status Bar:** At the bottom, it shows the current view ("Coronal" and "Sagittal"), coordinates ("X: 176", "Y: 348", "Z: 345"), and the current value ("Value: 0.000").

Seg3D: Volume Visualization



Seg3D: Provenance

The screenshot displays the Seg3D Version 2.0 software interface. The main window is titled "Seg3D Controller" and contains several tabs: "Actions", "State Variables", and "Event Log". The "Action History" tab is active, showing a table of actions performed. The table has two columns: "Action" and "Result".

Action	Result
Translate viewer0::volume_view [-2.2885 -2.07853 1.44249]	
Translate viewer0::volume_view [-0.762833 -0.381417 0.660633]	
Translate viewer0::volume_view [-0.762833 -1.31569 0.121228]	
Translate viewer0::volume_view [-0.762833 -0.381417 0.660633]	
Translate viewer0::volume_view [-0.762833 -1.31569 0.121228]	
Translate viewer0::volume_view [-0.762833 -0.381417 0.660633]	
Translate viewer0::volume_view [-0.762833 -1.31569 0.121228]	
Translate viewer0::volume_view [-0.762833 -0.381417 0.660633]	
Translate viewer0::volume_view [-0.762833 -1.31569 0.121228]	
Translate viewer0::volume_view [-0.762833 -0.381417 0.660633]	
Translate viewer0::volume_view [2.9943e-17 -0.934276 -0.539404]	
Translate viewer0::volume_view [-0.762833 -0.381417 0.660633]	
OpenTool painttool	painttool_0
ImportLayer /Users/jeroen/projects/kid_defib/Torso_Scans/2y/2y-12kgcombined.nrrd importer=[Teem Importer] mode=label_mask	
ShowWindow controller	

Below the table, there is a section for "Run Action from command line:" with an input field and an "Action" button. At the bottom, there are "Status:" and "Usage:" labels.



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