

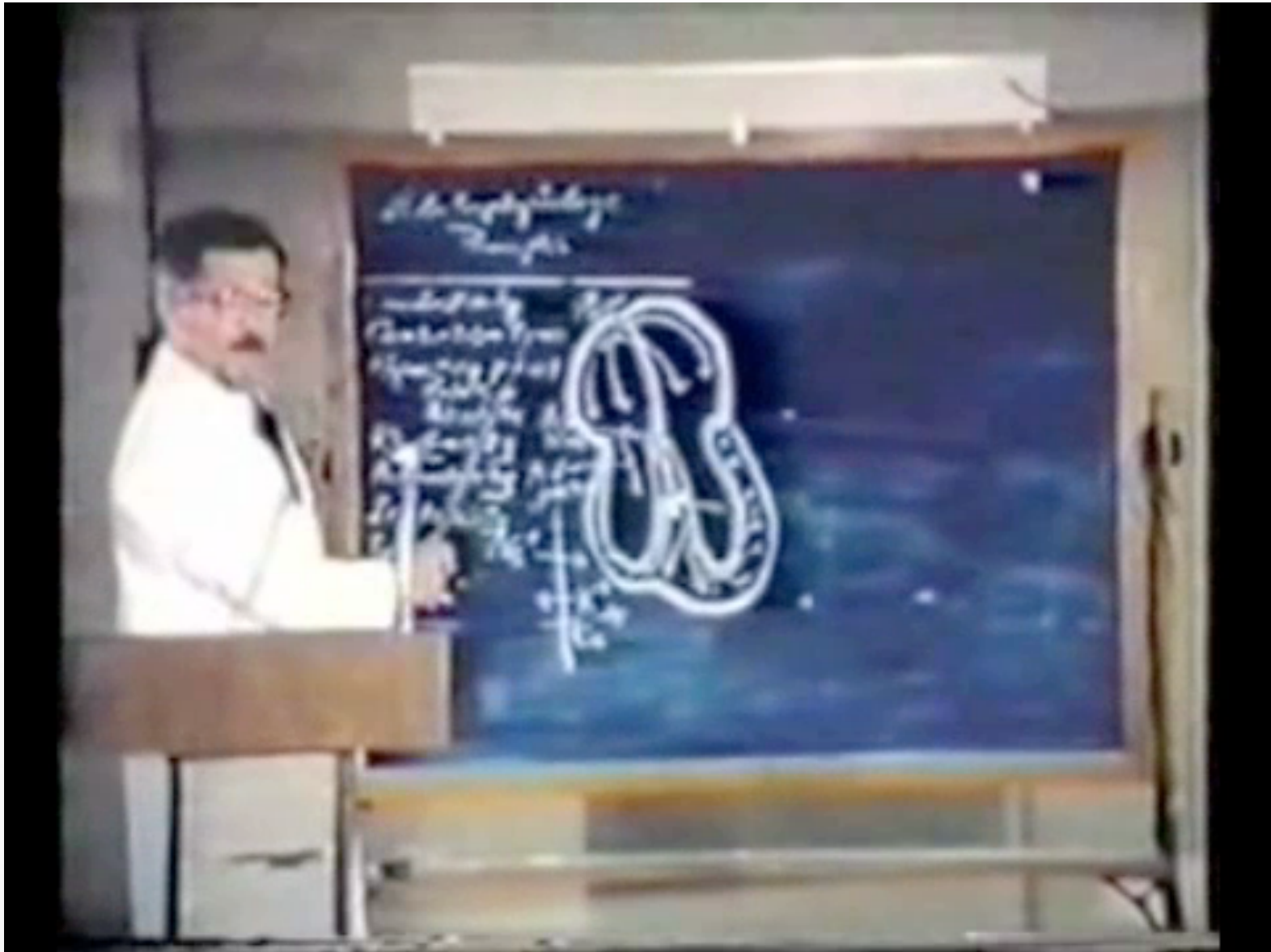
Imaging Based Analysis of Patients with Atrial Fibrillation

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

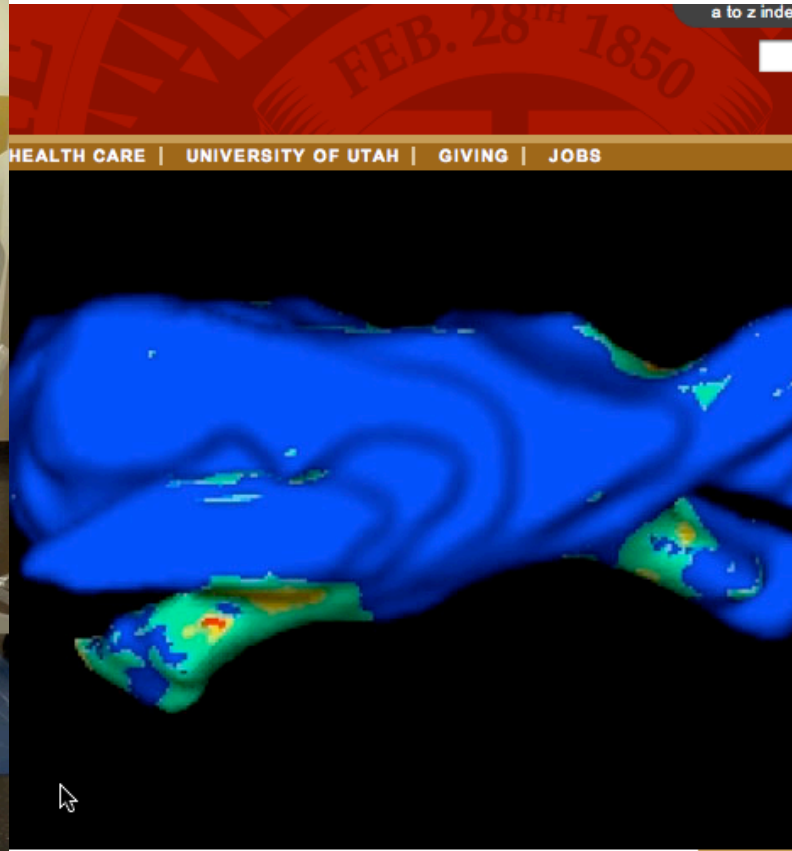
What is Atrial Fibrillation? = Afib = AF

Background I

John C Grammer MD FACC



Comprehensive Arrhythmia Research and Management



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News

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



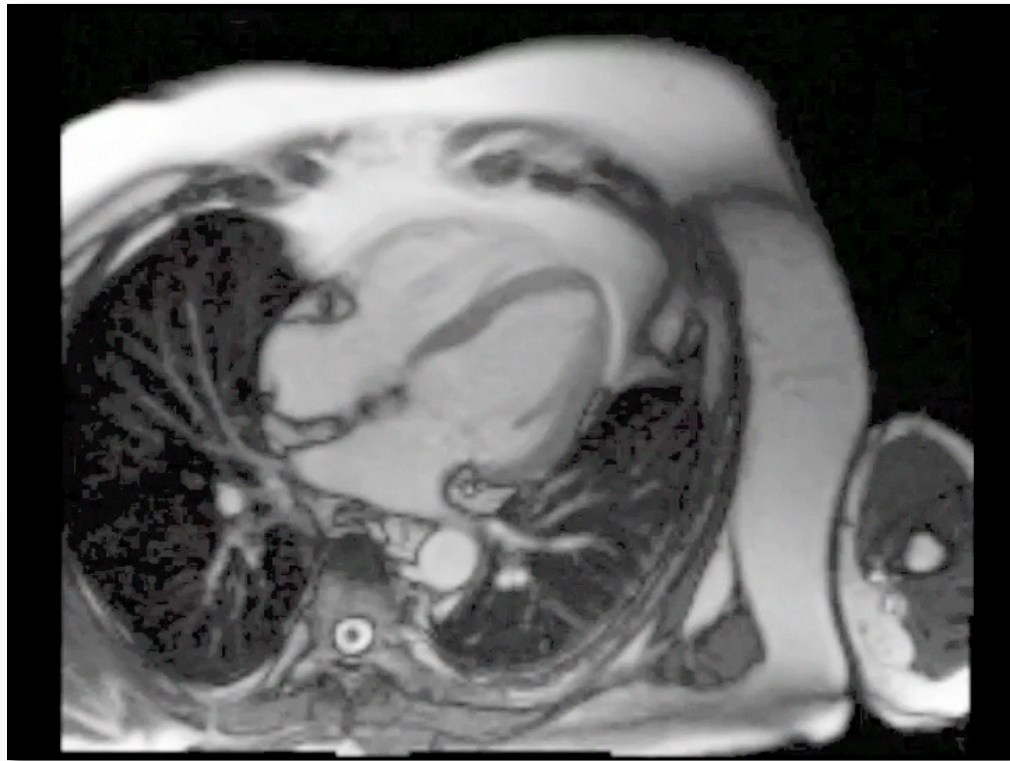
CARMA= Comprehensive Research and Management



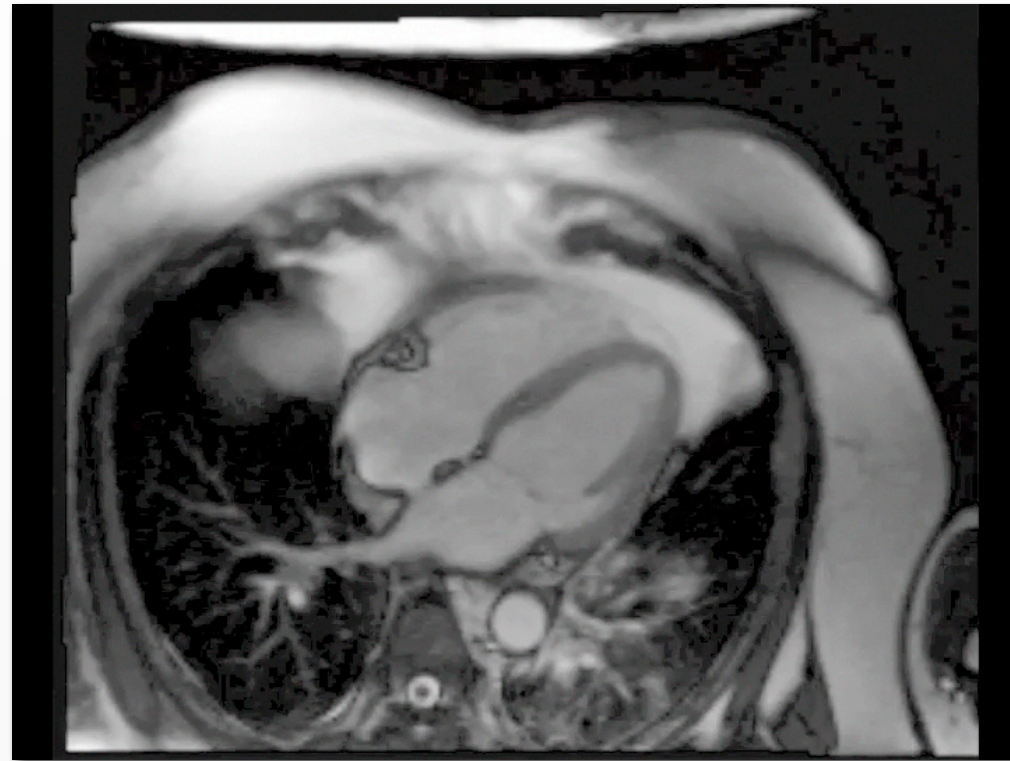
Atrial Fibrillation Illustrated



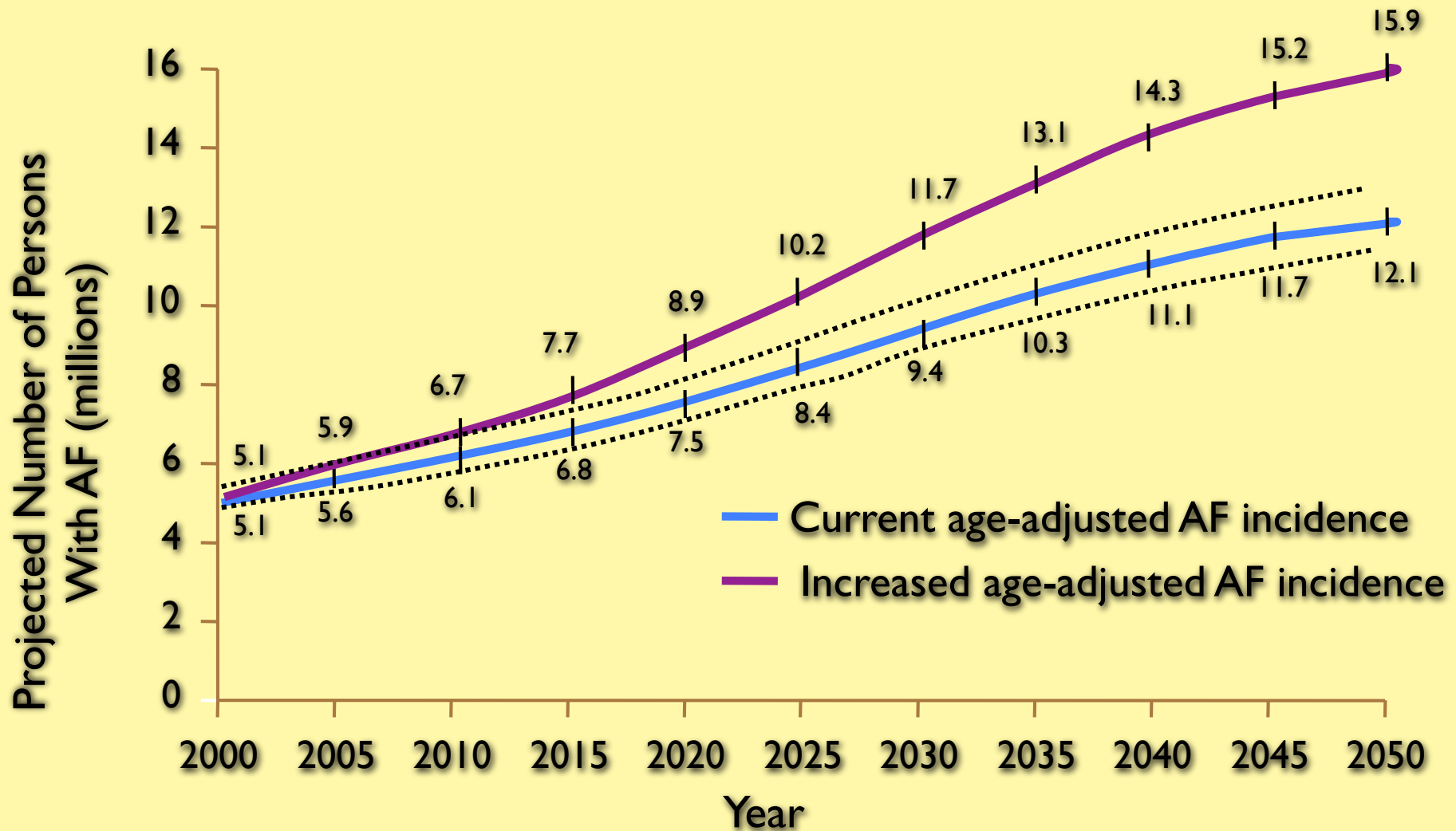
Normal Contraction



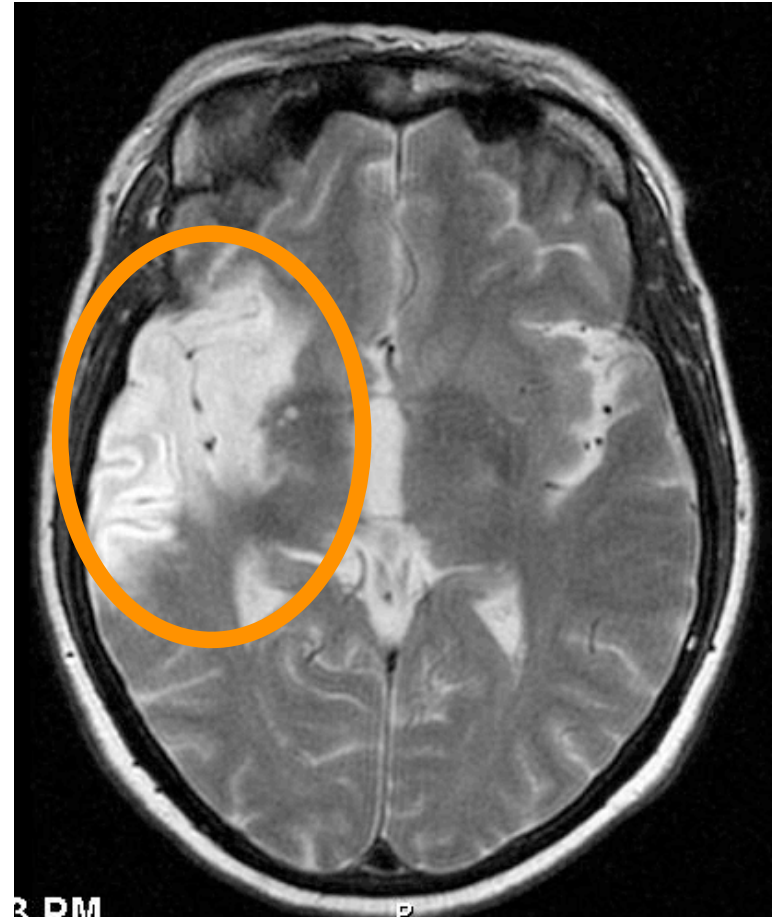
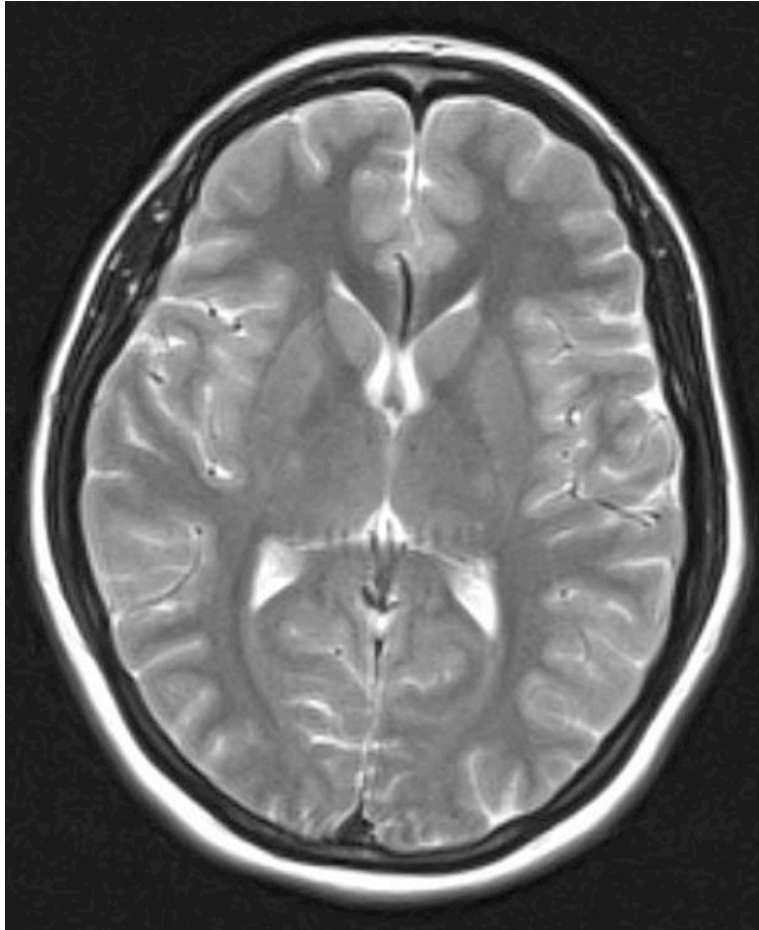
Atrial Fibrillation



AF Prevalence



20% of Strokes



\$20 billion/year

The CARMA Perspective

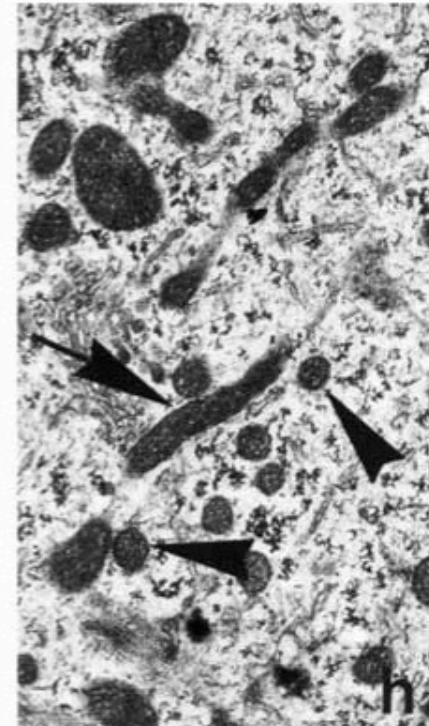
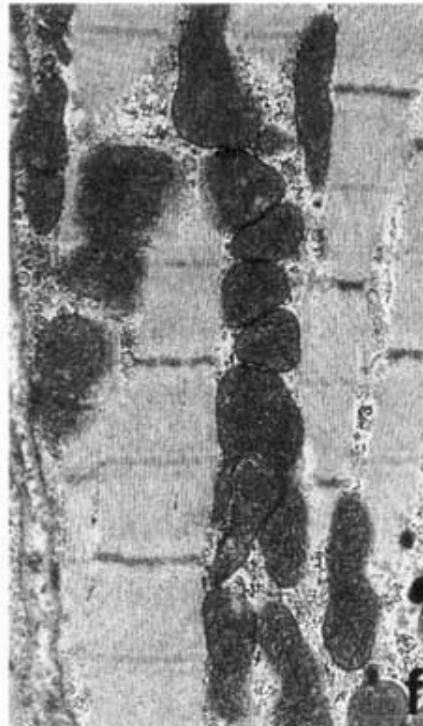
“AF is a heart tissue disease”

Normal

Early stage

Mid stage

Late stage

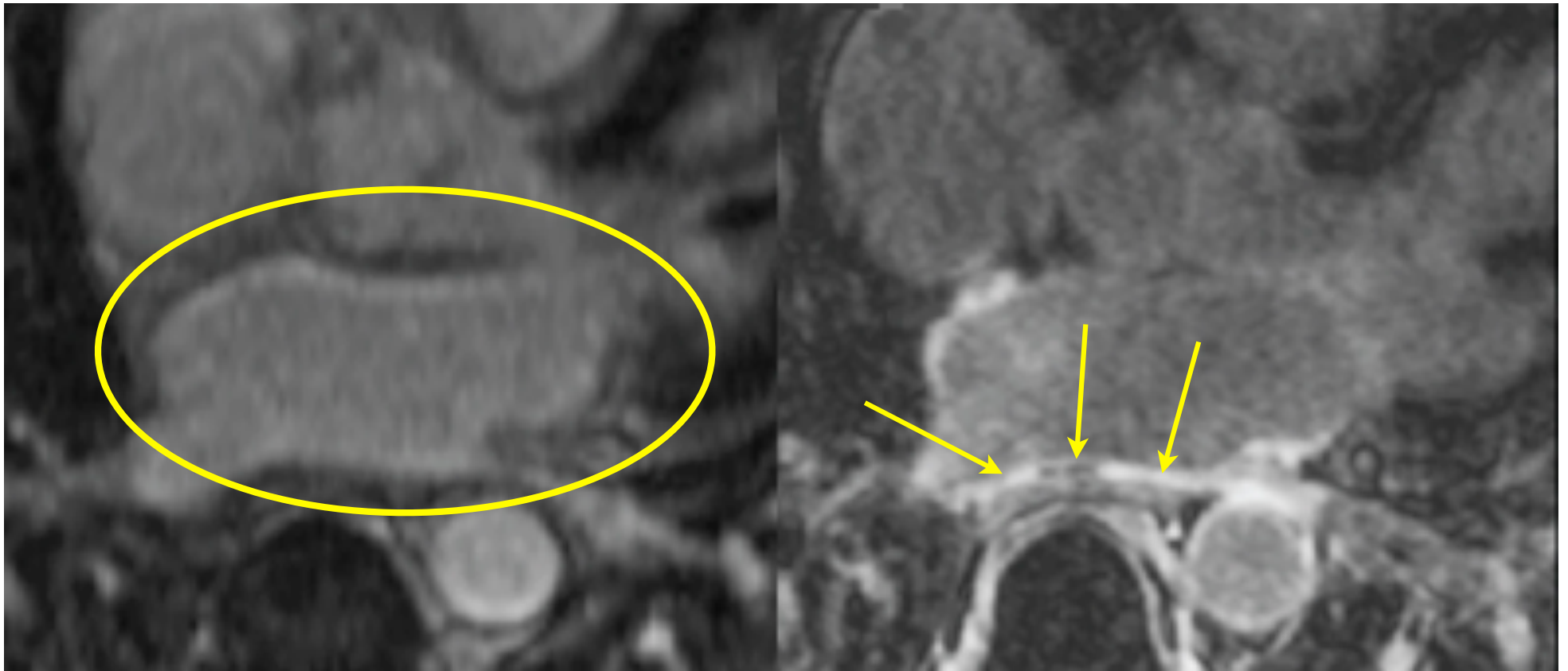


Ausma J, Alessie M ...J mol Cell Cardiol. 2001: 2083.

Structure Matters



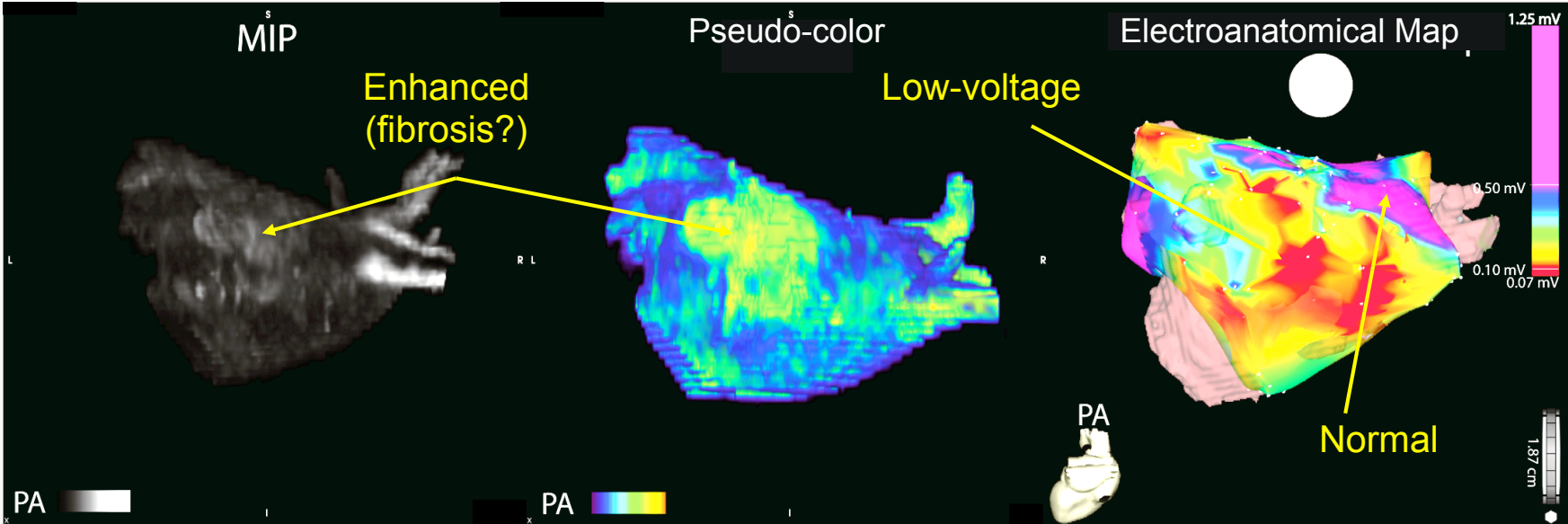
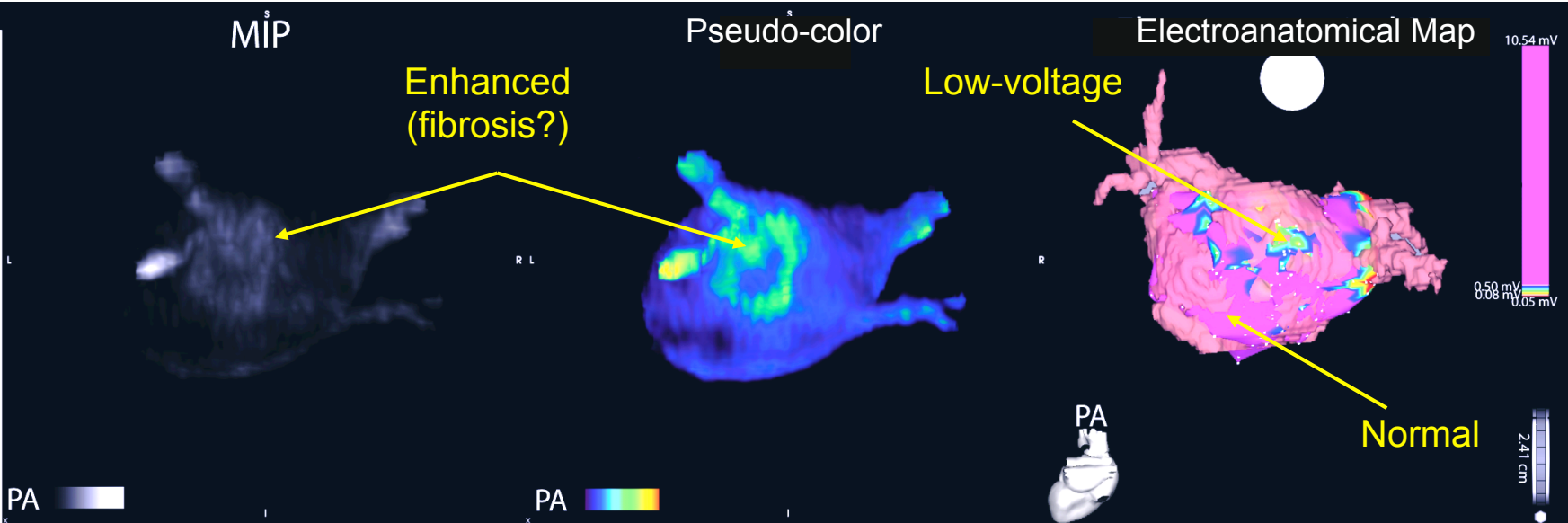
Late Gadolinium Enhancement MRI



Pre-treatment

3 month Post

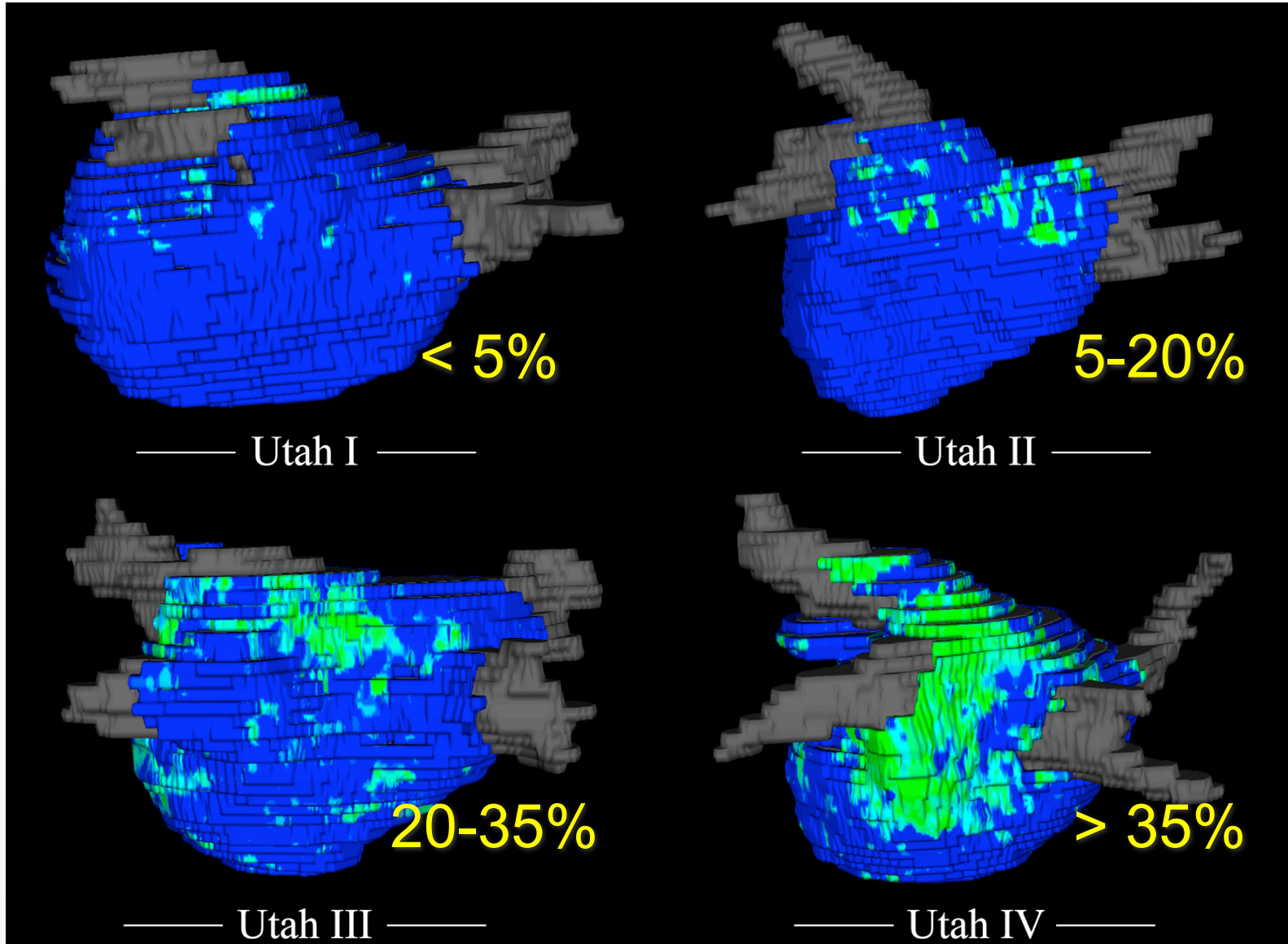
CARMA Started Here



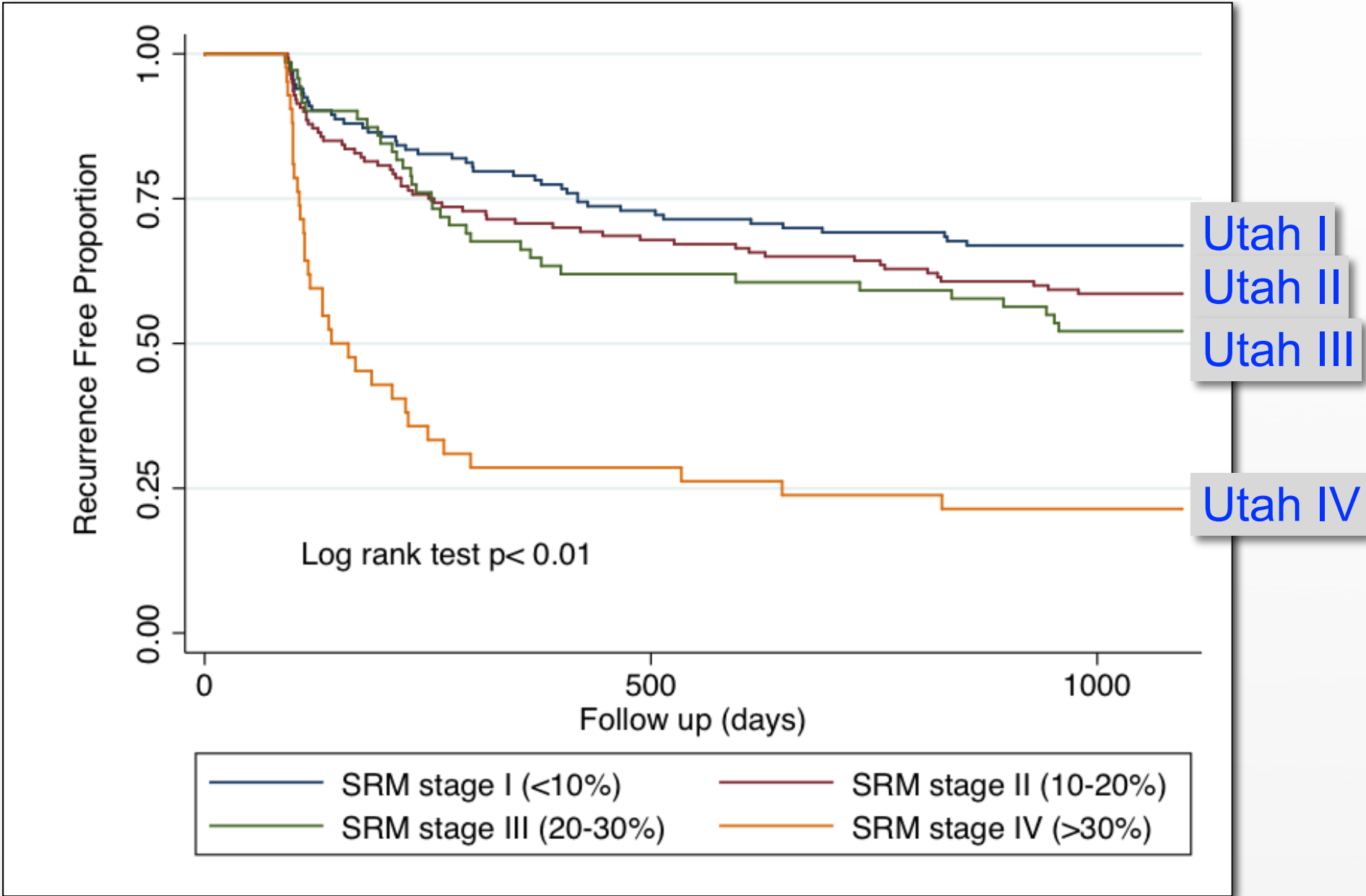
Utah Scoring Scheme: 2011



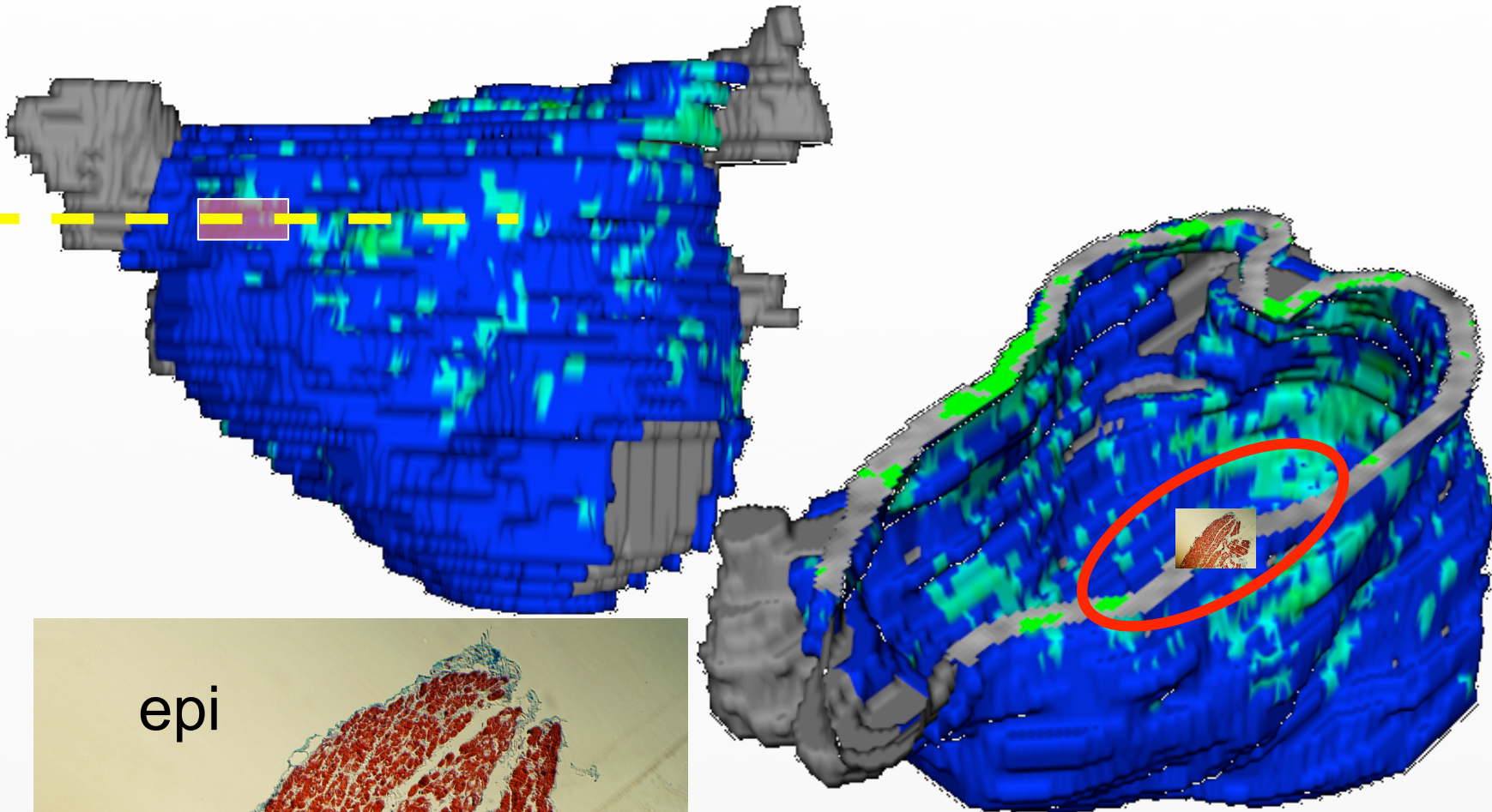
Nazem Akoum



Utah Score Predicts Outcome



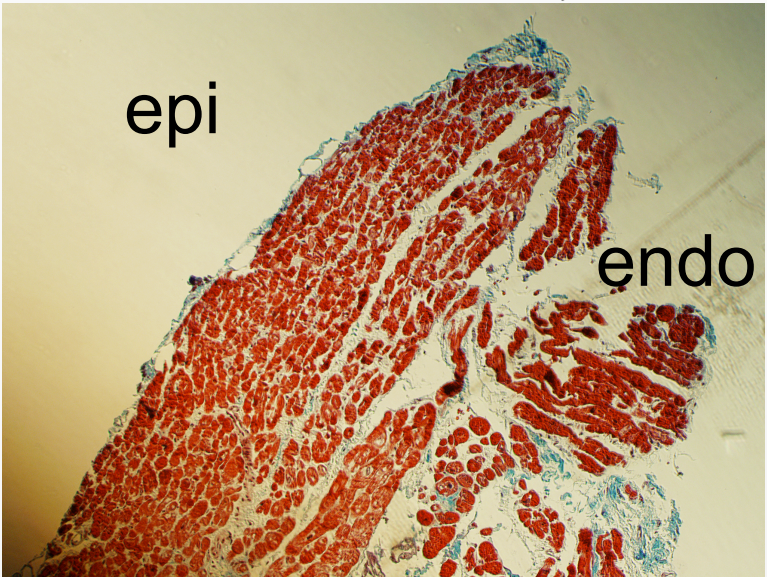
MRI & Fibrosis: Blue is Normal



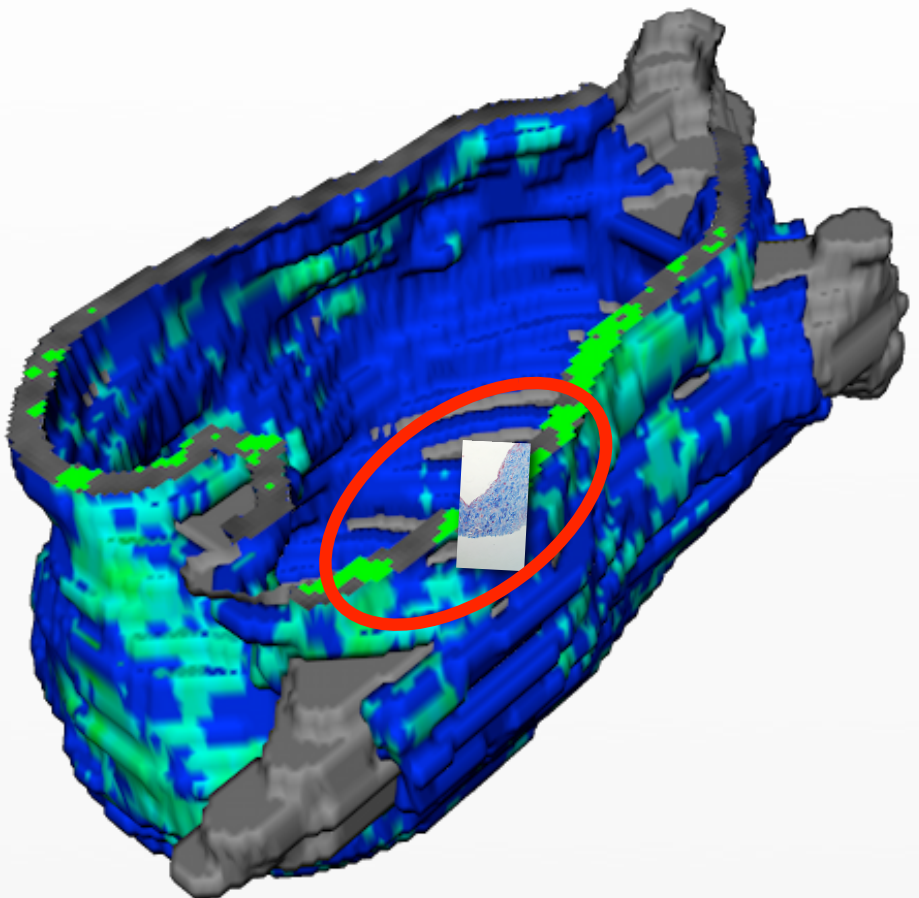
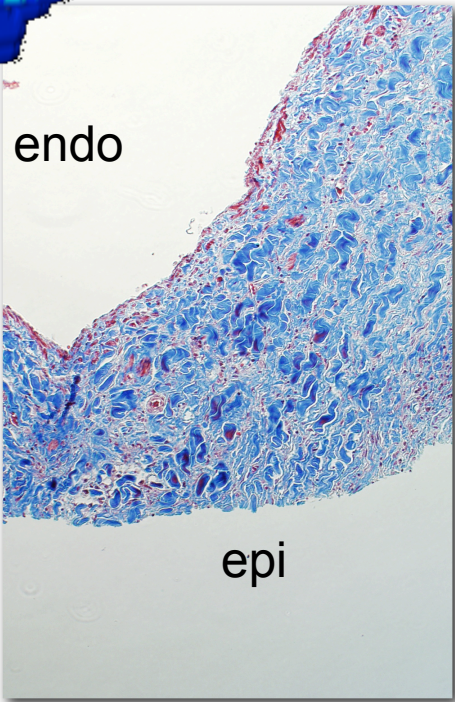
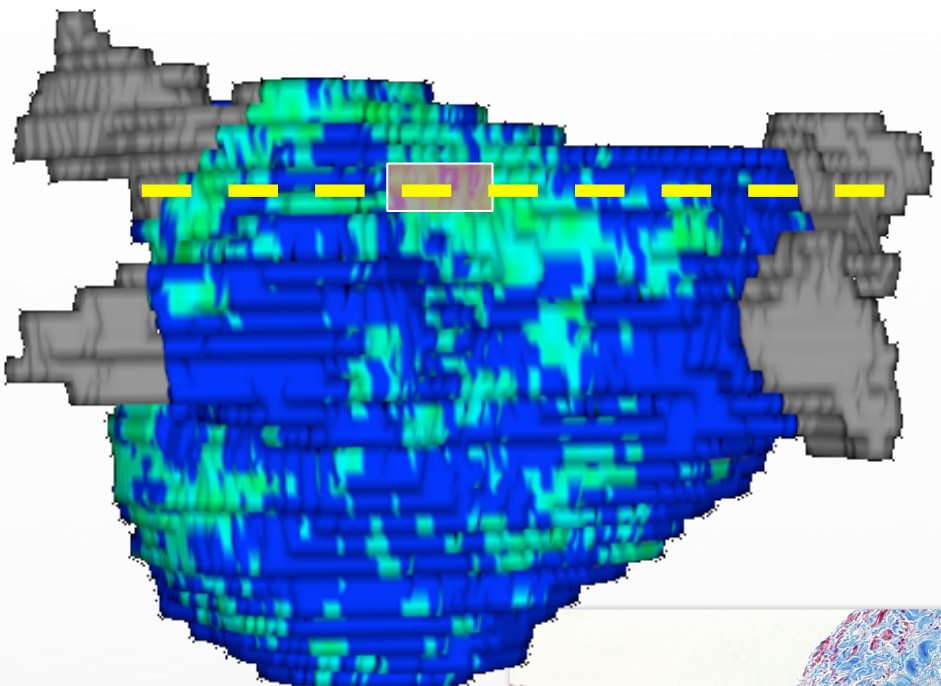
Chris McGann



Amit Patel



MRI & Fibrosis: Green is Fibrosis

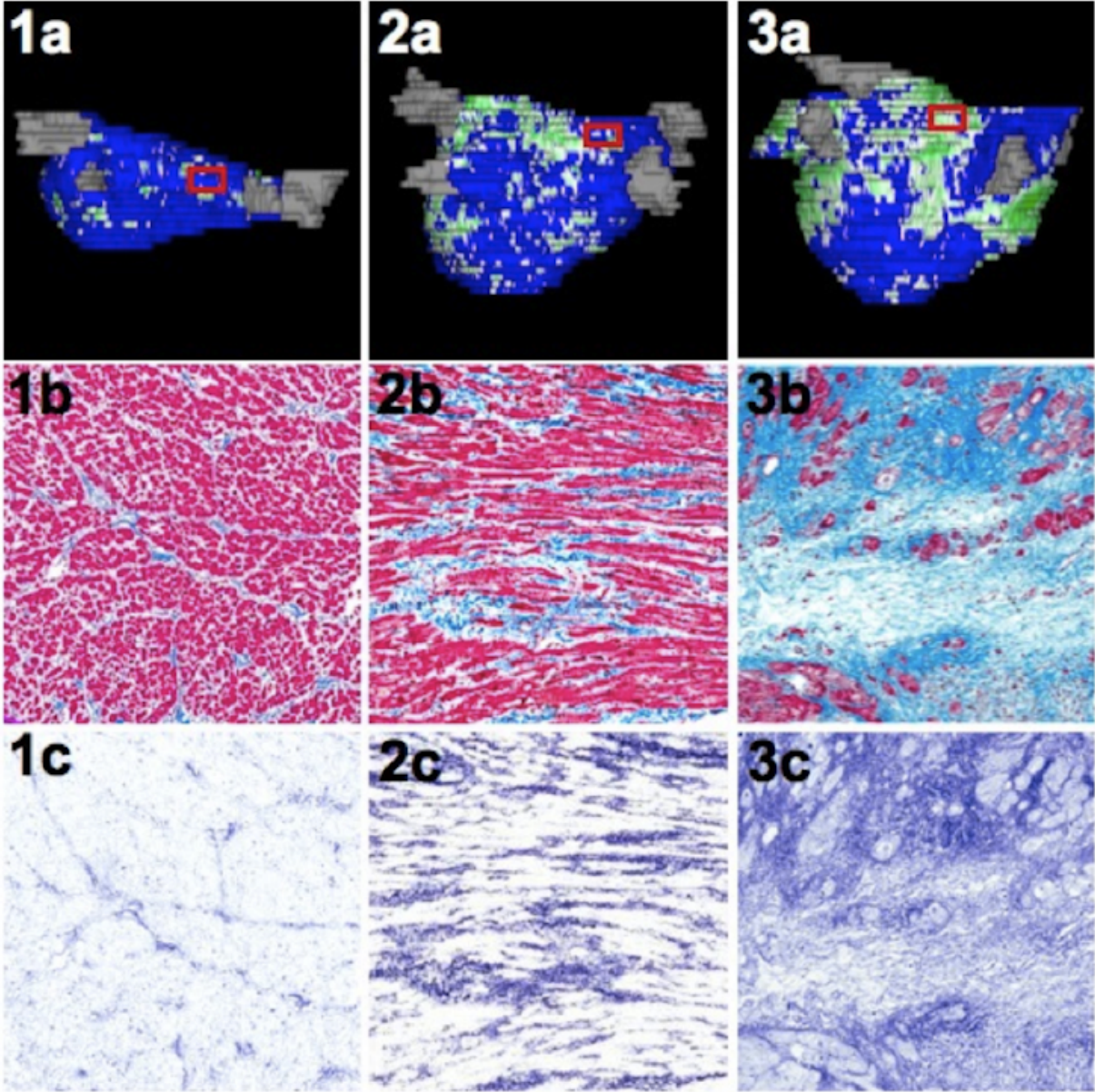


Histology Summary

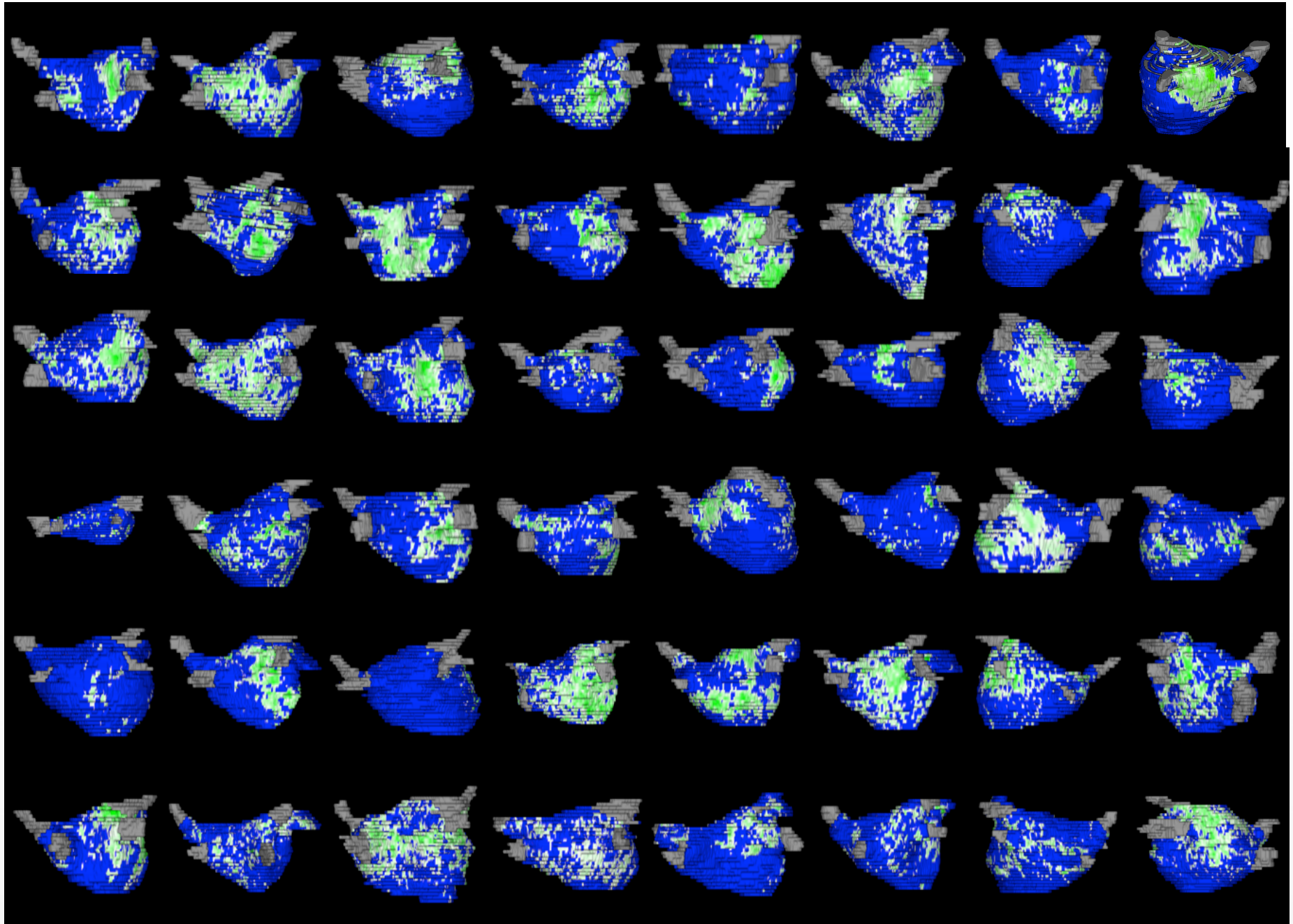
Control

AF-mix

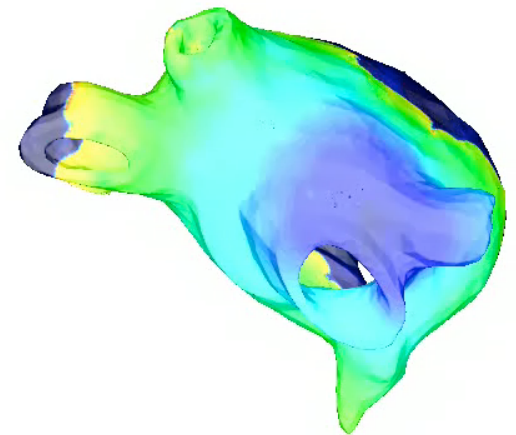
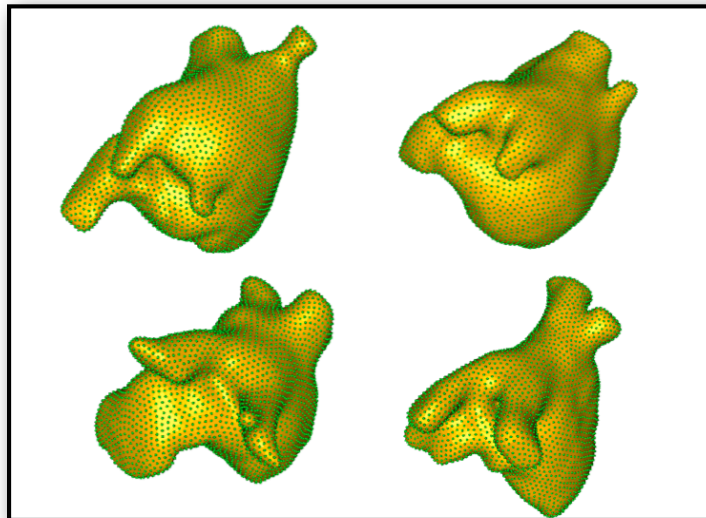
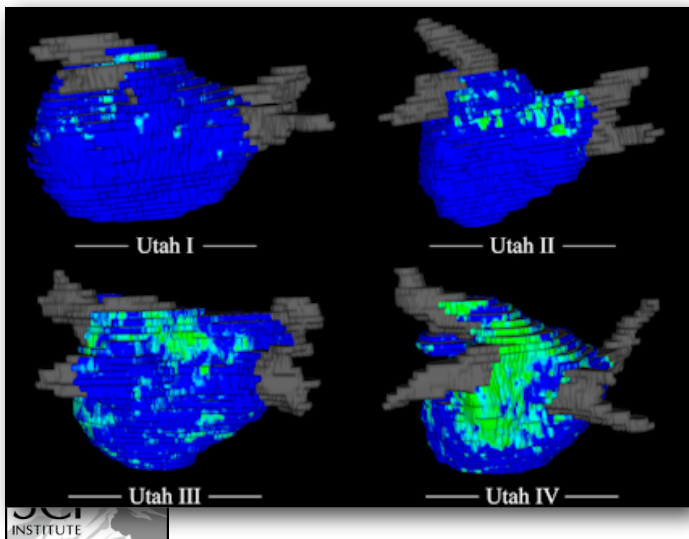
AF-fibrosis



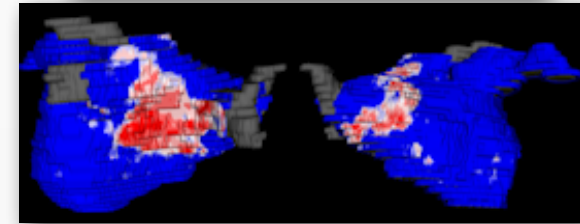
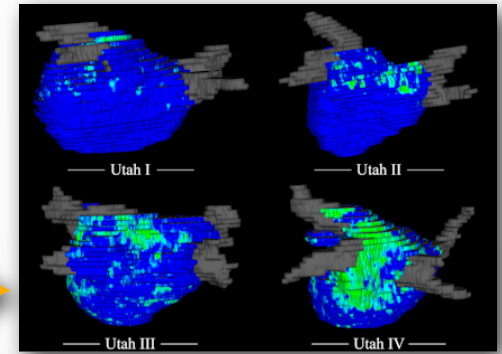
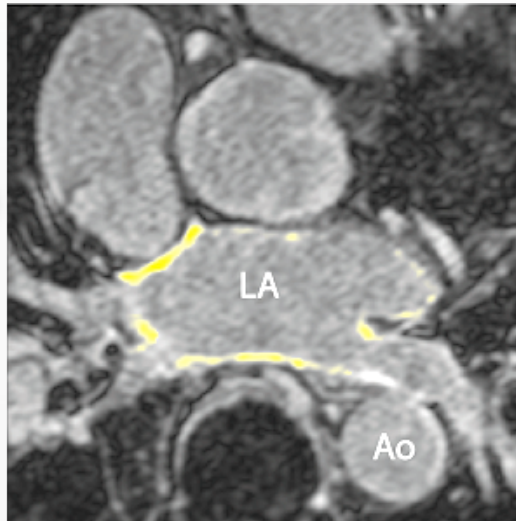
Fibrosis Analysis



What Role Does Image Segmentation Play?



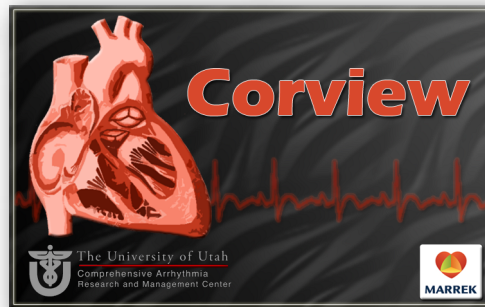
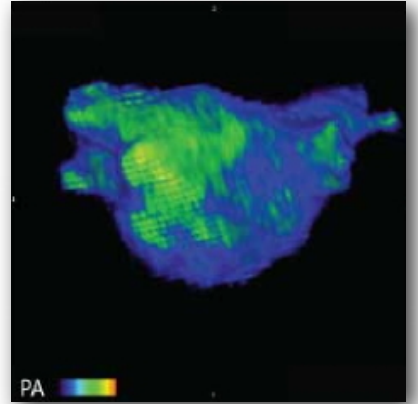
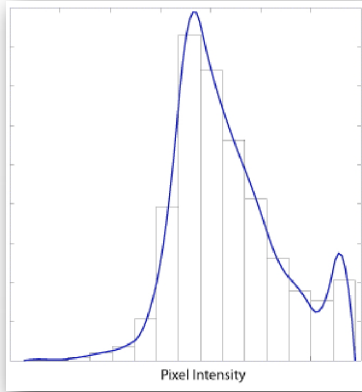
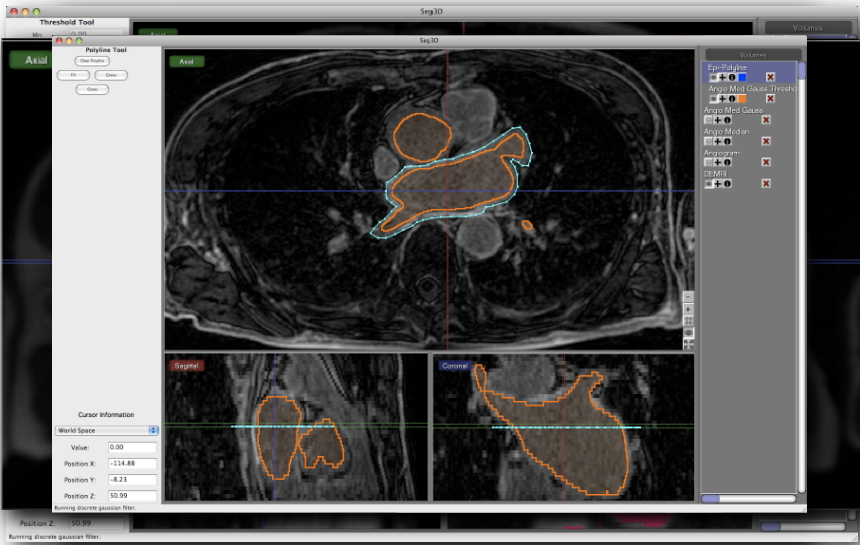
The CARMA AF Workflow



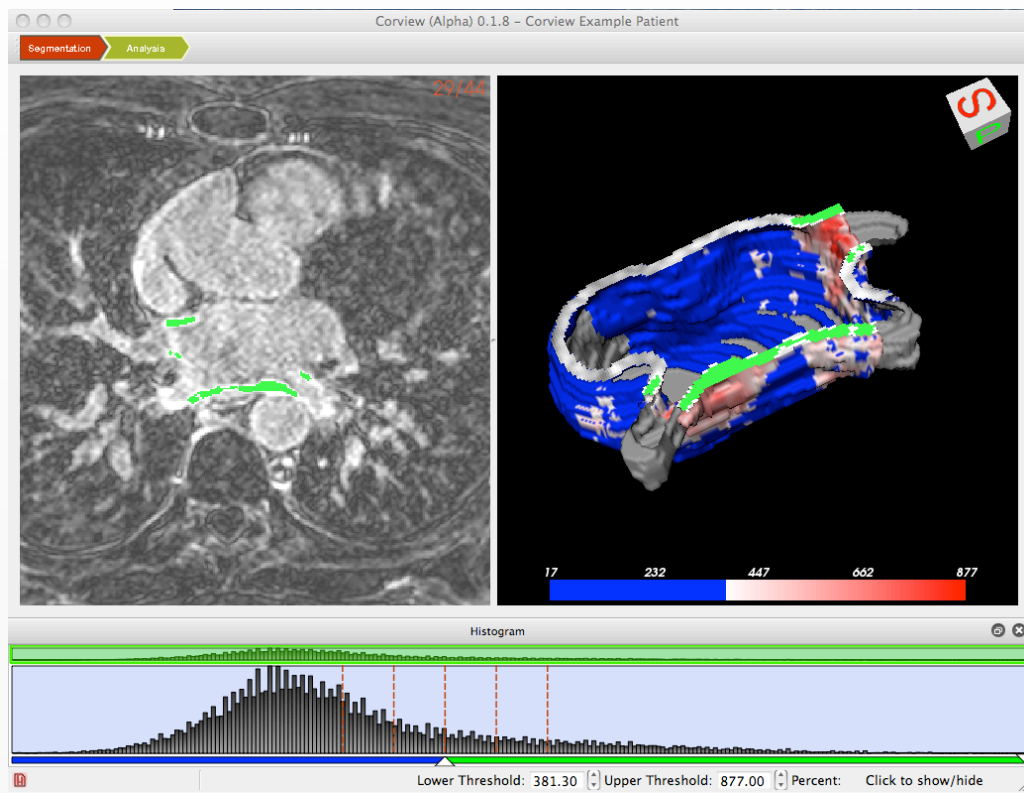
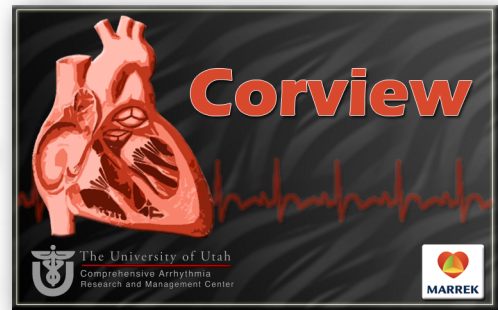
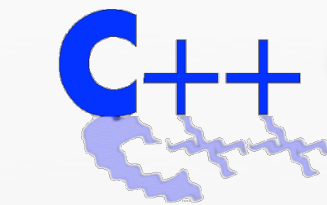
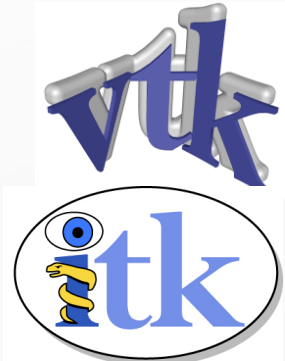
Automated Segmentation



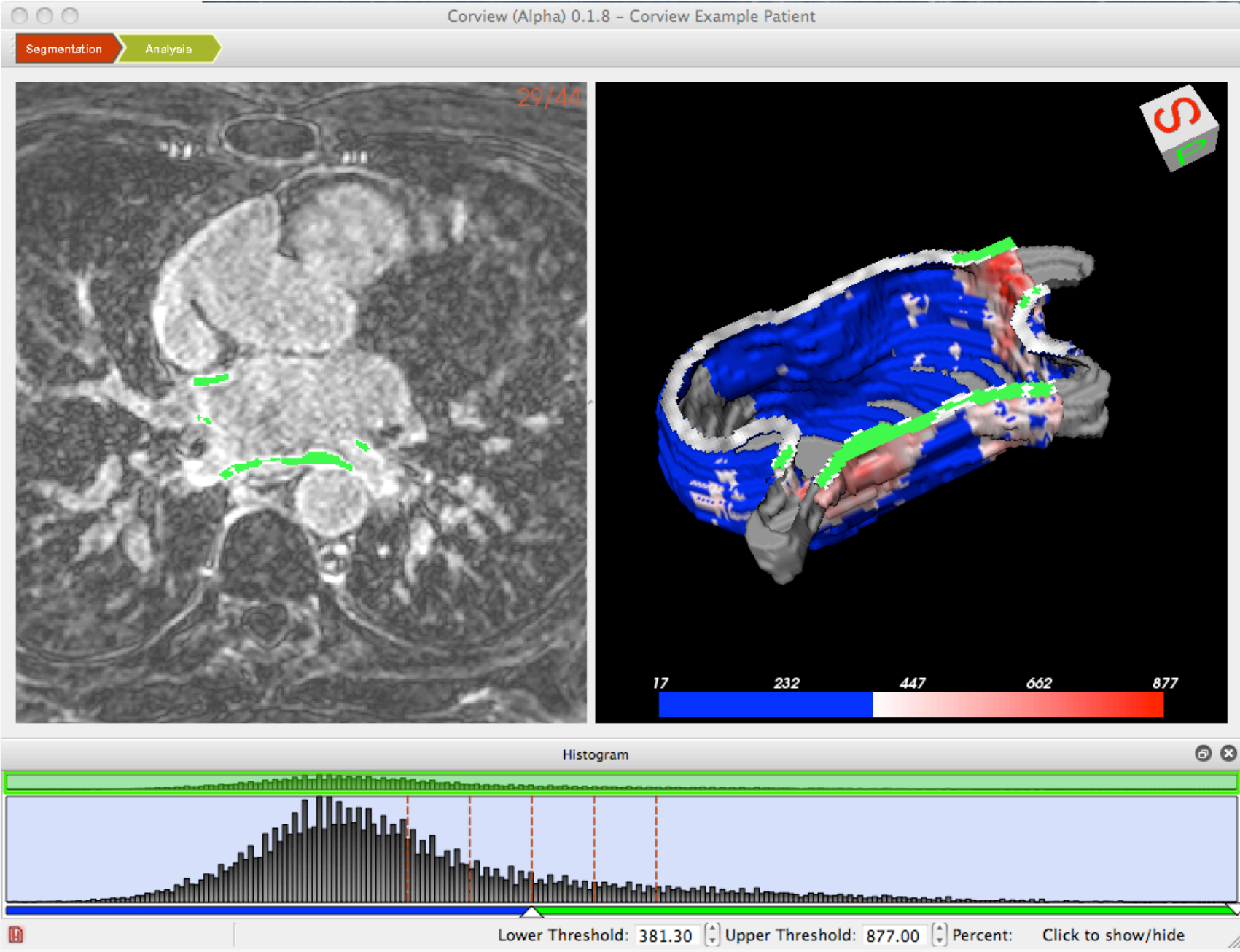
Workflow Past



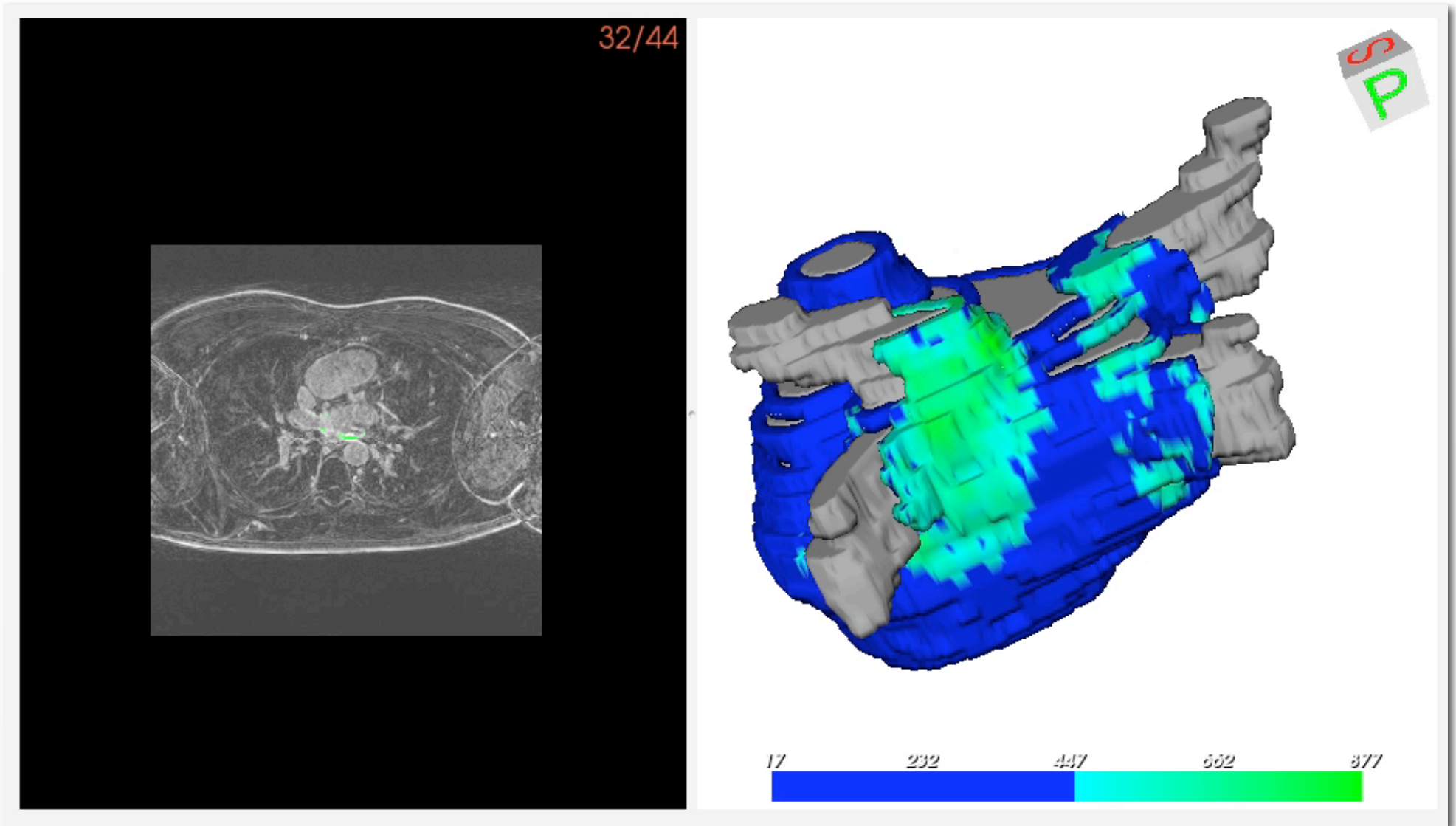
The New Workflow



Corview in Action



Corview in Action



Role of Shape Analysis in AF

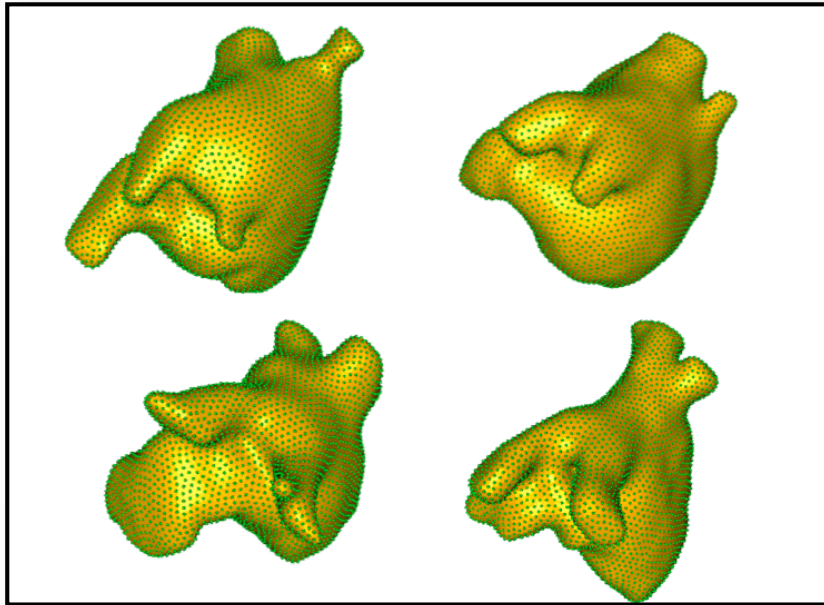
Shape Analysis



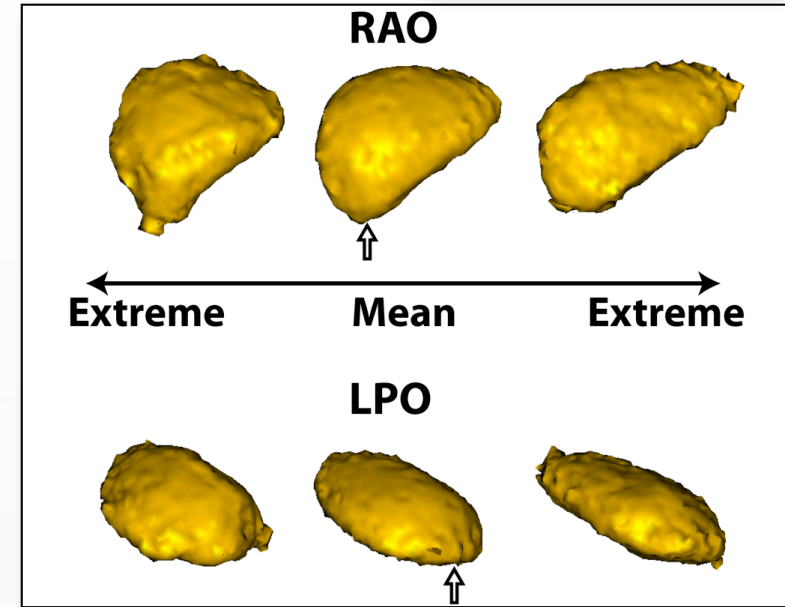
Greg Gardner



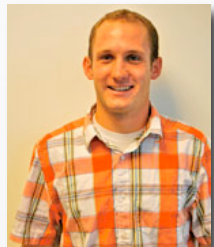
Josh Cates



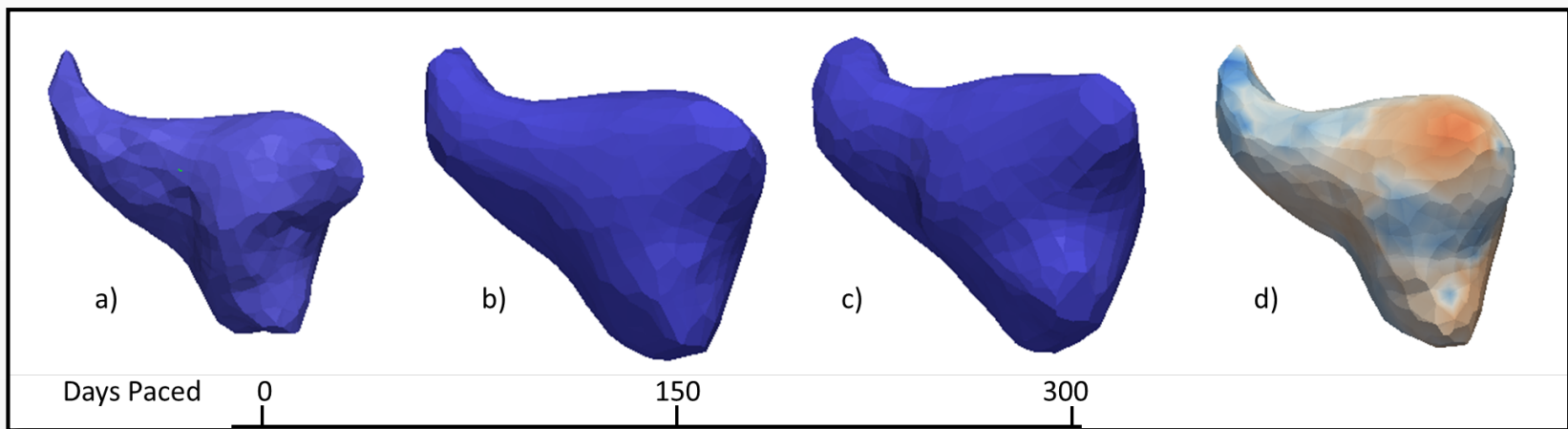
LA Shape



LAA Shape



Jason Jenson



LA Shape Change over Time

Registration



Greg Gardner



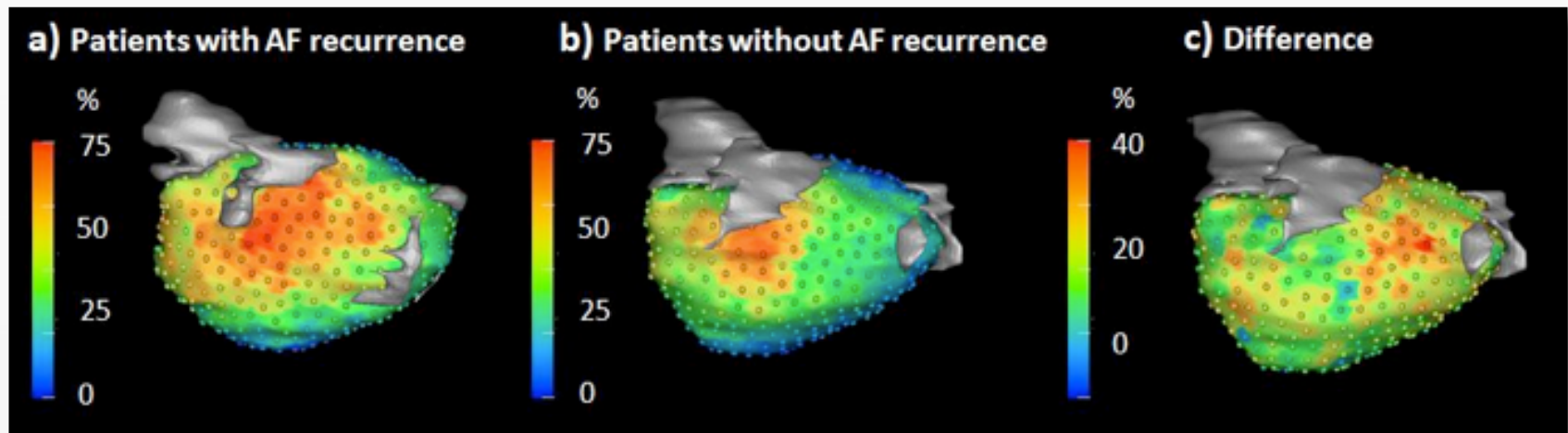
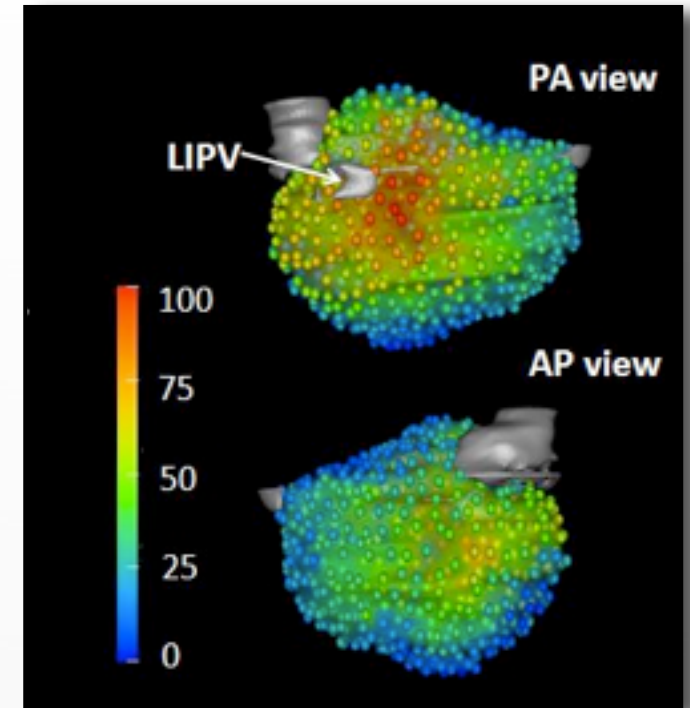
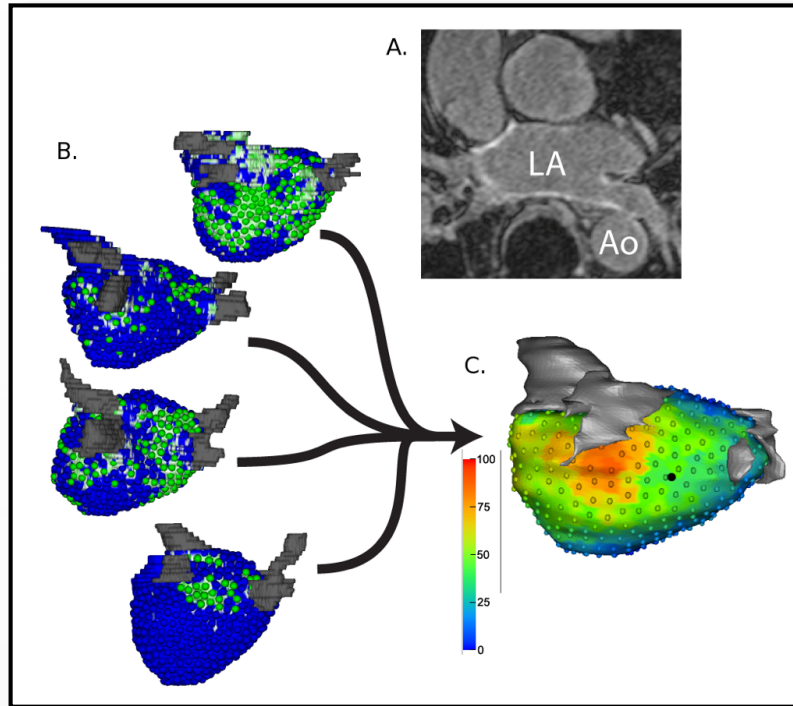
Koji Higuchi



Alan Morris



Josh Cates



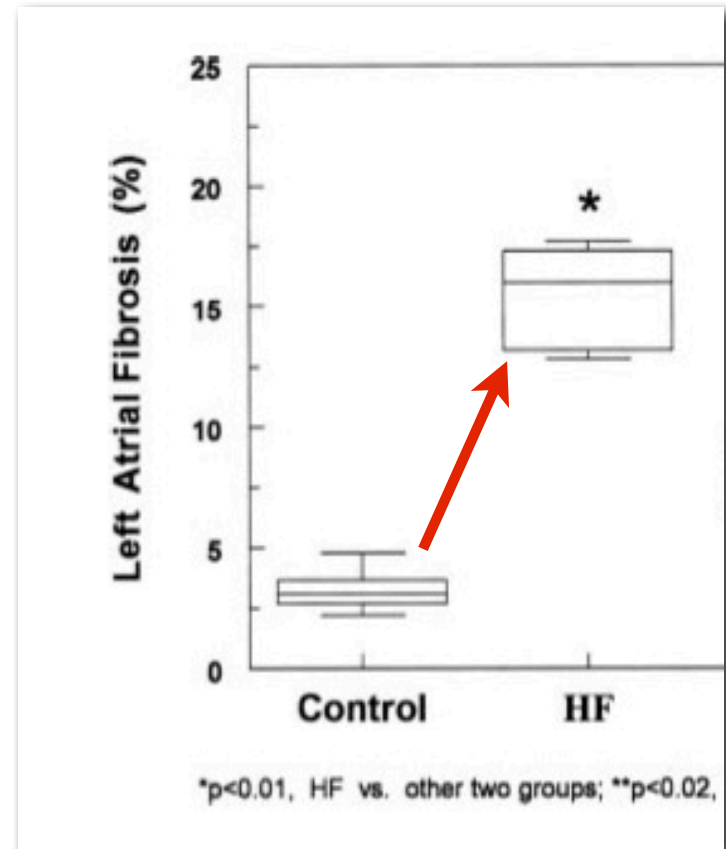
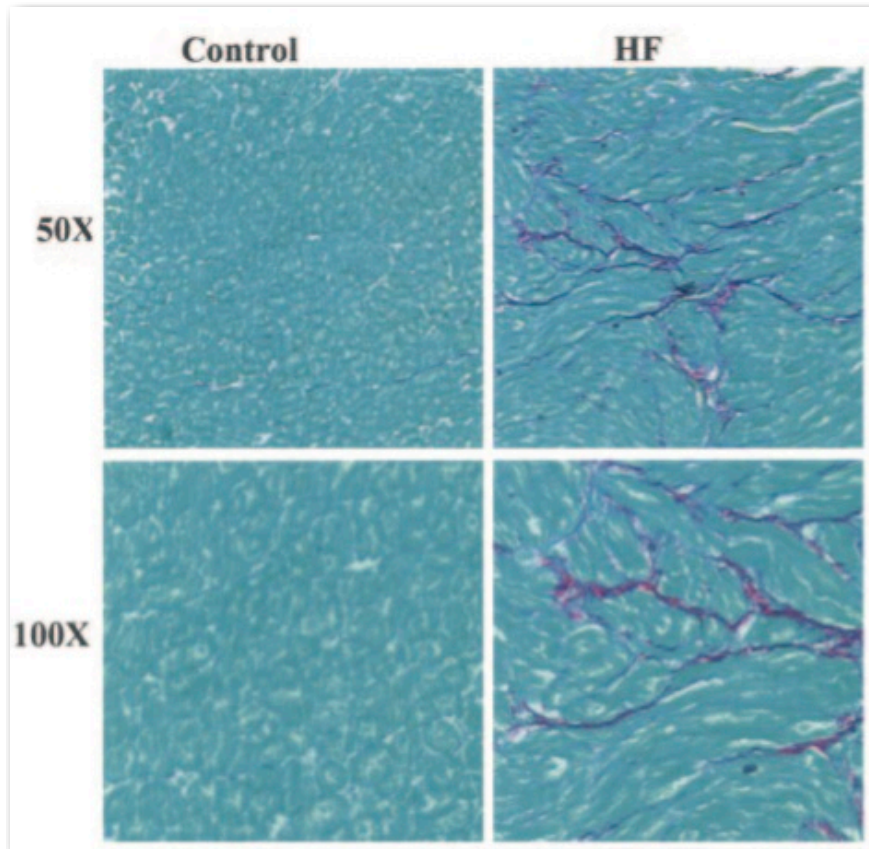
Simulation: What Causes AFib?

Substrate

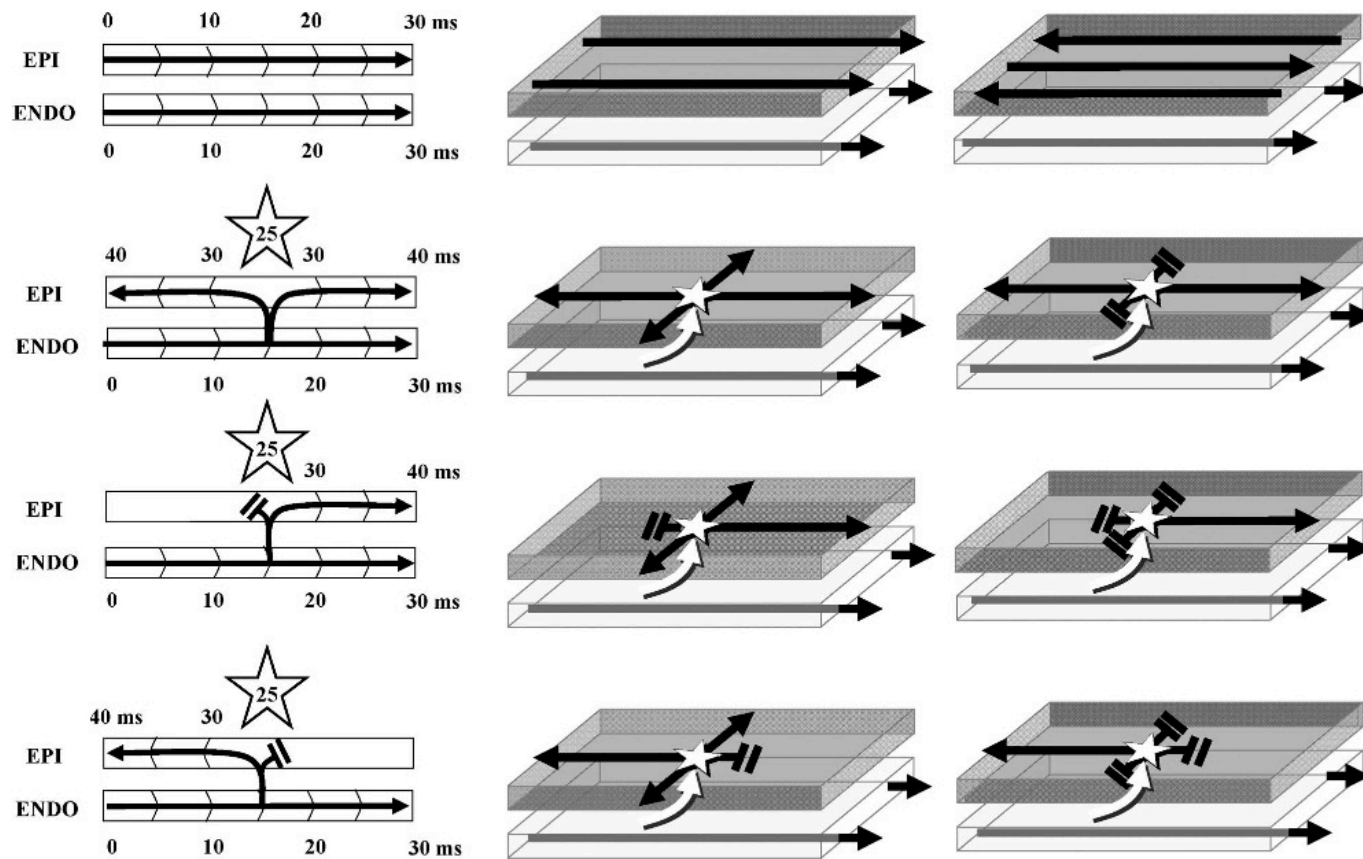
+

Trigger

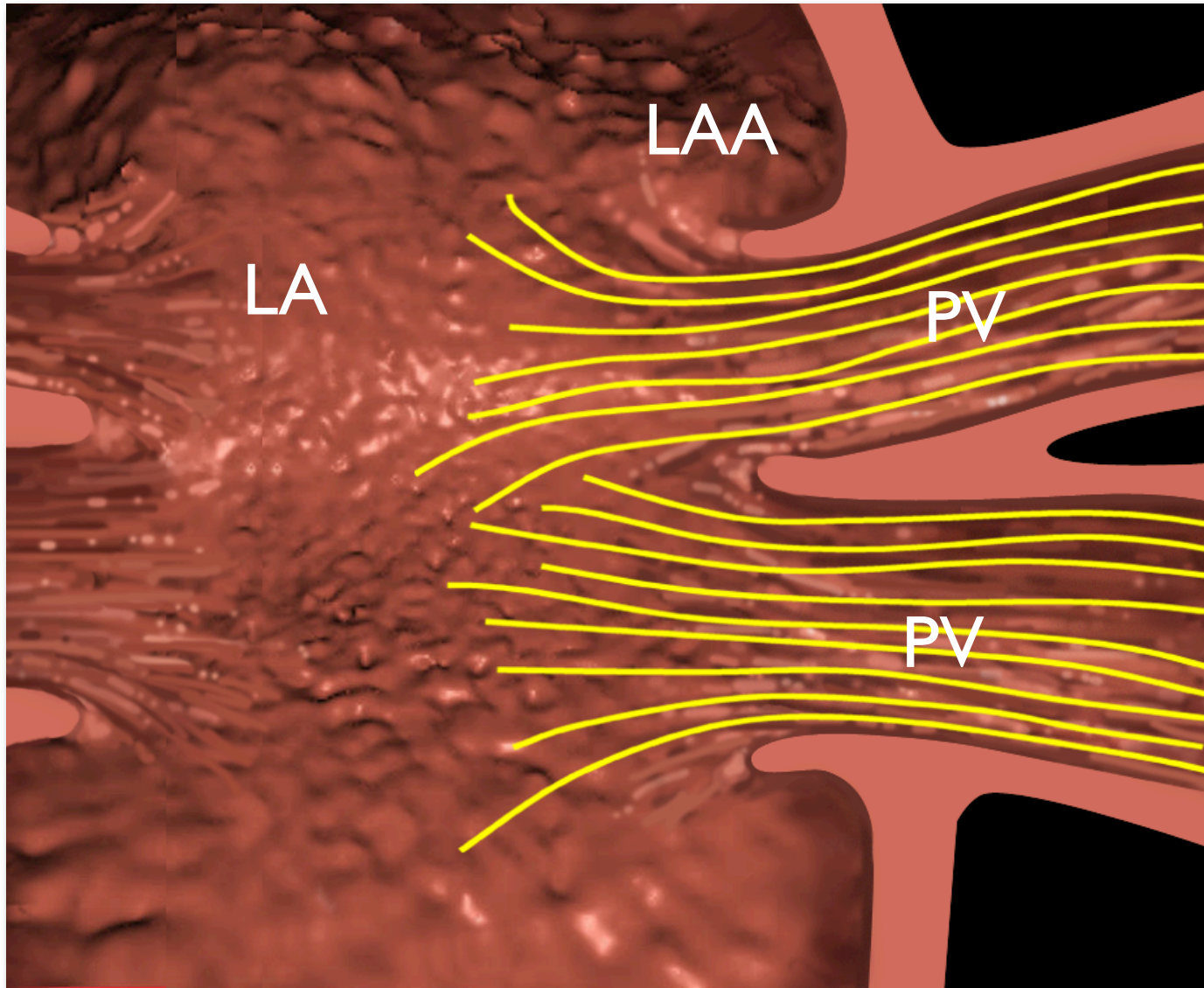
Substrate:Fibrosis



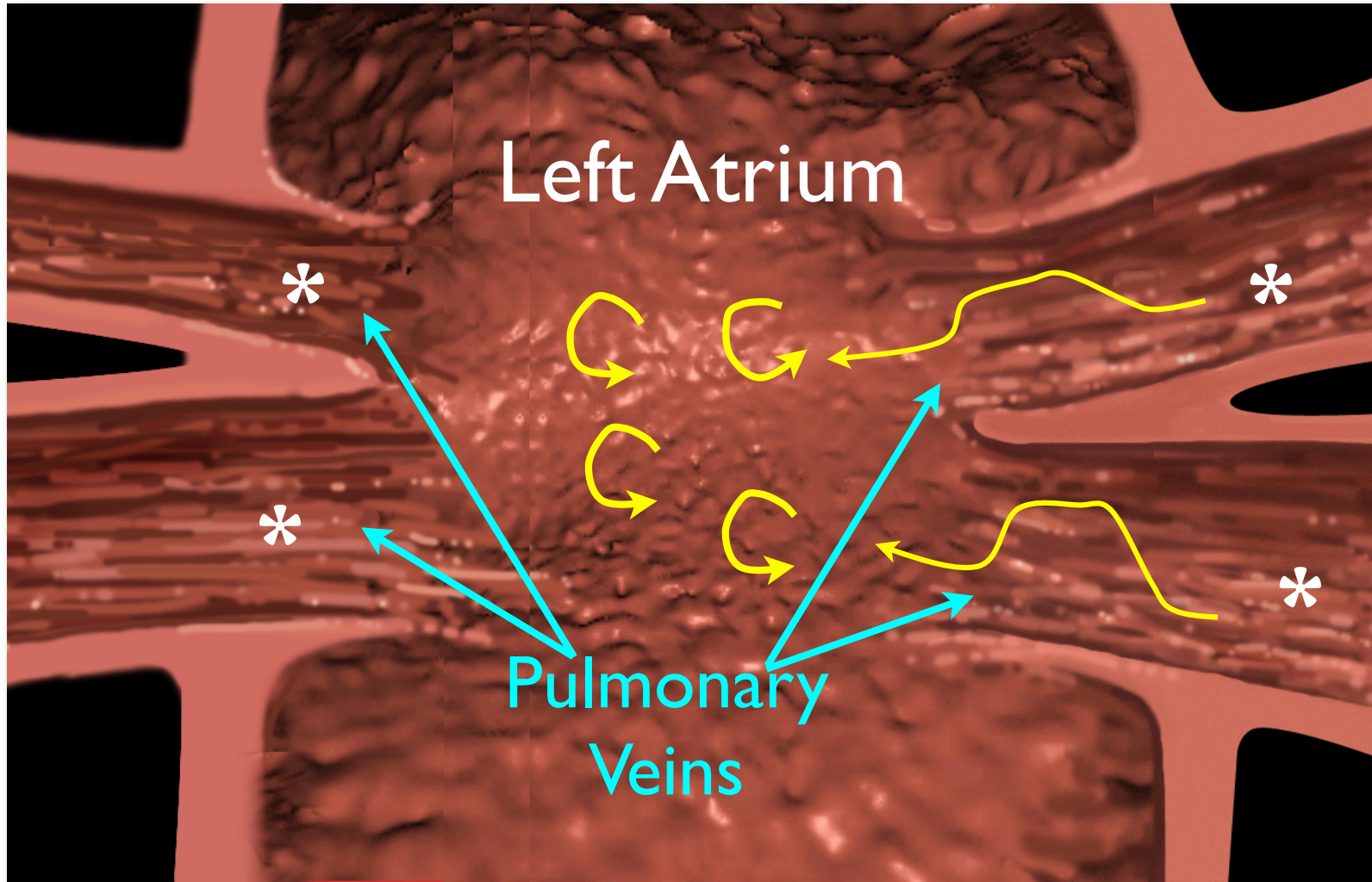
Complex Propagation



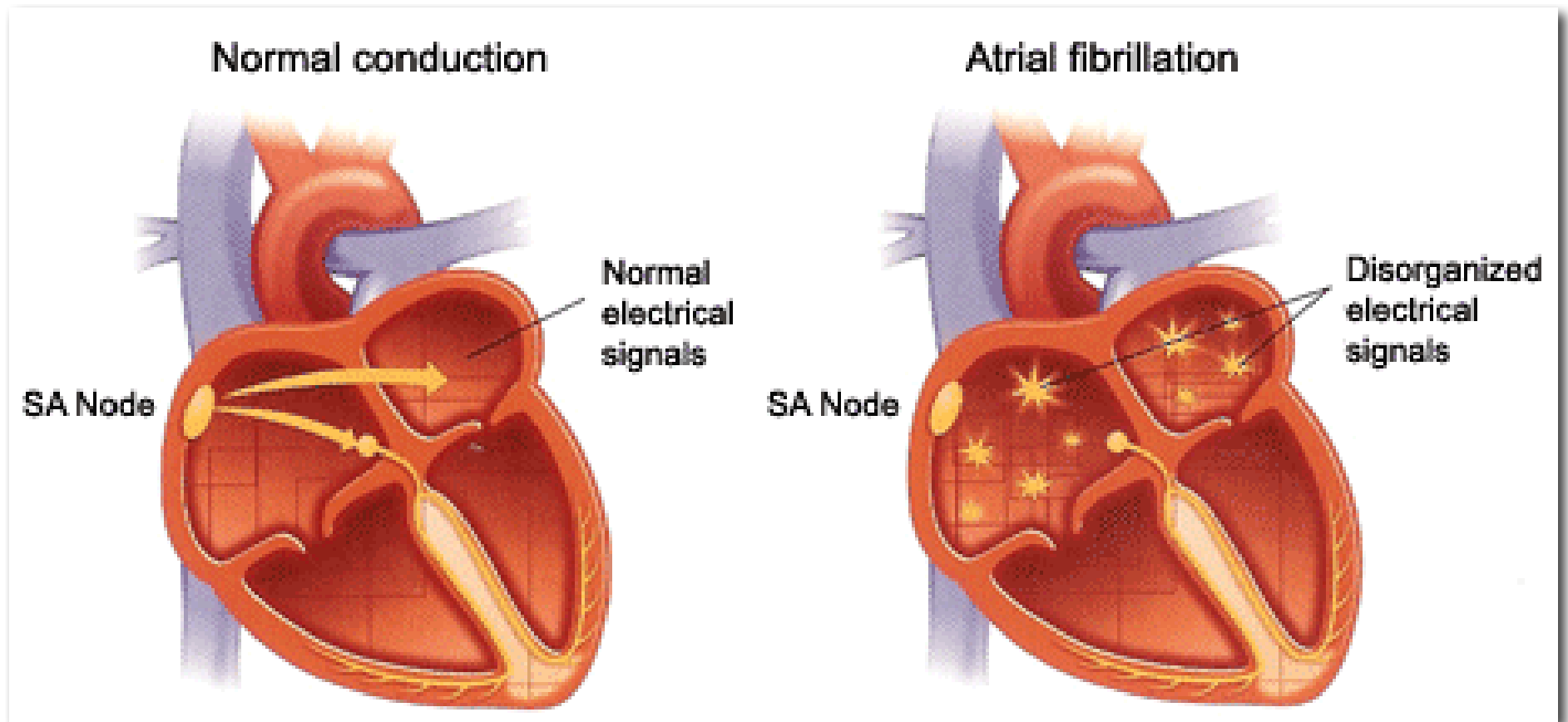
Substrate: Extension of muscle sleeves



Triggers



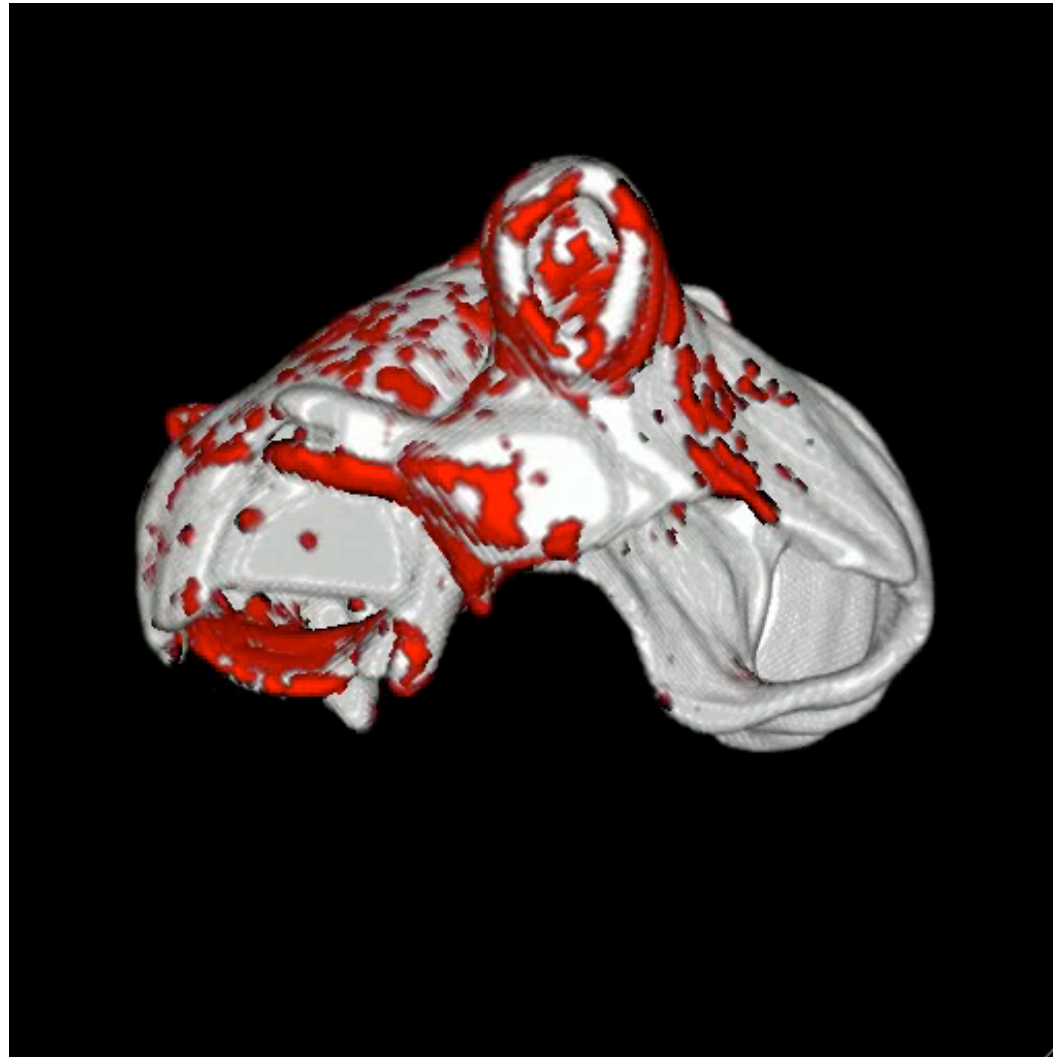
Clinical Result



Patient Specific Models of AF



Josh Blauer

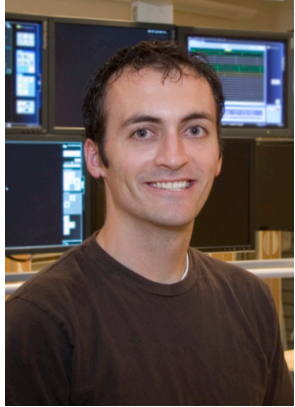


Natalia
Trayanova

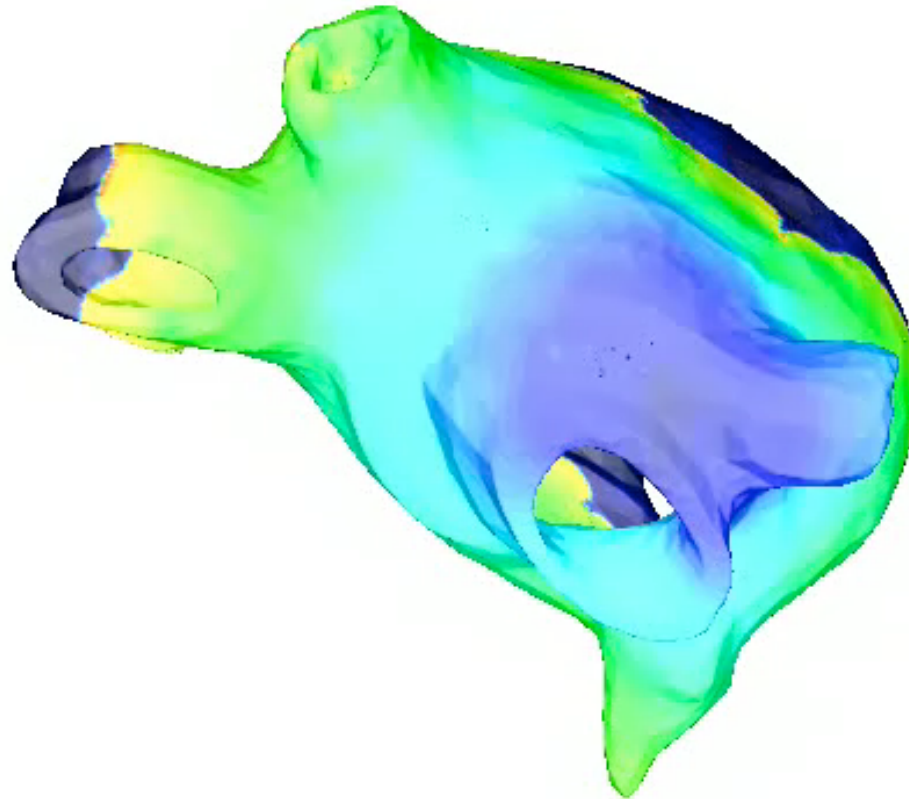


Kathleen
McDowell

Patient Specific Models of AF



Josh Blauer



Natalia
Trayanova

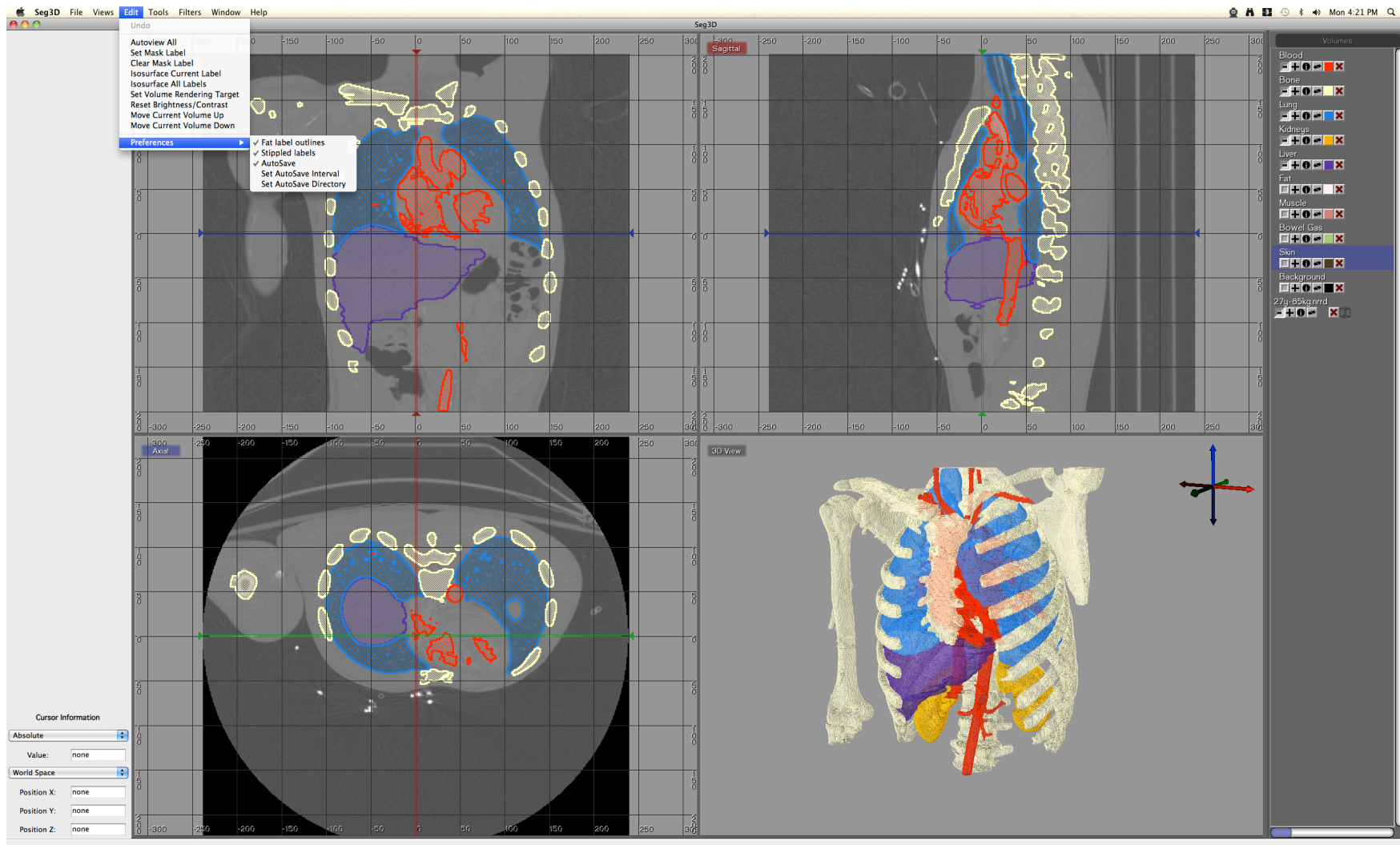


Kathleen
McDowell

Segmentation



Goal: Identifying Structures



Segmentation in the Real World



Seg3D - 3D Segmentation



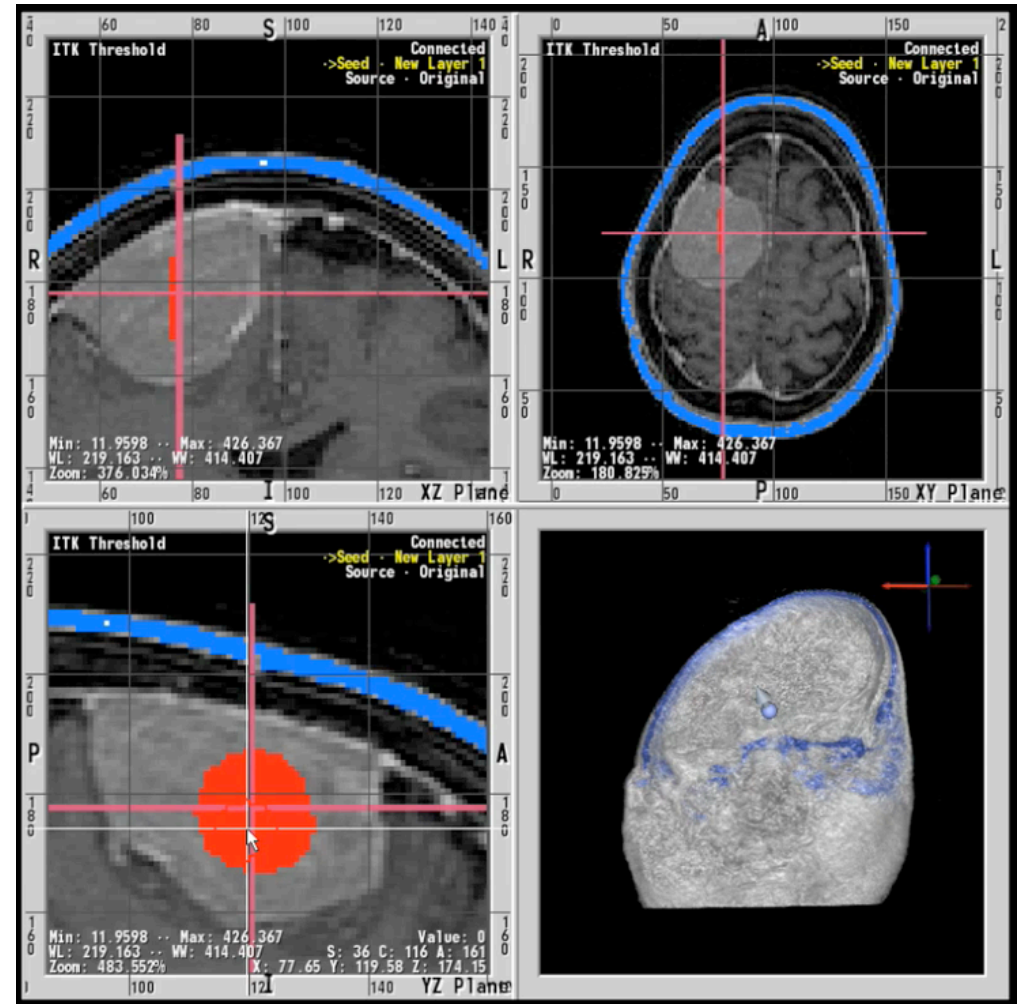
Seg3D 2.0

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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 Kindlmann, 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.

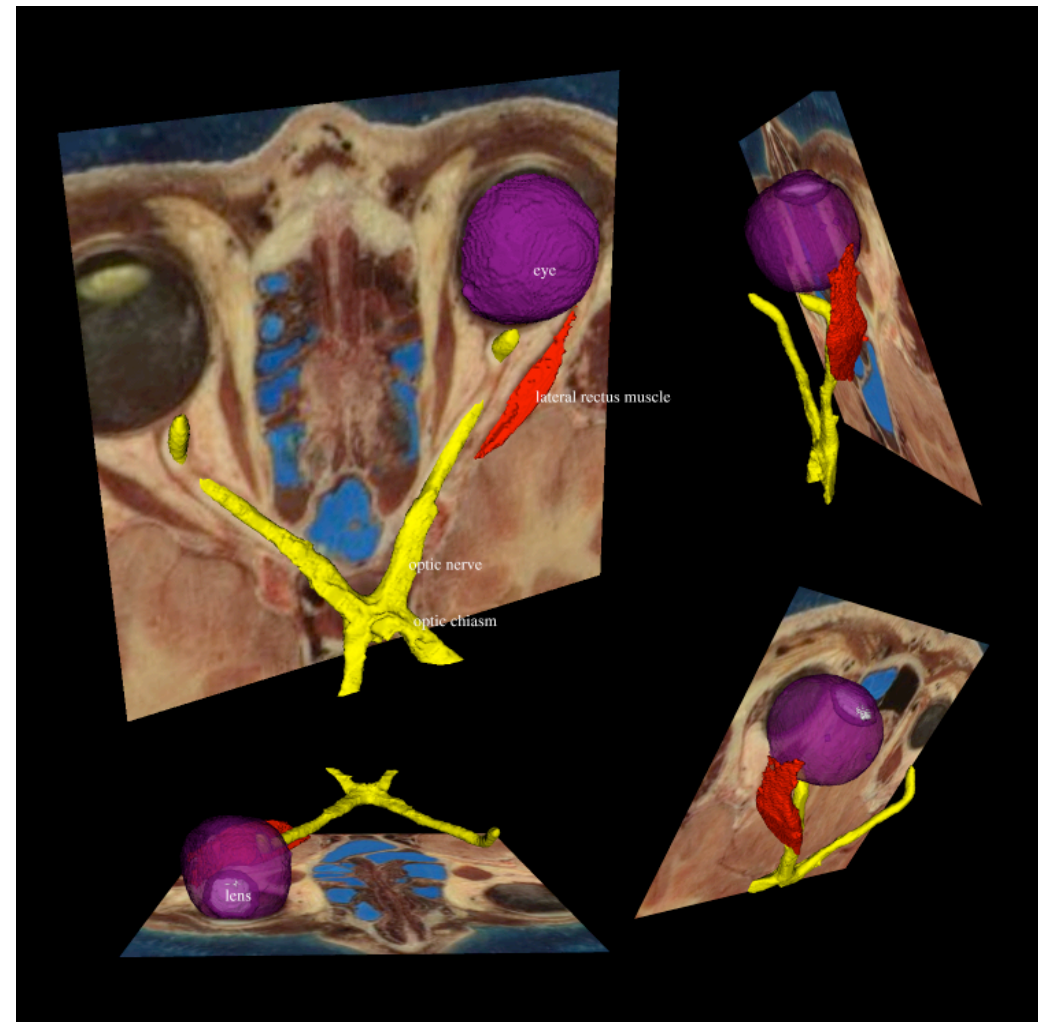
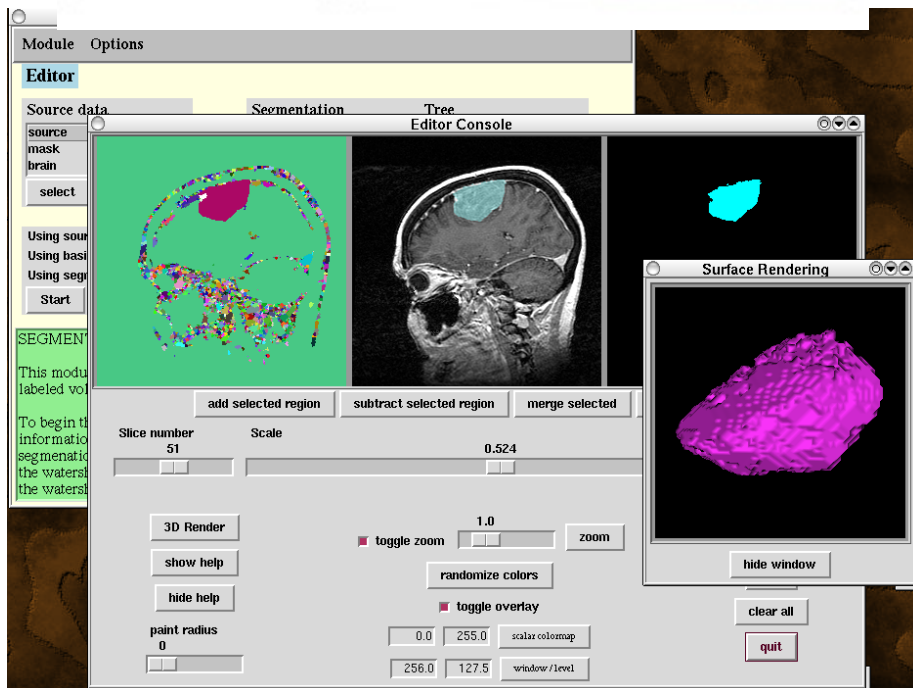
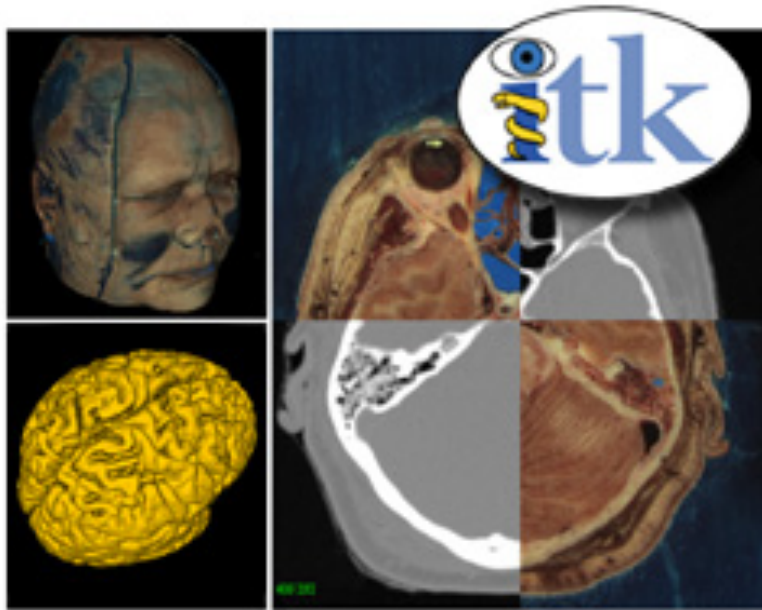
Stinstra, Erik Anderson, Nathan Galli, Erik Jorgensen, Chems Touati.

www.seg3d.org



ITK: Insight Toolkit

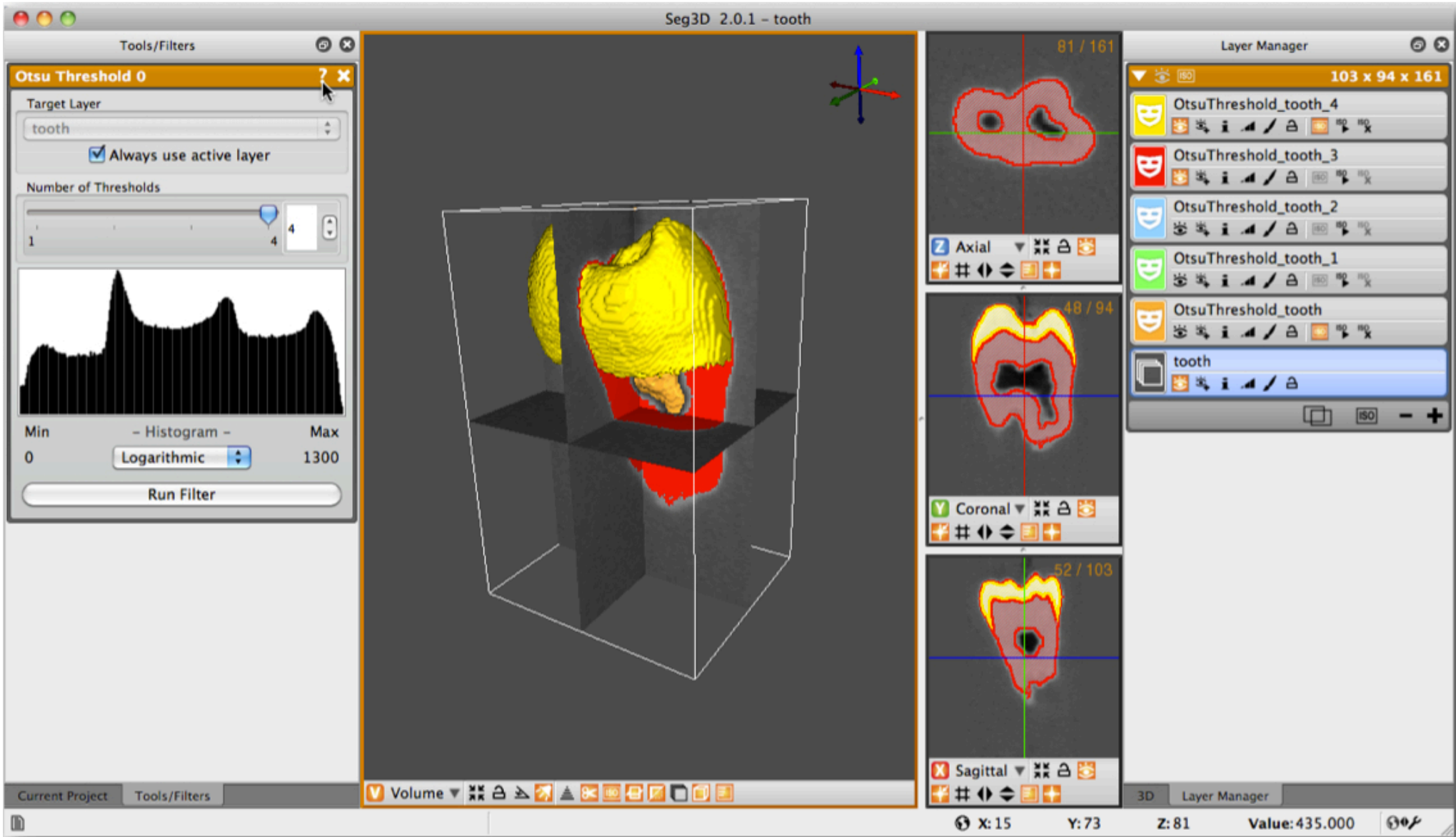
www.itk.org



Seg3D: Introduction



Seg3D: Layers



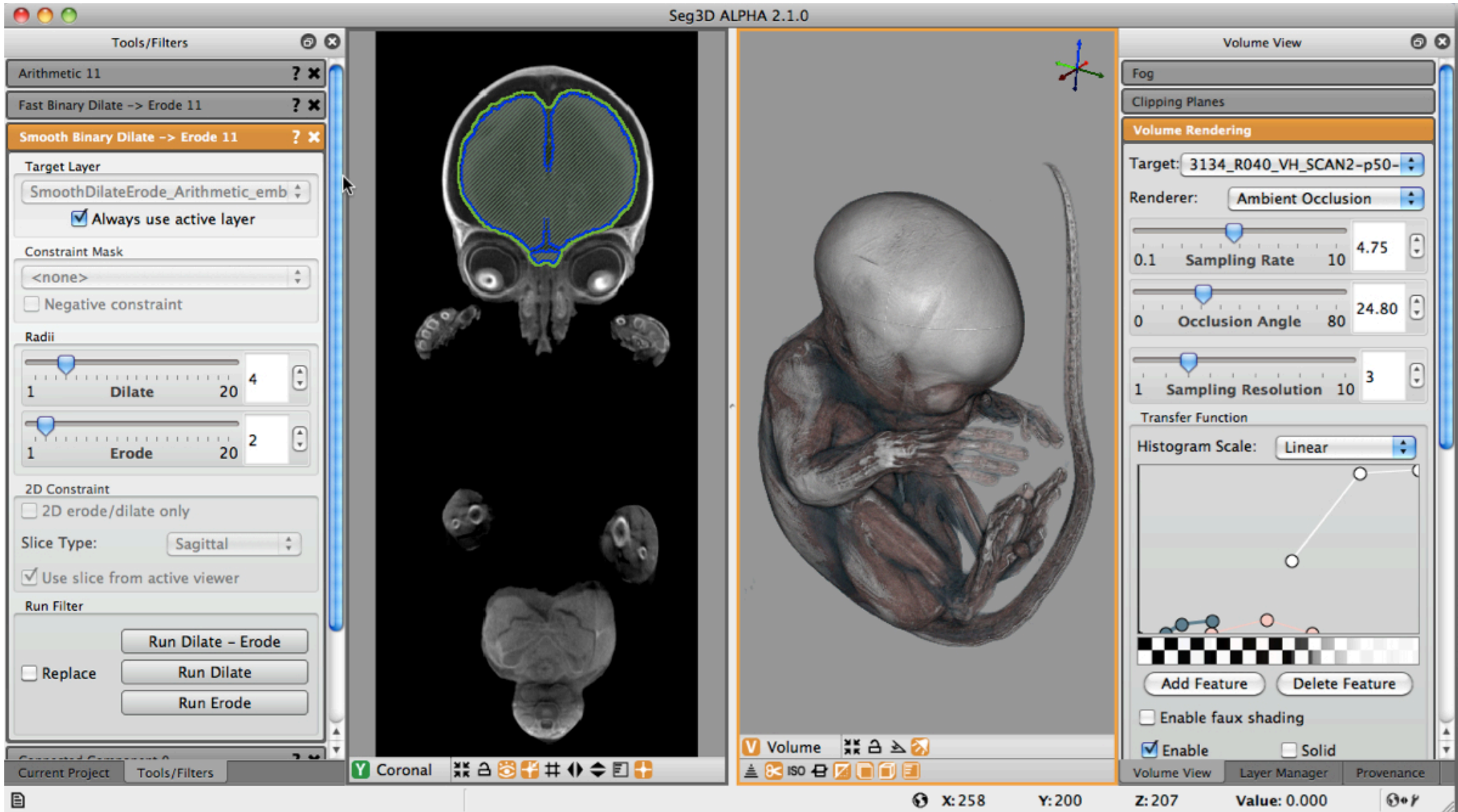
Seg3D: Measurements

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 "Measure 0" panel with a table of measurements and a "Note" field.
- Measurements Table:** A table with columns for "Length" and "Note". It contains one entry: "M0" with a length of "15.056" and a note of "Interocular".
- Layer Manager:** Located on the right, it lists various segmented layers such as "MaskLayer_1", "embryo_brain", "embryo_lungs_1", "embryo_lungs", and "embryo_kidneys". It also includes a "Reset Brightness/Contrast" button and a "Volume View" section.
- 3D Viewport:** The central area shows two views of a 3D model of an embryo. The left view is a coronal slice showing the interocular distance, and the right view is a sagittal slice. Both views show segmented regions in yellow and green.
- Status Bar:** At the bottom, it displays the current project name, view mode (Coronal/Sagittal), and coordinates (X: 176, Y: 348, Z: 345, Value: 0.000).

Measurements	Length	Note
M0	15.056	Interocular

Seg3D: Volume Visualization



Seg3D: Provenance

The screenshot displays the Seg3D Version 2.0 software interface. The main window is titled "Seg3D Controller" and features three tabs: "Actions", "State Variables", and "Event Log". The "Actions" tab is active, showing an "Action History" table with 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 "Run Action from command line:" section with a text input field and an "Action" button. At the bottom, there are "Status:" and "Usage:" labels.

On the left side of the interface, there is a "Paint Brush 0" panel with various settings: Target Mask (<none>), Mask Constraint (<none>), Data Constraint (<none>), Erase Mode (checked), Brush Size (1), Threshold Upper (0), and Threshold Lower (0). The "Tools/Plugins" window is also visible at the top left.



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