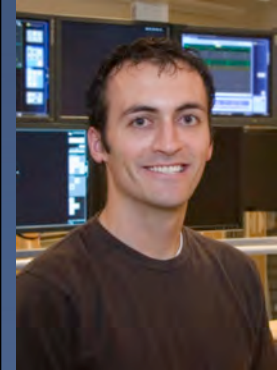
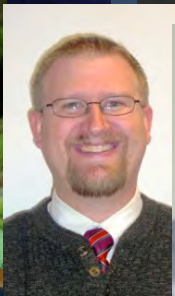
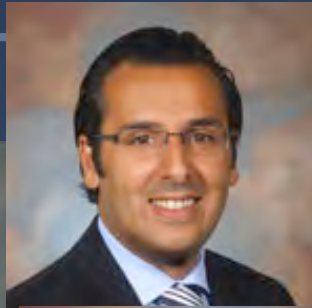
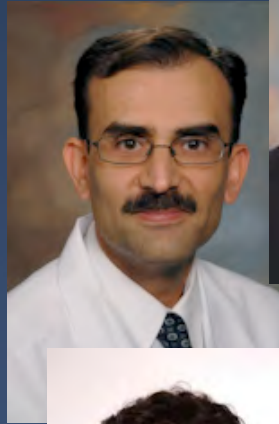
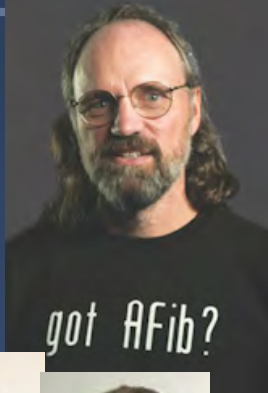
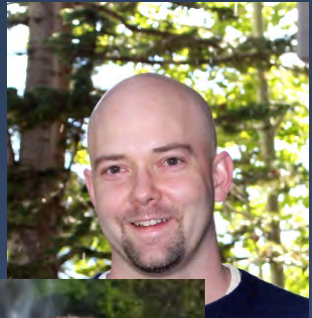
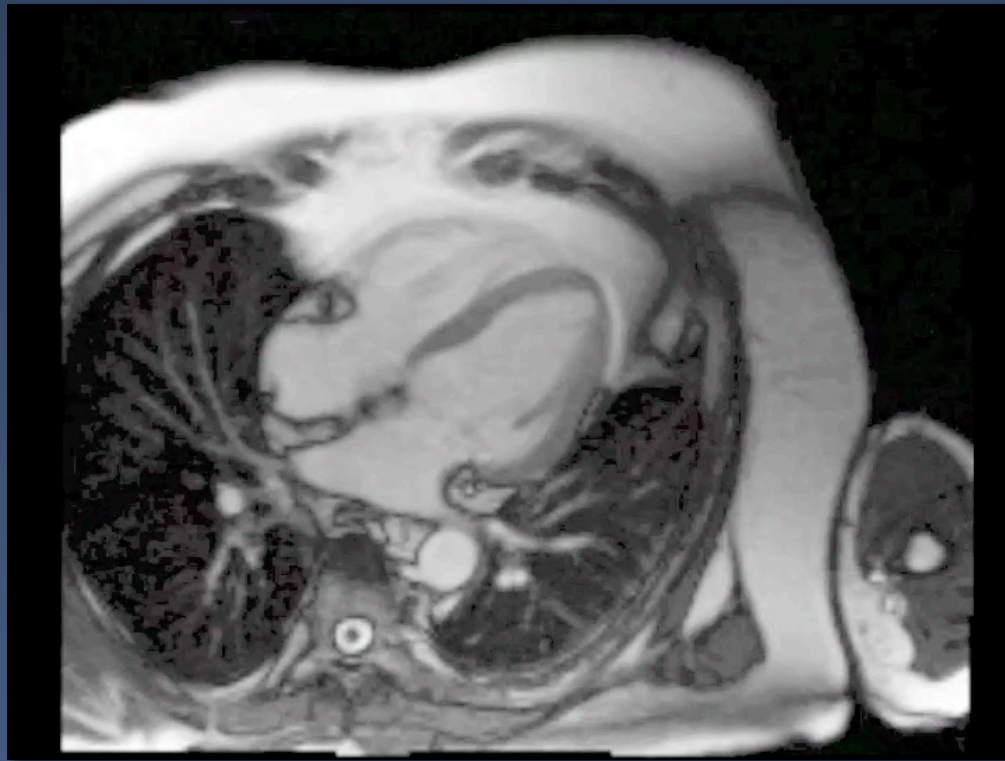

Image Analysis for Atrial Fibrillation

Rob MacLeod, PhD
SCI Institute, Dept. of Bioengineering
CVRTI, CARMA

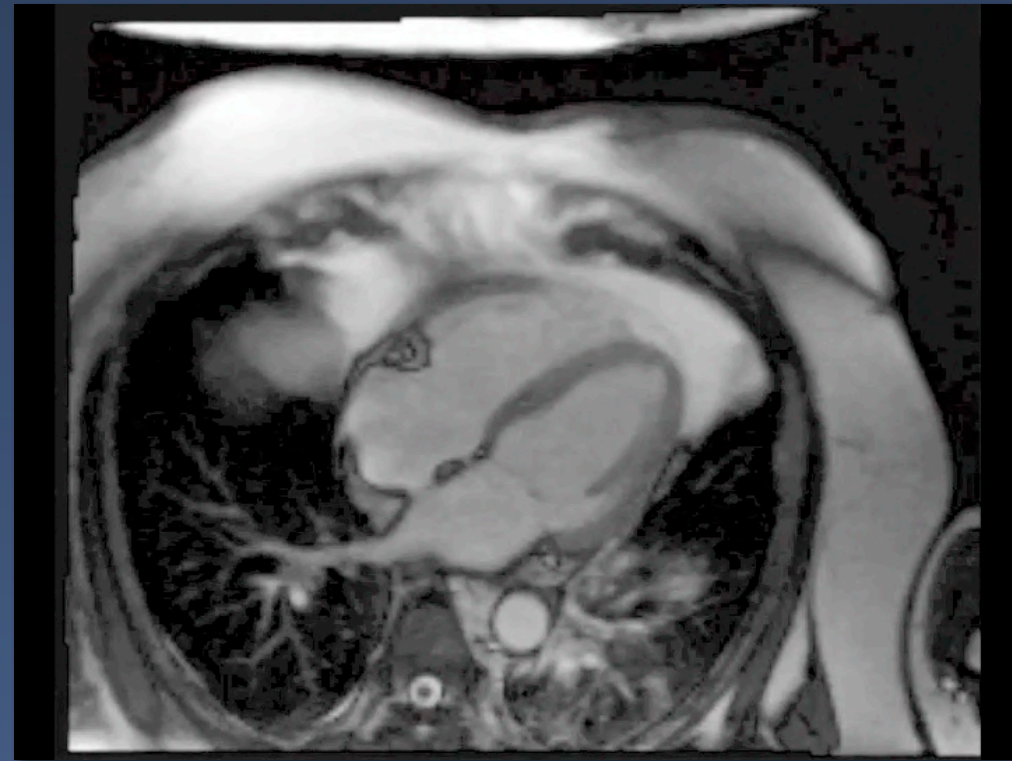
CARMA



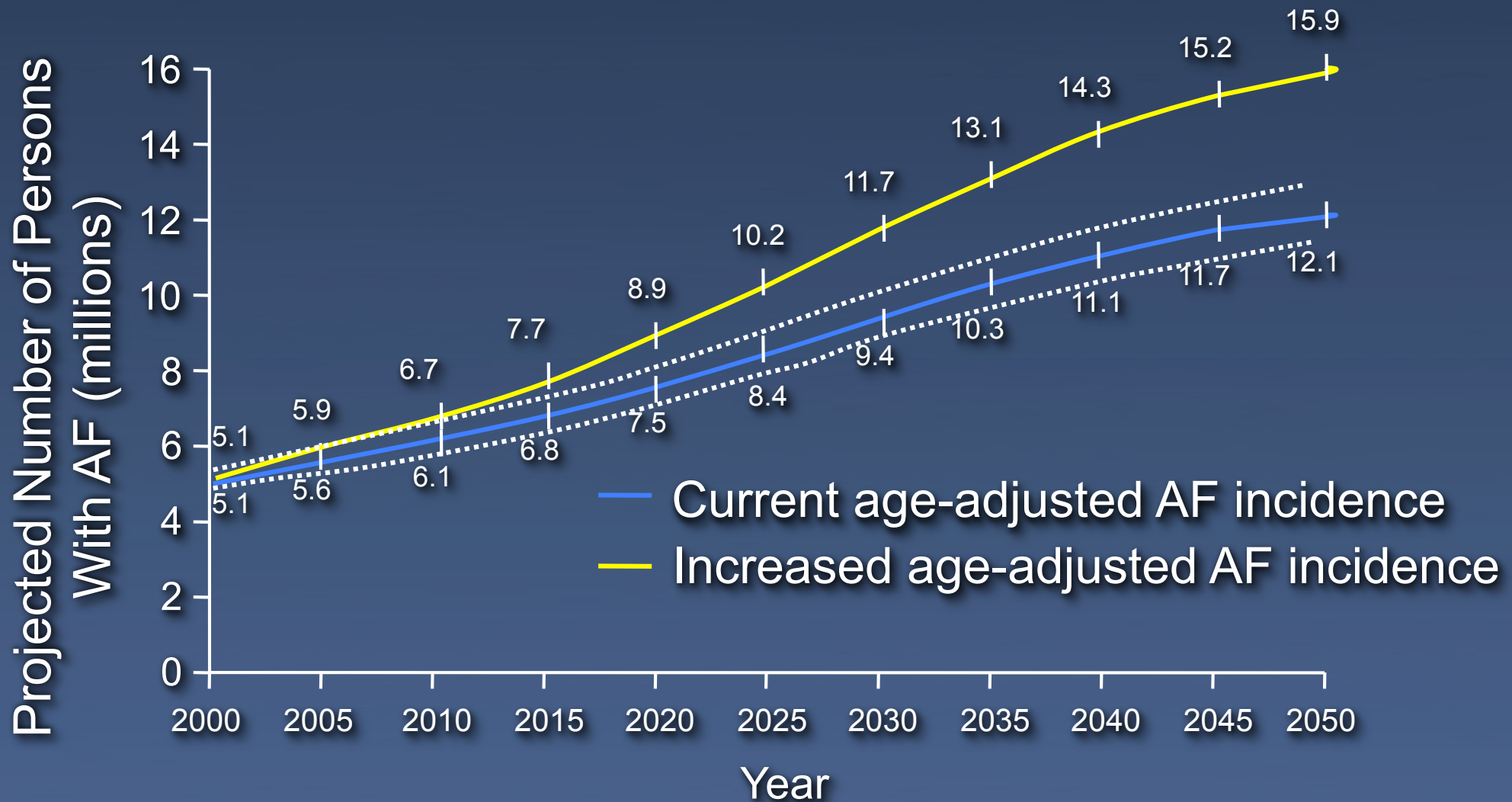
Normal Contraction



Atrial Fibrillation



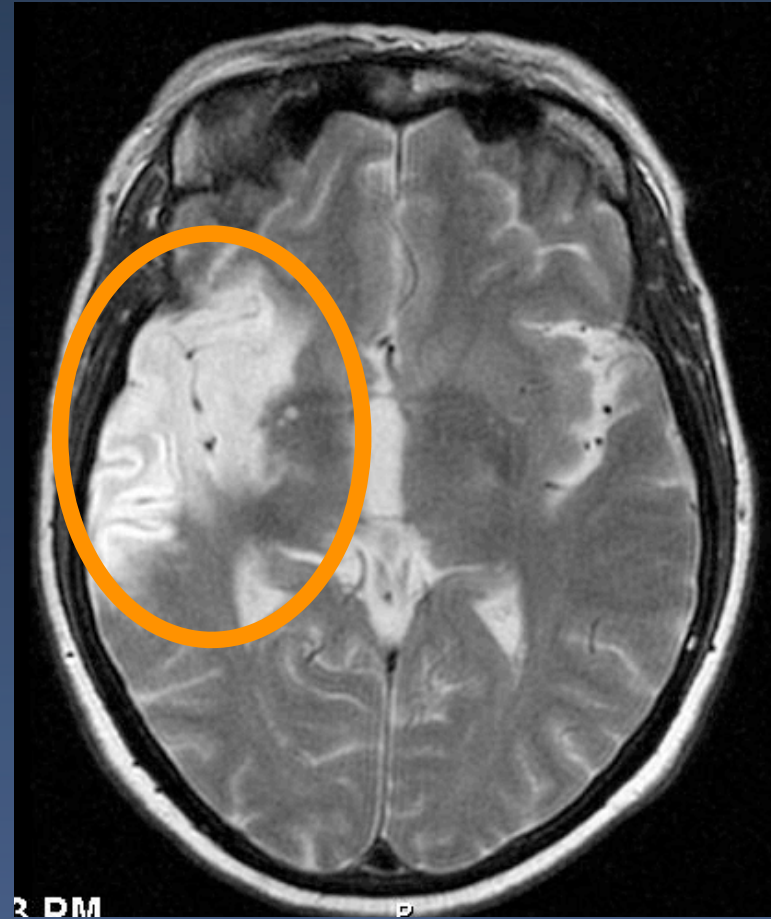
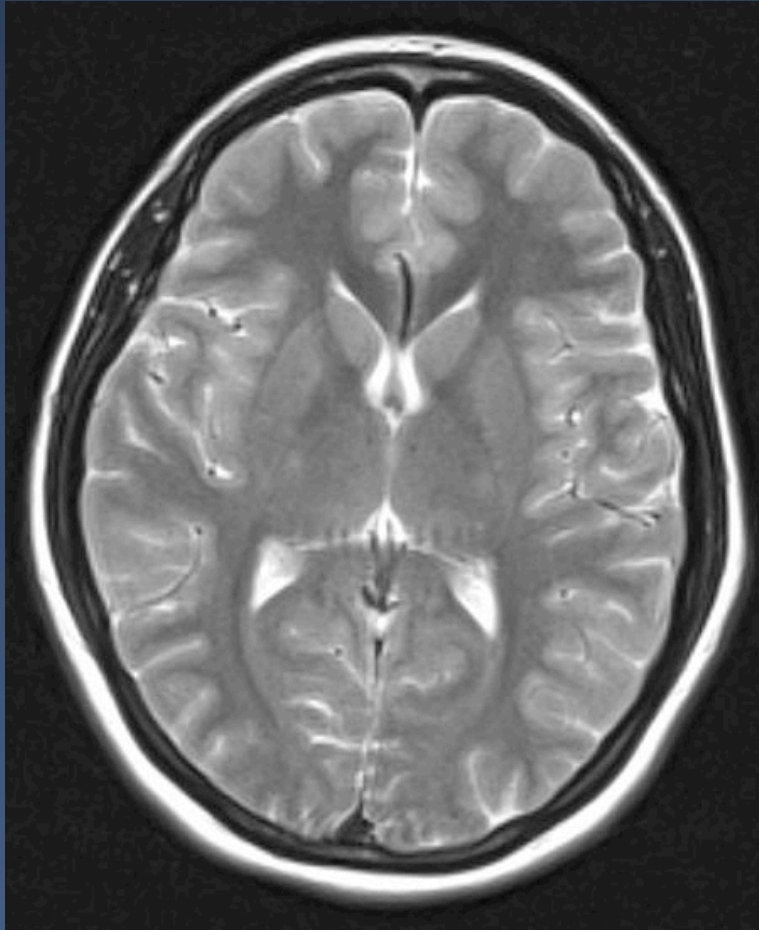
AF Prevalence Is Increasing Rapidly



Miyasaka et al. *Circulation*. 2006;114:1119-125.



20% of Strokes



\$20 billion/year

Clinical Imaging at CARMA

Evaluation



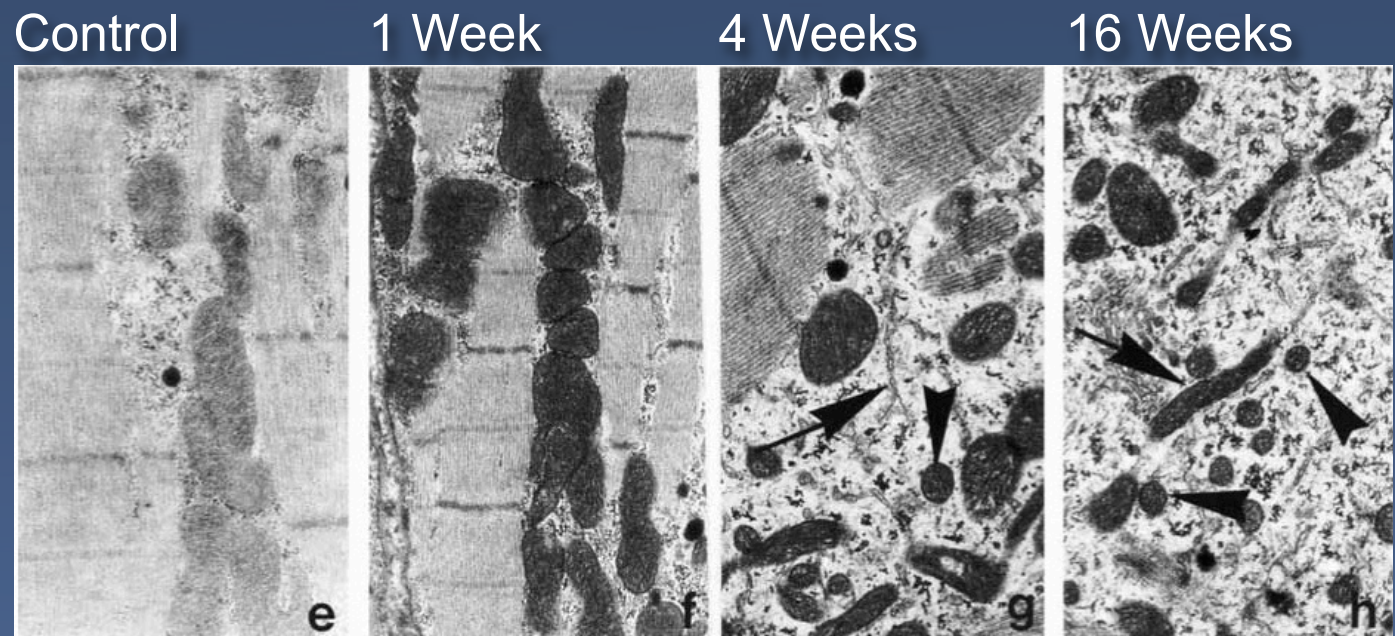
Treatment



Followup

The CARMA Mantra

“Cardiac Arrhythmia is a substrate disease”



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

Evaluation

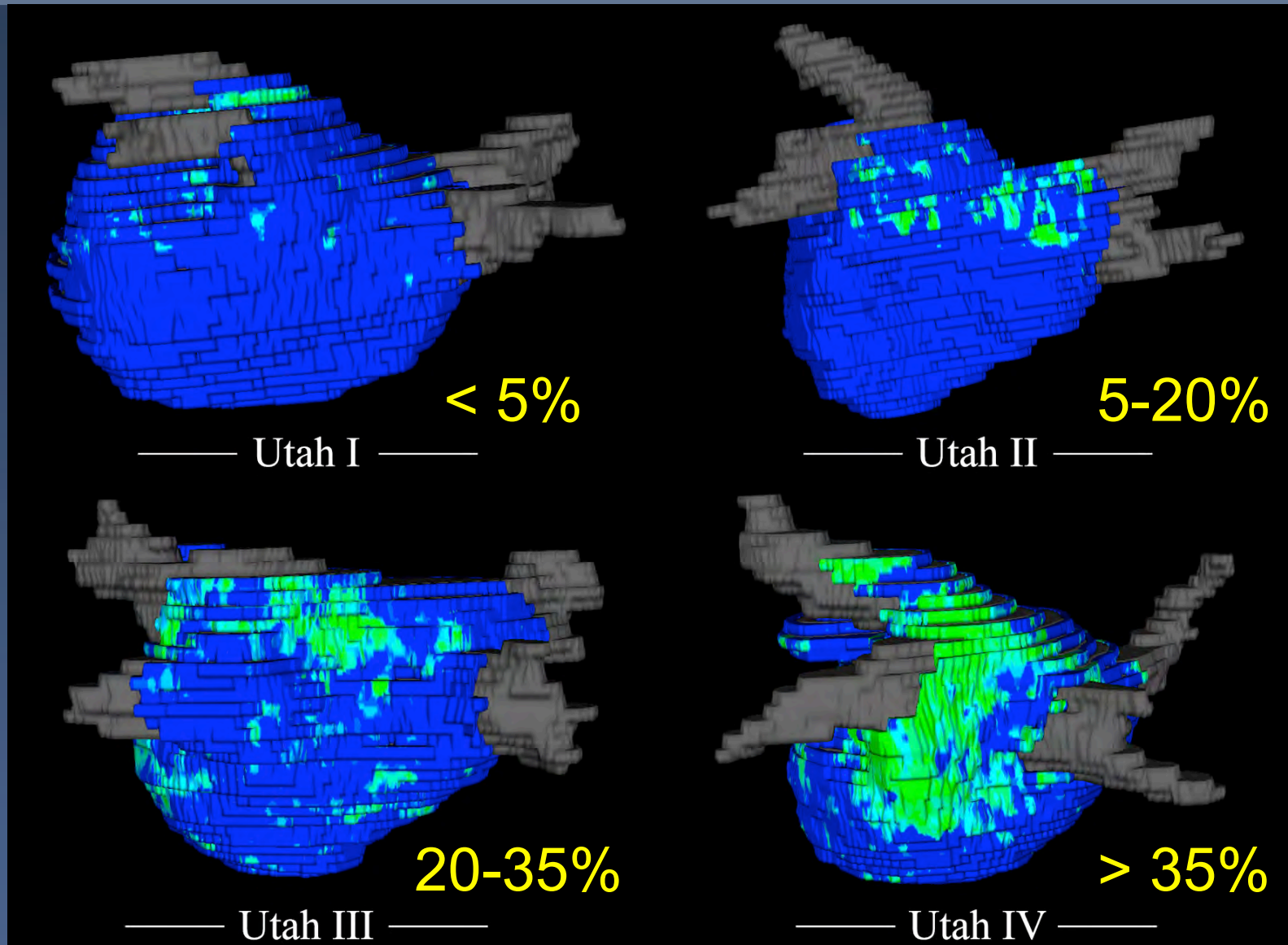


Treatment



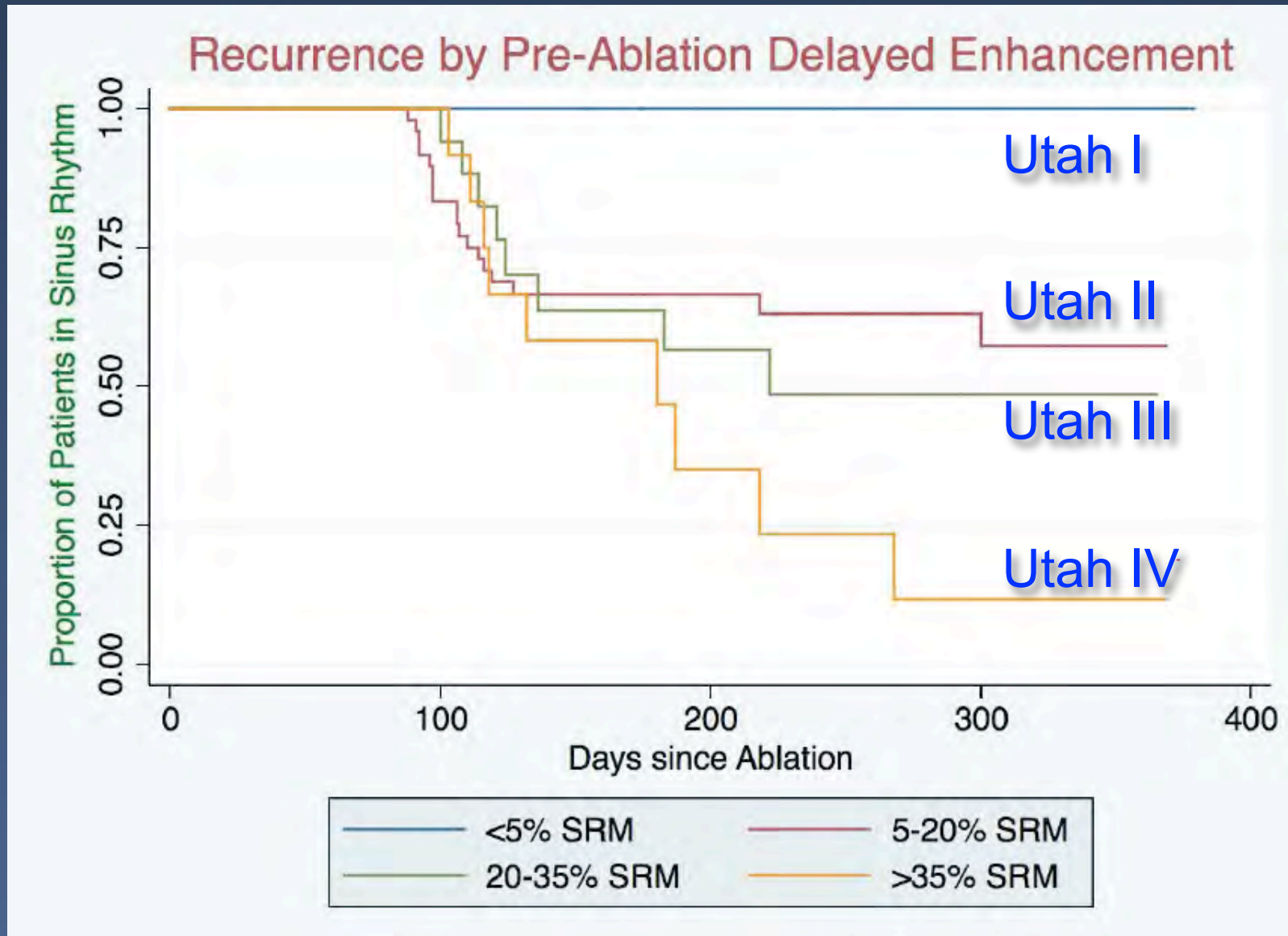
Followup

Utah Scoring Scheme

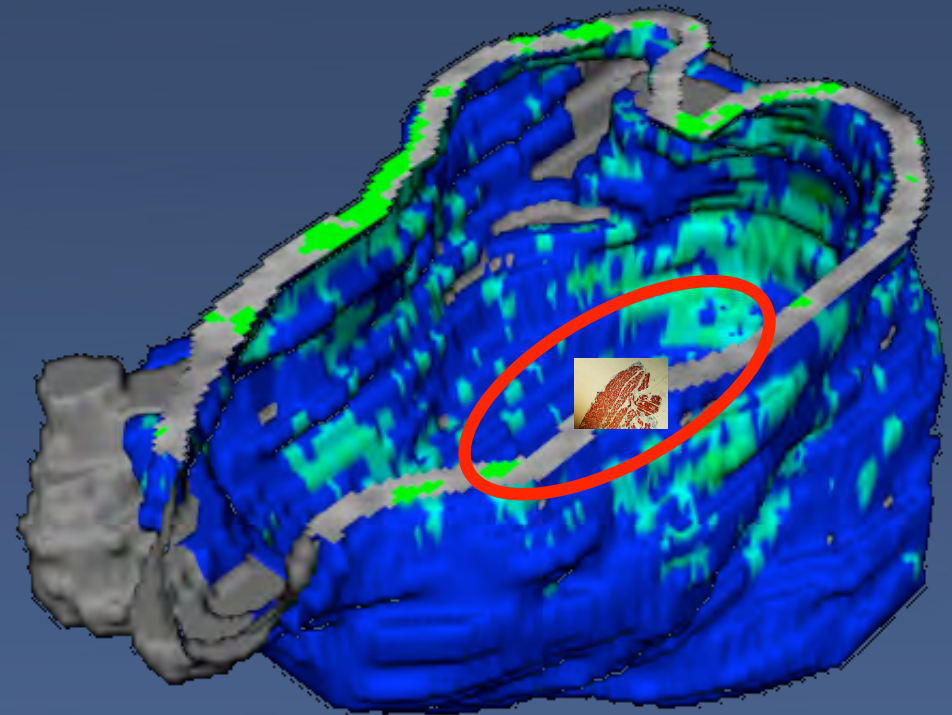
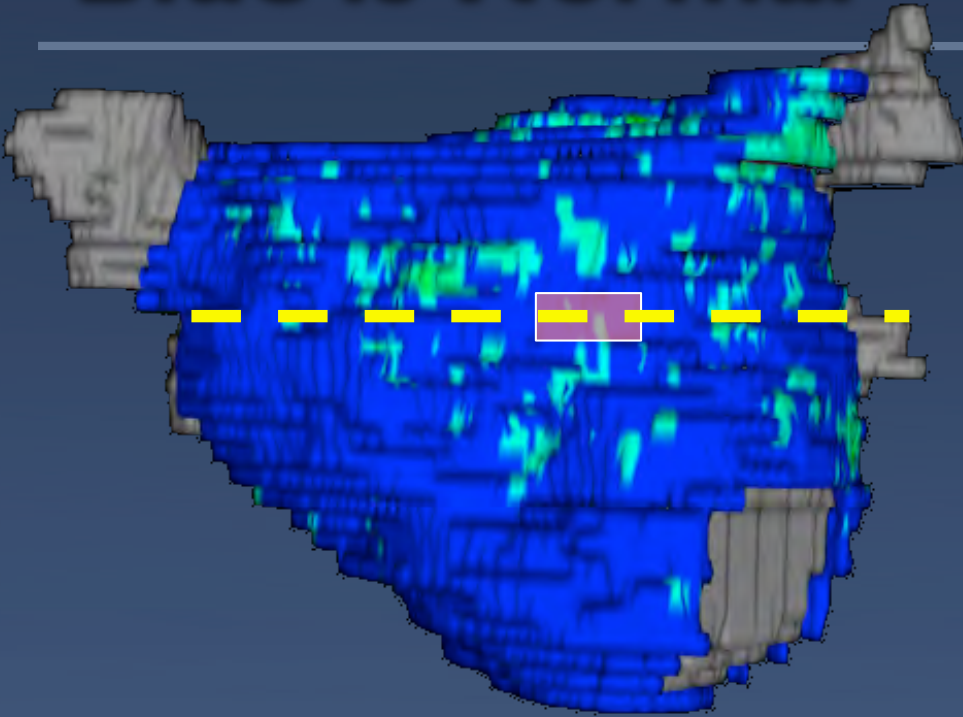


Akoum et al. J Cardiovasc Electrophysiol, 22:16-22, 2011

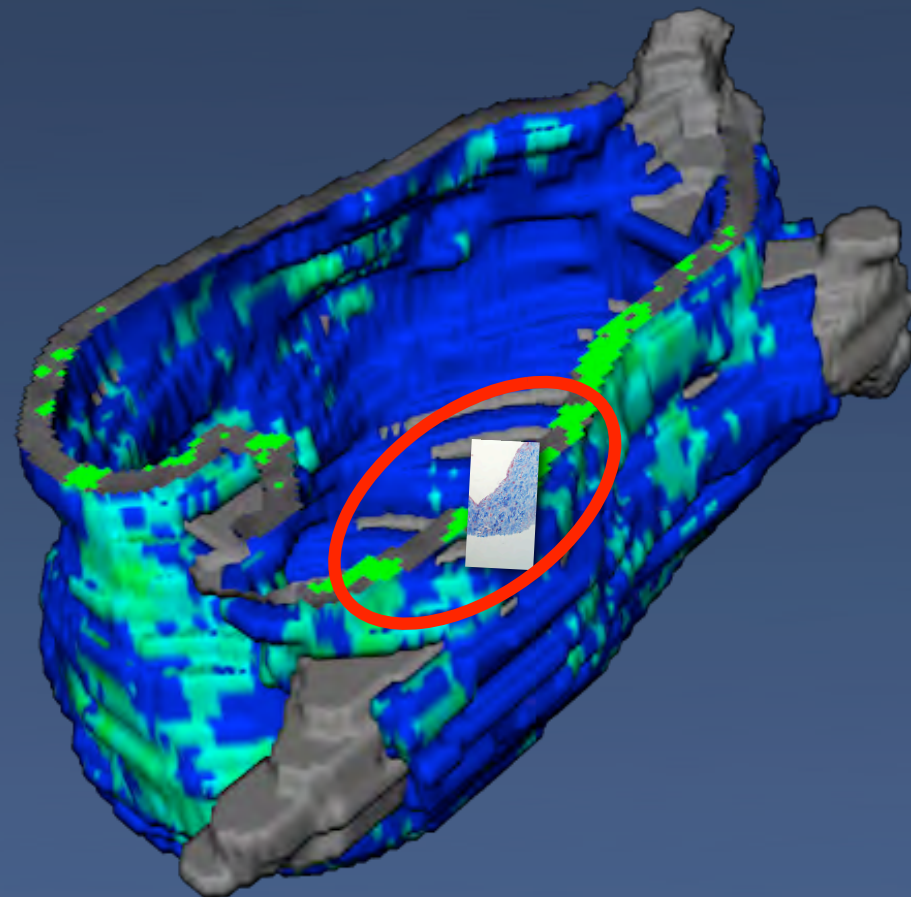
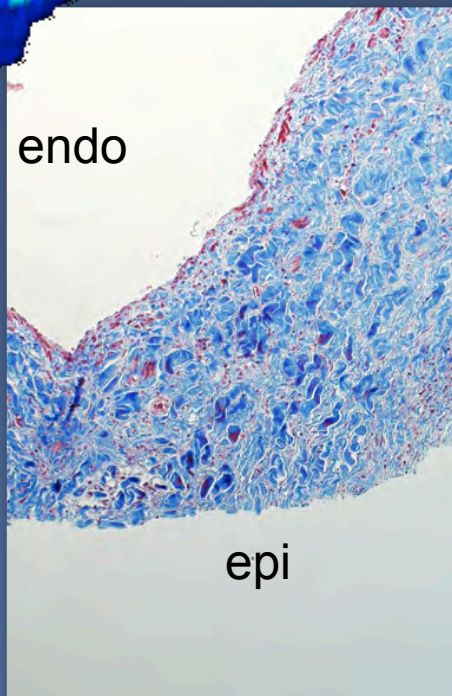
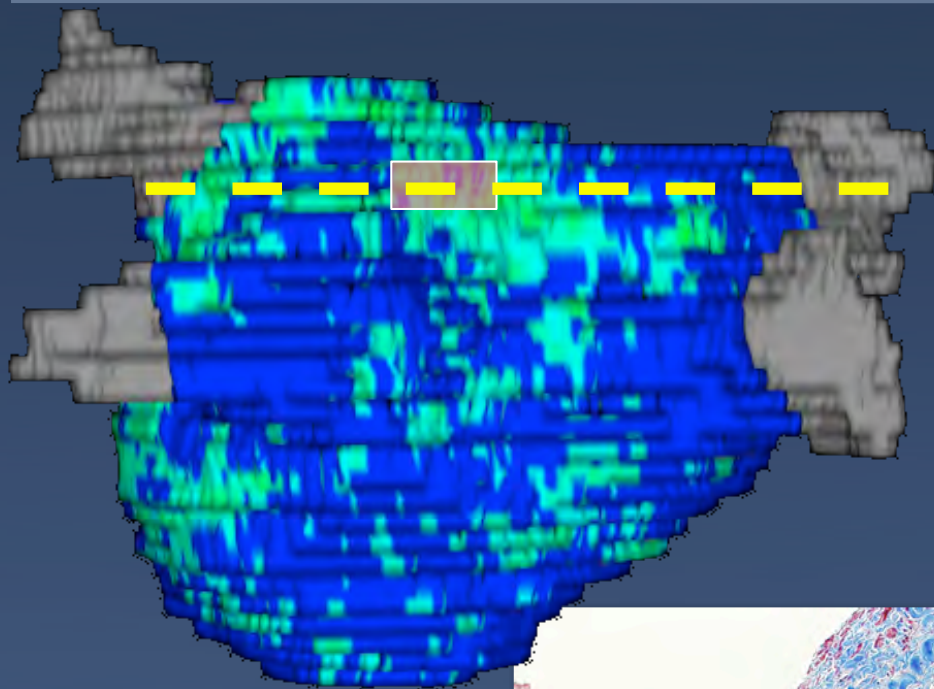
Fibrosis Predicts Outcome



Blue is Normal



Green is Fibrosis



Evaluation

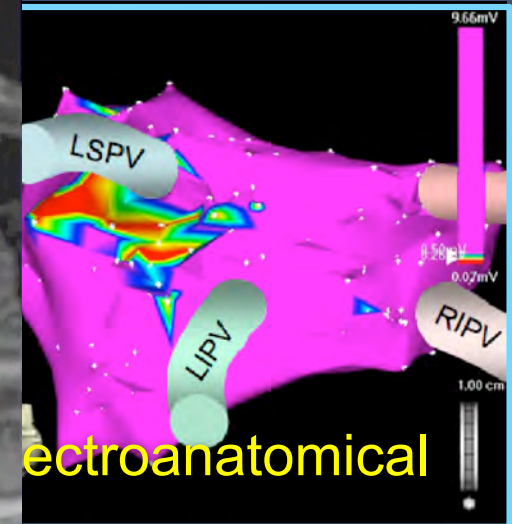
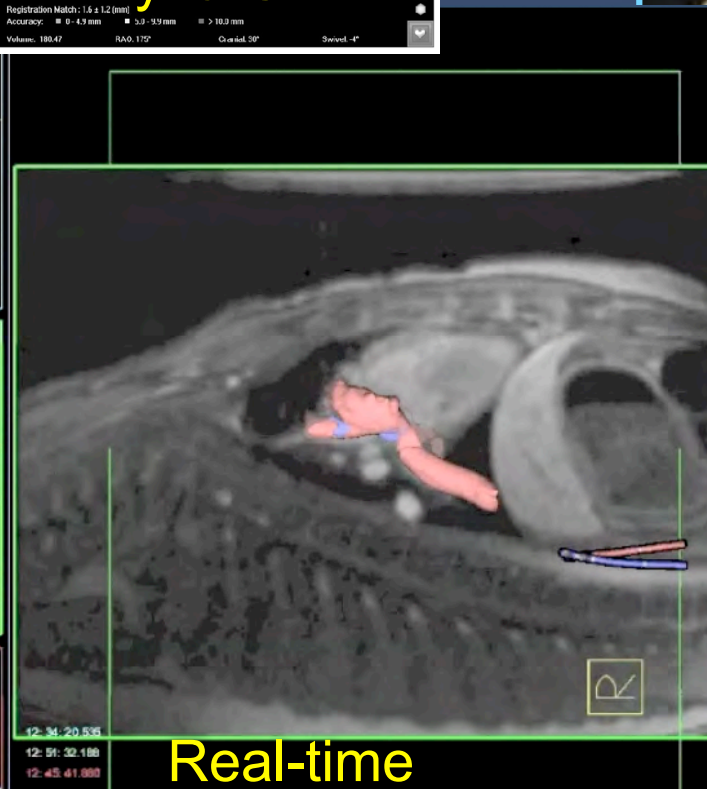
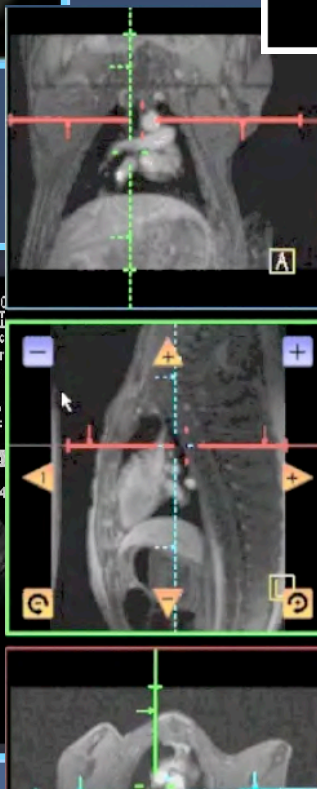
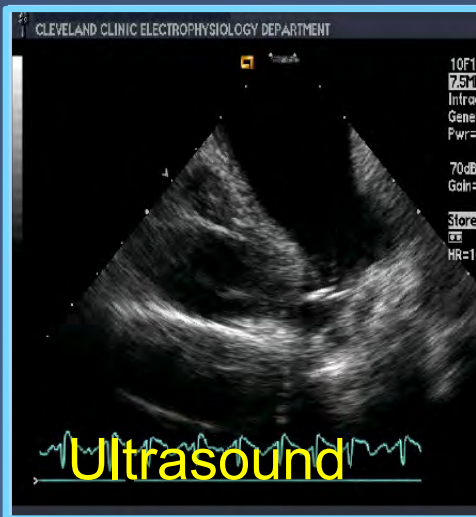
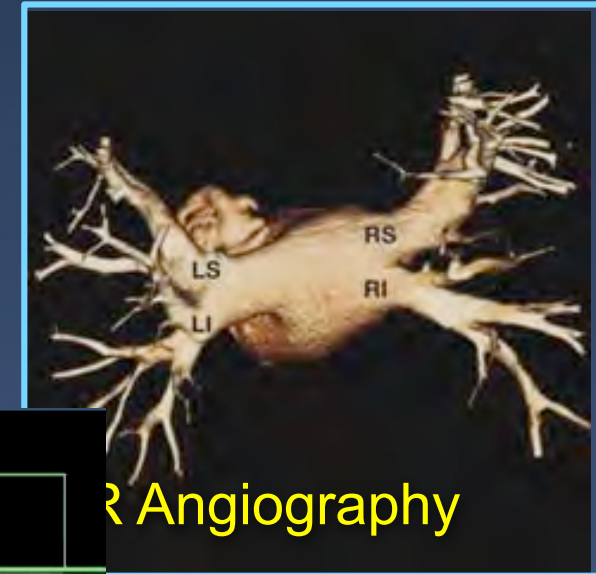
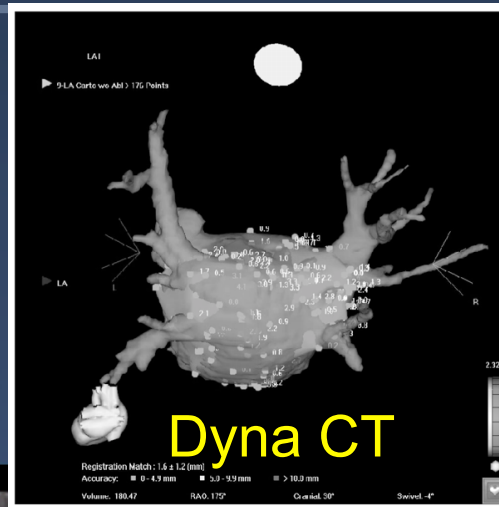
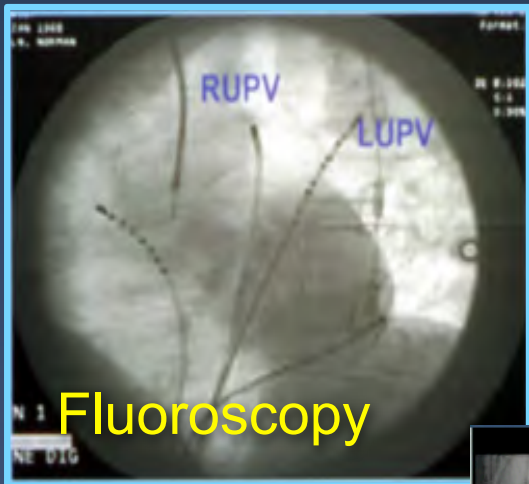


Treatment

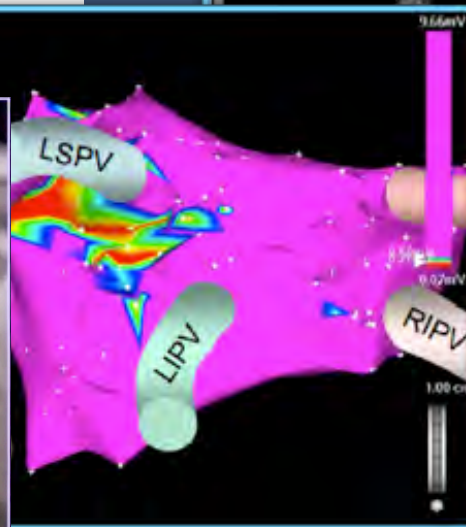
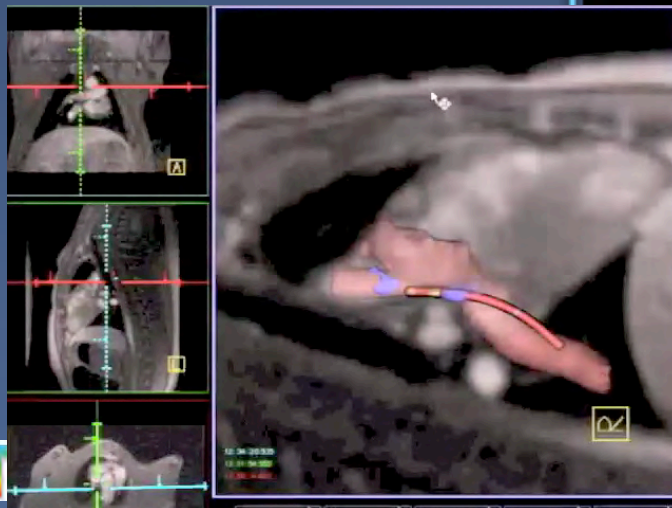
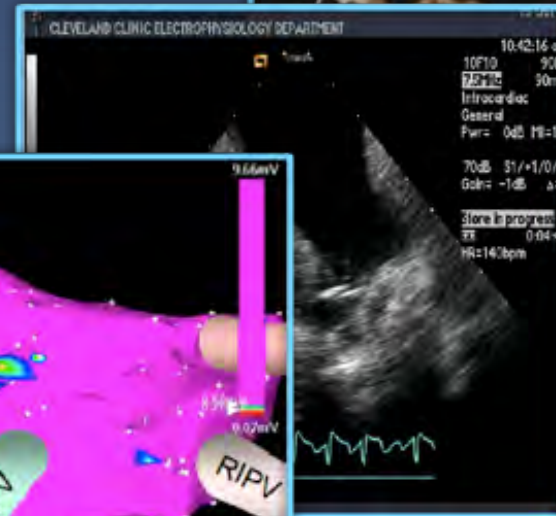
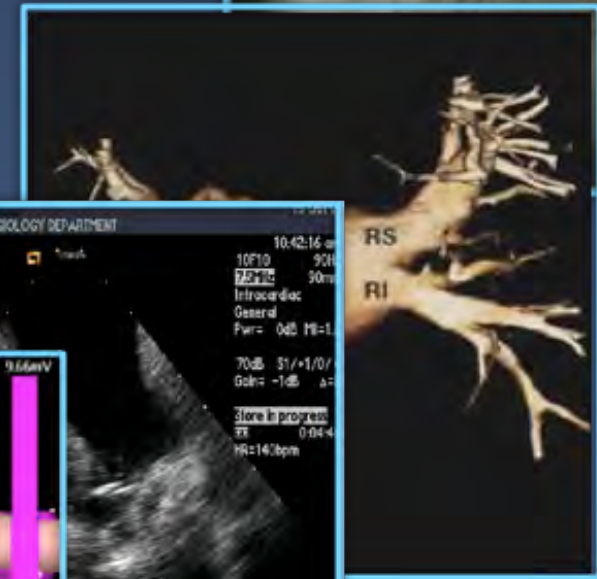
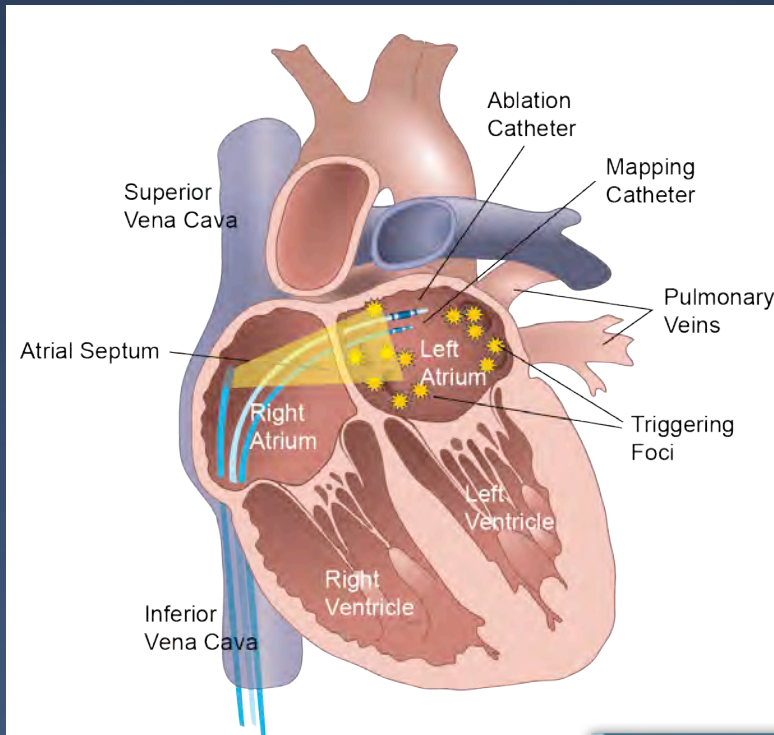


Followup

Imaging Modalities in AF Management



Ablation Guidance



Real Time MRI



SIEMENS



Healthcare worldwide



INTERVENTIONS

MRI-Guided Interventions

Evaluation

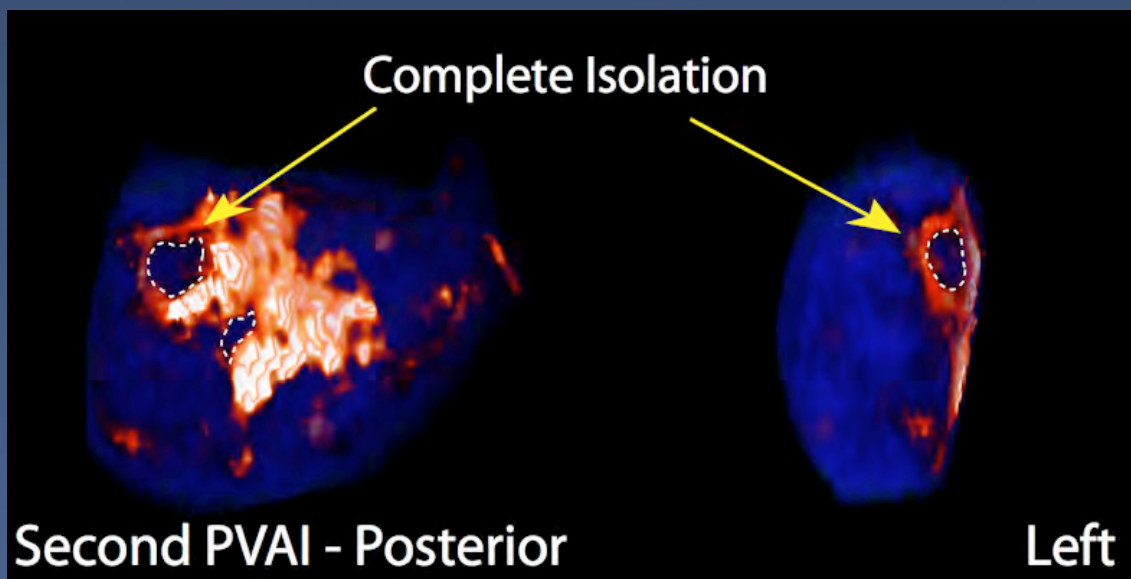
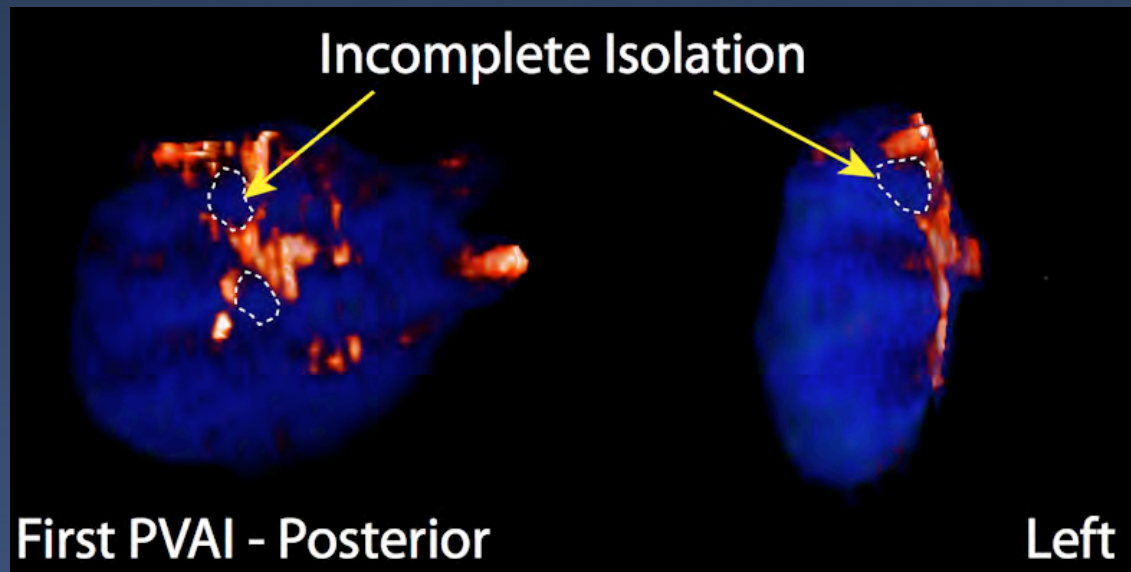


Treatment



Followup

Post Ablation Scar Mapping



McGann et al. JACC,52(15): 1263-1272, 2008

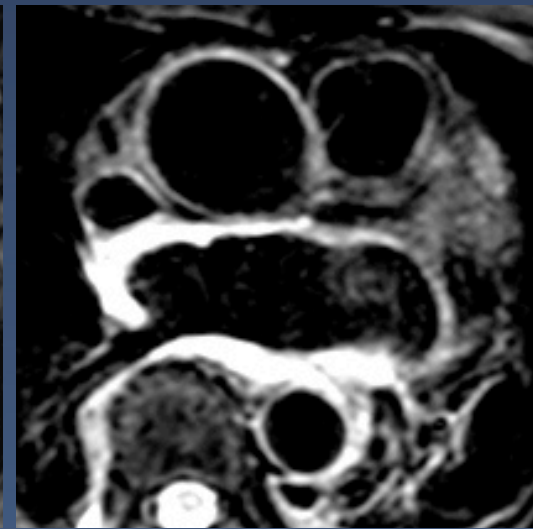


Predicting Success

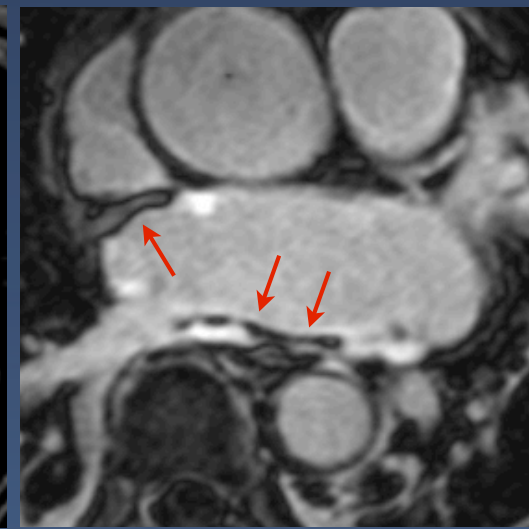
Lesion



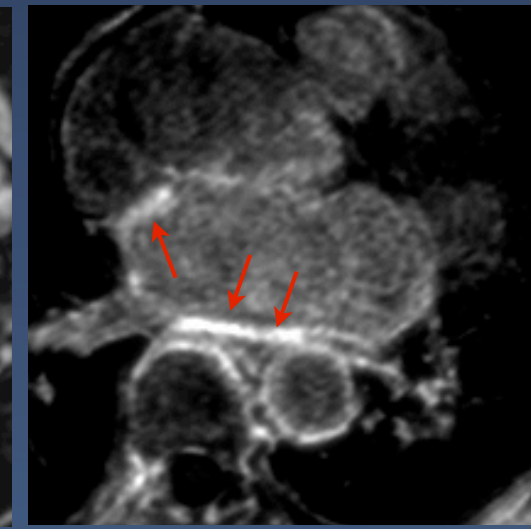
LGE (pre)



T2w (<1hr)



LGE (<1 hr)



LGE (3 mo)



Time

The CARMA Questions

“Cardiac Arrhythmia is a substrate disease”

“How can we evaluate substrate?”

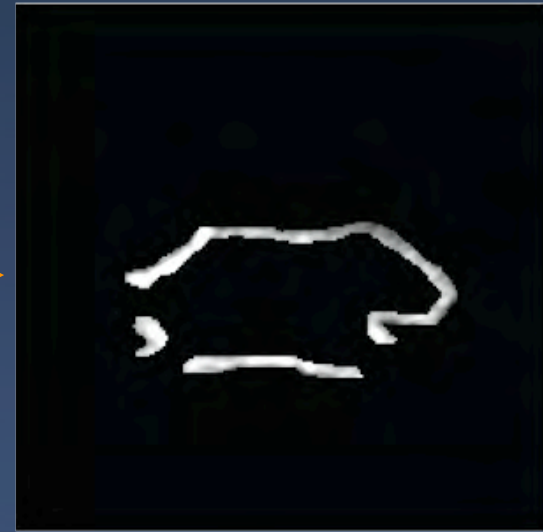
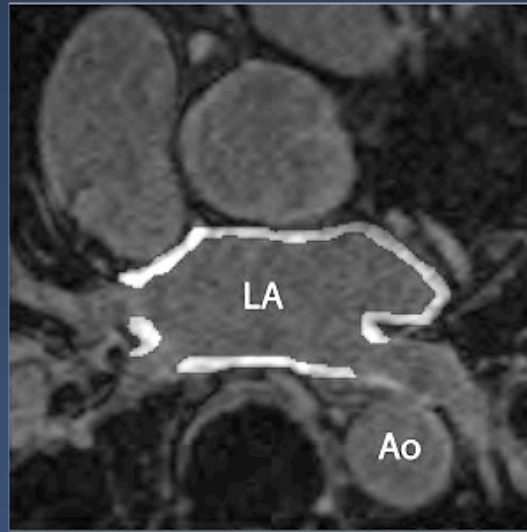
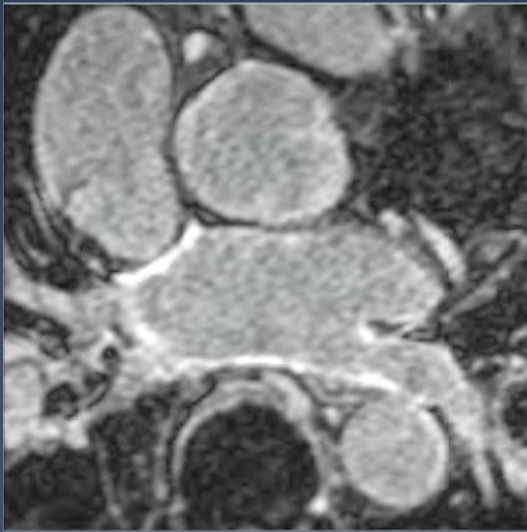
“How can we track substrate progression?”

“How can we ablate less?”

Image Analysis

The Engineering

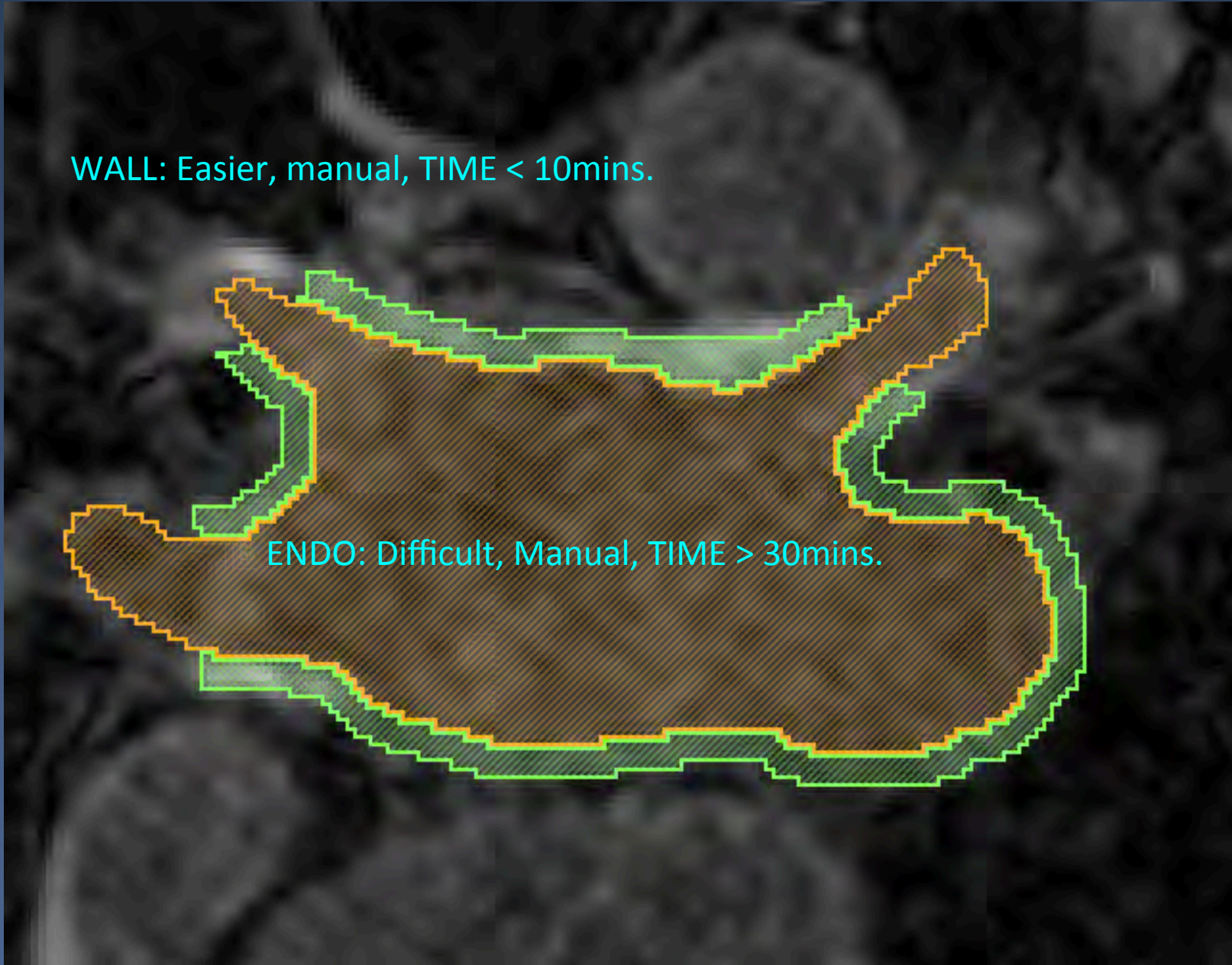
Segmentation Goals



Segmentation Status

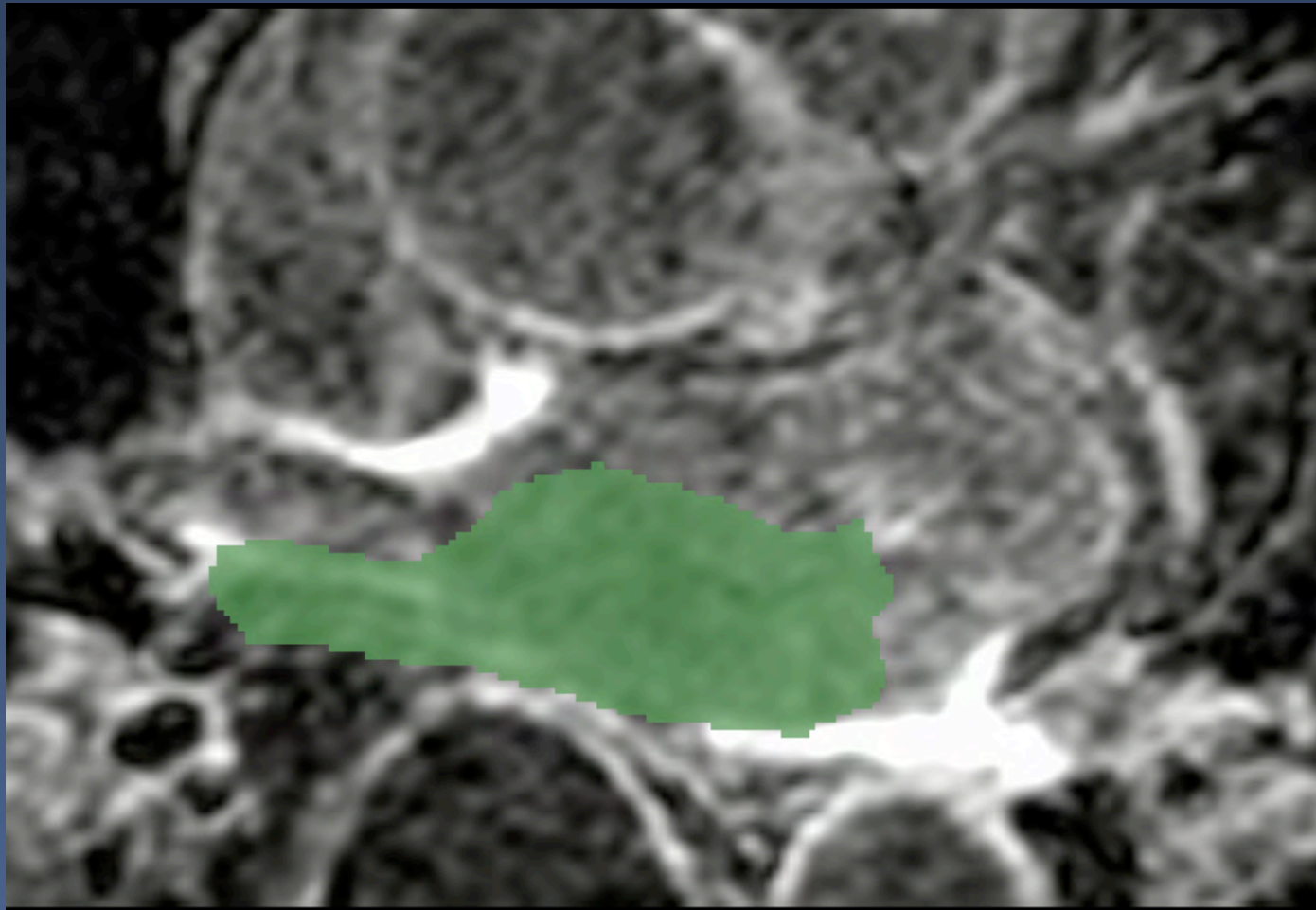
WALL: Easier, manual, TIME < 10mins.

ENDO: Difficult, Manual, TIME > 30mins.

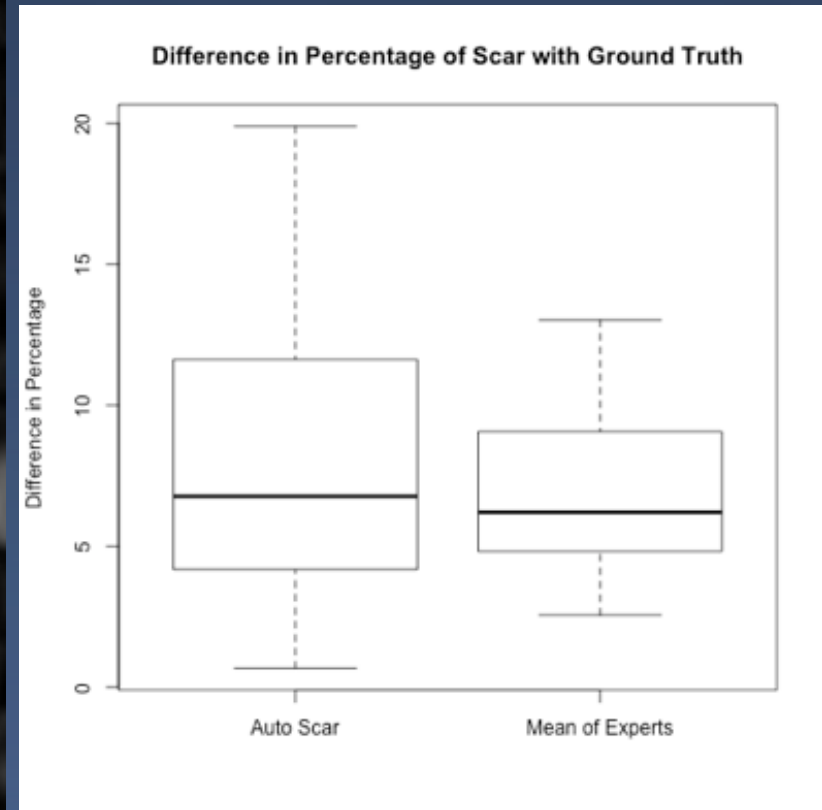
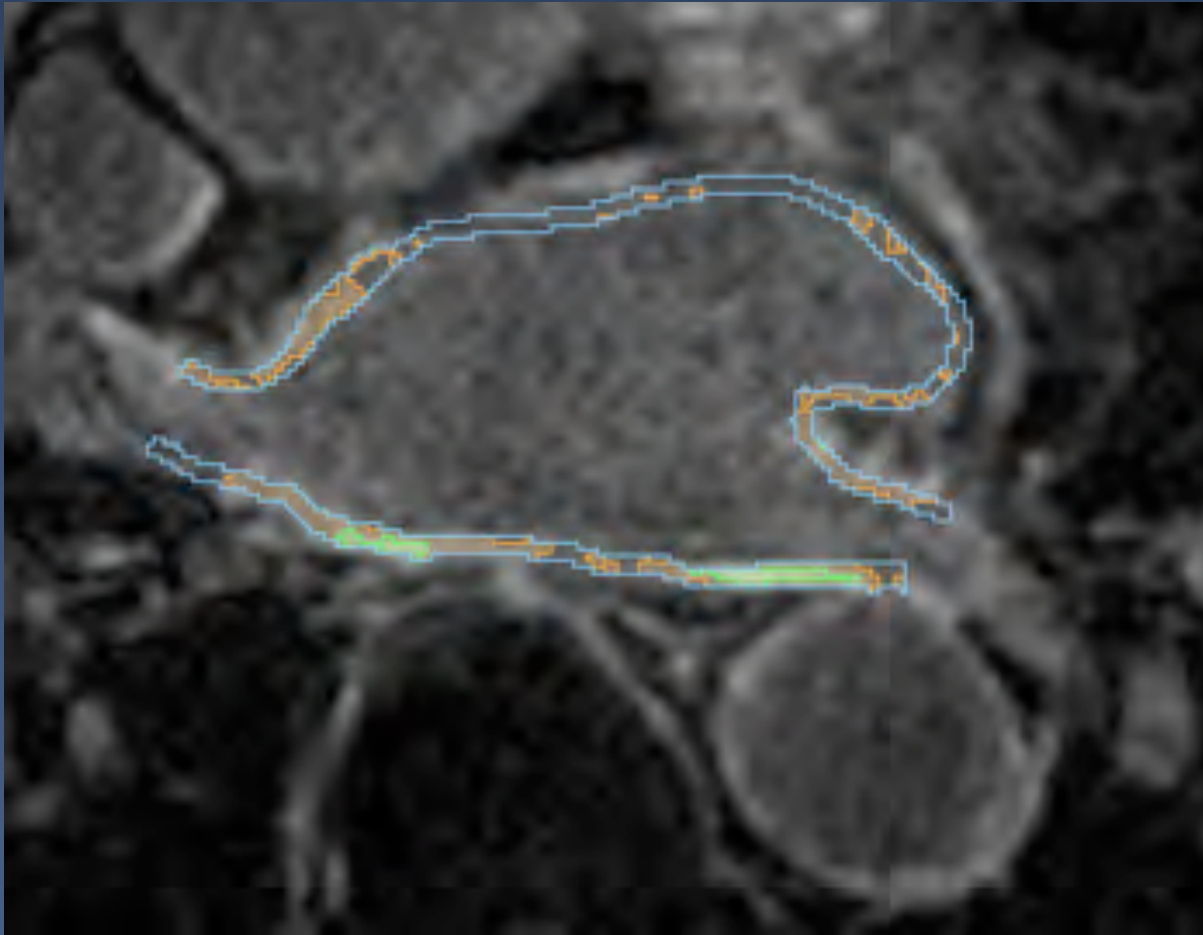


Multi-Atlas Method (Yi Gao)

<http://www.na-mic.org/Wiki/index.php/DBP3:Utah:AutoEndoSeg>



Automated Scar Segmentation



SPIE 2012

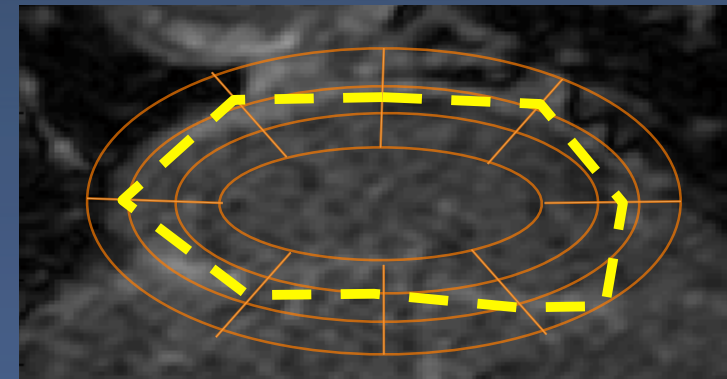
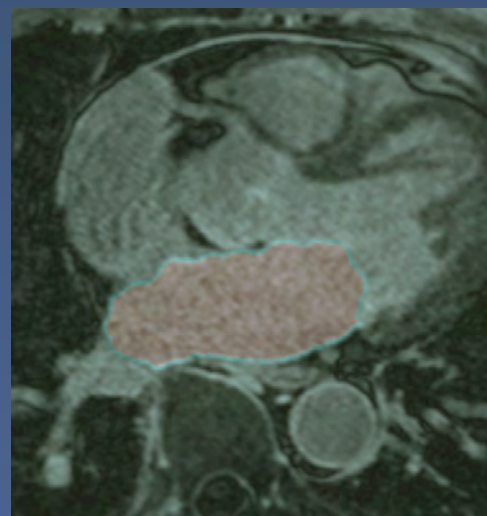
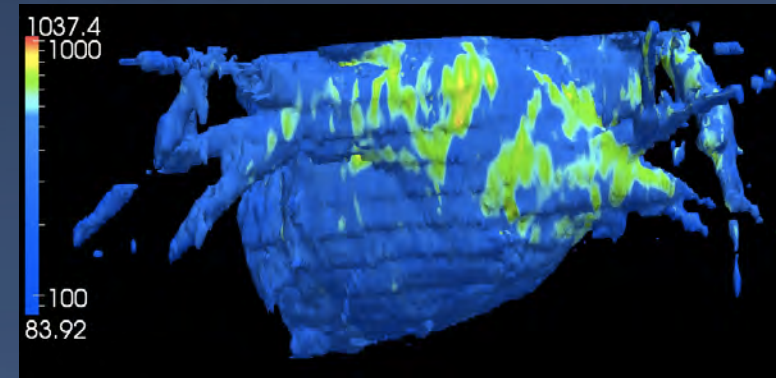
New Approaches

From this Meeting!

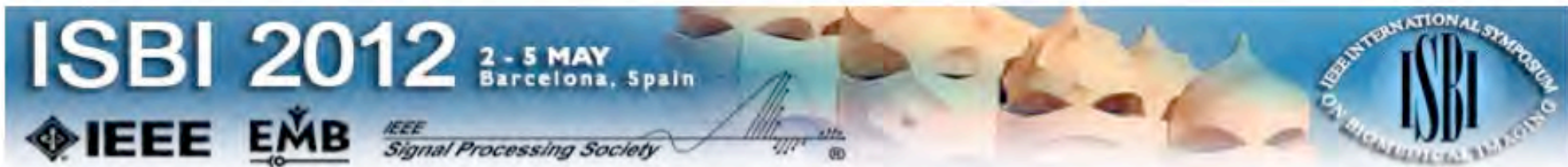
Nonparametric Approaches, Label Fusion
(Golland)

Graph based segmentation
(Whitaker)

Interactive segmentation
(Tannenbaum)



ISBI Challenge

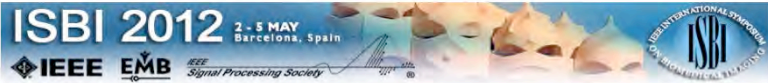


CALL FOR PARTICIPATION

ISBI 2012 Challenge Workshop

**Cardiac Delayed Enhancement Magnetic Resonance Image Segmentation
cDEMRS**

ISBI Challenge



CALL FOR PARTICIPATION

ISBI 2012 Challenge Workshop

Cardiac Delayed Enhancement Magnetic Resonance Image Segmentation
cDEMIRIS

cDEMIRIS Challenge: Delayed-enhancement magnetic resonance imaging (DE-MRI) is a powerful tool for detecting myocardial fibrosis and scarring in both the ventricles and atria. The figure shows three examples of DE-MRI slices of the left atrium (LA) where scar (see arrows) appears as brighter signal in locations of myocardium. Recently there has been much interest in the quantification of DE-MRI for a variety of applications. The quantification of DE-MRI in the LA of patients with atrial fibrillation



has been shown to be potentially useful for selecting suitable candidates for ablation therapy and the subsequent monitoring of this therapy. This quantification is particularly challenging due to the thin myocardium of the atrium, the variable geometry of the LA, and the difficulties in imaging these patients at sufficient resolution and signal-to-noise ratio. This challenge-workshop will make available 60 DE-MRI clinical data sets to challengers for segmentation of

enhanced regions from patients with atrial fibrillation. 30 data sets will be from patients prior to ablation therapy for fibrosis segmentation and 30 will be at least 3-months post-ablation therapy for ablation-related scar segmentation. Data provided will include the DE-MRI scans and a segmentation of LA cavity from an anatomical MRI, which is a guide to the LA wall, within which the enhanced regions are found. Ground truth will be established by using manual segmentations from clinical experts.

The **cDEMIRIS** challenge workshop will be run as a collaboration between researchers, rather than a competition. There will be no “winner” and comparative results will be presented without rankings. We encourage participation by a broad selection of researchers using a range of methods, both complex and simple. Groups are encouraged to provide results from algorithms in preliminary stages of development. Each participant commits to submitting an abstract to the CDEMIRIS’12 workshop summarizing the method used and results of the test dataset.

MICCAI Challenge



18-22 September
MICCAI
Toronto, CA

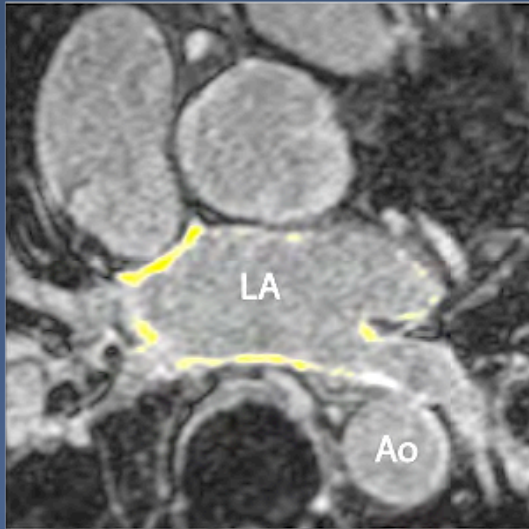
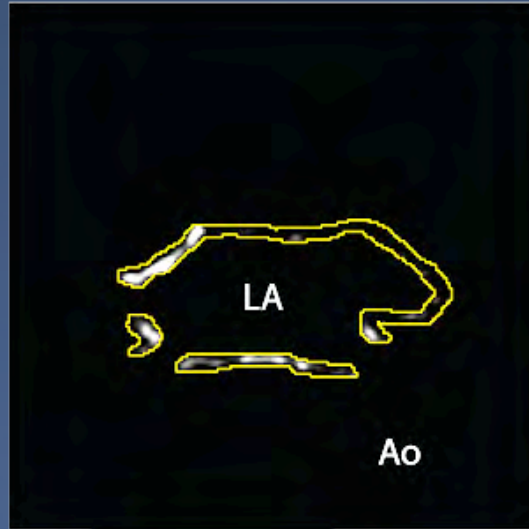
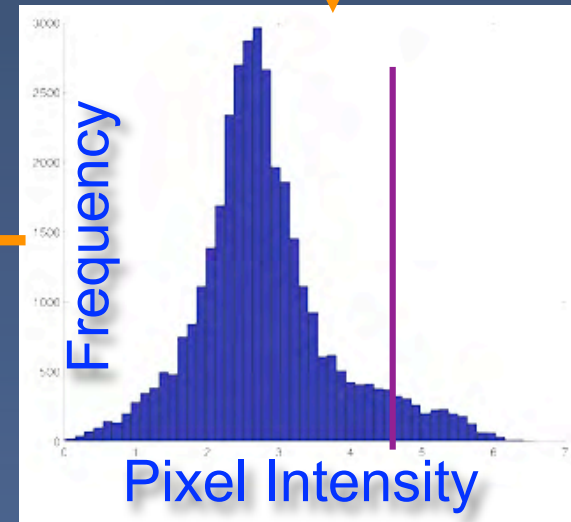
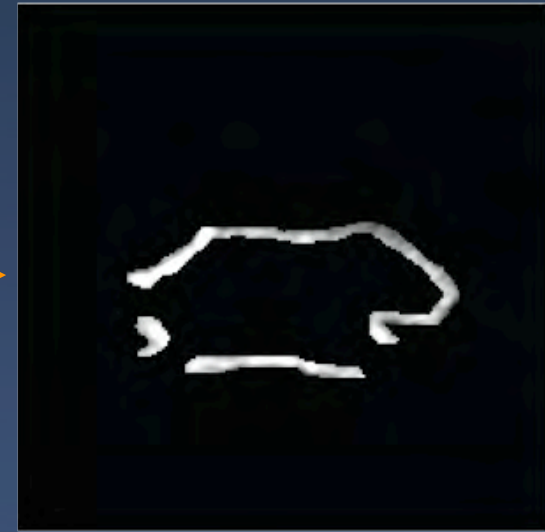
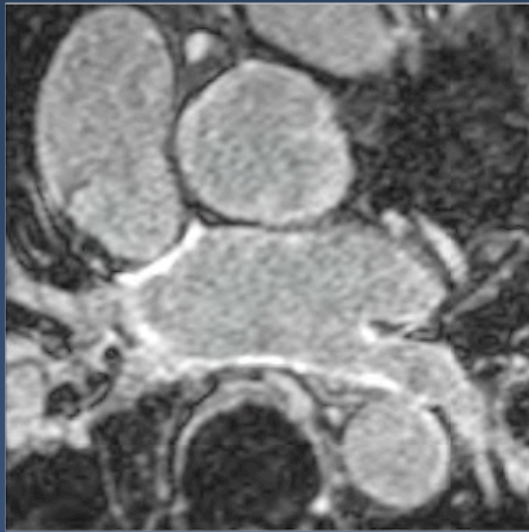
**2012 Update:
Ventricular Segmentation**

Home
Keynote Speakers
Segmentation Challenge

Statistical Atlases and Computational Models of the
Imaging and Modelling Challenges
~ 22 SEPTEMBER 2011 ~

News
List of accepted papers
Submission System is Open!!!
2011 Website is up!

Quantification



CARMA Workflow



Corview (Alpha) 0.1.8 - Corview Example Patient

Segmentation Analysis

Analysis

Layers

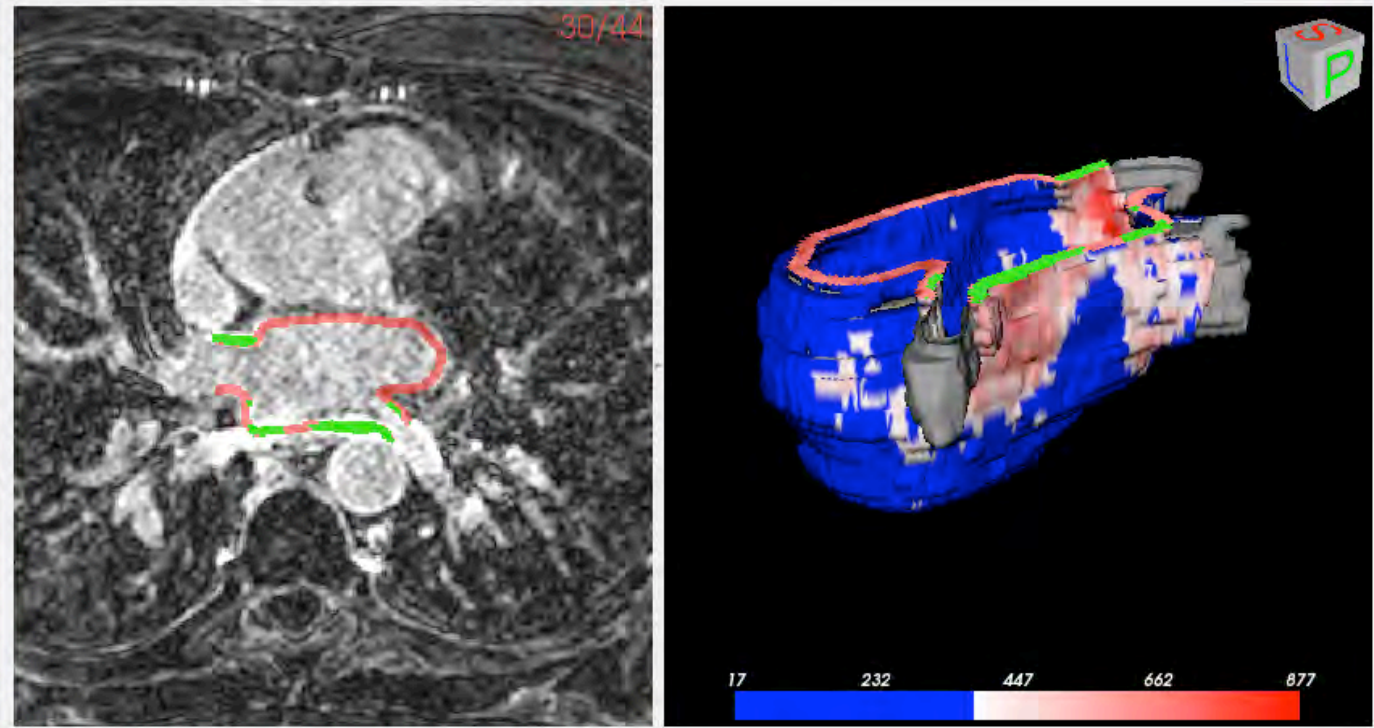
- Data: Original
- Endo: Endo
- Wall: Wall

Options

- Show Image Mask Opacity: 75
- Show Non-Mask Opacity: 75
- Show Threshold Opacity: 75
- Histogram Bars: Scar Quantification
- Histogram Bins: 250
- Histogram Mode: Linear
- Color Map: Cool to Warm
- Background Color: Black
- Threshold Seeds: Clear Set Add

Advanced

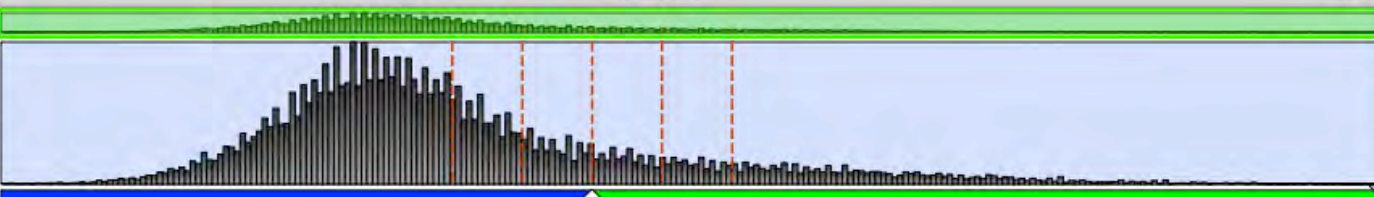
Current Project: Analysis



30/44

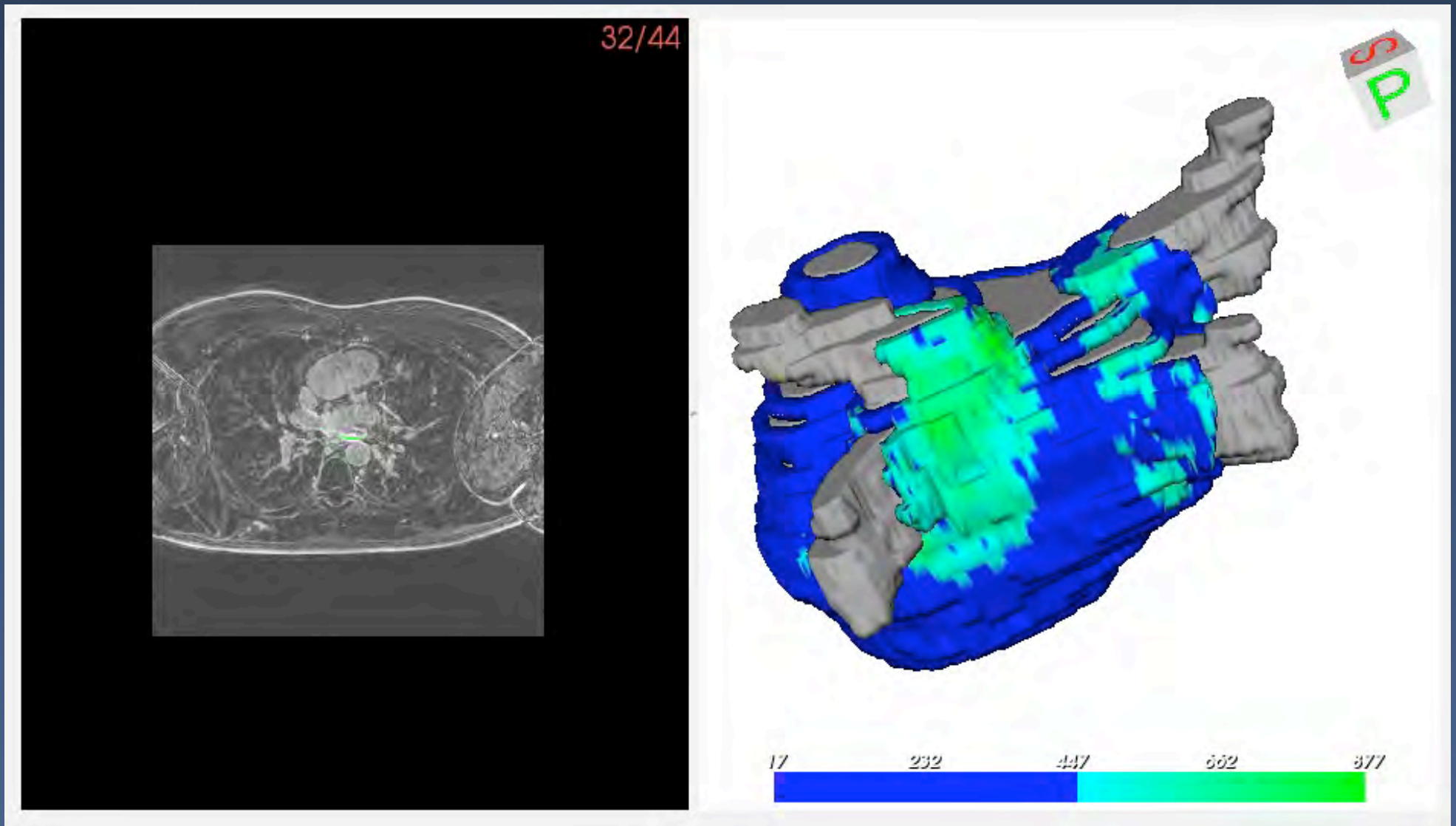
17 232 447 662 877

Histogram

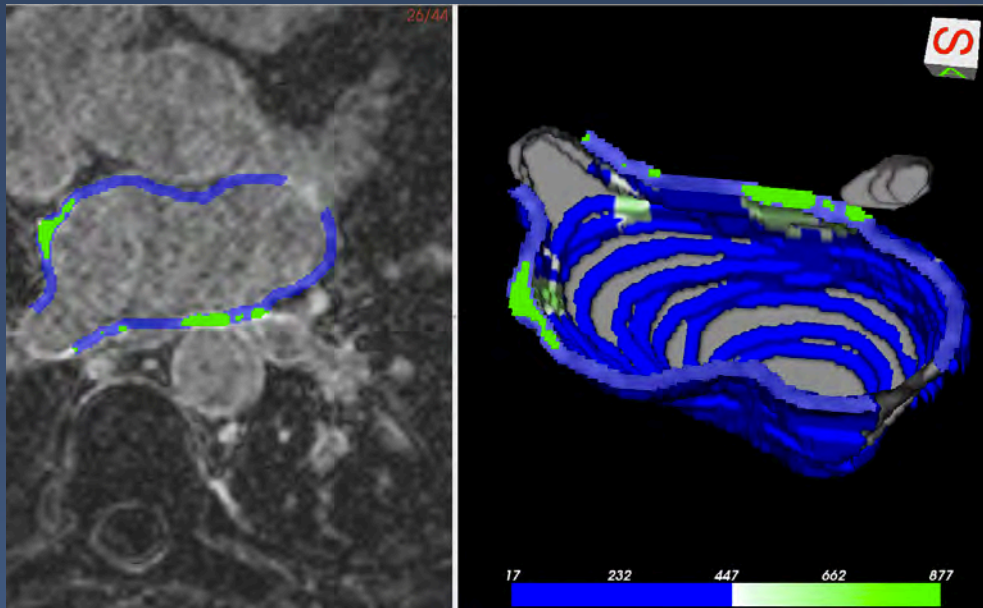


Lower Threshold: 381.30 Upper Threshold: 877.00 Percent: Click to show/hide

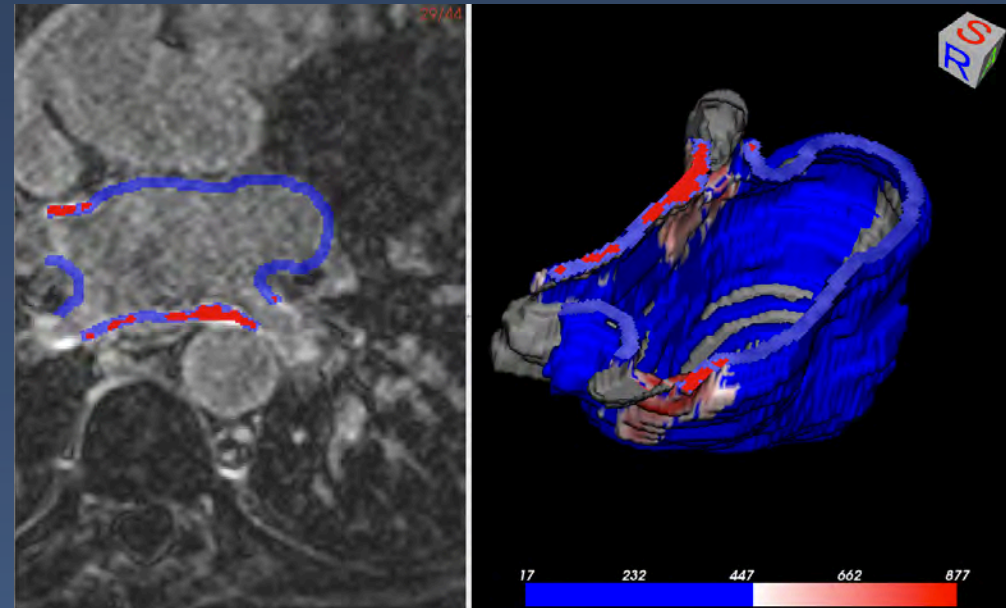
CARMA Workflow



Registration



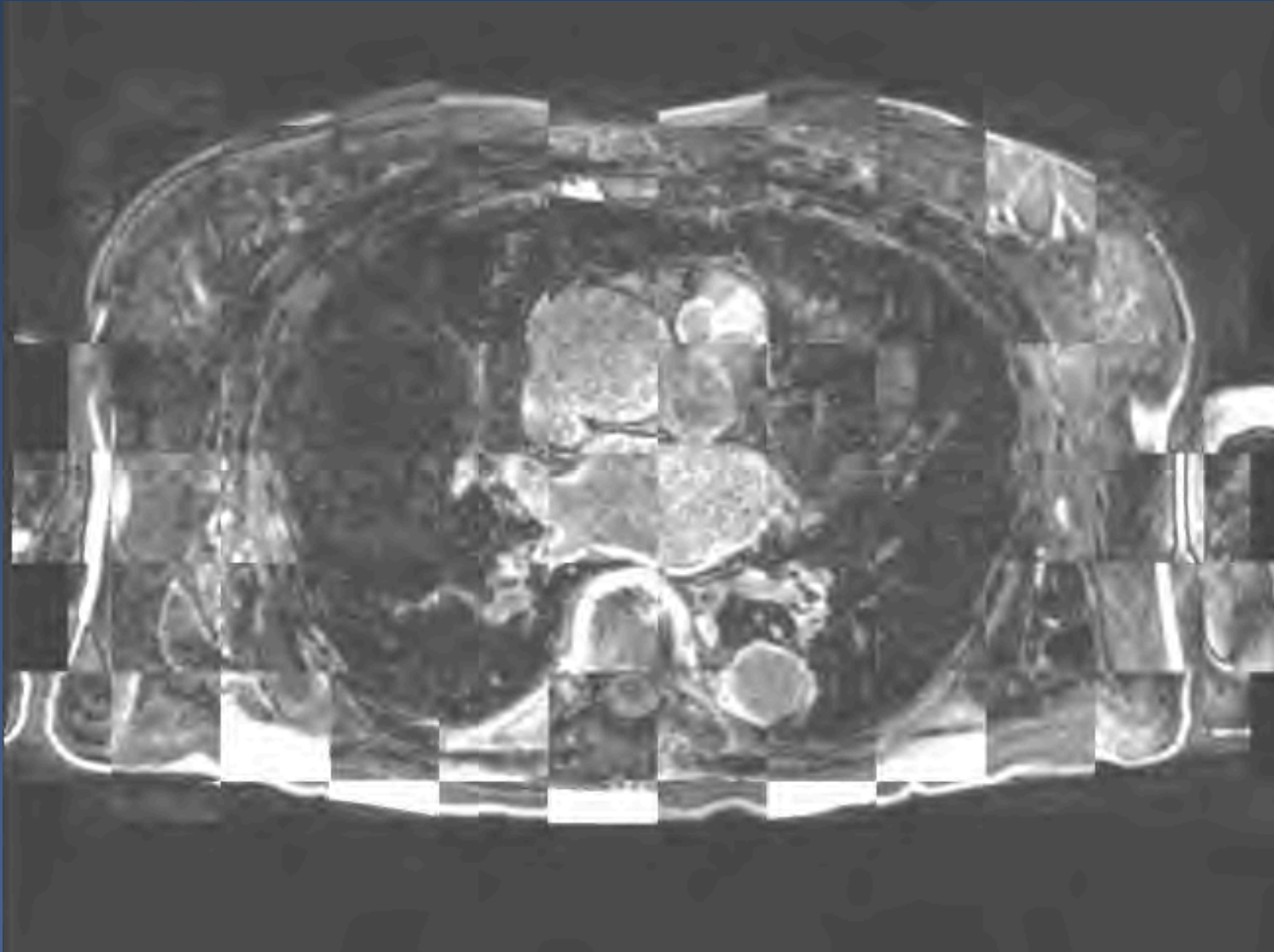
Pre-Ablation (FIBROSIS)



Post-Ablation (SCAR)

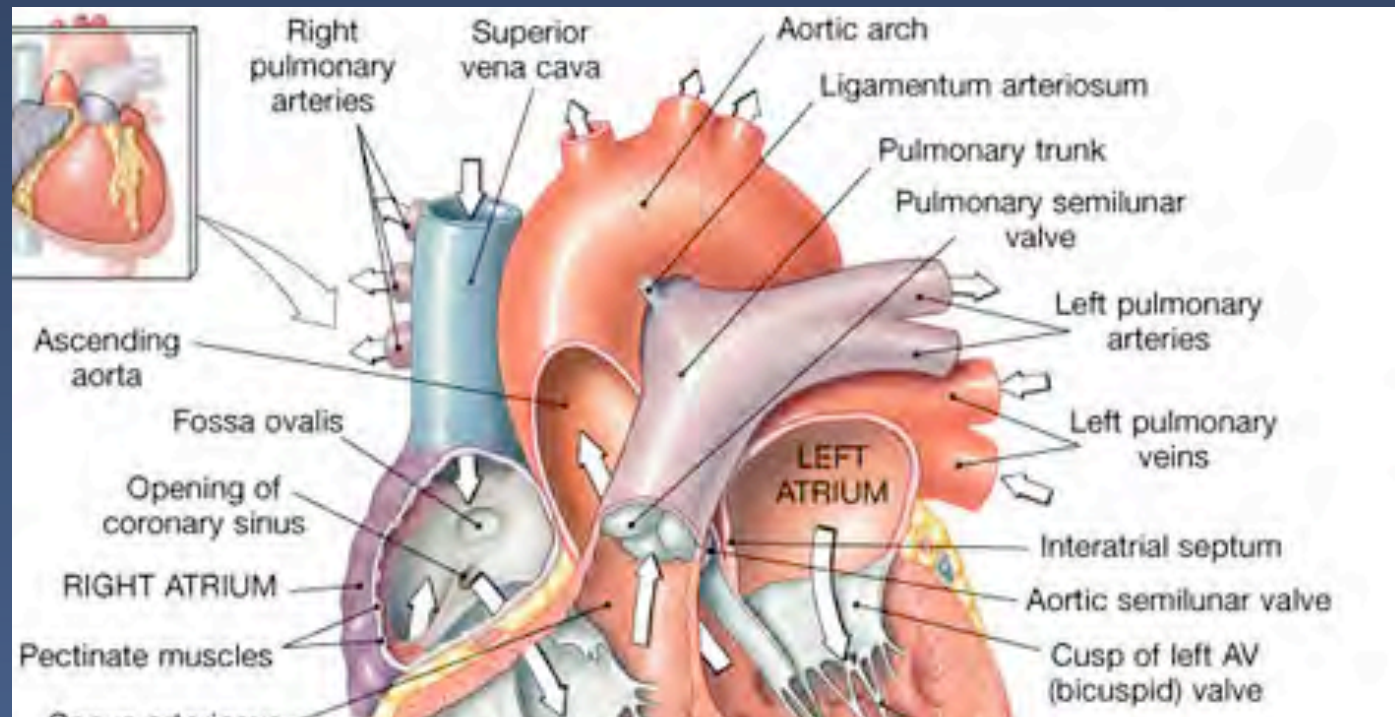
How does the GREEN overlap with the RED?

Current Status



New Approaches

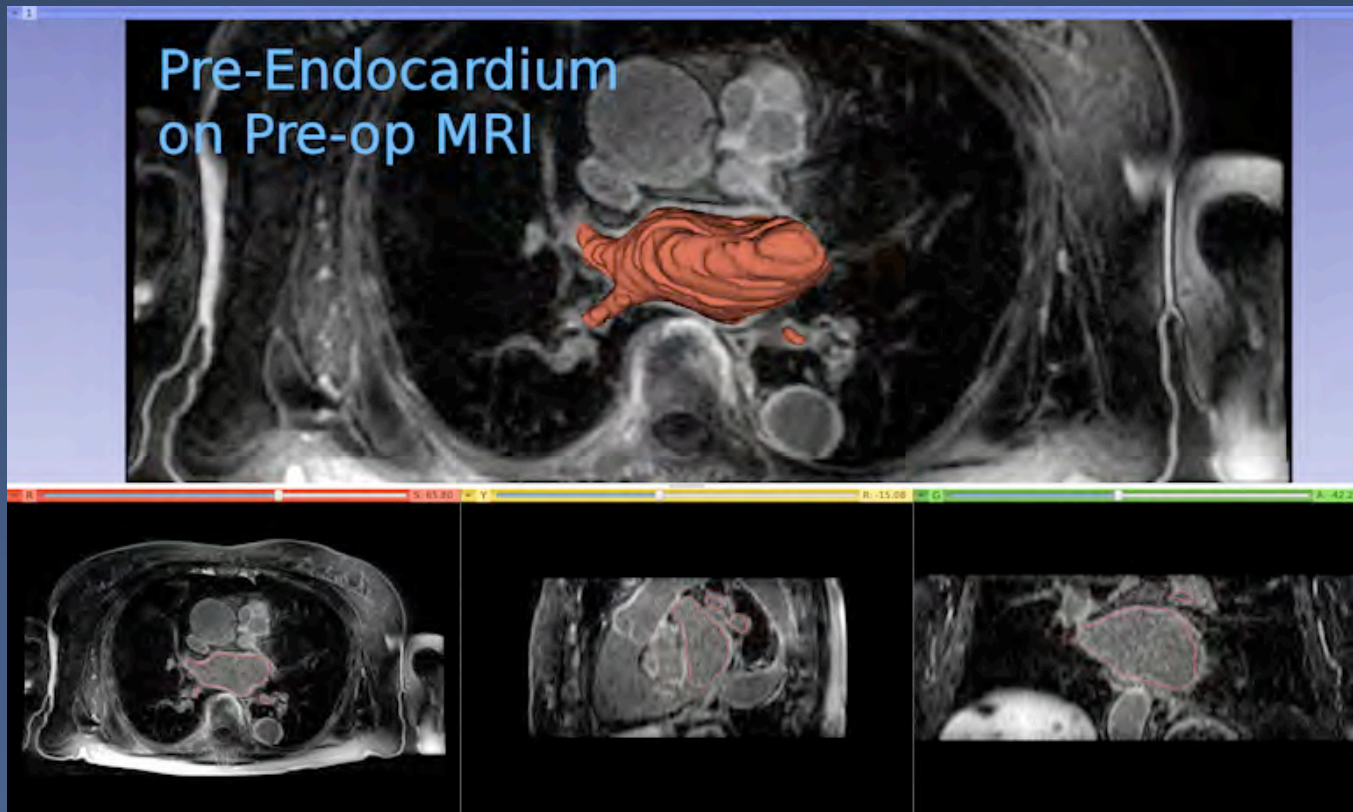
Landmark based registration (CARMA)



New Approaches

From this Meeting!

Segmentation driven registration
(Gao)



Data Repository

The screenshot shows the MIDAS data repository interface. At the top left is the MIDAS logo. A navigation bar contains buttons for Home, Browse, Search, and Collection. A search bar is located on the left. The main content area displays a collection titled "NAMIC - CARMA Left Atrial MRI" with a size of 1 Gb and 19 downloads. The collection description includes: "> In community MIDAS/National Alliance for Medical Image Computing (NAMIC) Cardiac MRI data from the Comprehensive Arrhythmia Research and Management (CARMA) Center at the University of Utah". A citation instruction states: "Please use this identifier to cite or link to this collection: <http://hdl.handle.net/1926/1755>". Below this, it indicates "1 item within this collection" and lists the "PRE and POST Radiofrequency Ablation LGE-MRI Collection" with details: "lge-mri, atrial fibrillation, cardiac magnetic resonance, left atrial segmentation, radiofrequency ablation", "last update on 2011-11-23 17:04:49 (1.9 GB in 97 files)", and "Download this study. [All the data](#)". A five-star rating is visible on the right side of the collection entry.

MIDAS

Home Browse Search Collection

Search MIDAS

NAMIC - CARMA Left Atrial MRI (Size: 1 Gb Downloads: 19) ★★★★★

> In community MIDAS/National Alliance for Medical Image Computing (NAMIC)
Cardiac MRI data from the Comprehensive Arrhythmia Research and Management (CARMA) Center at the University of Utah

Please use this identifier to cite or link to this collection: <http://hdl.handle.net/1926/1755>

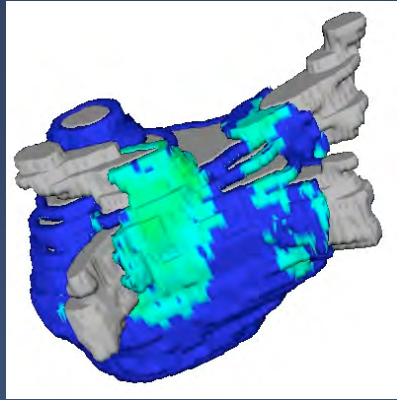
1 item within this collection

PRE and POST Radiofrequency Ablation LGE-MRI Collection

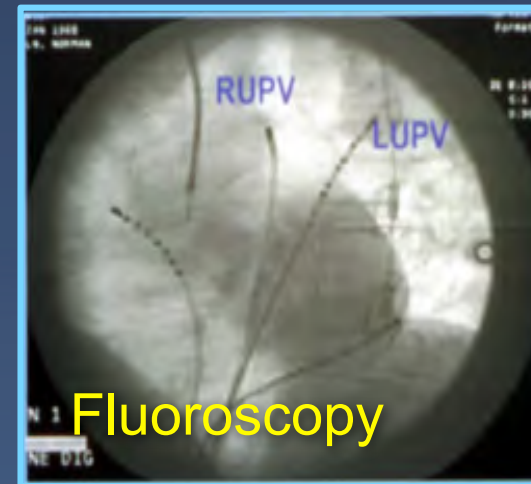
- lge-mri, atrial fibrillation, cardiac magnetic resonance, left atrial segmentation, radiofrequency ablation
- last update on 2011-11-23 17:04:49 (1.9 GB in 97 files)
- Download this study. [All the data](#)

Some New Ideas

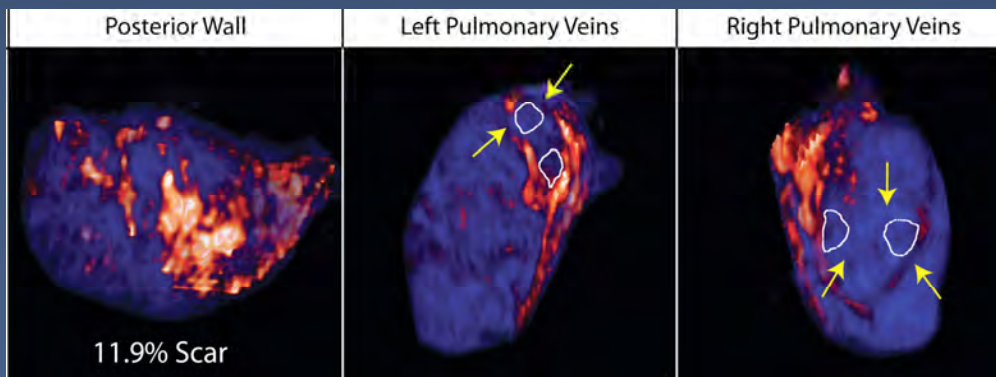
Image Merging



+

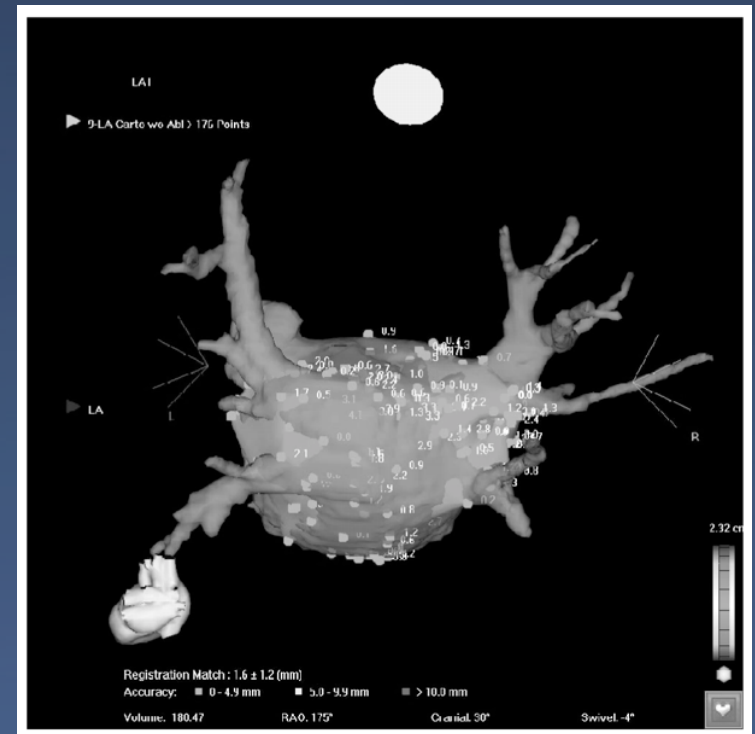


= ?

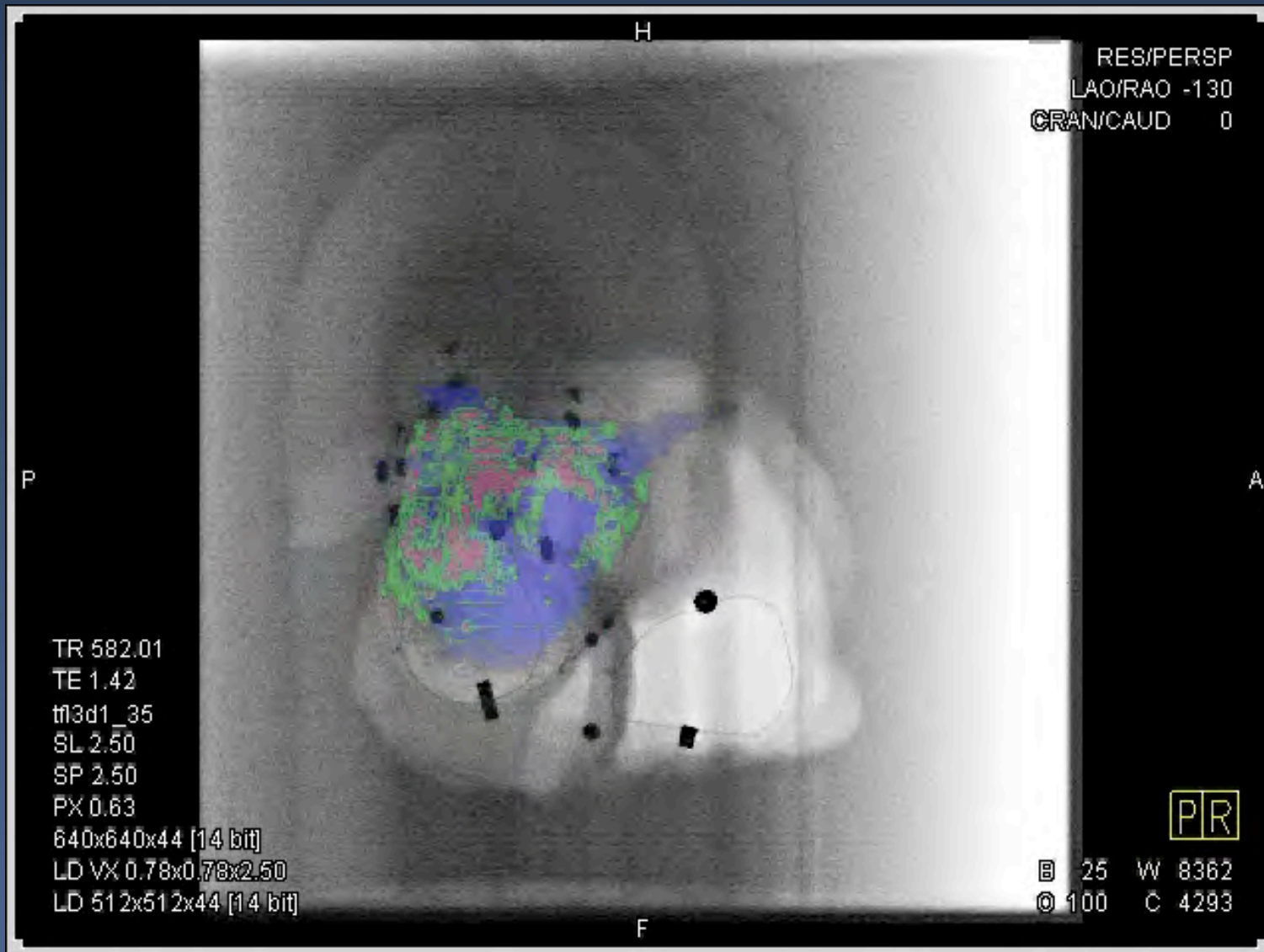


The Link

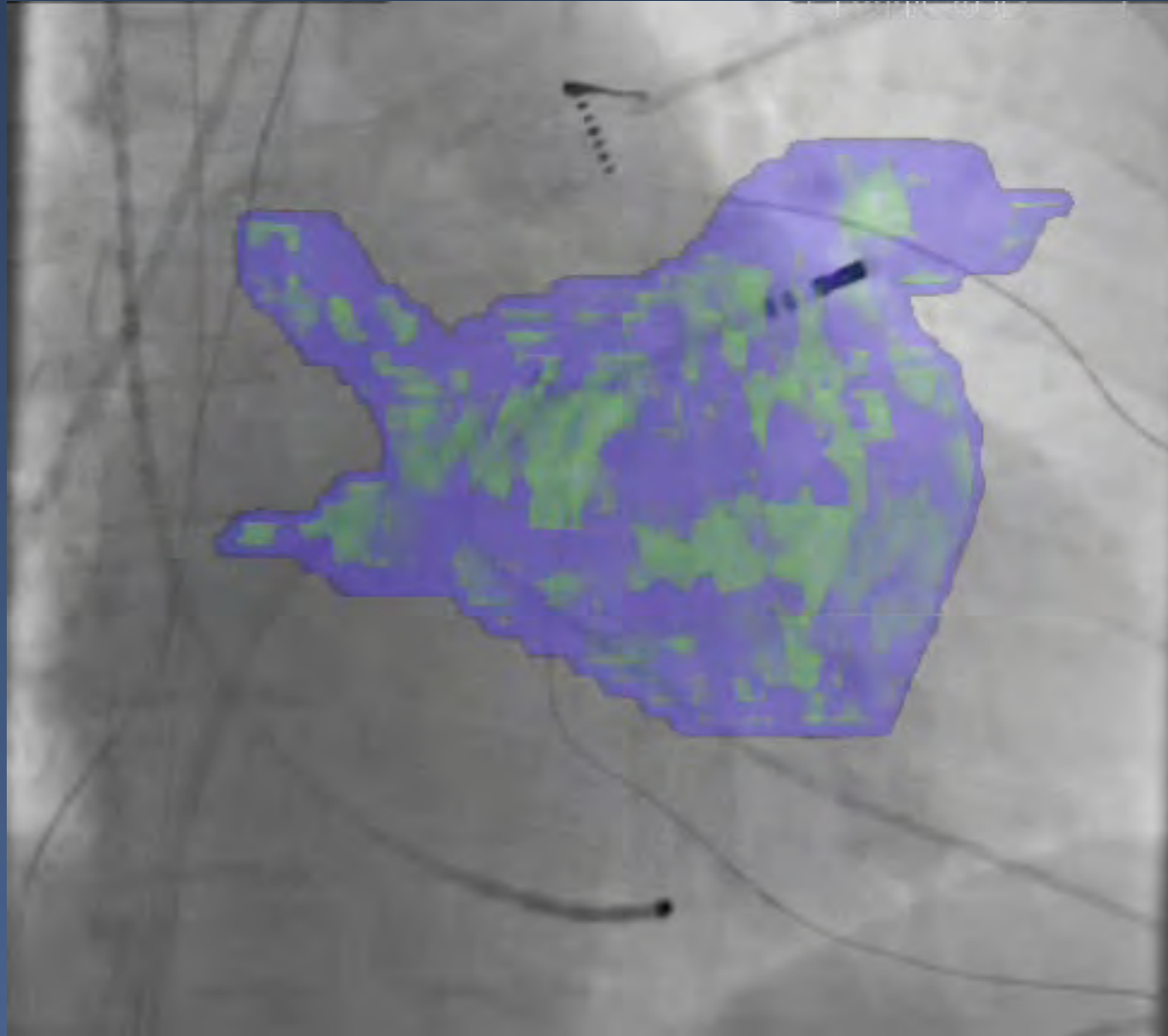
DynaCT



Some Results



Some Results



Some Goals

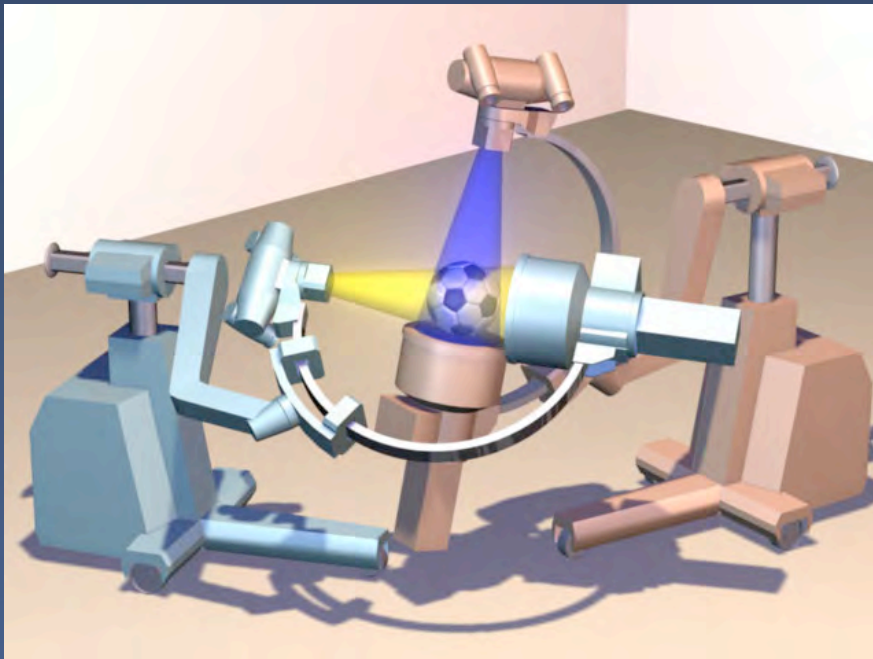


Some Goals



Biplanar

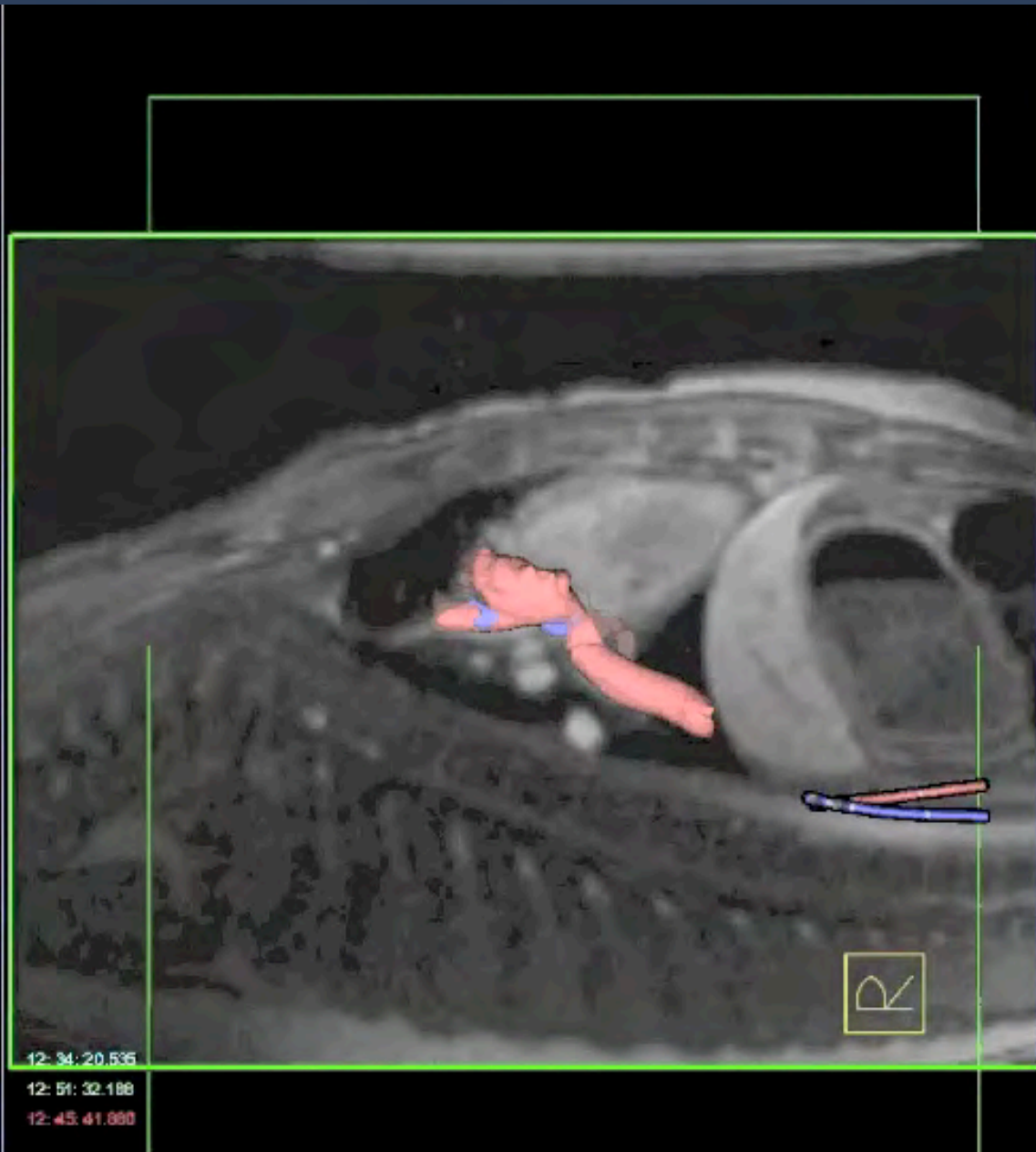
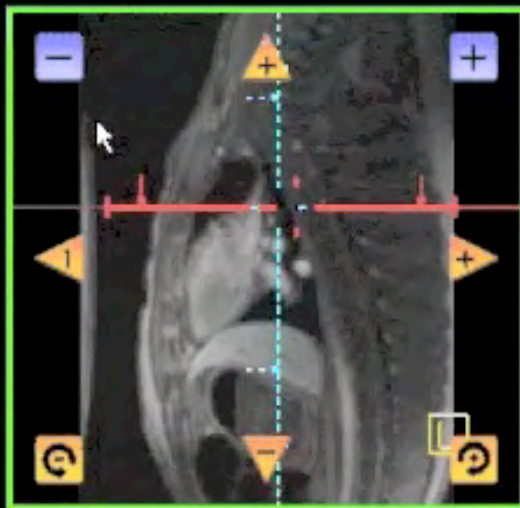
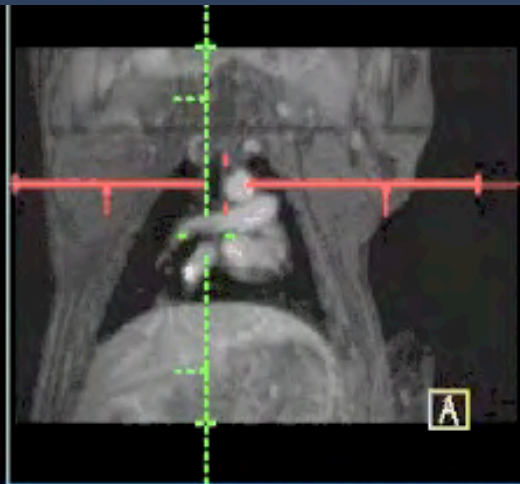
Monoplanar



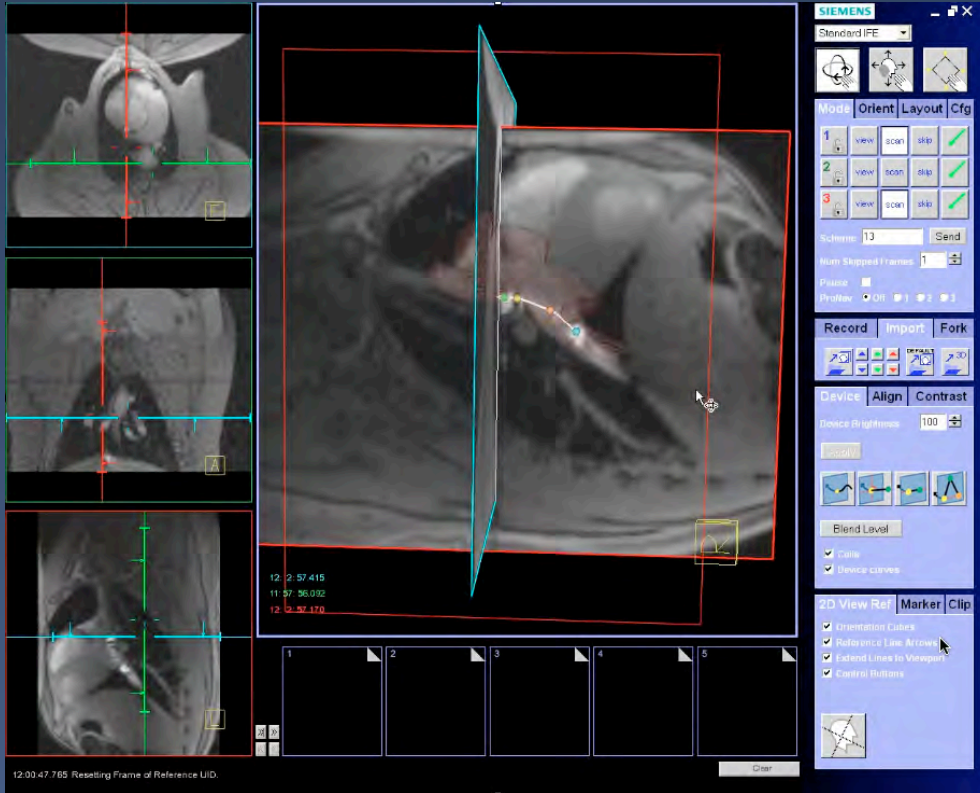
Realtime MRI Guided Ablation



Real Time MRI

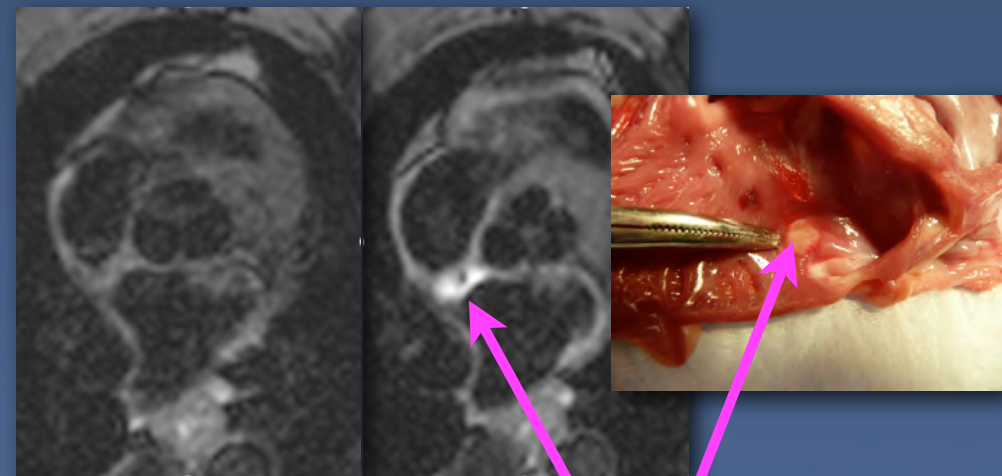


Current Status



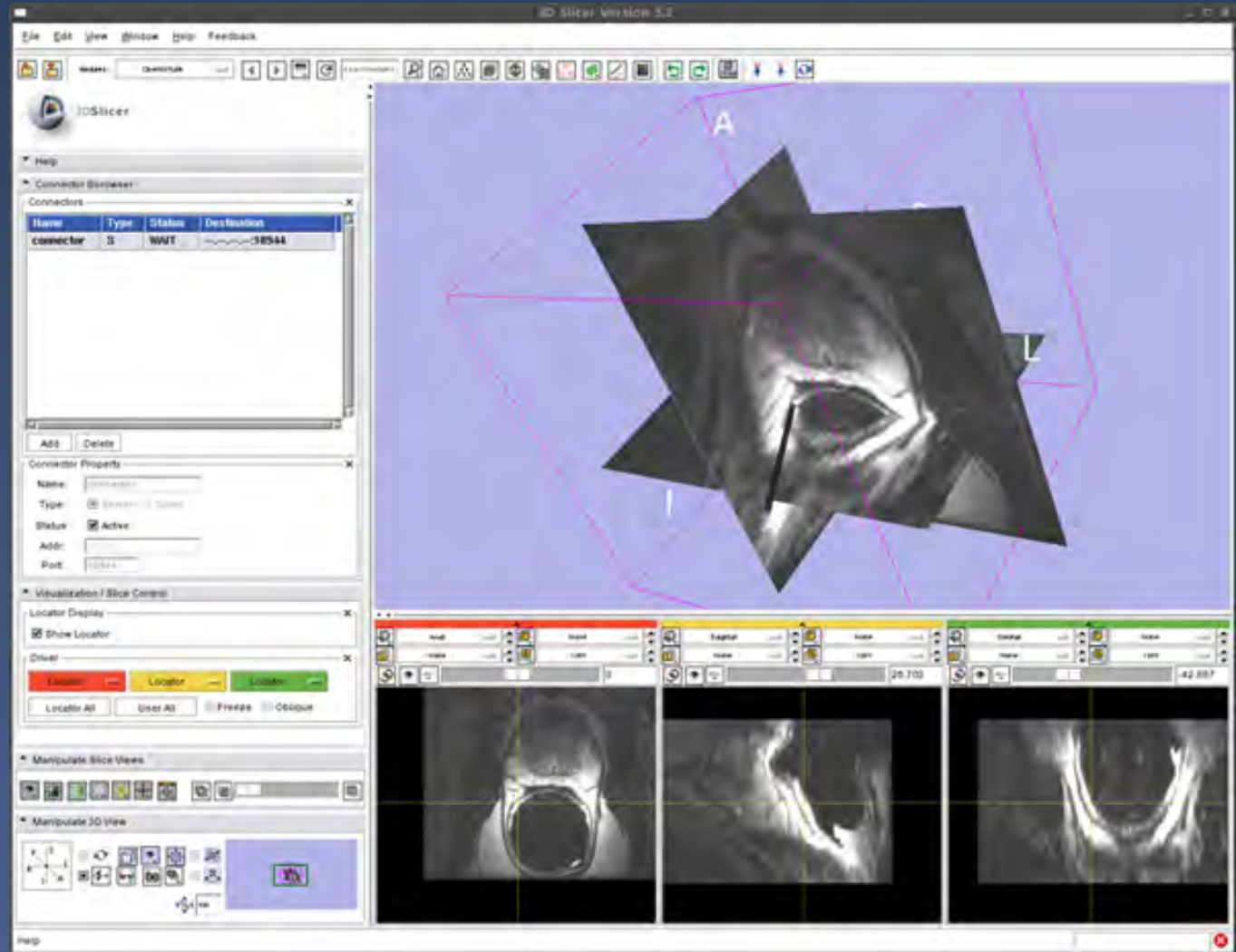
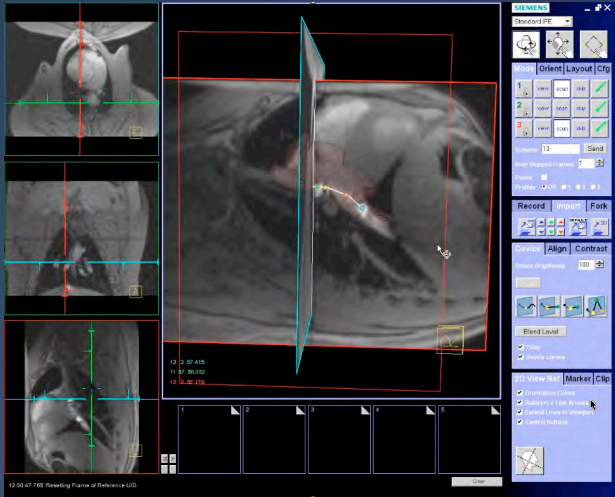
Before

After



Lesion 

Challenges



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