Image Analysis for Atrial Fibrillation

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

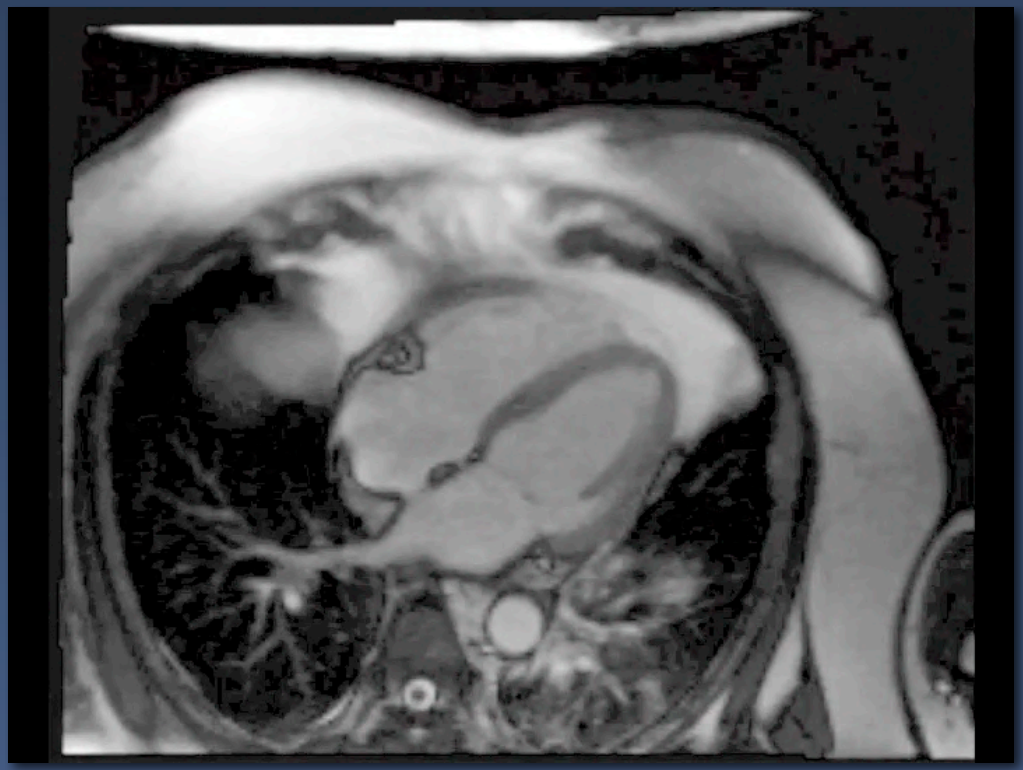
CARMA

CVRTI

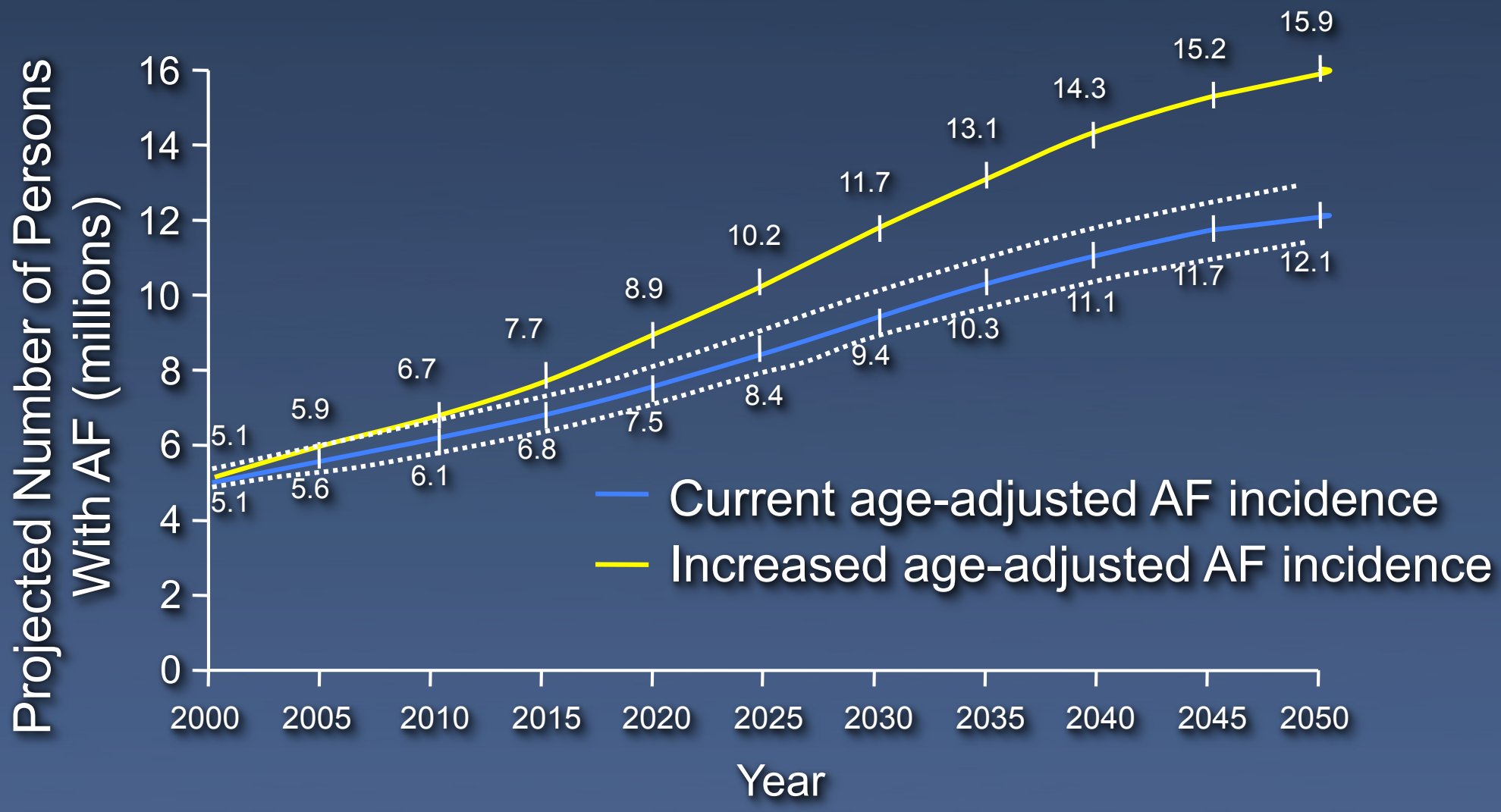
INSTITUTE

Normal Contraction

Atrial Fibrillation

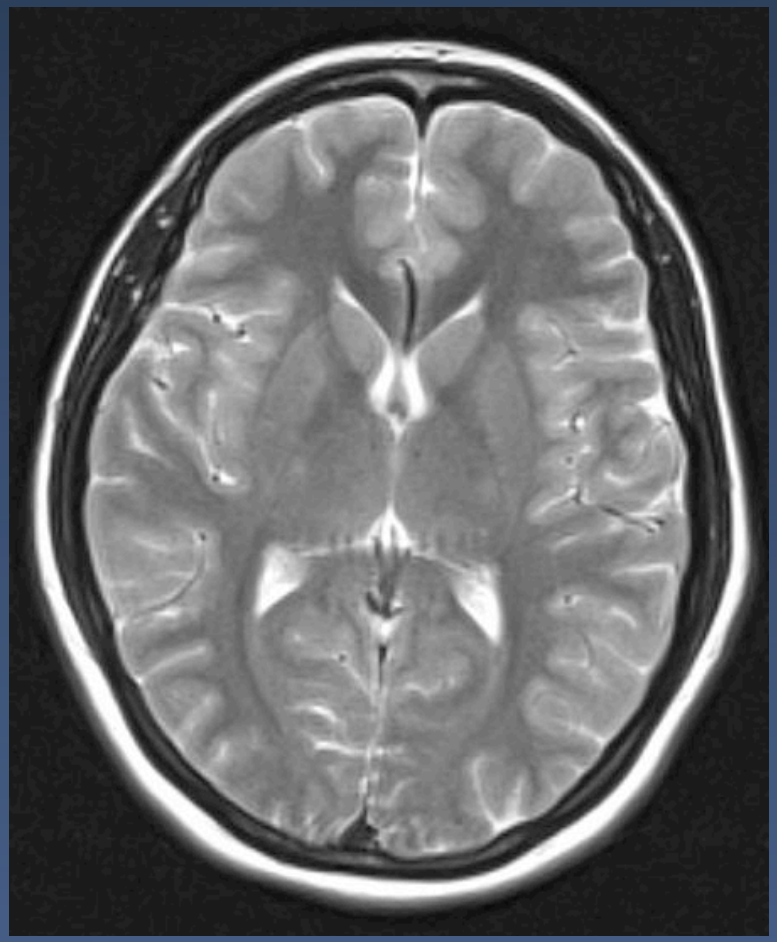


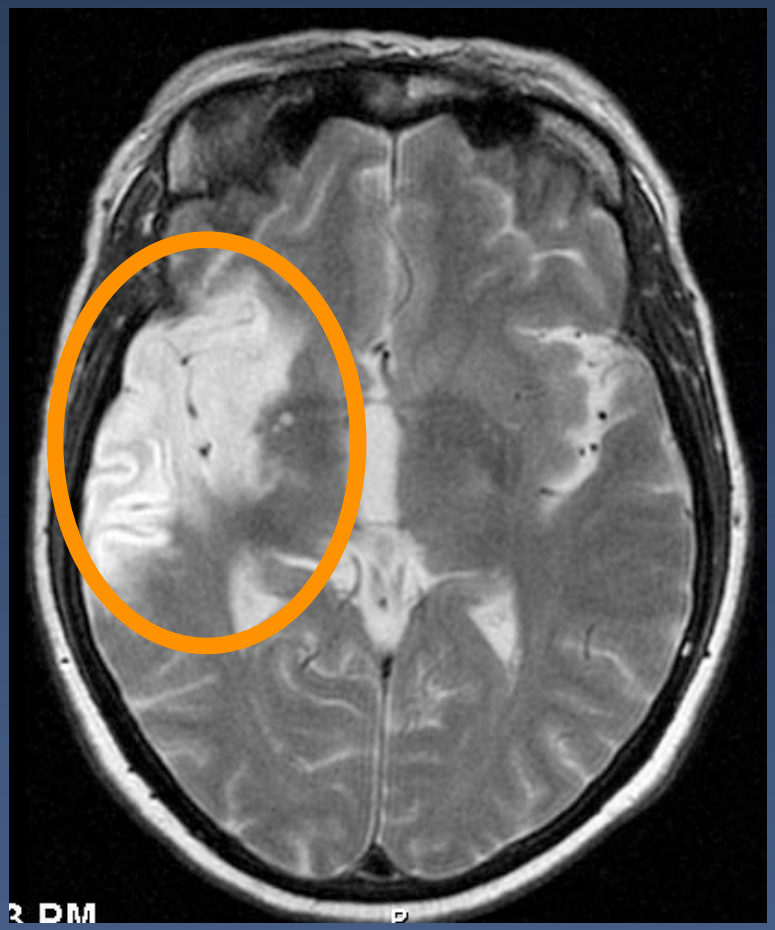
AF Prevalence Is Increasing Rapidly



Miyasaka et al. *Circulation*. 2006;114:119-125.

20% of Strokes



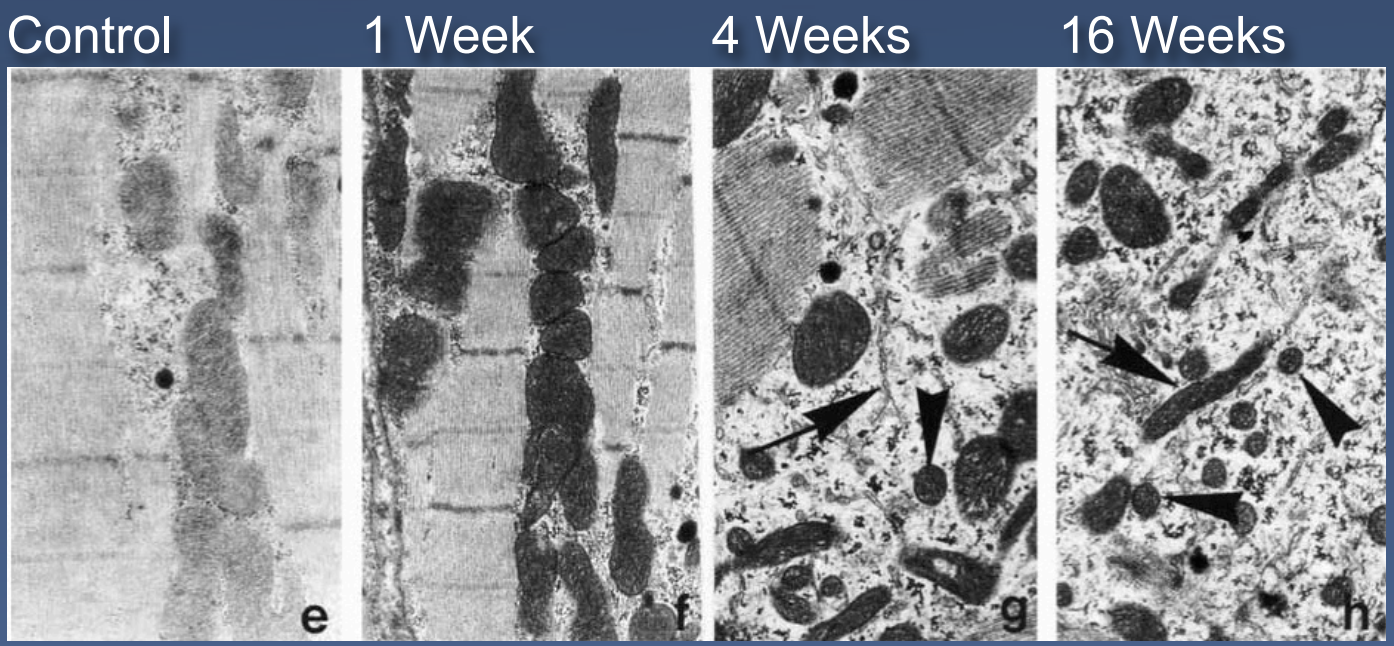


$20 billion/year

Clinical Imaging at CARMA

The CARMA Mantra

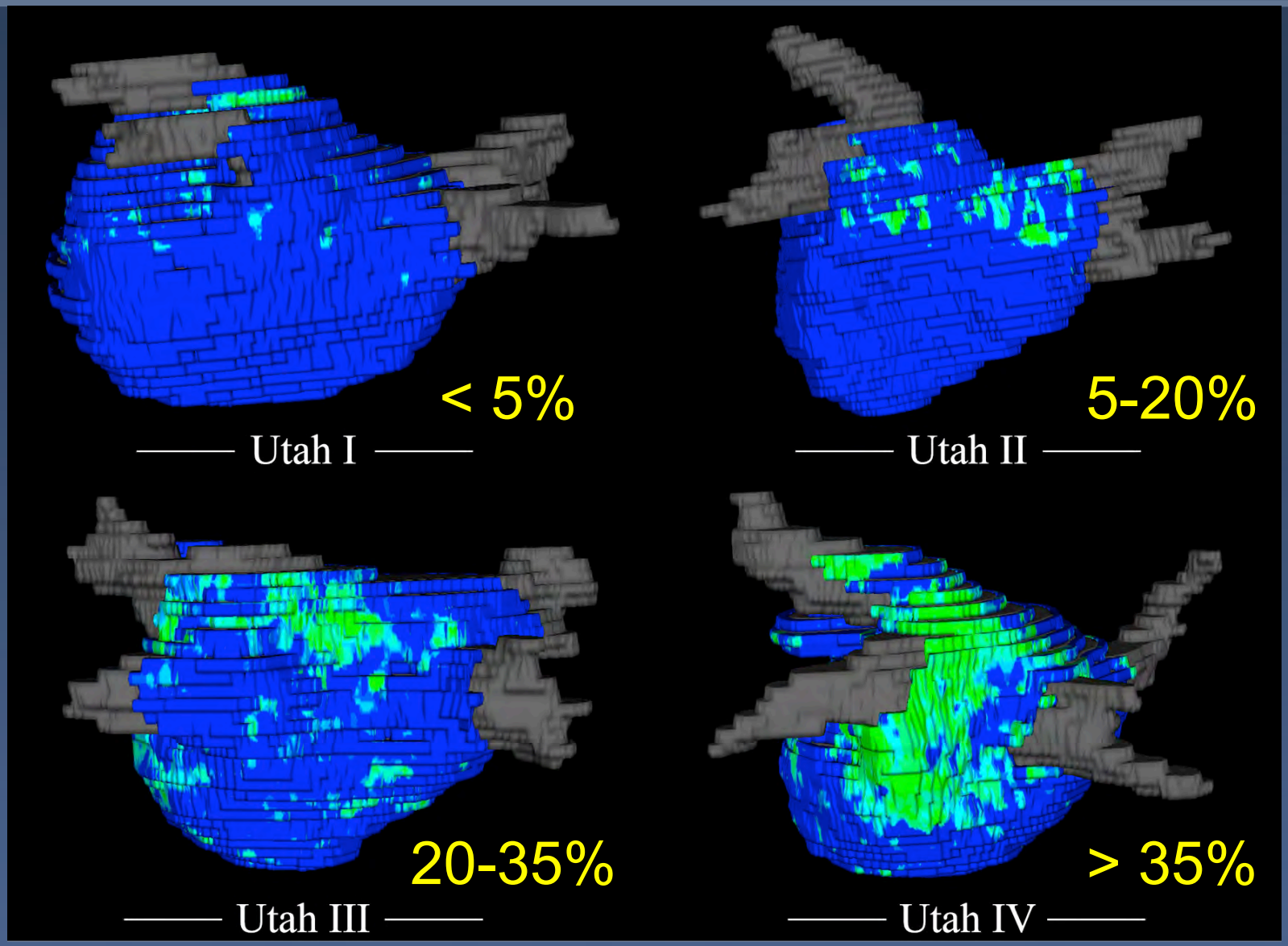
"Cardiac Arrhythmia is a substrate disease"



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

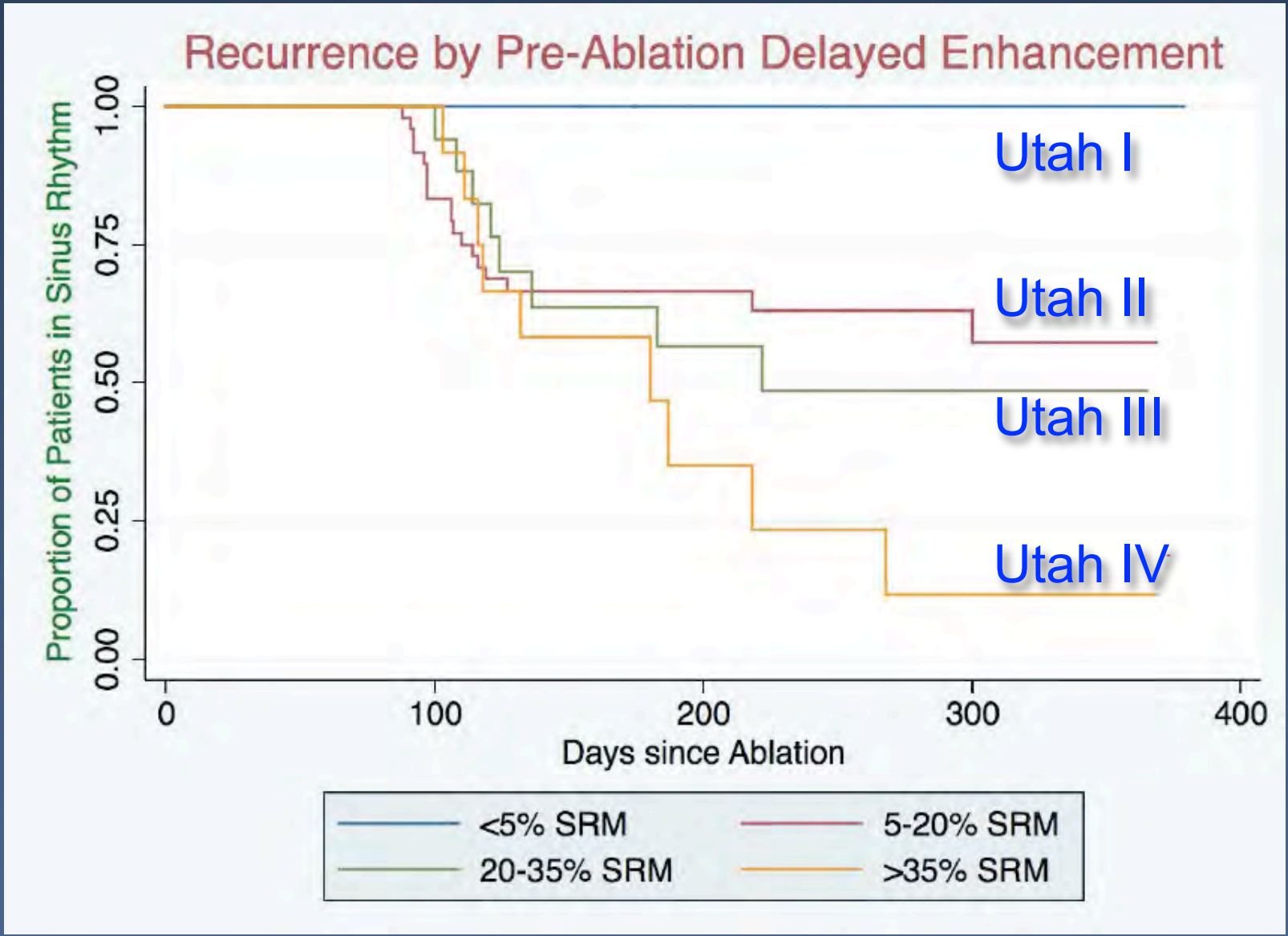
Evaluation
Treatment
Followup

Utah Scoring Scheme

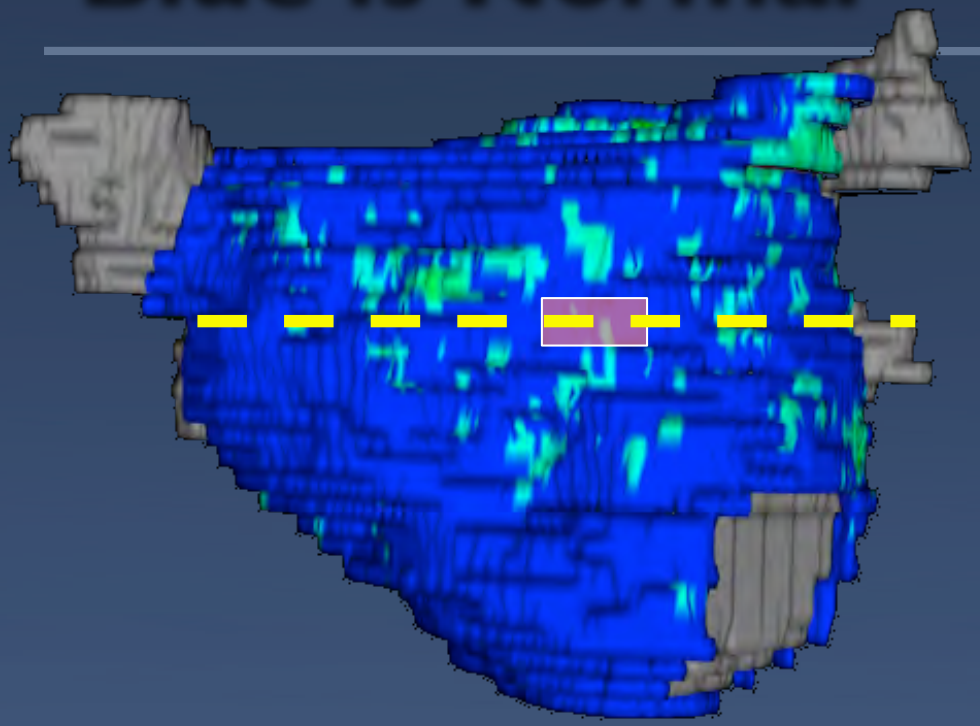


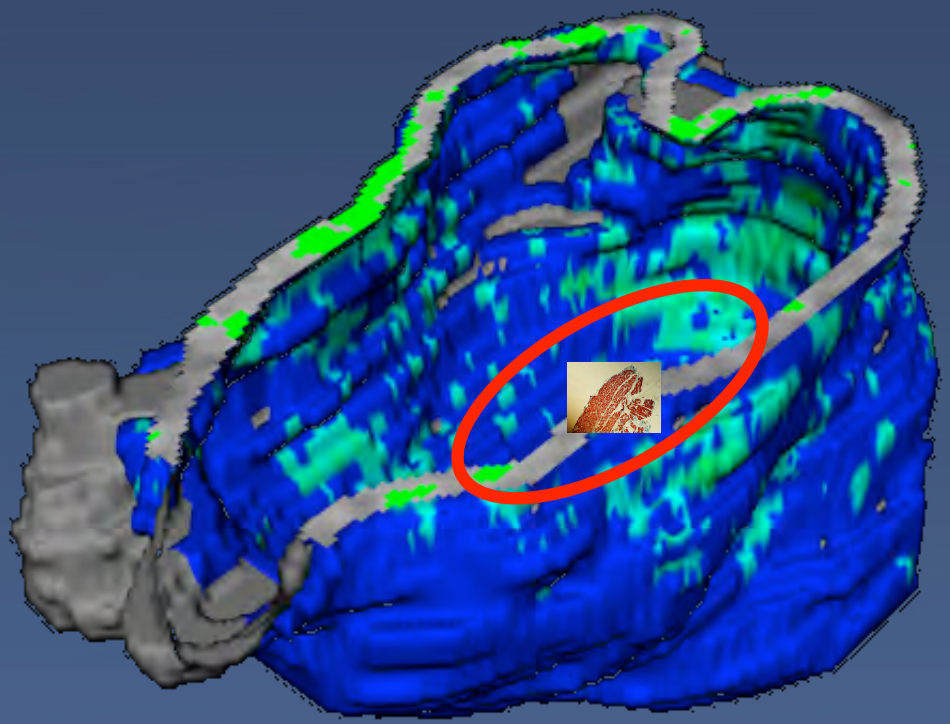
Akoum et al. J Cardiovasc Electrophysiol, 22:16-22, 2011

Fibrosis Predicts Outcome

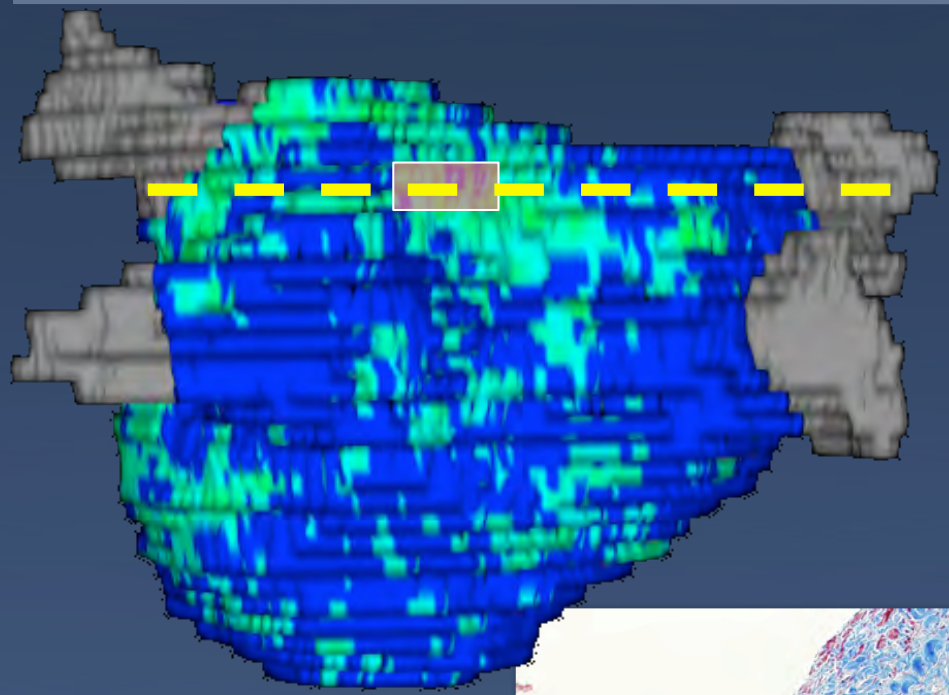


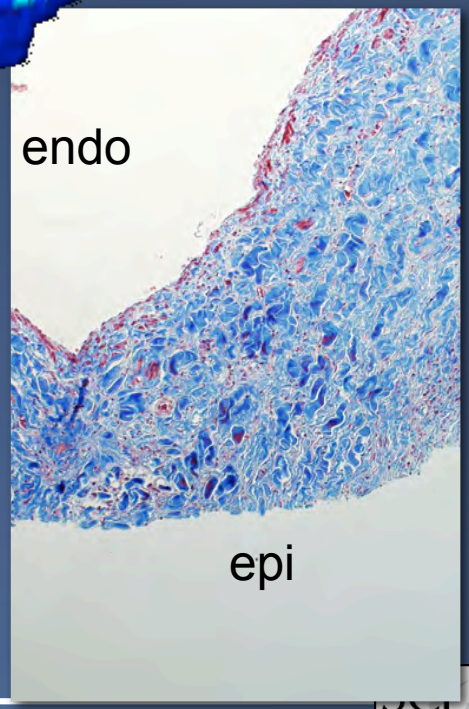
Blue is Normal

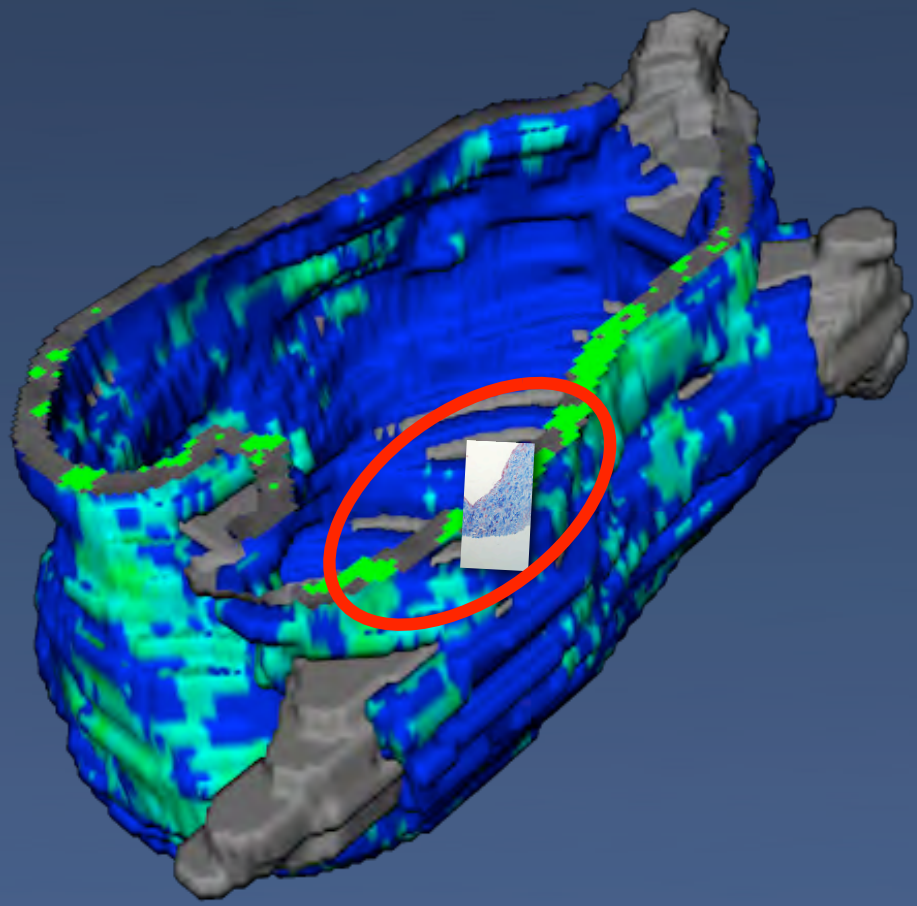




Green is Fibrosis

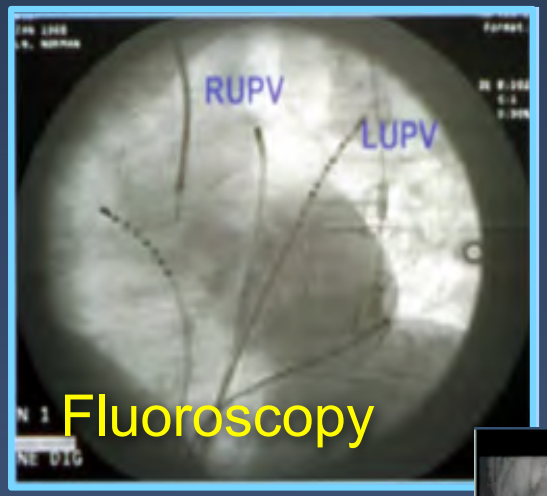




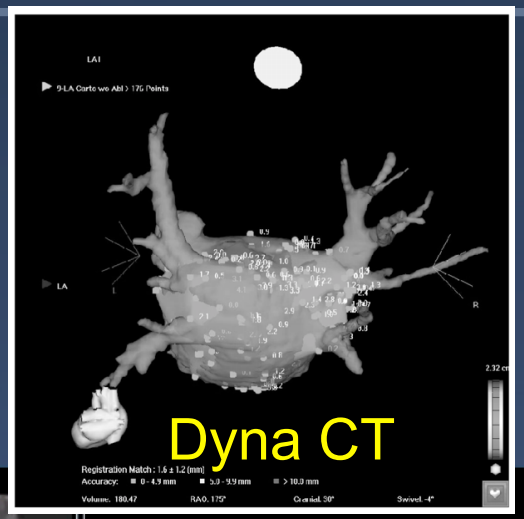


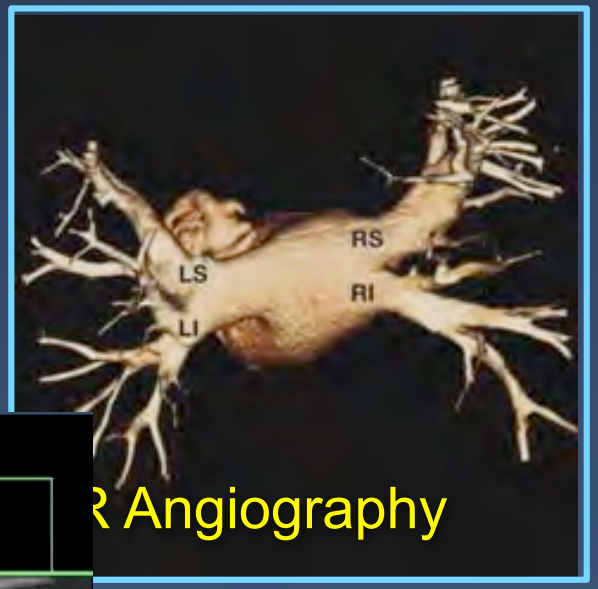
Evaluation
Treatment
Followup

Imaging Modalities in AF Management

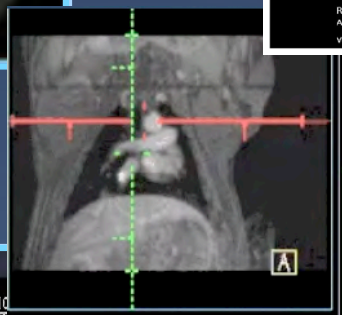


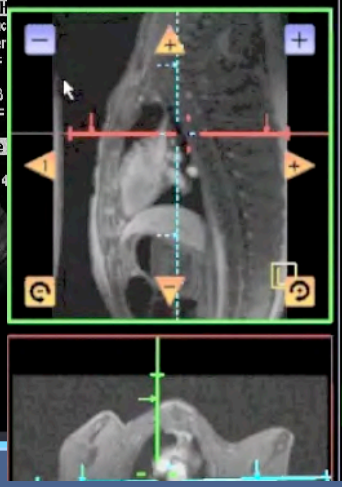
Fluoroscopy

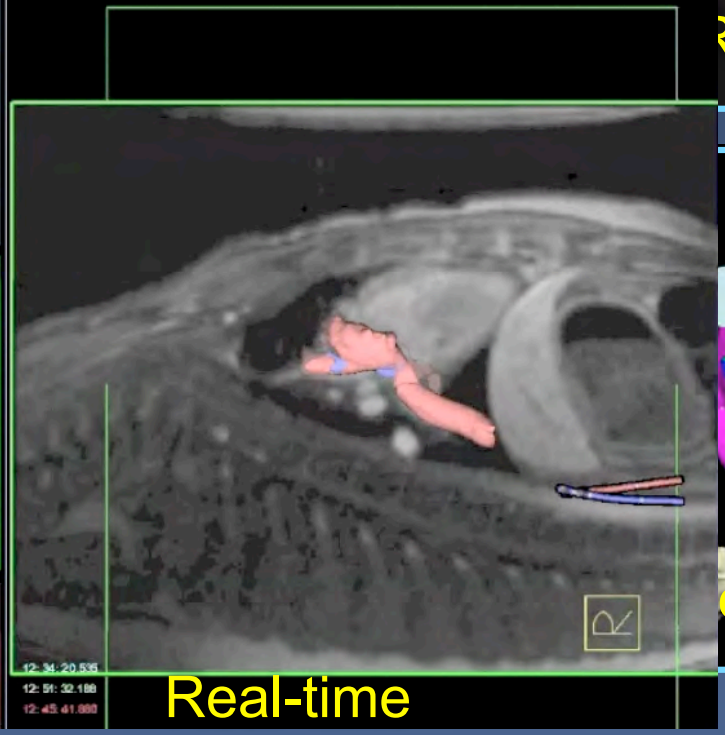

Dyna CT

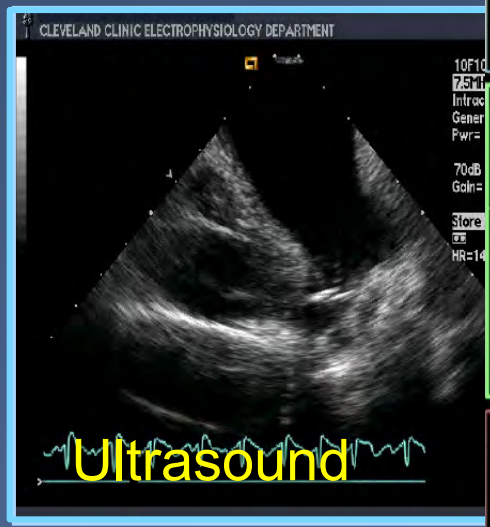


R Angiography

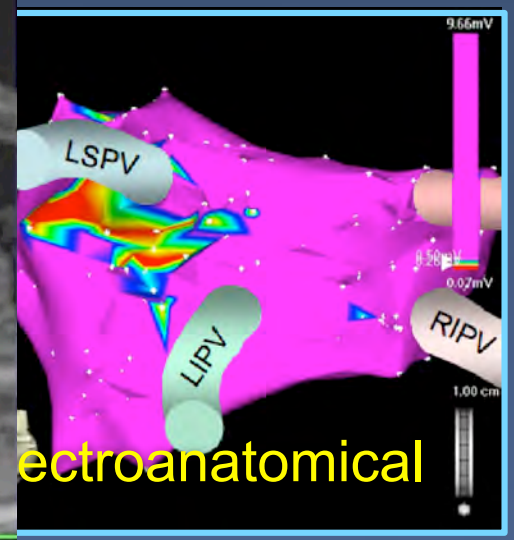





Real-time



Ultrasound



ectroanatomical

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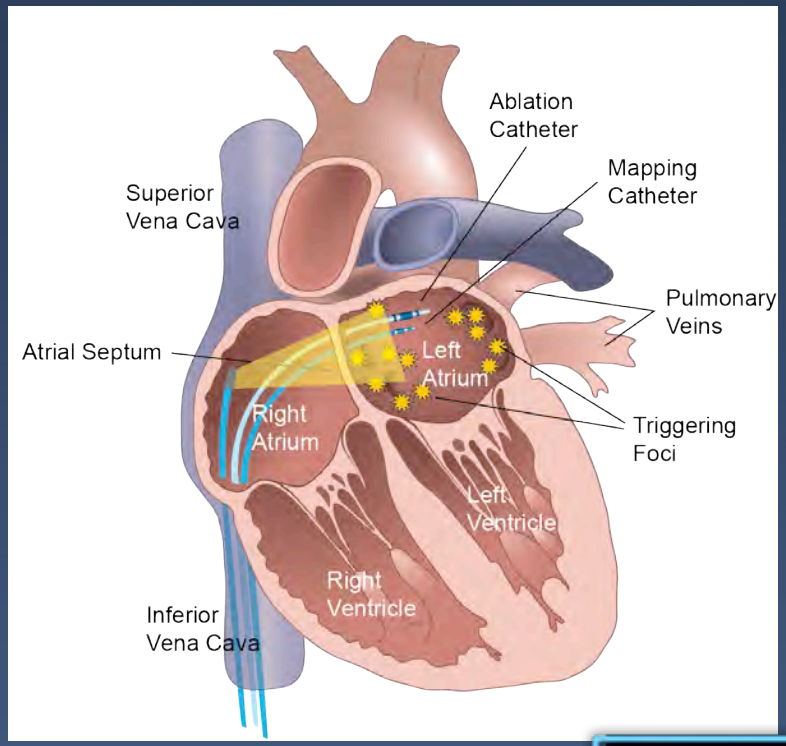
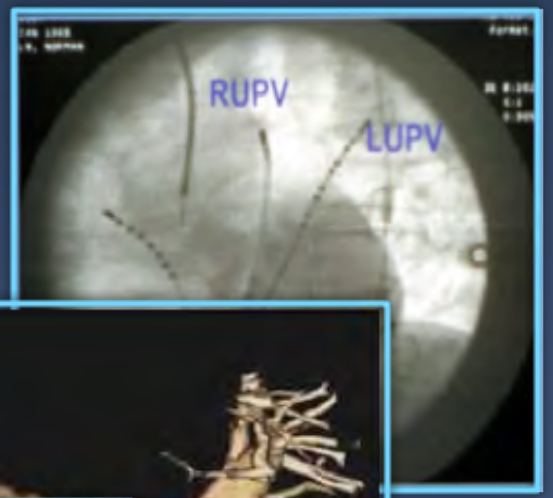
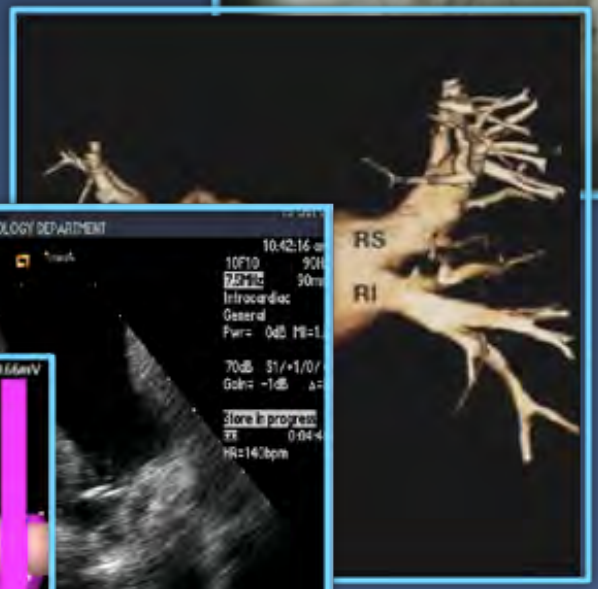
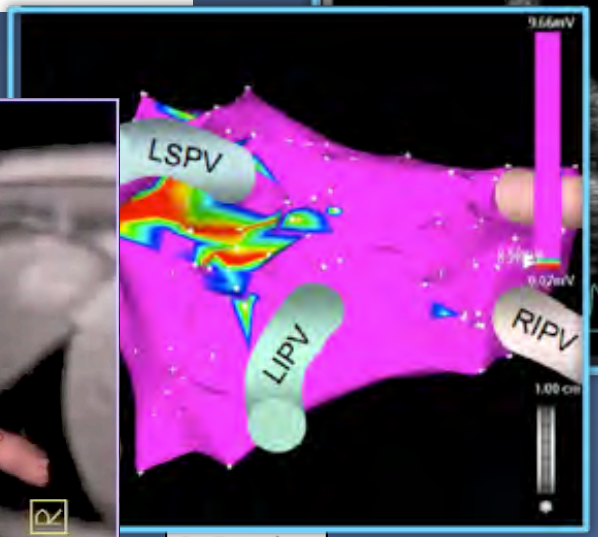
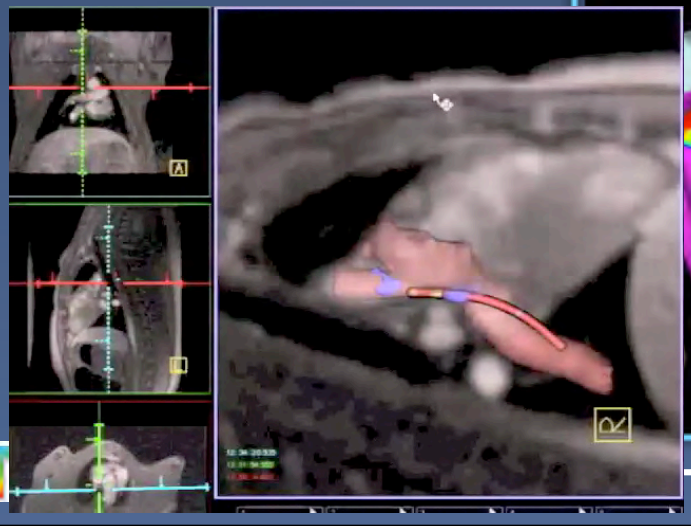
Ablation Guidance











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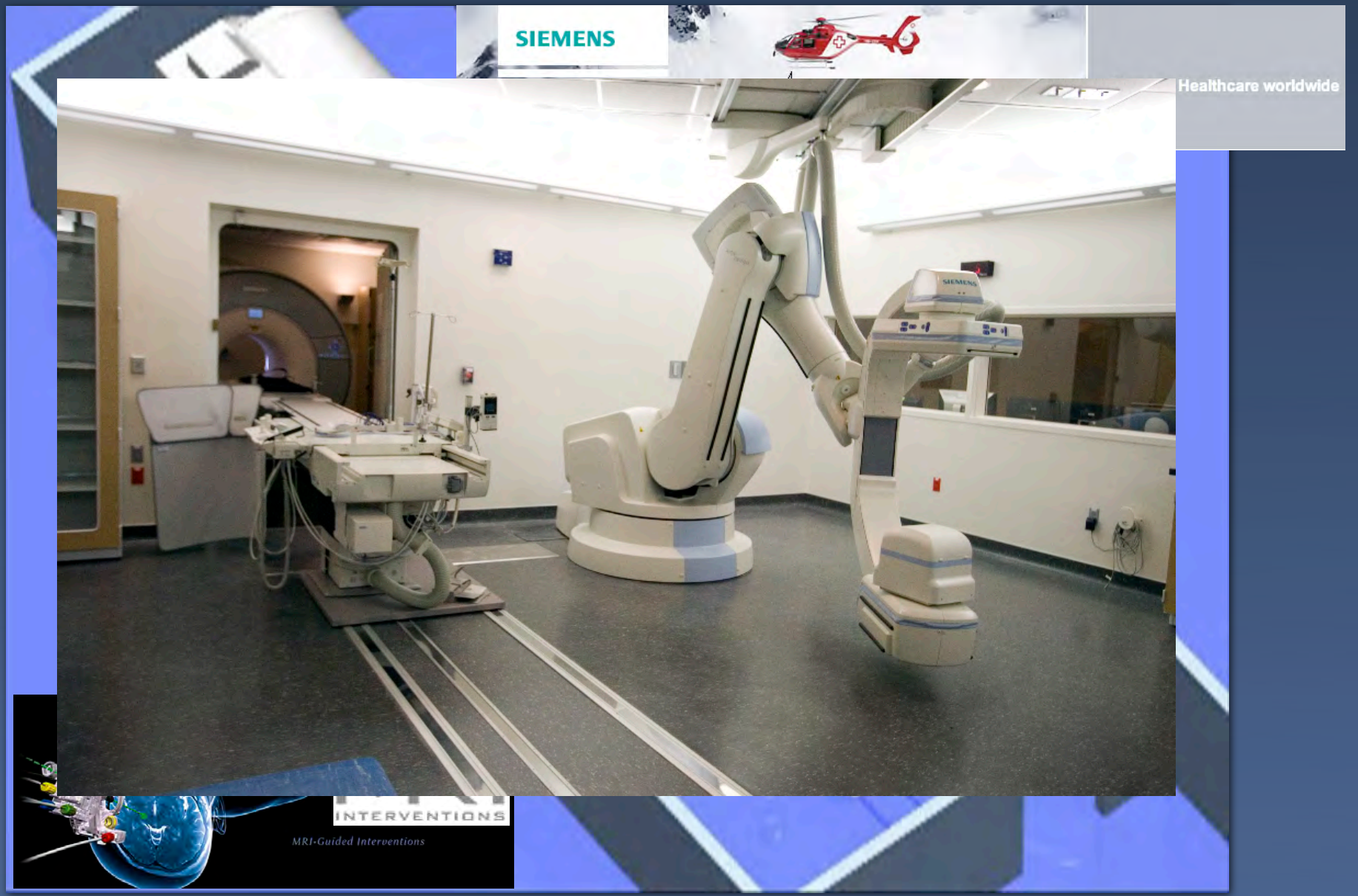
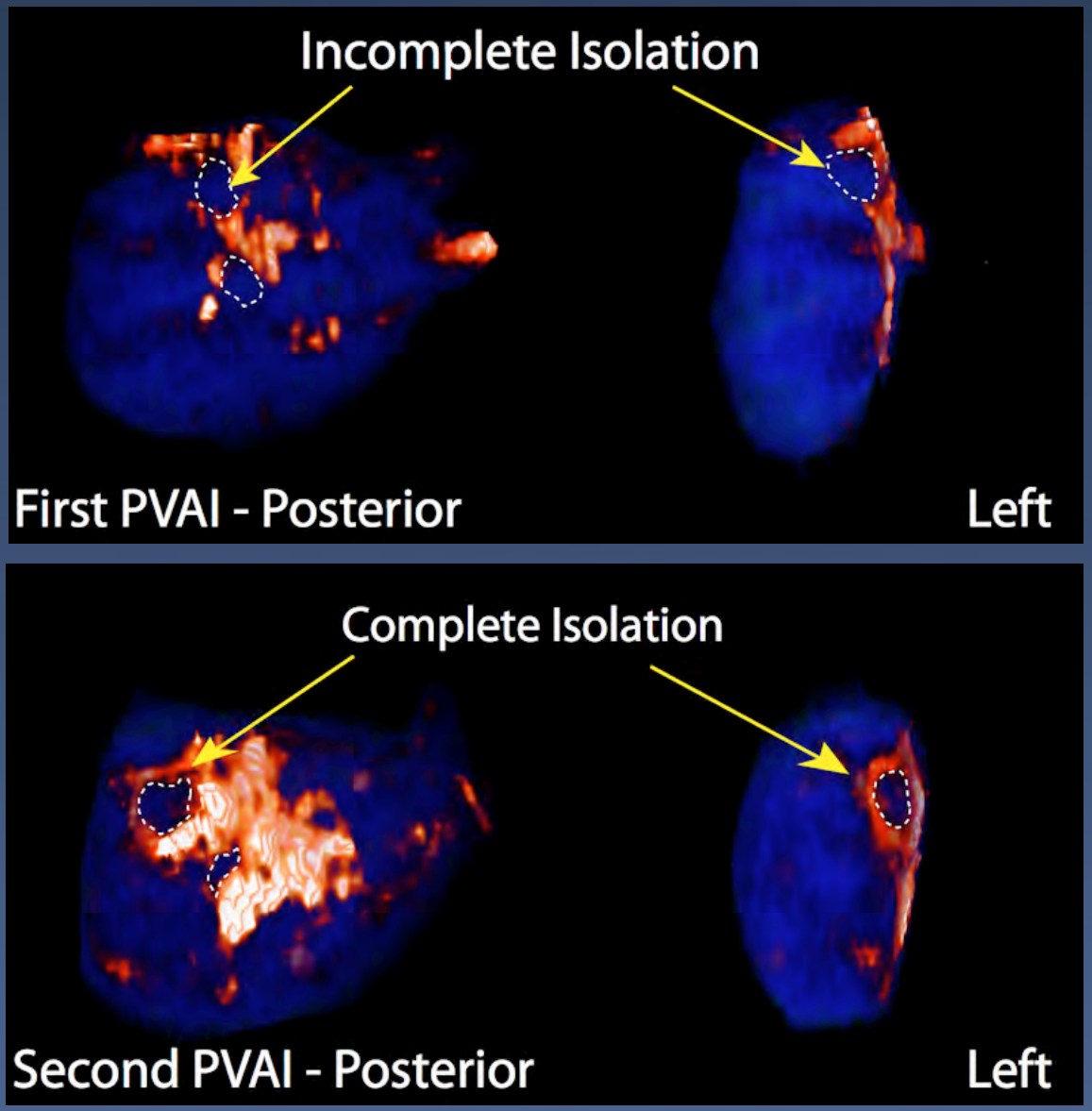
Real Time MRI



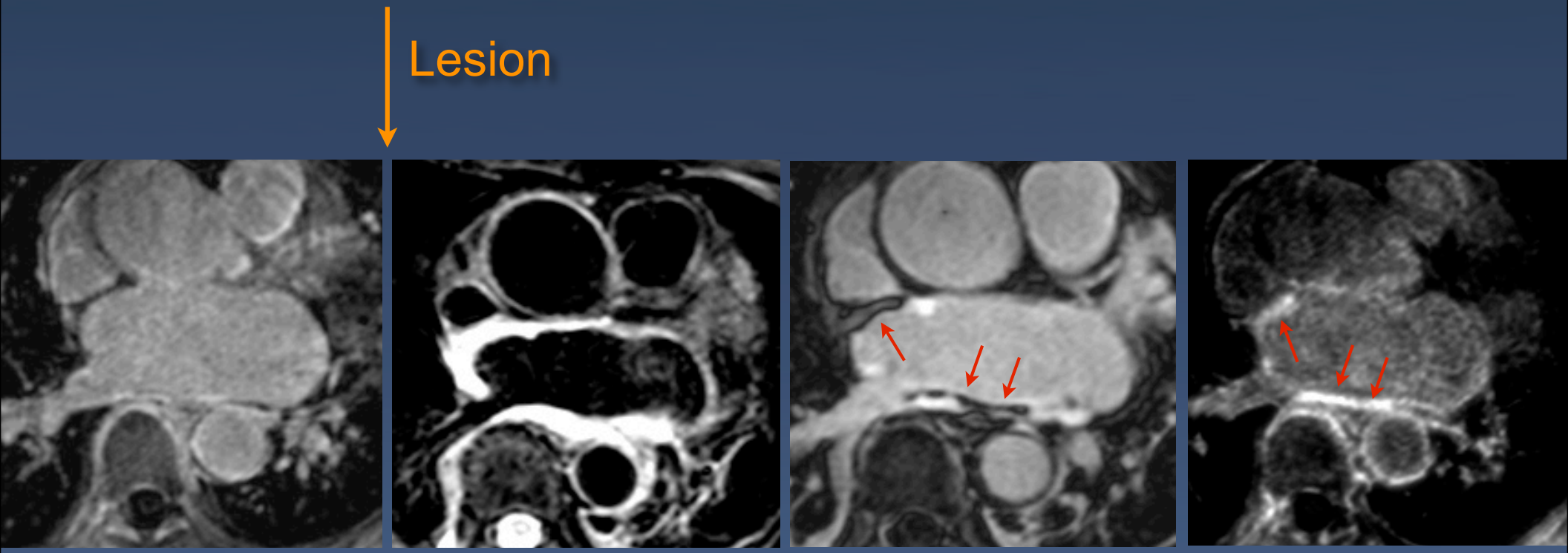
Evaluation
Treatment
Followup

Post Ablation Scar Mapping



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

Predicting Success



The CARMA Questions

"Cardiac Arrhythmia is a substrate disease"

"How can we evaluate substrate?"

"How can we track substrate progression?"

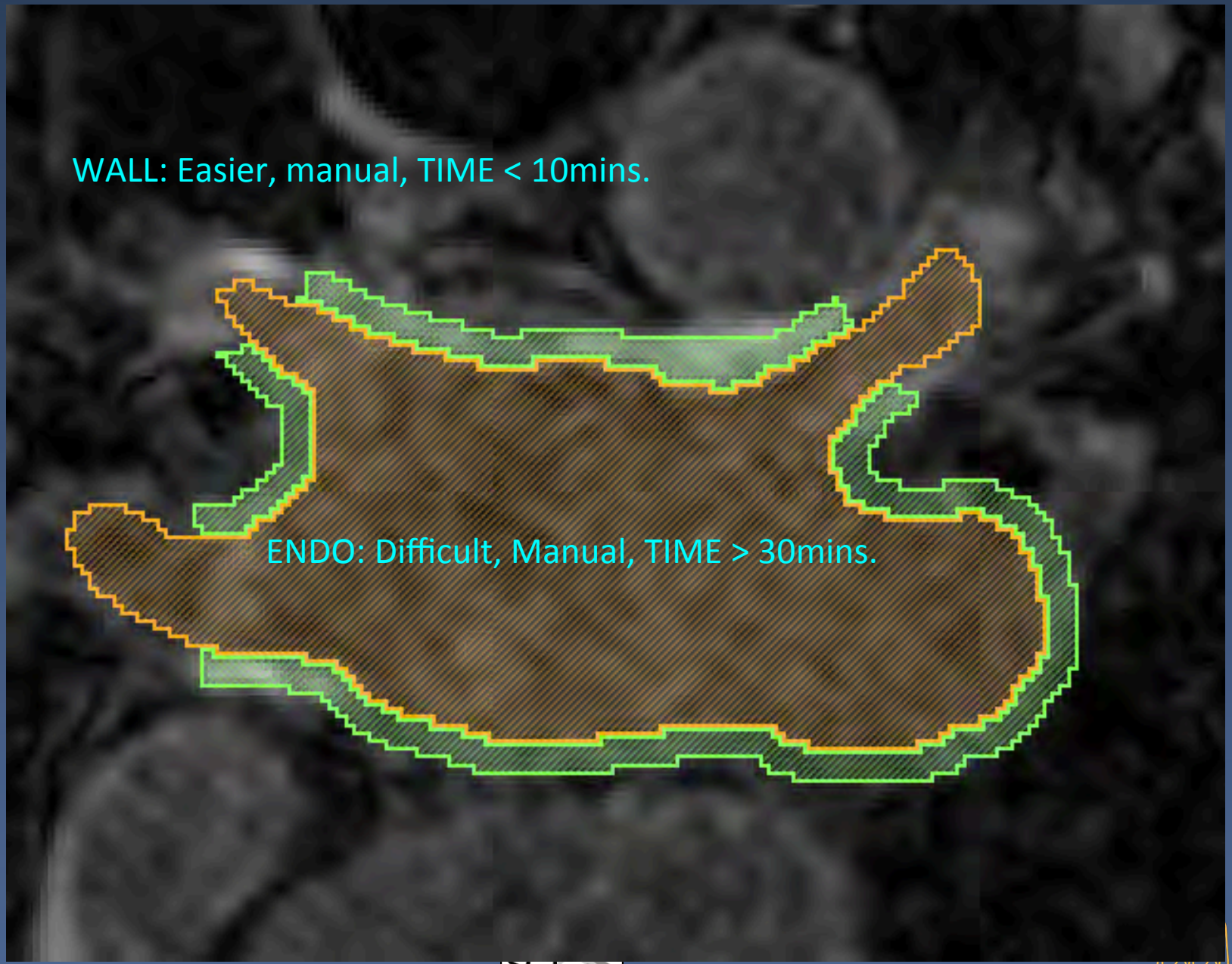
"How can we ablate less?"

Image Analysis

The Engineering

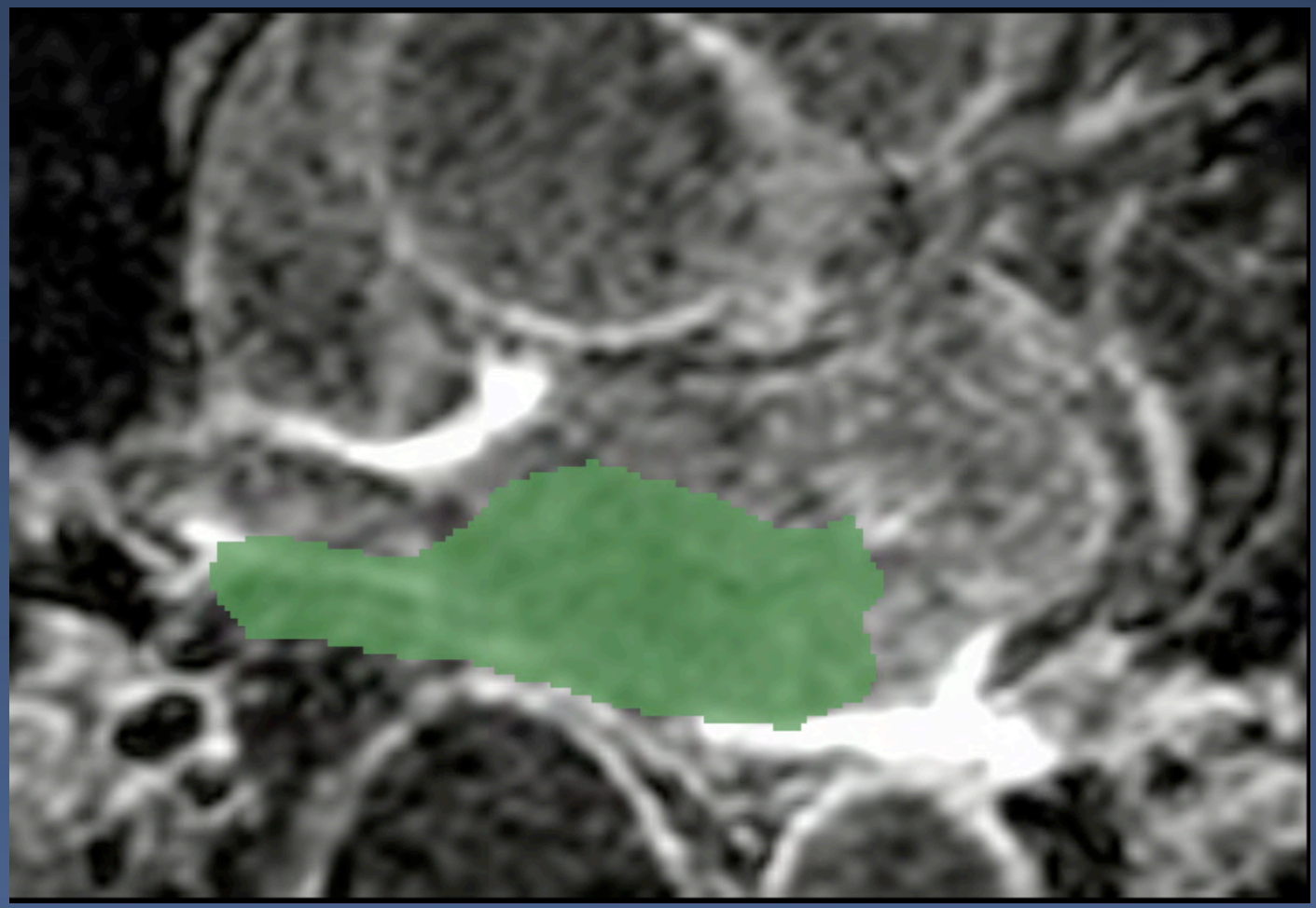
Segmentation Goals

Segmentation Status

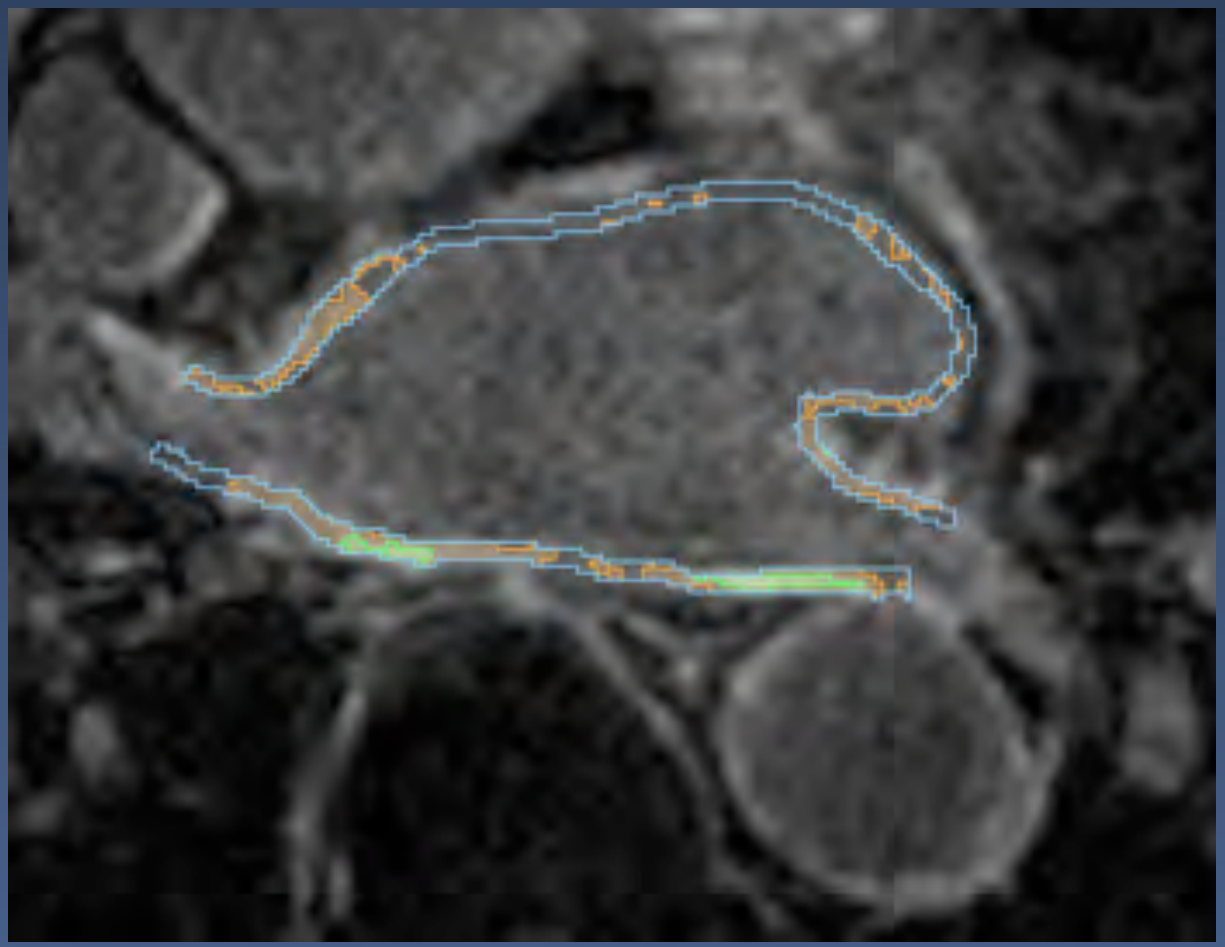


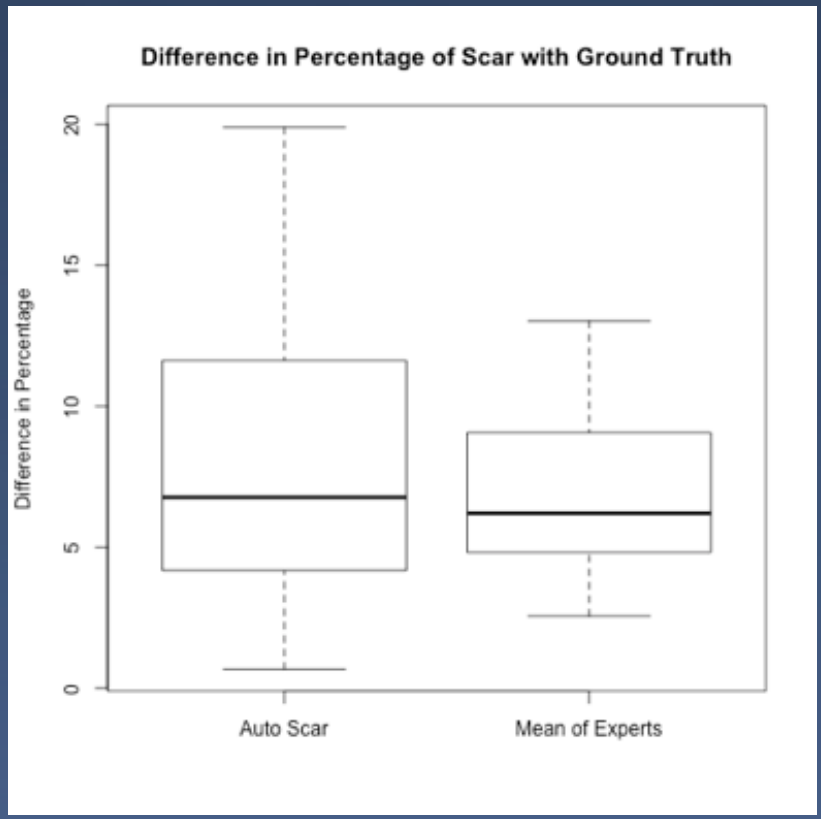
Multi-Atlas Method (Yi Gao)

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



Automated Scar Segmentation





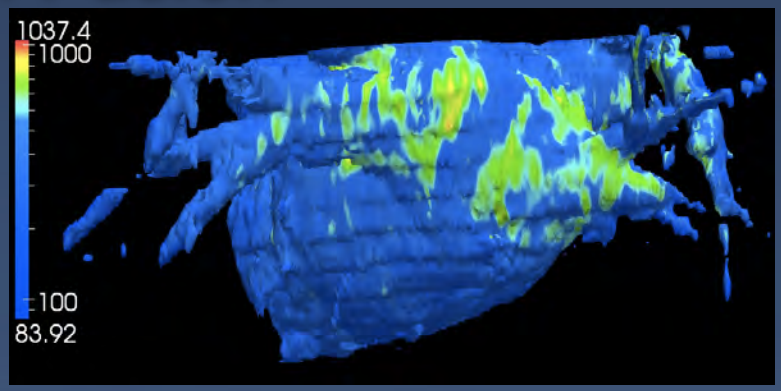
SPIE 2012

CVRTI SCI INSTITUTE CARMA

New Approaches

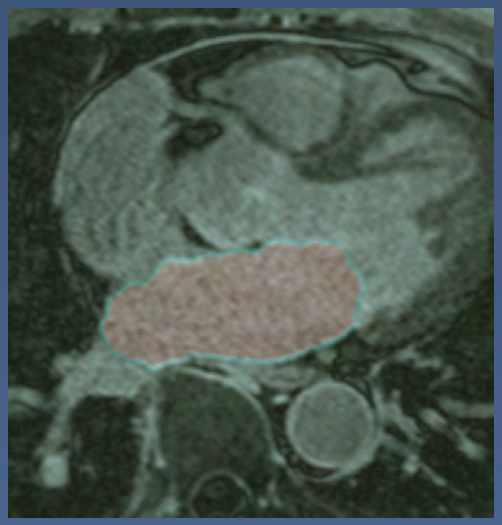
From this Meeting!

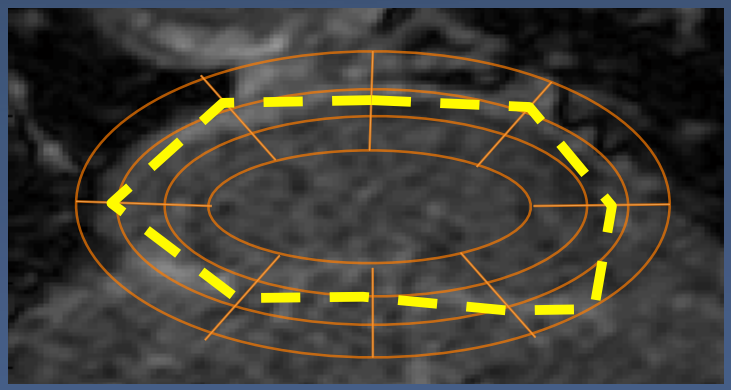
Nonparametric Approaches, Label Fusion (Golland)



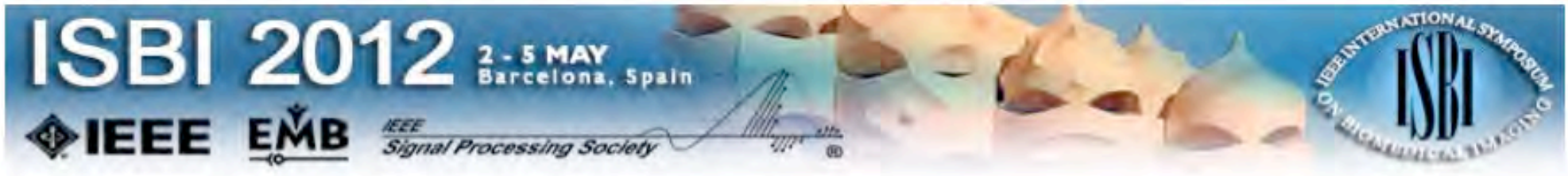
Graph based segmentation (Whitaker)

Interactive segmentation (Tannenbaum)





ISBI Challenge



CALL FOR PARTICIPATION

ISBI 2012 Challenge Workshop

Cardiac Delayed Enhancement Magnetic Resonance Image Segmentation
cDEMRIS

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ISBI Challenge

ISBI 2012 2 - 5 MAY Barcelona, Spain

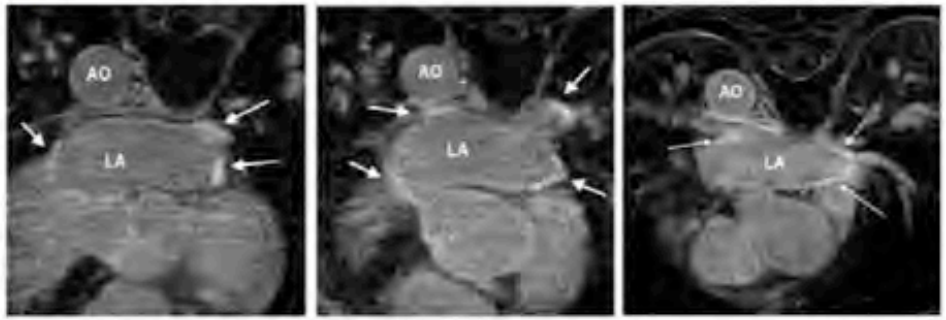
IEEE EMB IEEE Signal Processing Society

CALL FOR PARTICIPATION

ISBI 2012 Challenge Workshop

Cardiac Delayed Enhancement Magnetic Resonance Image Segmentation
cDEMRIS

cDEMRIS 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 **cDEMRIS** 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 CDEMRIS'12 workshop summarizing the method used and results of the test dataset.

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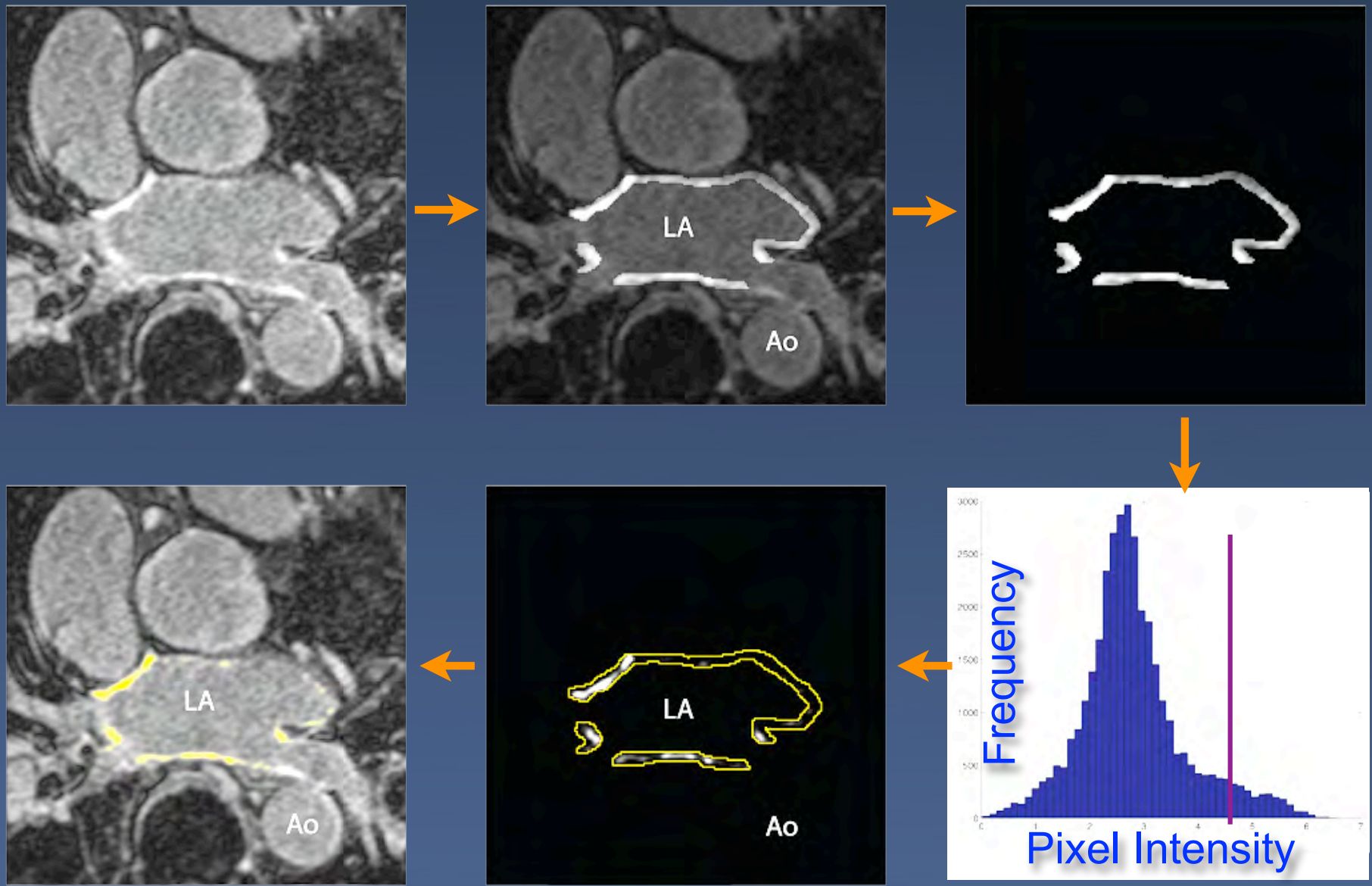
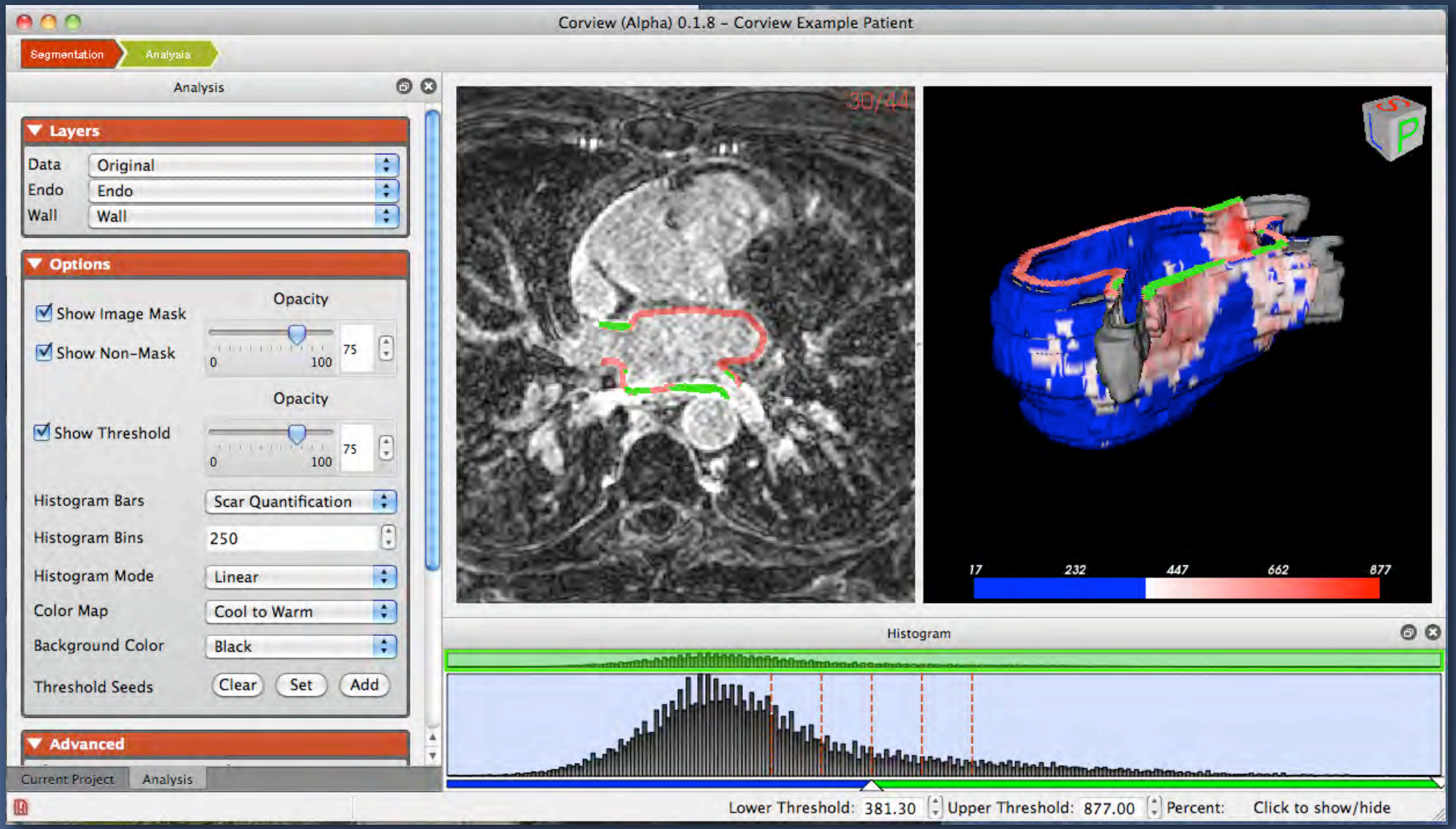
MICCAI Challenge

Quantification



CARMA Workflow



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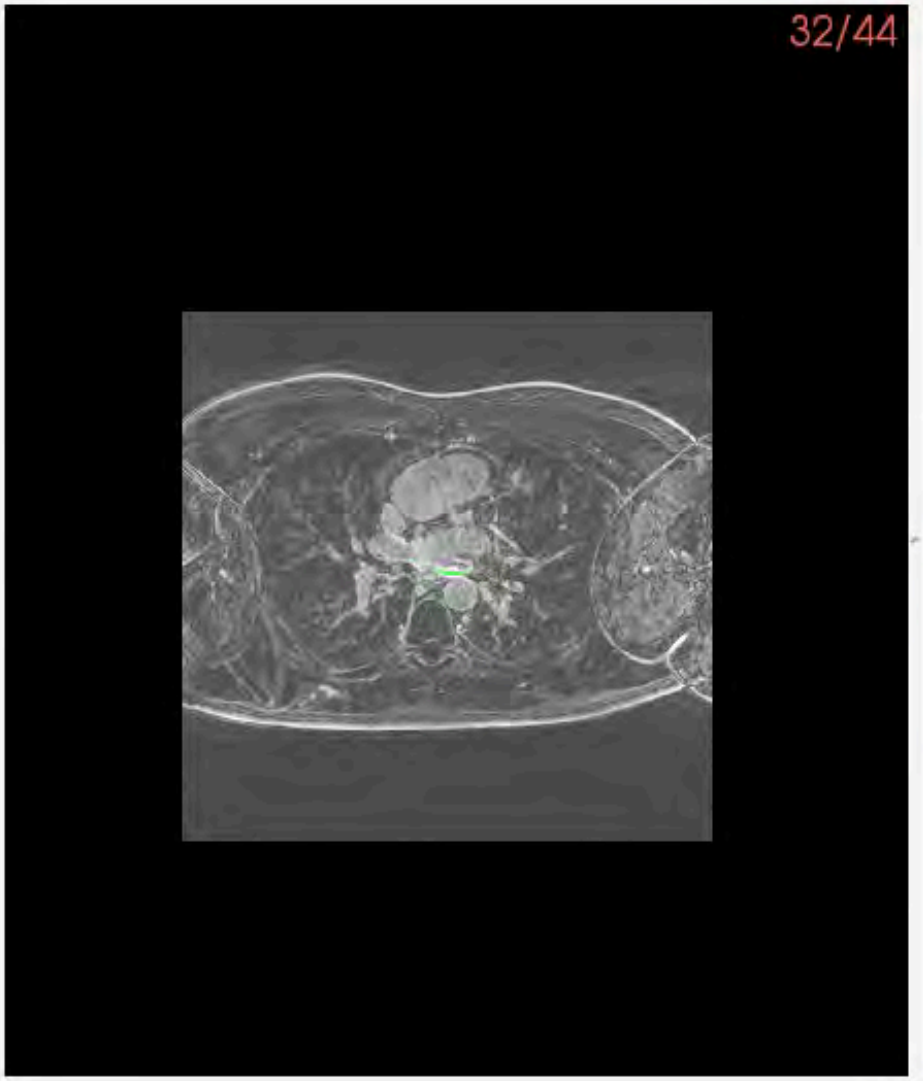
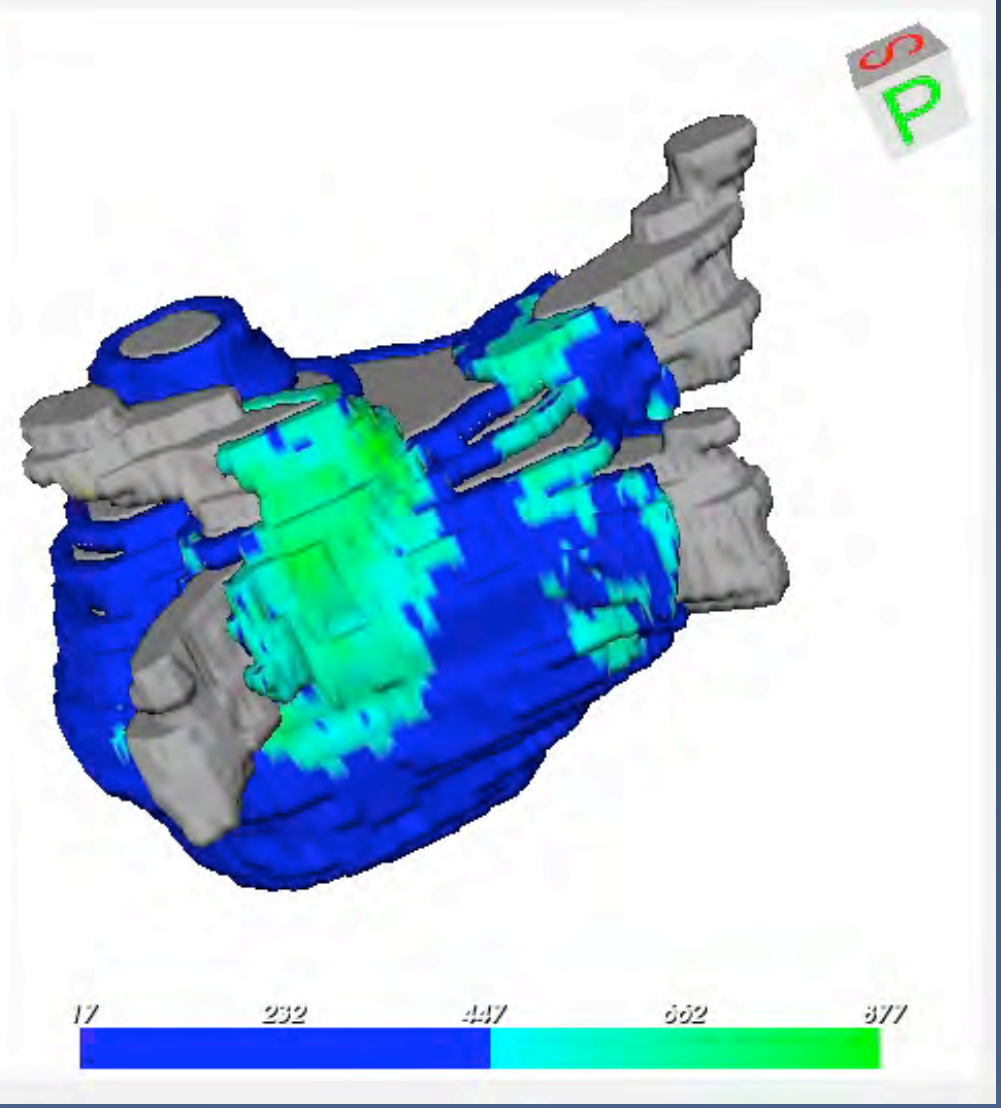
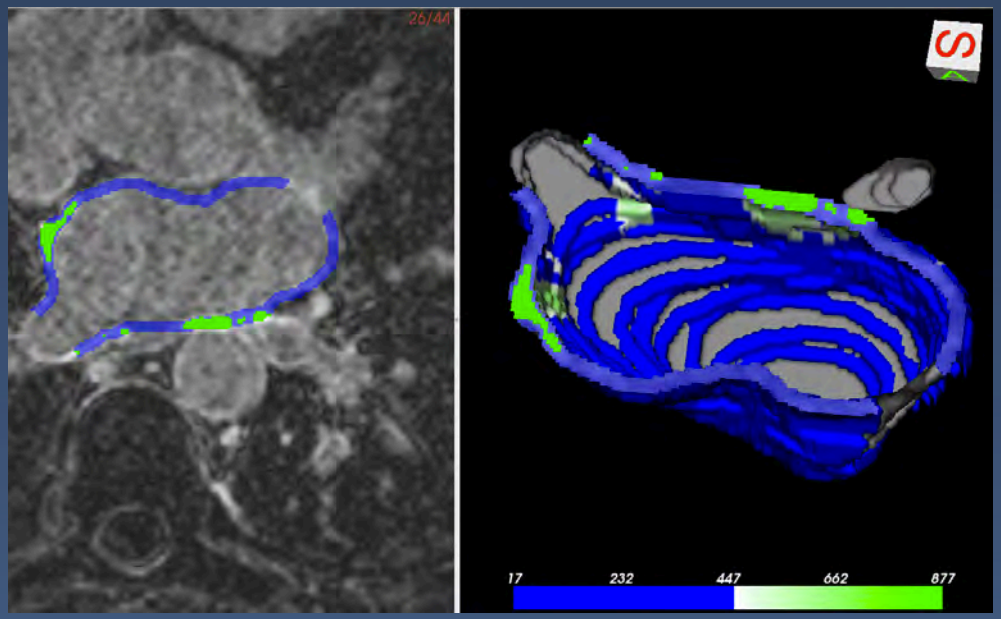
CARMA Workflow

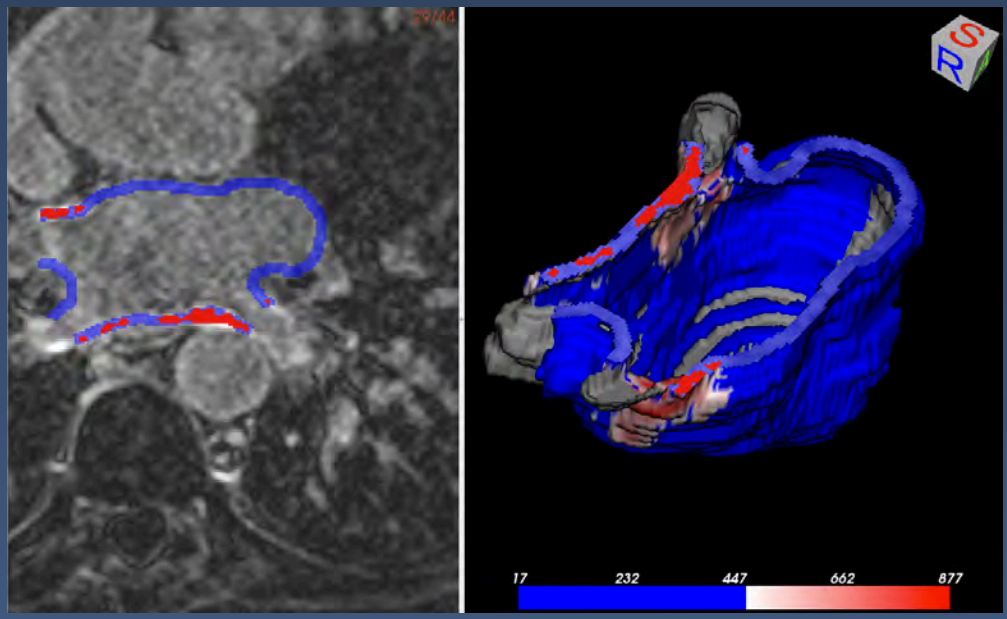




Registration



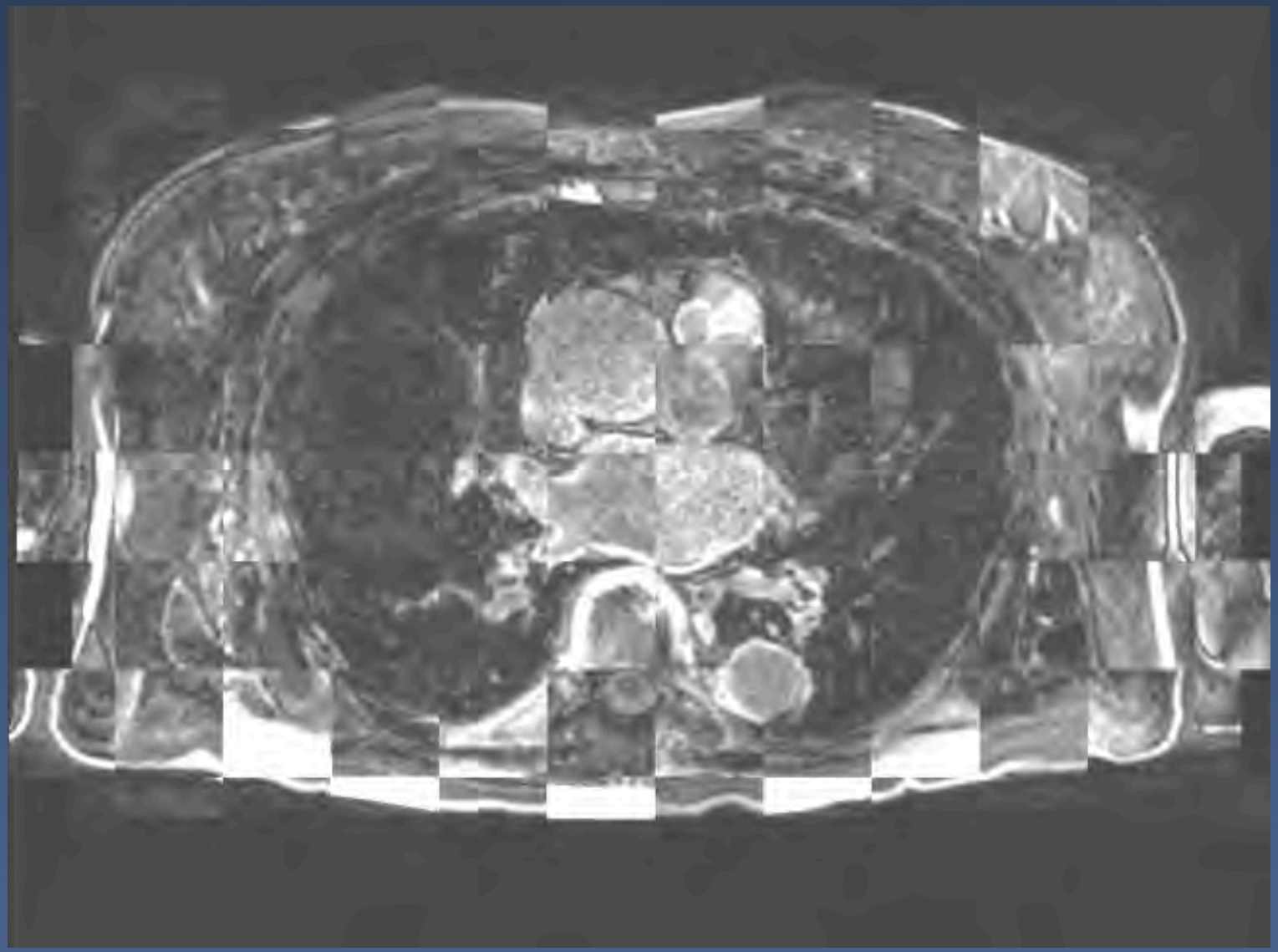
Pre-Ablation (FIBROSIS)



Post-Ablation (SCAR)

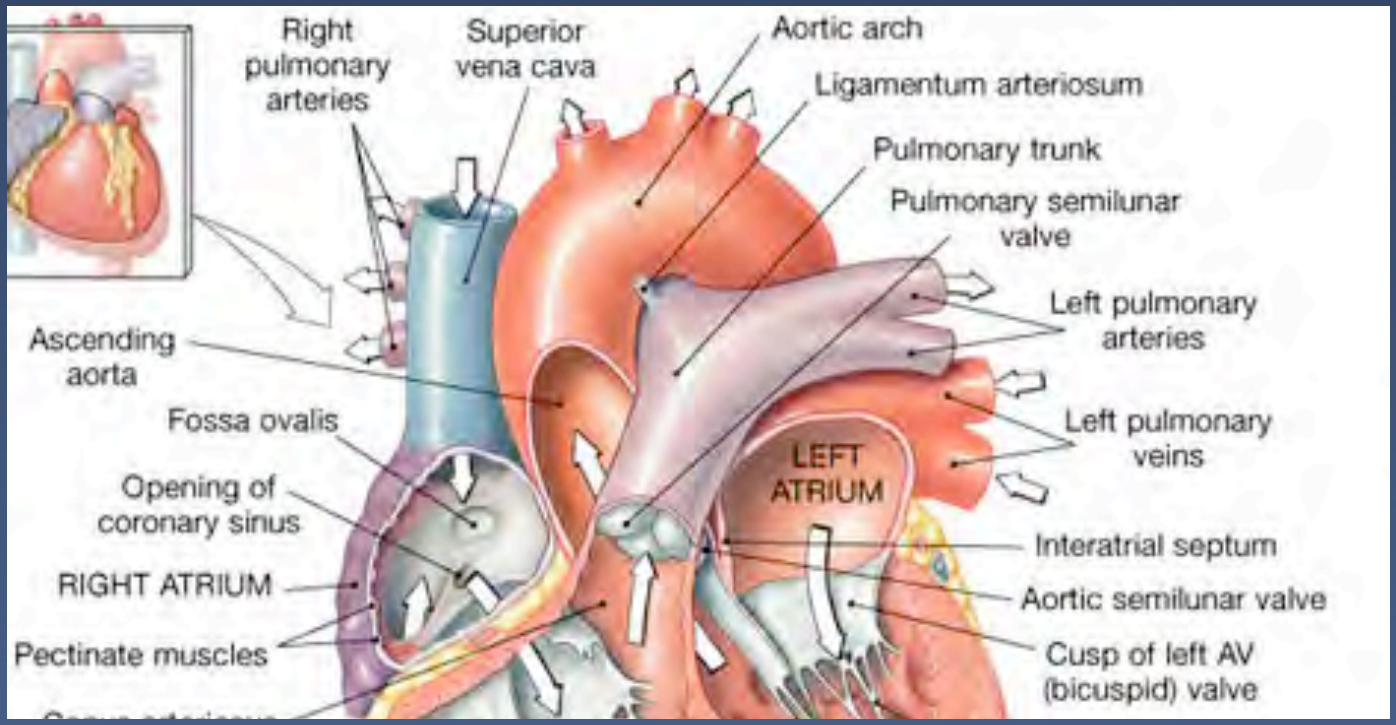
How does the GREEN overlap with the RED?

Current Status



New Approaches

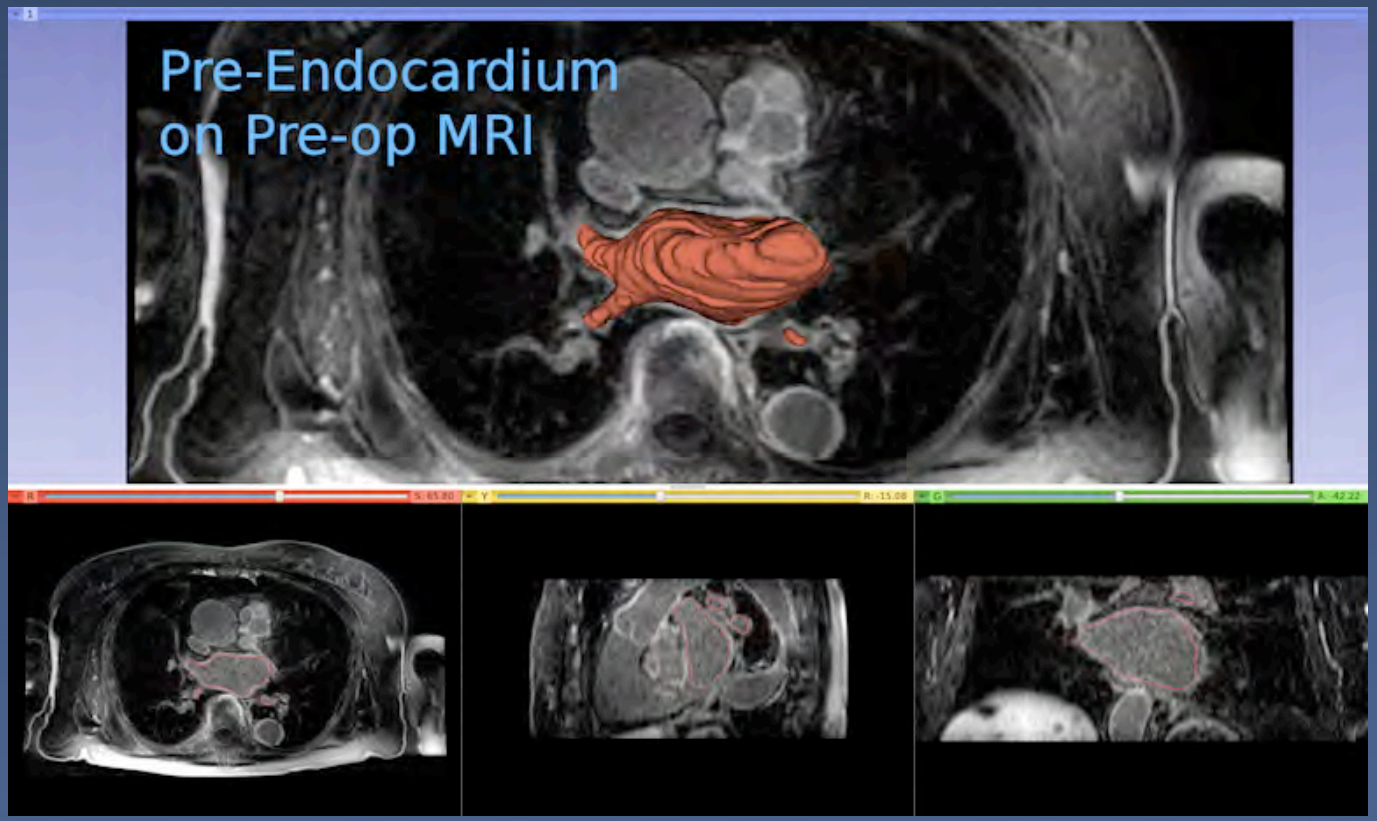
Landmark based registration (CARMA)

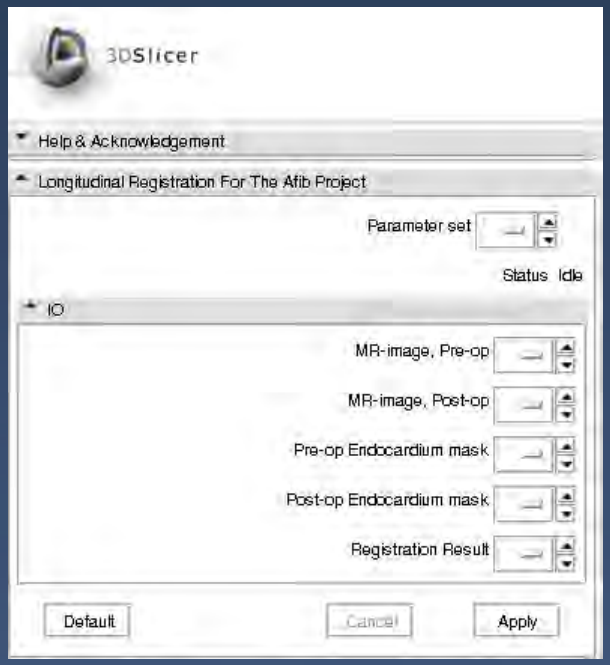


New Approaches

From this Meeting!

Segmentation driven registration (Gao)

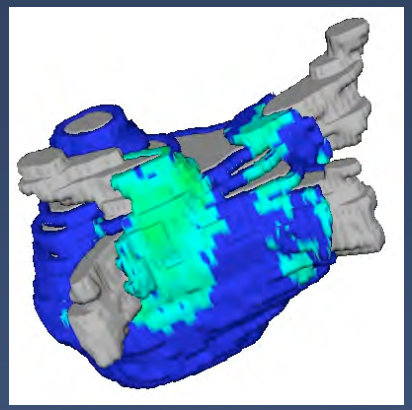




Data Repository

Some New Ideas

Image Merging



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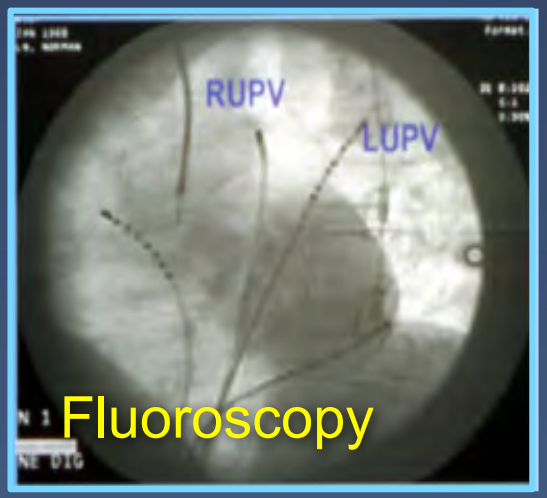

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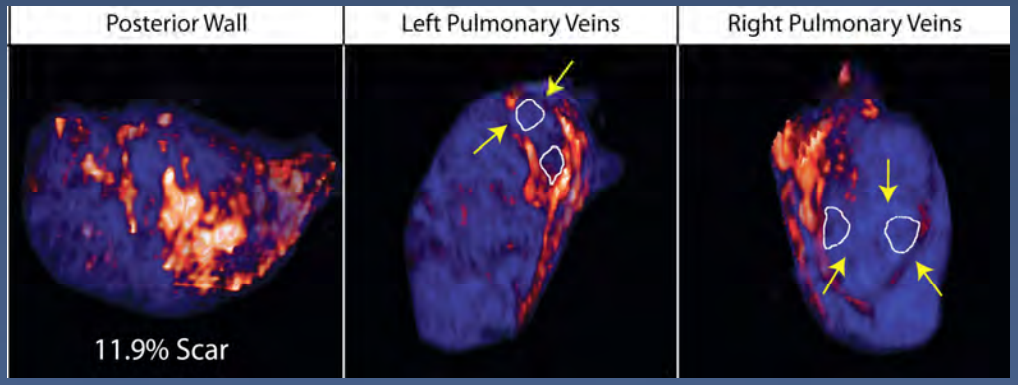

The Link

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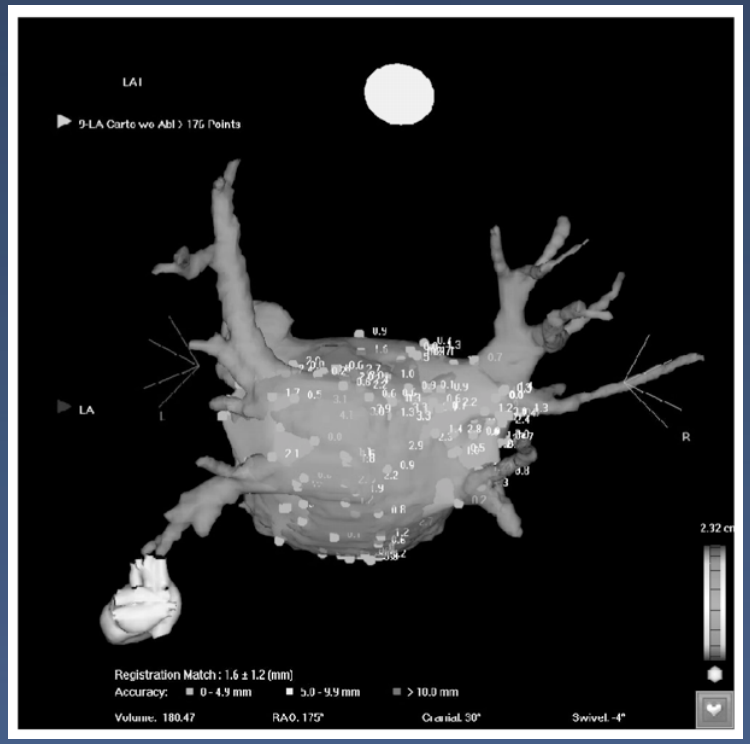
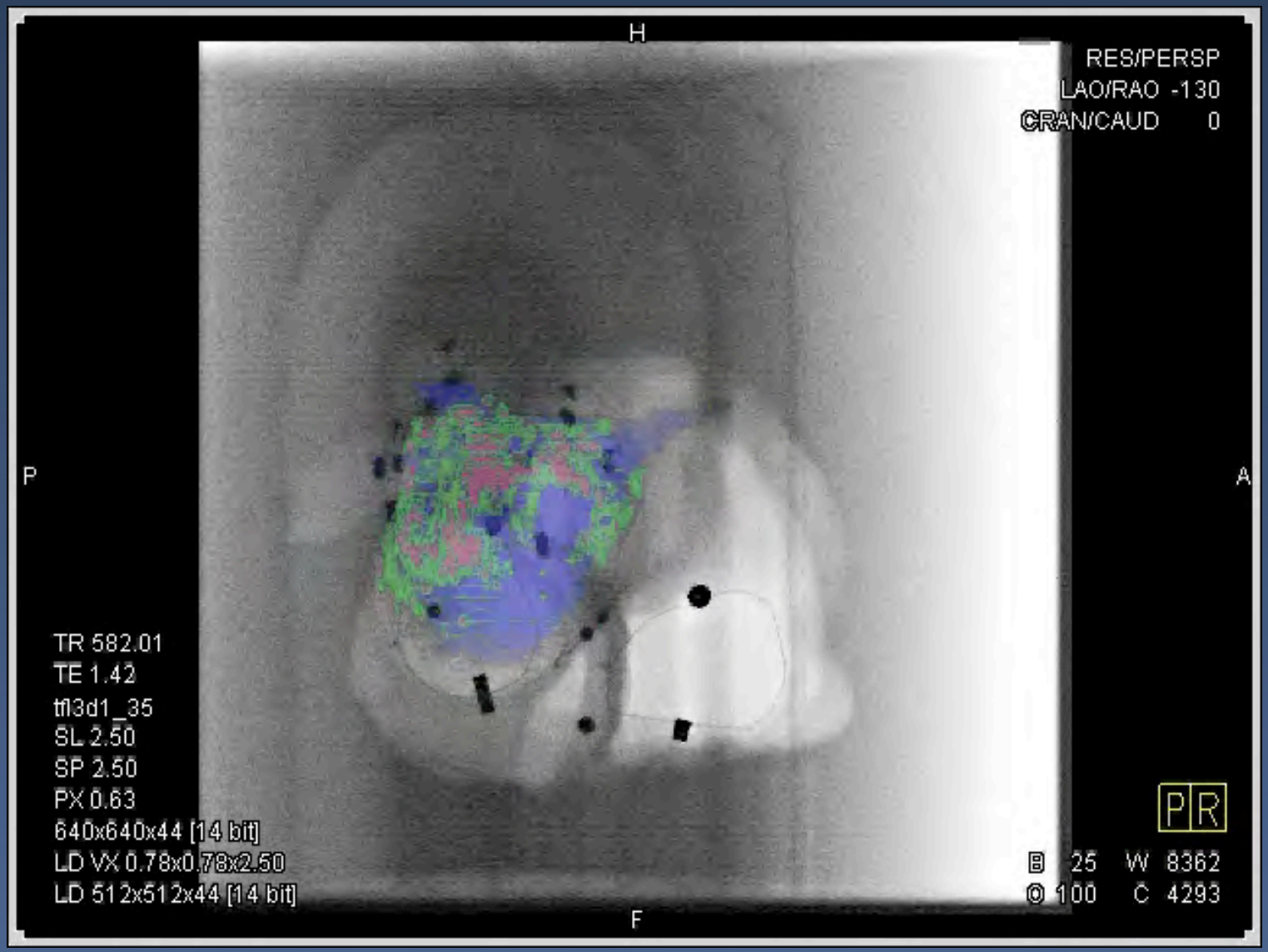


Some Results



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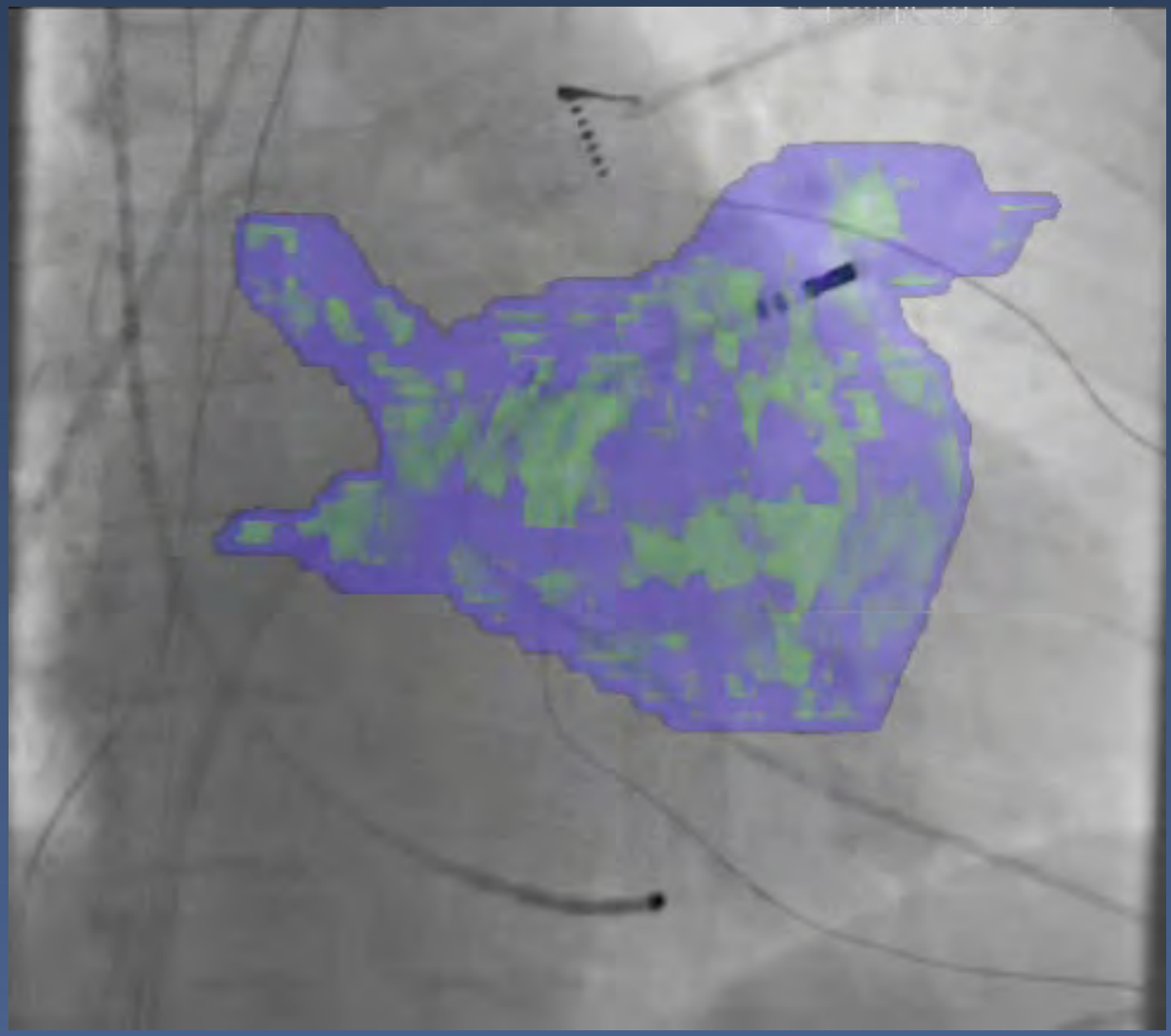
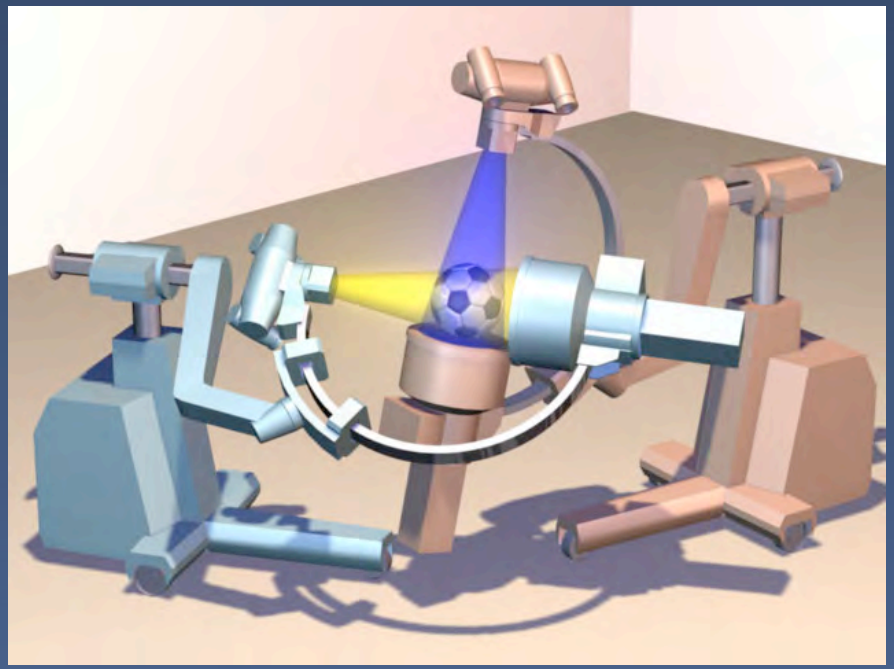


Some Goals

Some Goals

Biplanar



Monoplanar

Realtime MRI Guided Ablation

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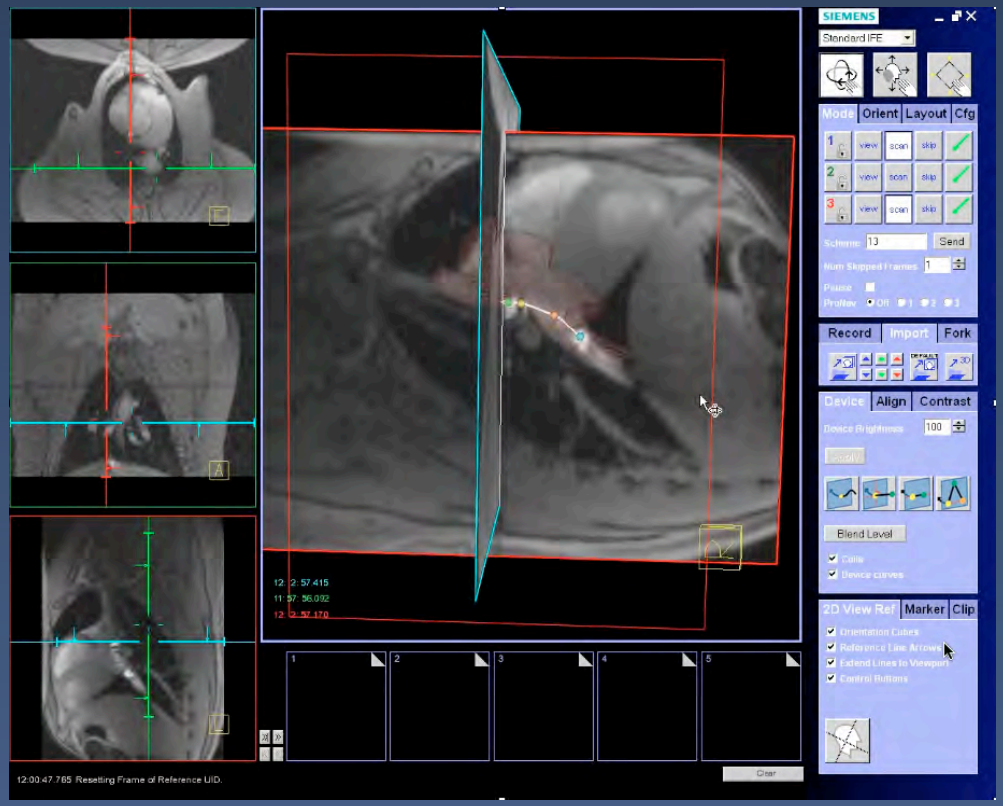
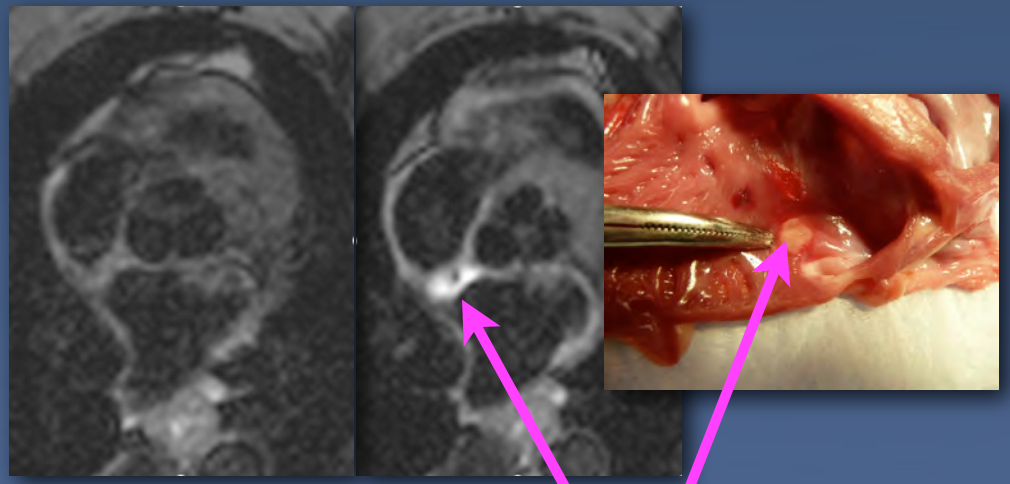
Real Time MRI

Current Status

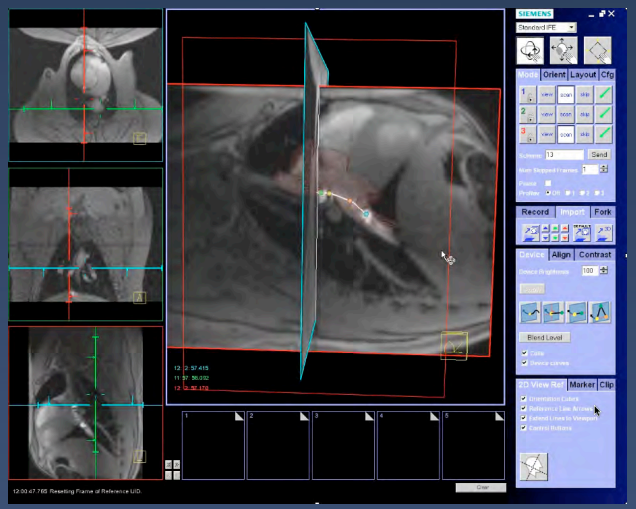


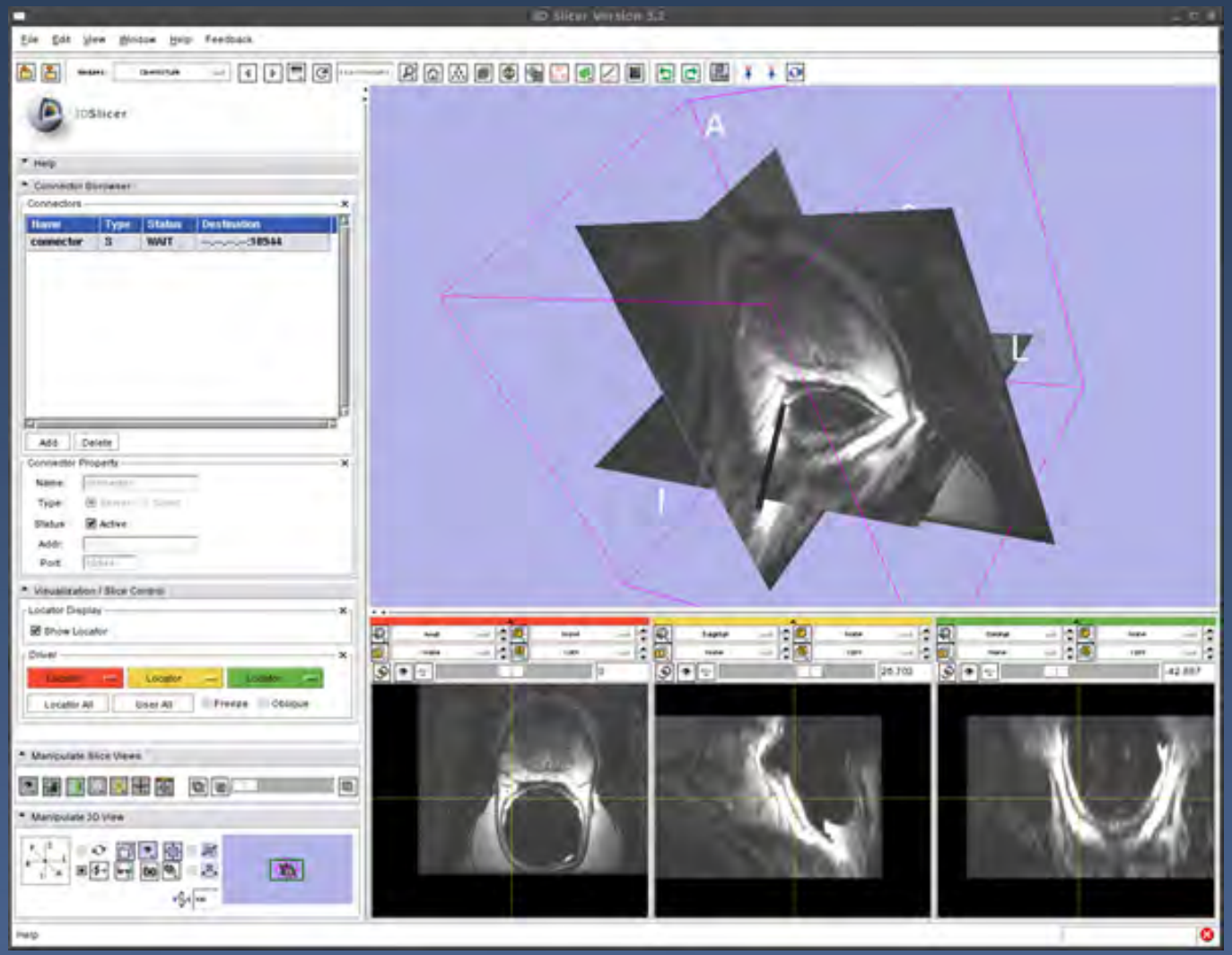
Before After



Lesion

Challenges

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