대한 순환기 학회 춘계학술대회 2010

Targeting non PV foci -when and how

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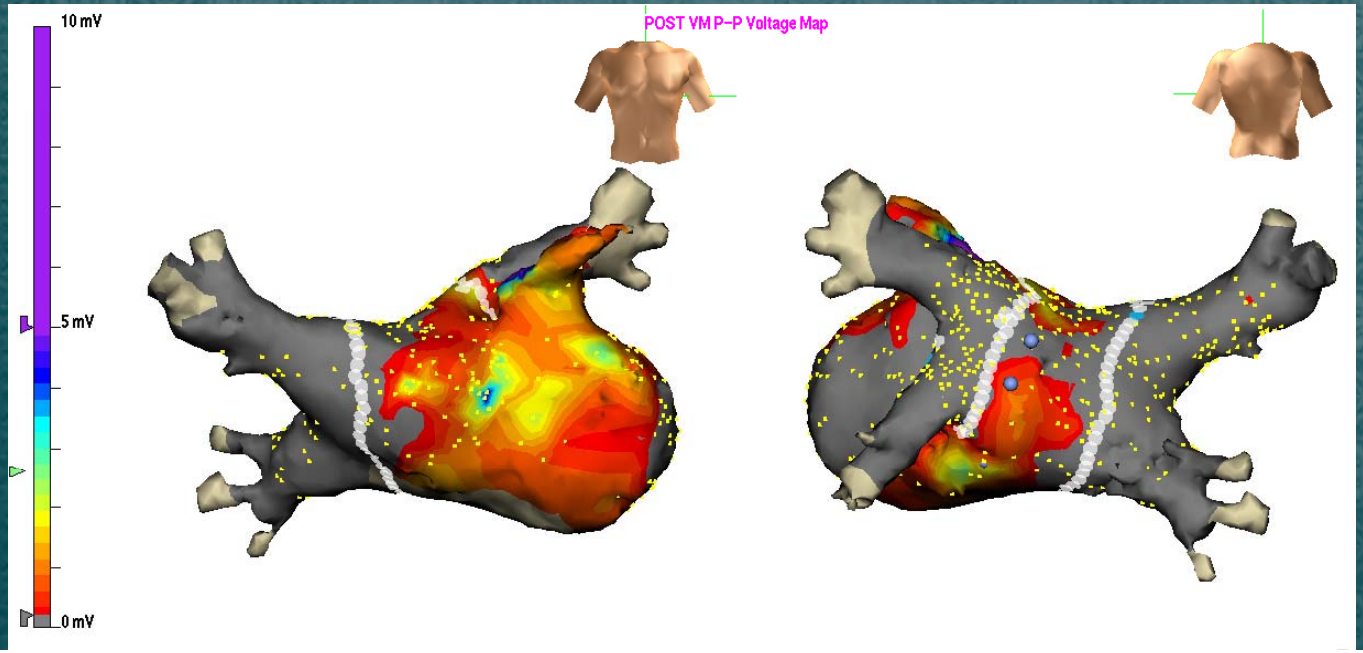
Catheter Ablation for Atrial Fibrillation (Af)

- Pulmonary Vein (PV) isolation is a mainstay of Af ablation.
- PV serves as a trigger initiating Af and maintenance of Af



Non-PV Focus After Circumferential PV Ablation in Patients with AF

Hong Euy Lim, et al. Unpublished, 2007

To investigate the location of non-PV foci identified after CPVA and to assess the effect of their elimination on the outcome of catheter ablation for AF.

Provocation of Non-PV Focus After Circumferential PV Ablation in Patients with AF

1. After PV isolation, we first attempted to localize the spontaneous APBs that initiated AF after the infusion of isoproterenol (7-10 μg/min).

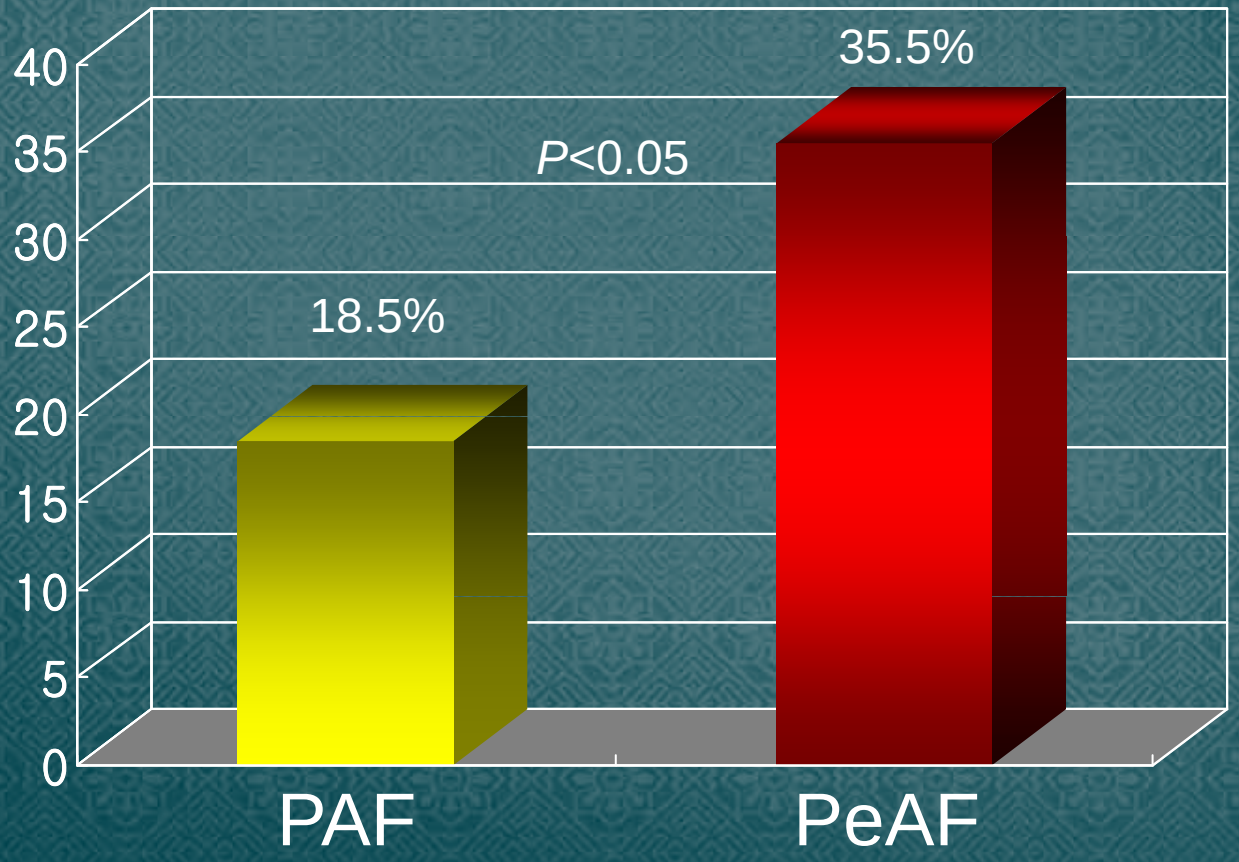
2. If spontaneous AF did not appear, then burst atrial pacing was done for the induction of AF

3. Induced AF sustained for > 10 minutes or AF at baseline, we observed the re-initiation of AF after internal cardioversion (3-10 J, biphasic waveform of DC) under the effect of Isoproterenol.

Hong Euy Lim, et al. Unpublished, 2007

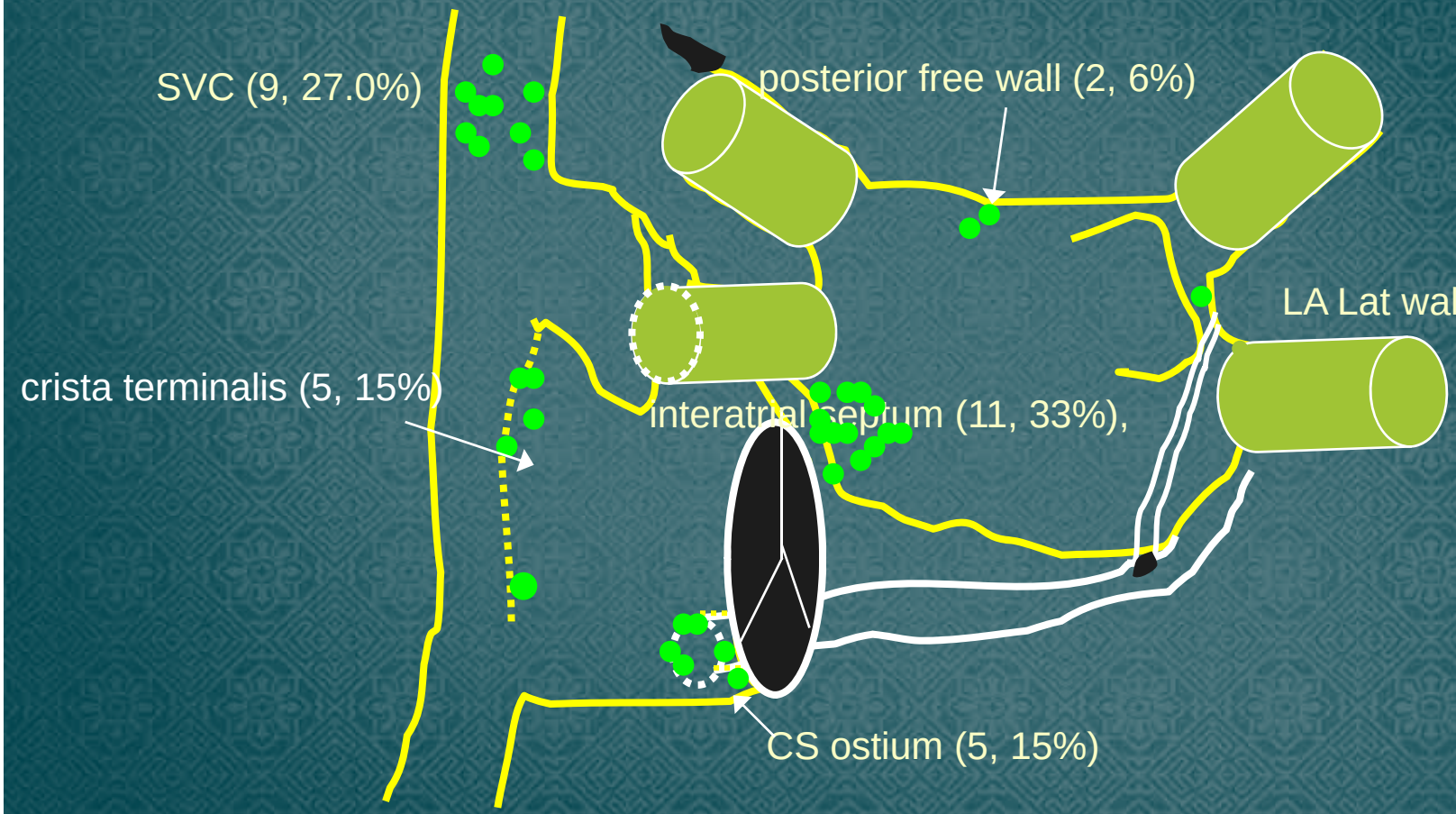
Non-PV Foci After Circumferential PV Ablation

56 (24.0%) patients had a total of 73 non-PV foci after CPVA.



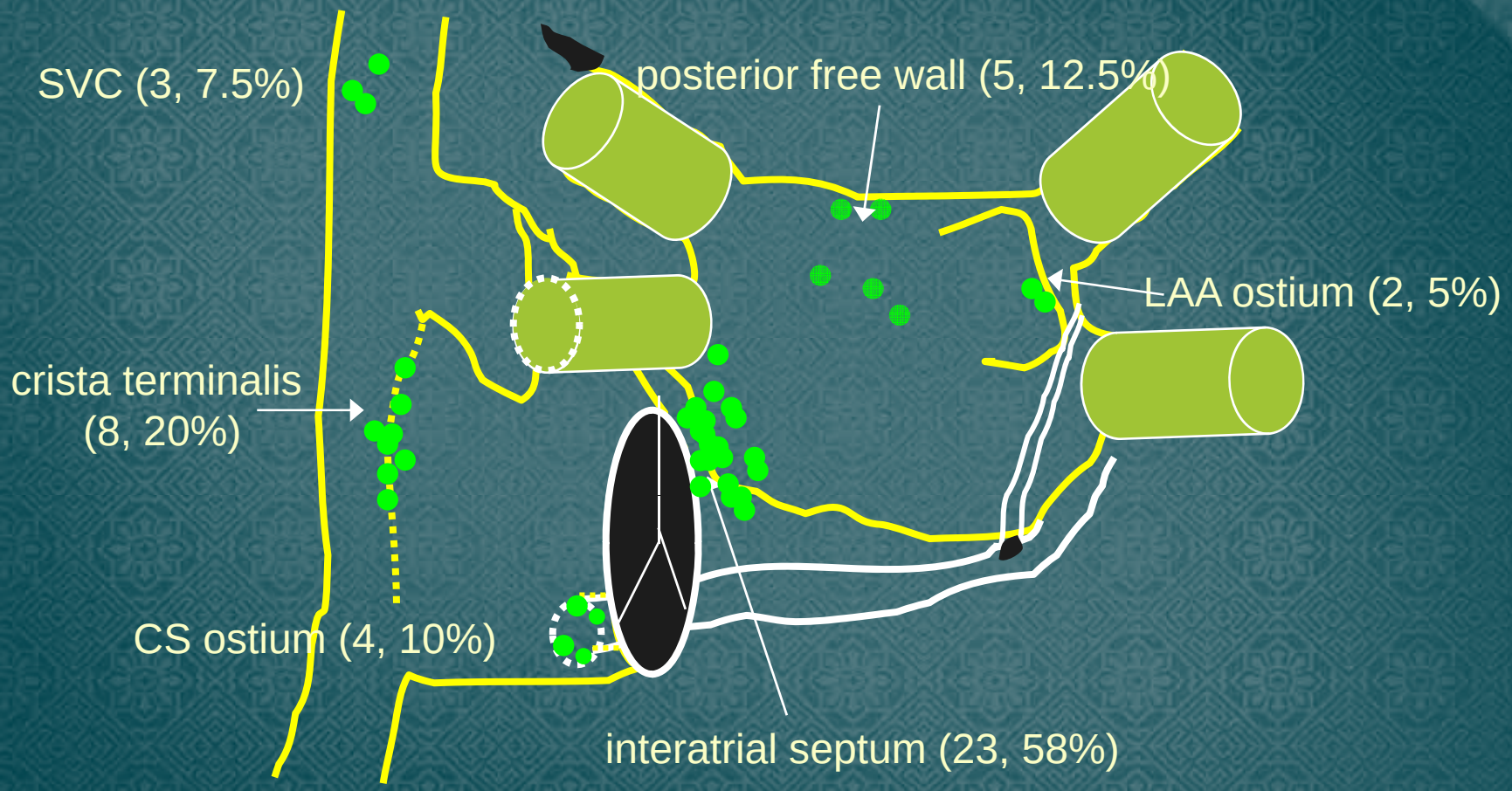
Hong Euy Lim, et al. Unpublished, 2007

Non-PV Foci in PAF



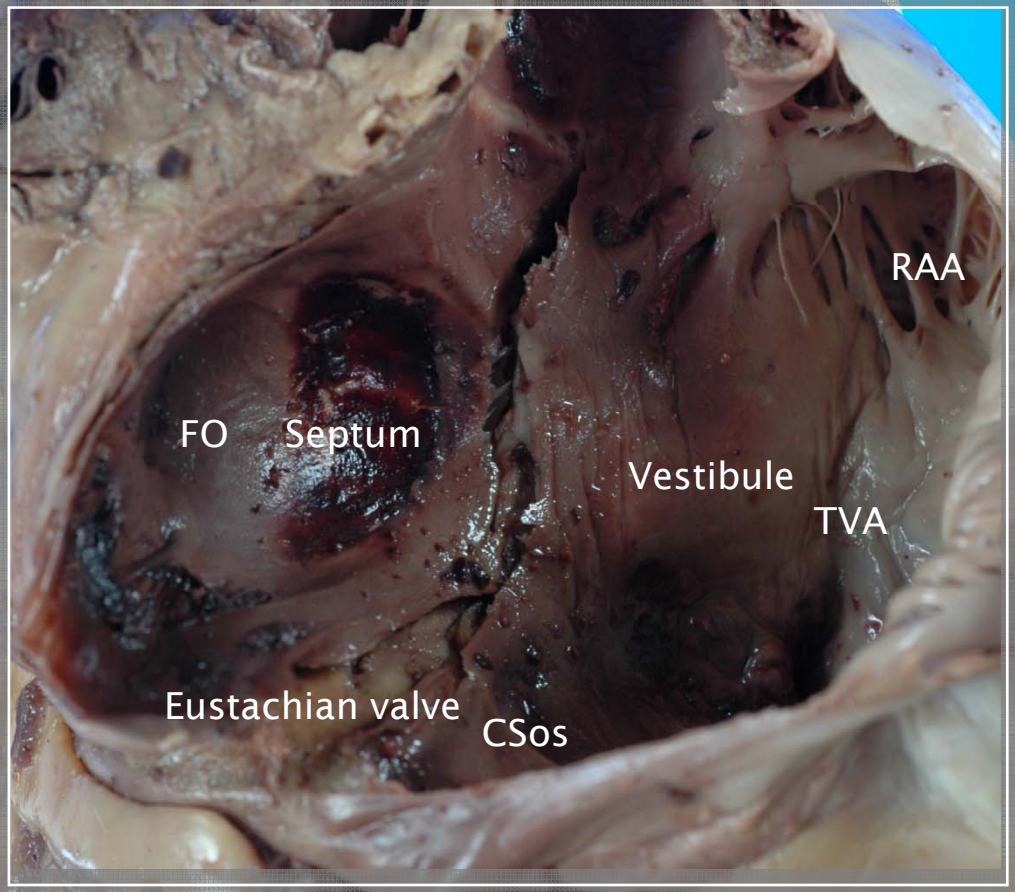
Hong Euy Lim, et al. Unpublished, 2007

Non-PV Foci in PeAF

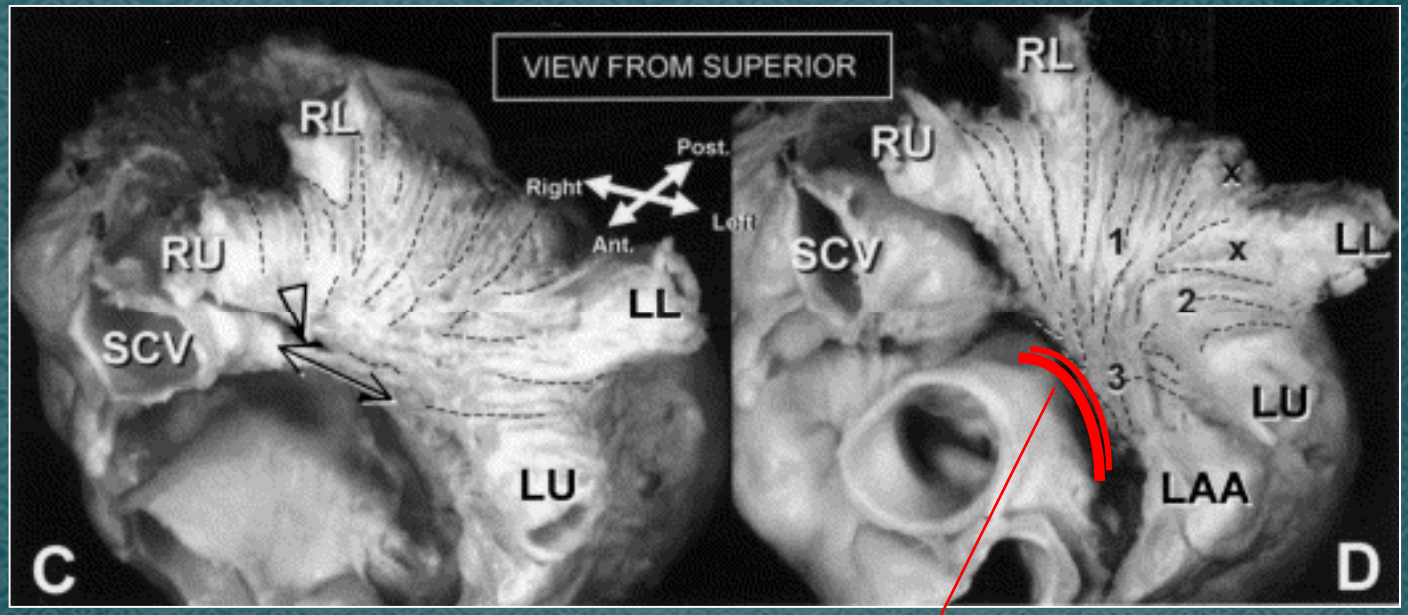


Hong Euy Lim, et al. Unpublished, 2007

Interatrial Septum



Septo-pulmonary or -atrial Bundle (SB)



Proximal septal bundle or Septal raphe

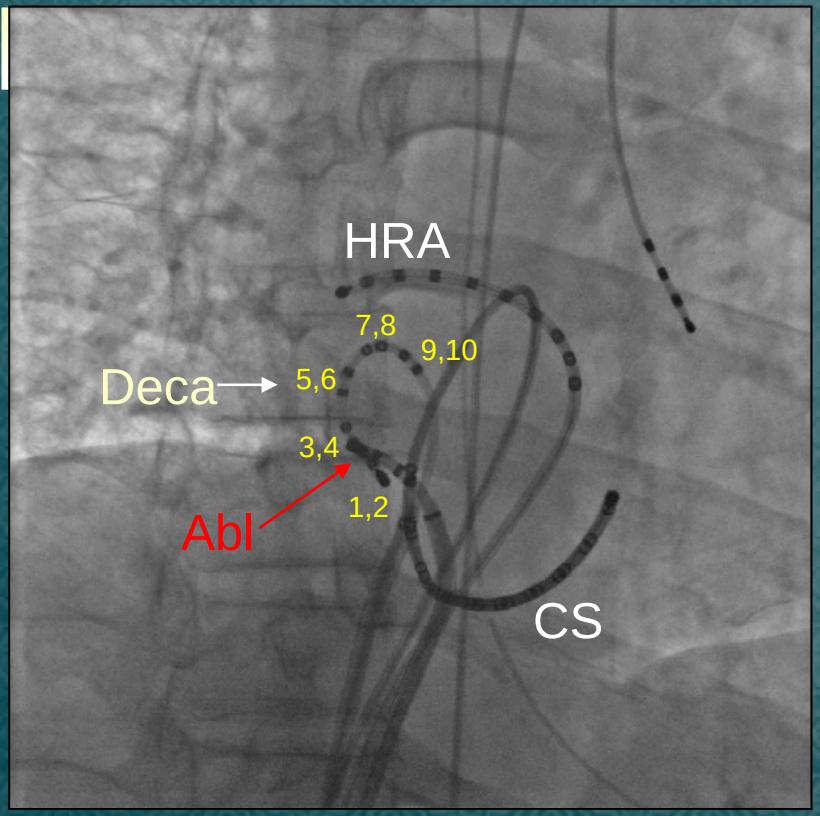
Ho SY, et al. Anatomy of the left atrium:implications for radiofrequency ablation of atrial fibrillation. J Cardiovasc Electrophysiol 1999;10:1525-1533.

Interatrial Septum

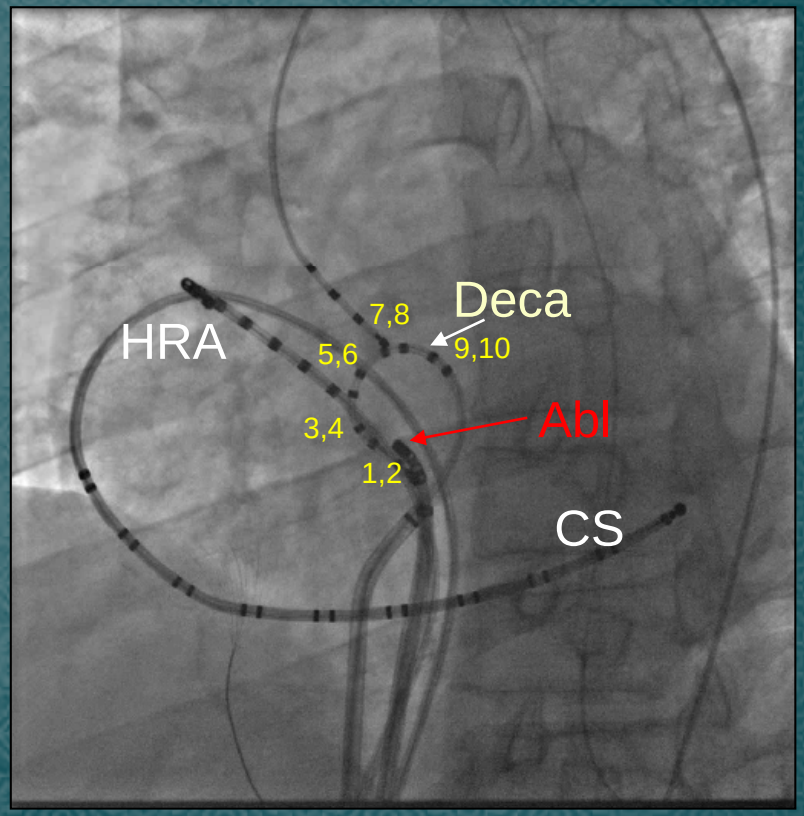
- Septal raphe before bifurcation into SPB and SAB
- Nonuniform anisotrophic conduction
- Decremental property
- Related to CFAE during Af

Y-H Kim, et al. Heart Rhythm 2007

Left Septal Bundle (SB) Potentials



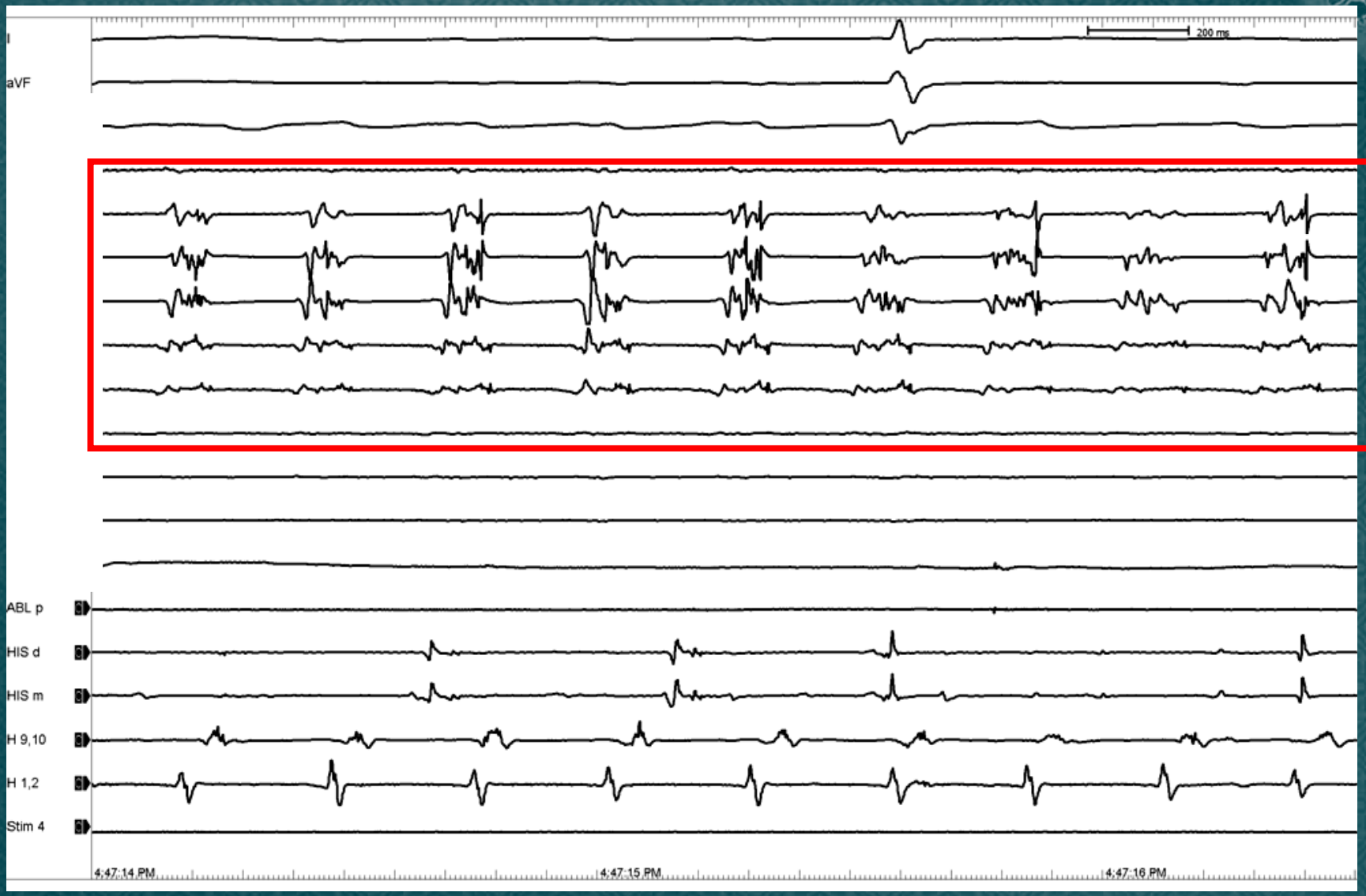
RAO30°



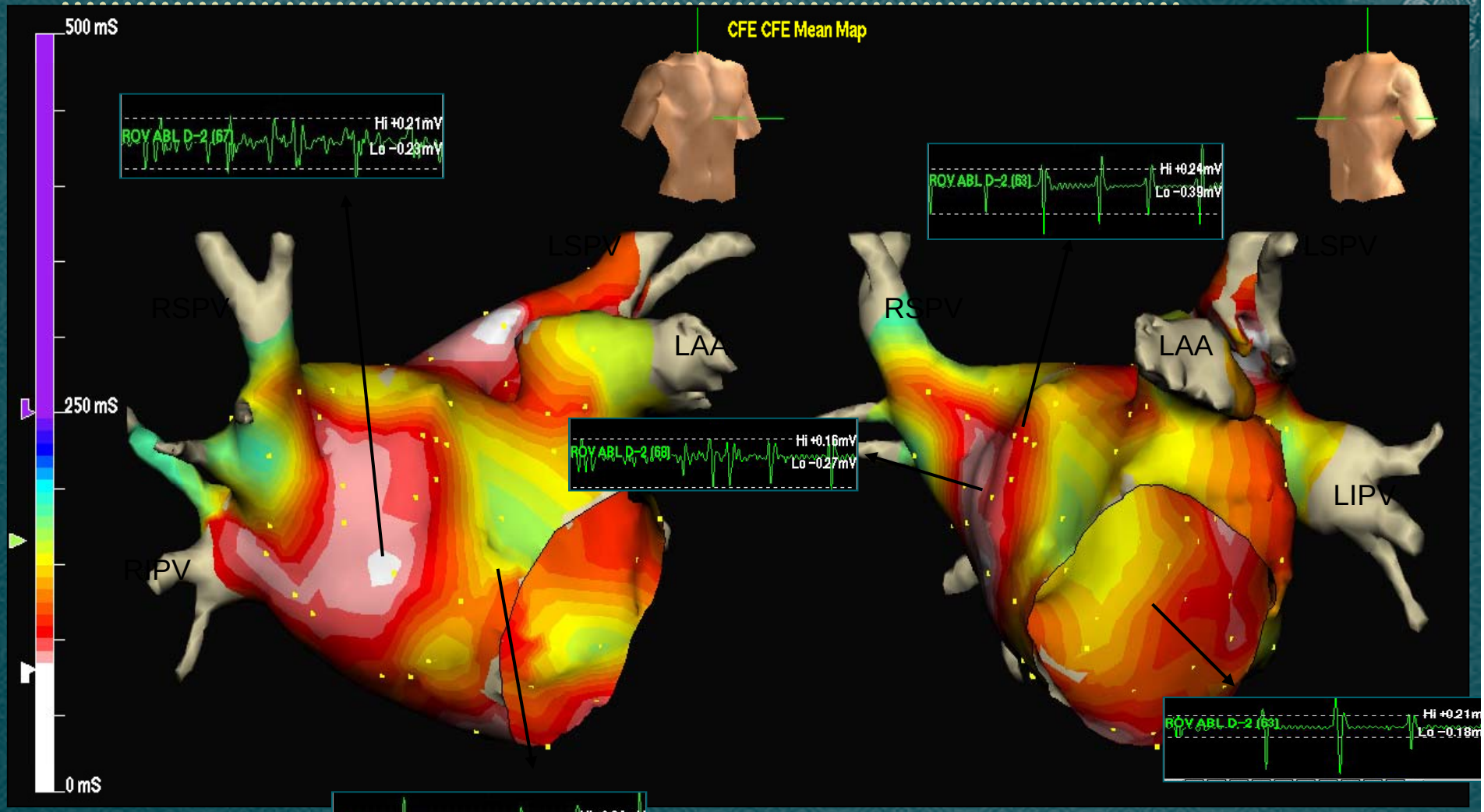
LAO30°

Atrial Extrastimulus 600/300 ms

RA Extrastimulus-Induced AF

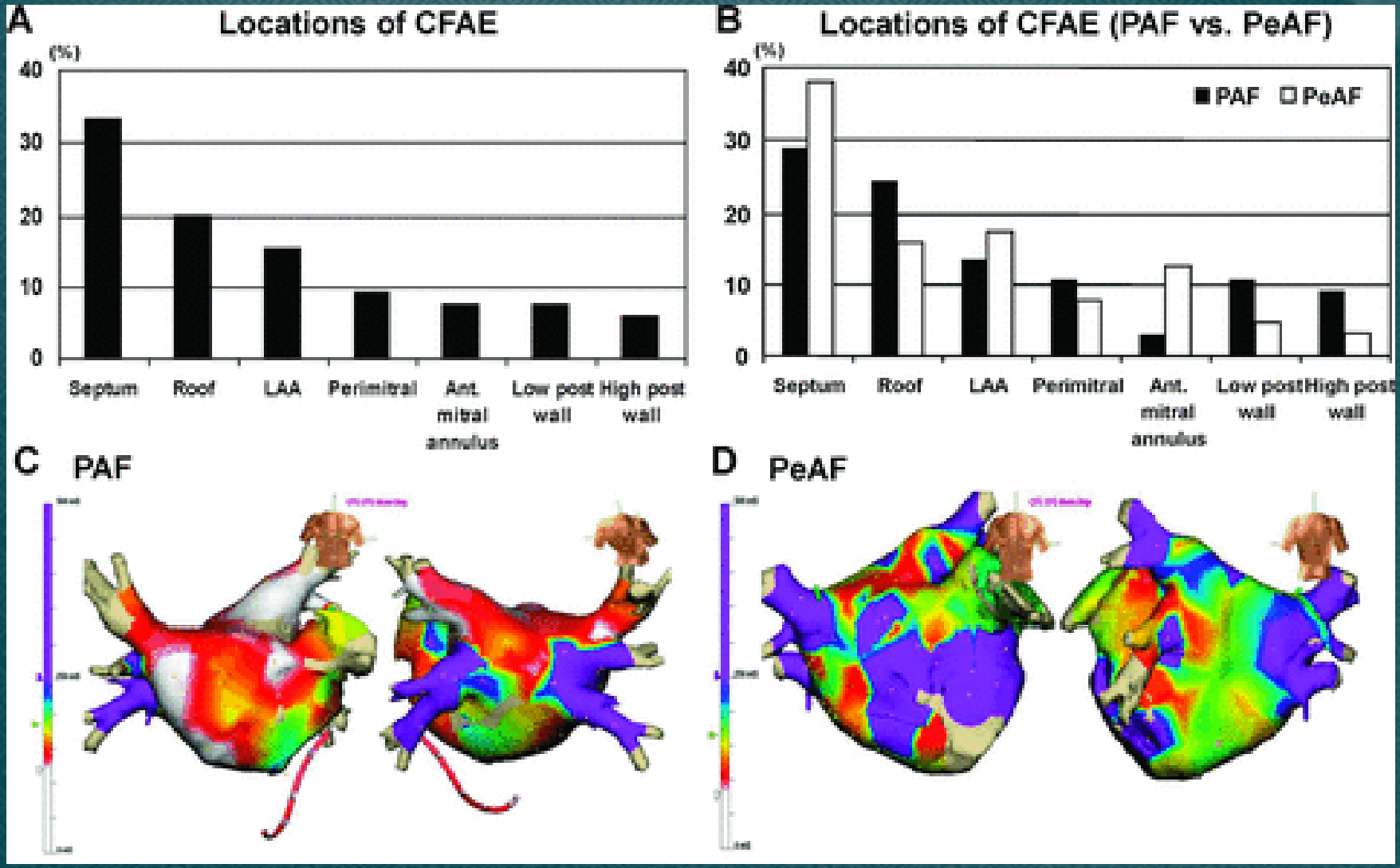


CFAE Map During AF



M/56, Chronic AF

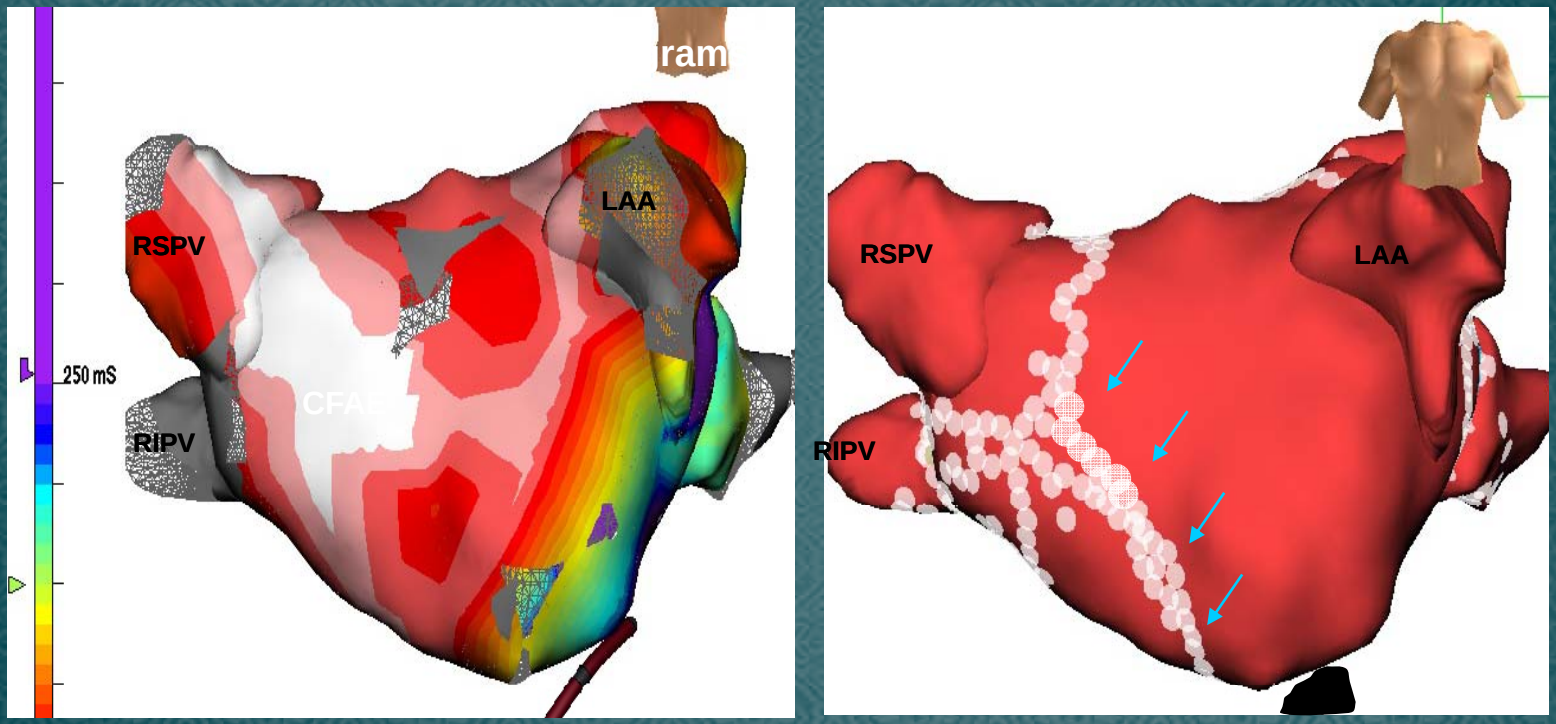
CFAE distribution in Af



Park JH et al. JCE 2009

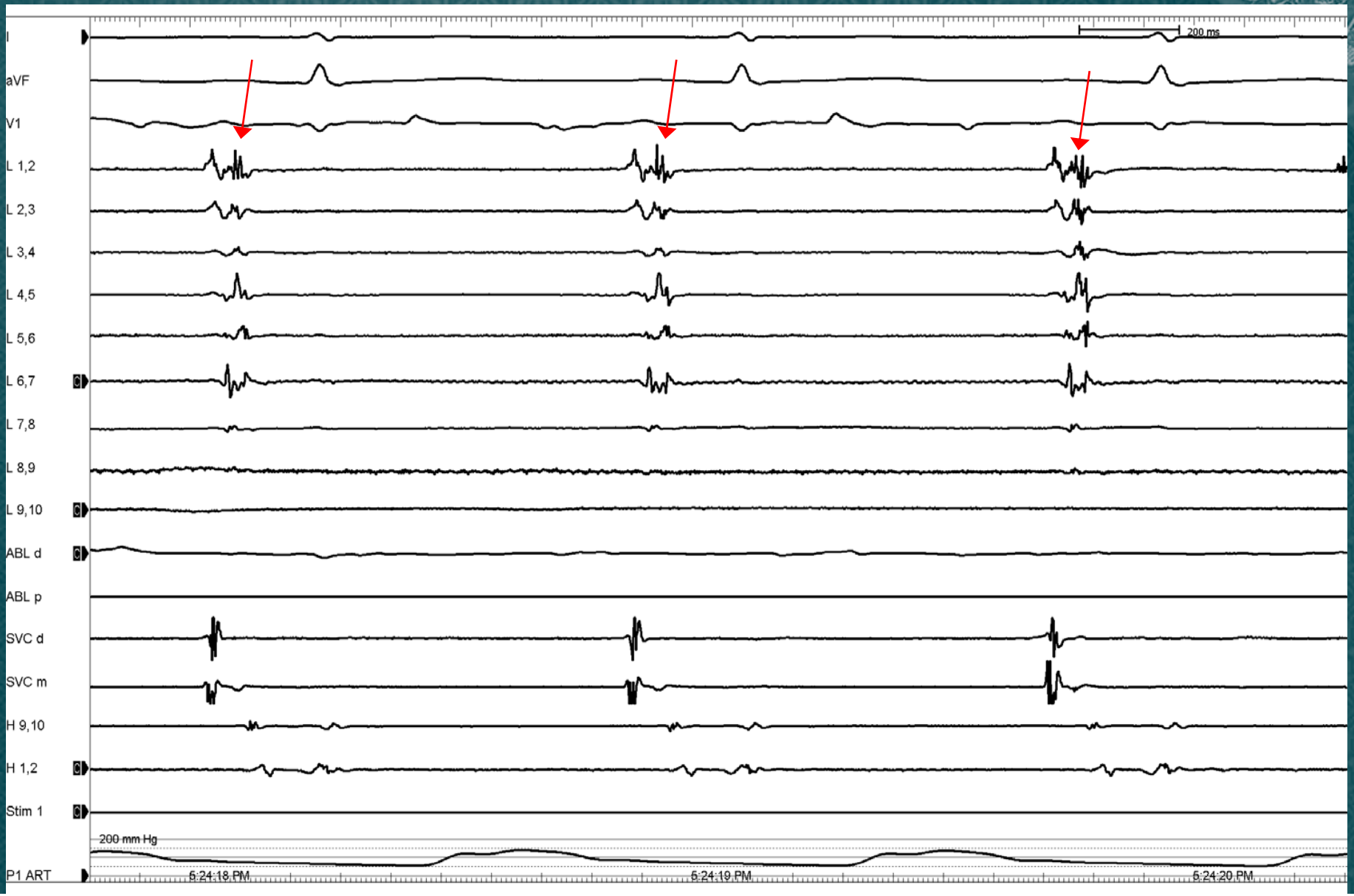
SB Linear Ablation

Relation Between the location of CFAE During AF and SB potentials

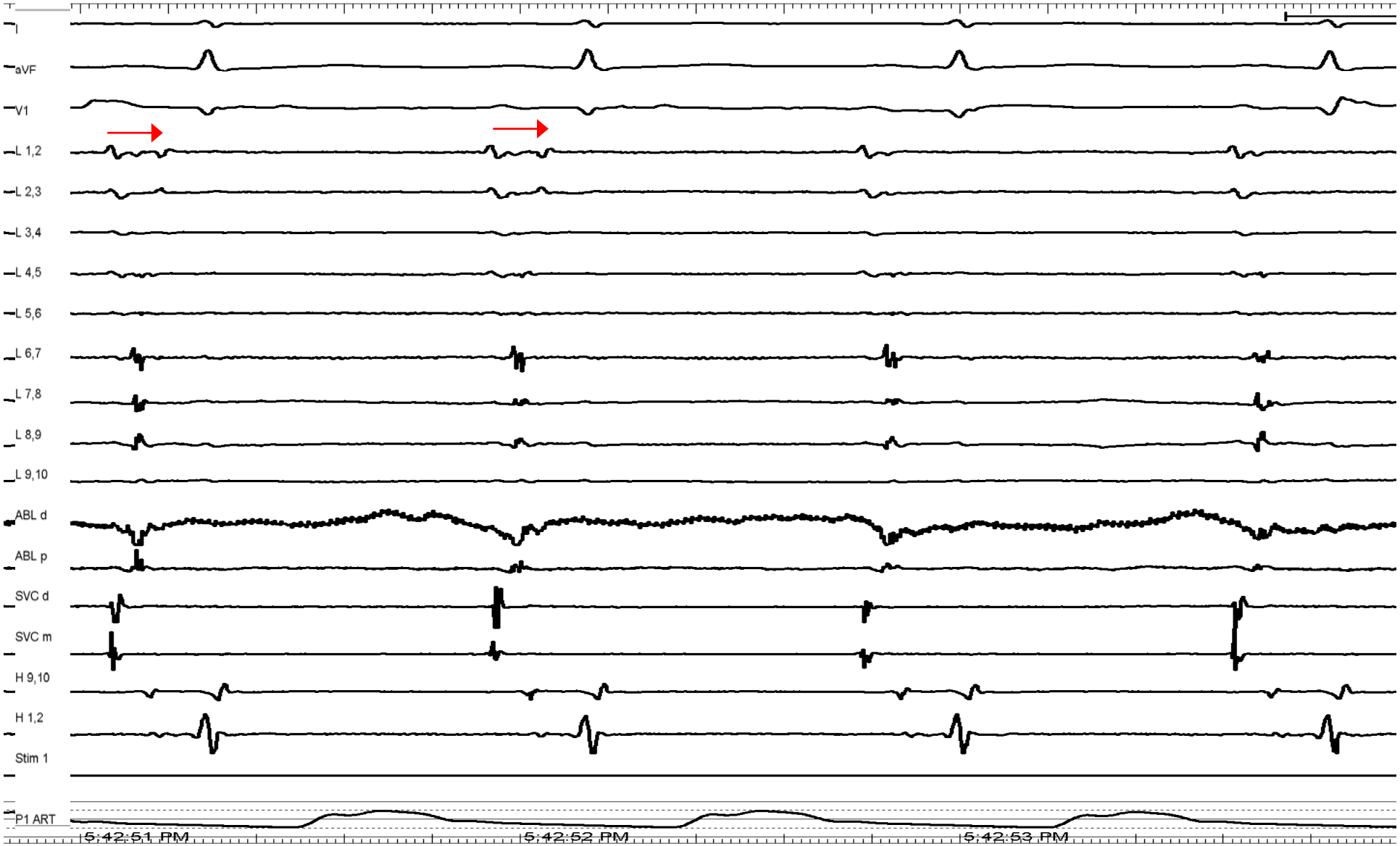


Y-H Kim, et al. Heart Rhythm 2007

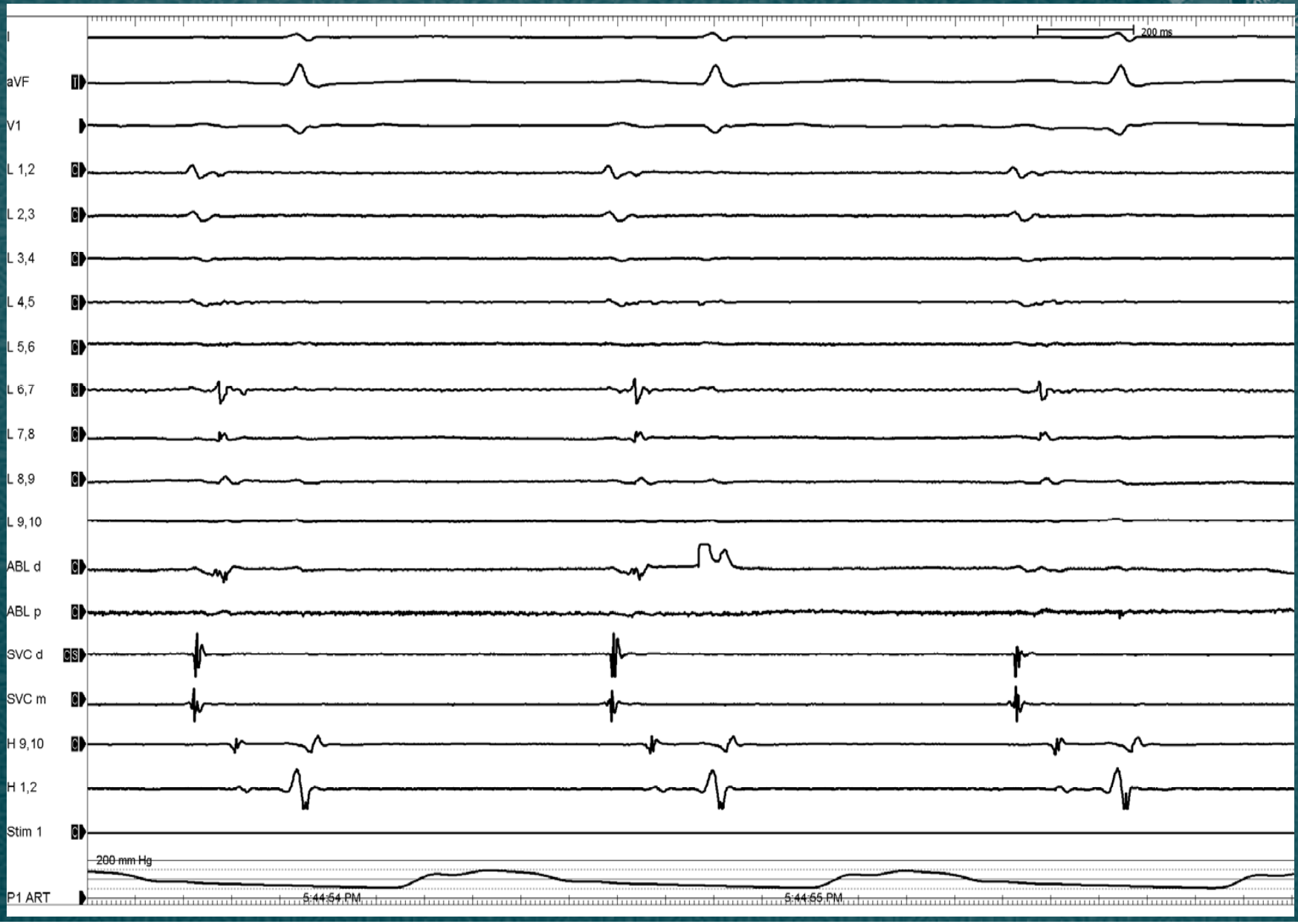
Baseline SB Potentials



Potential(-) during ABL



Post SB ABL


I
aVF
V1
L 1,2
L 2,3
L 3,4
L 4,5
L 5,6
L 6,7
L 7,8
L 8,9
L 9,10
ABL d
ABL p
SVC d
SVC m
H 9,10
H 1,2
Stim 1
200 ms
200 mm Hg
P1 ART
5:44:54 PM
5:44:55 PM

Left Septal Bundle Ablation has Incremental Value in Catheter Ablation for PAF and PeAF ?

Jong Il Choi, et al. 2007 (3rd APAFS, abstract)

Aim

2006, 1- 2007, 3

Compare the efficacy

PAF

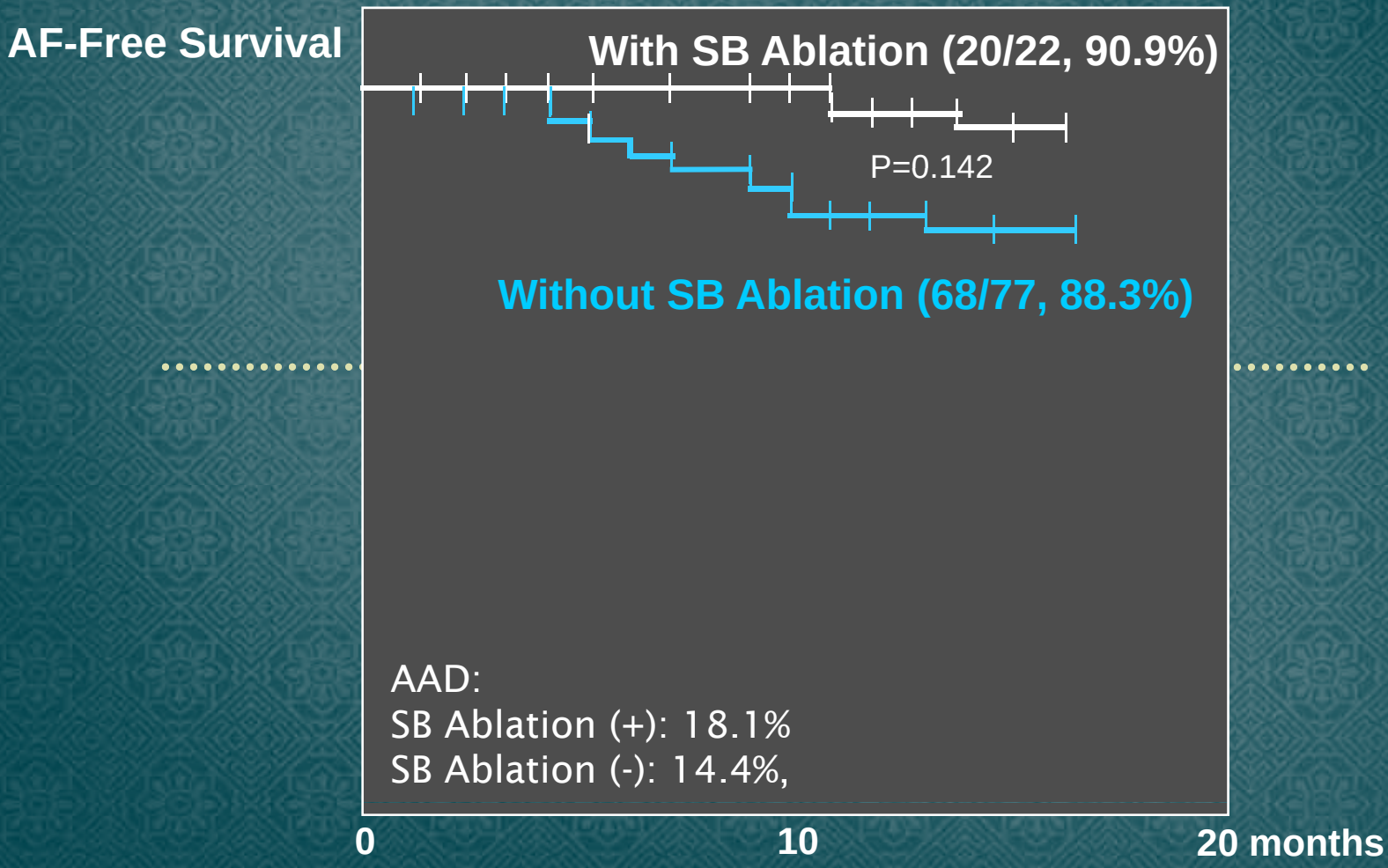
CPVA + EI (Electrical Isolation)	CPVA + EI + SB Ablation
n=77	n=22

PeAF

CPVA + EI + PMI and/or Roof	CPVA + EI + PMI and/or Roof + SB Ablation
n=30	n=12

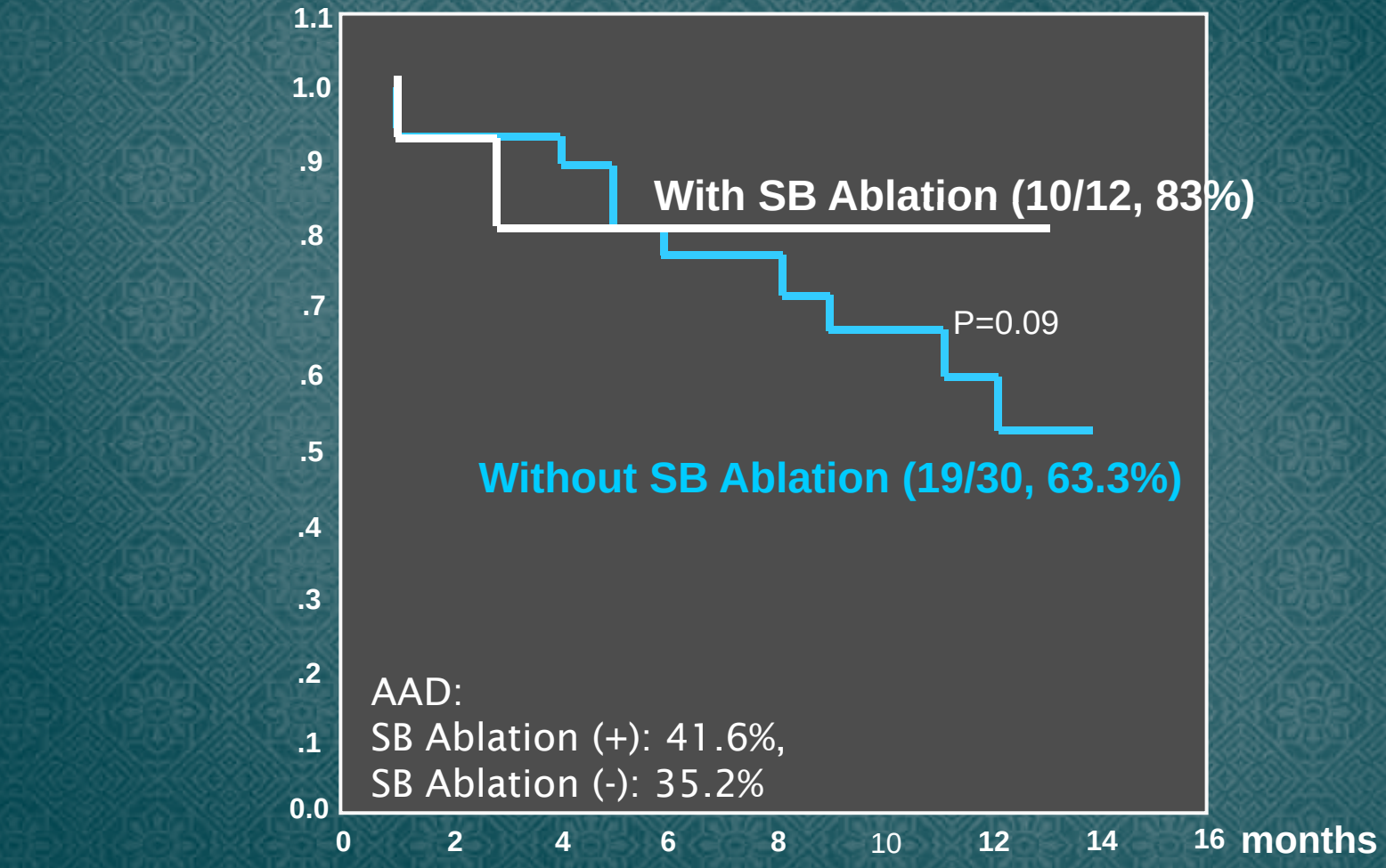
Jong Il Choi, et al. 2007 (3rd APAFS abstract)

Effect of SB Ablation in PAF (n=99)



Jong Il Choi, et al. 2007 (3rd APAFS abstract)

Effect of SB Ablation in PeAF (n=42)



Jong Il Choi, et al. 2007 (3rd APAFS abstract)

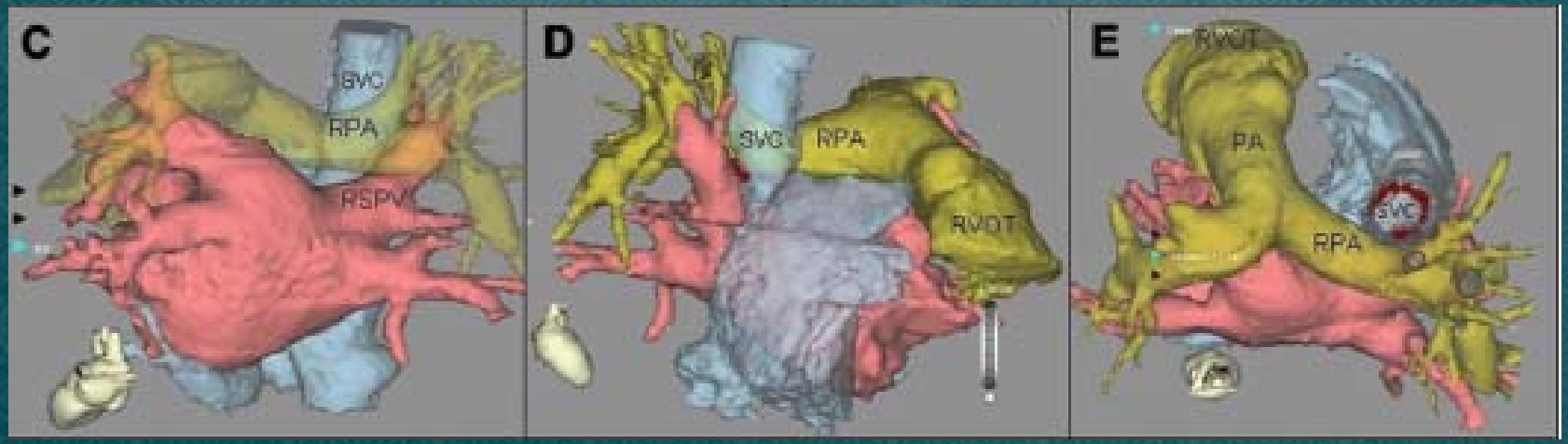
Limitation of septal linear ablation

- Sanders et. al. reported the efficacy of anterior LA line from LA roof to the anterior mitral annulus as septally as possible in 24 pts.
  - Complete linear block is difficulty (58%)
  - Results in significant prolongation in LA activation time

Sanders et al Heart Rhythm 2004

Superior Vena Cava (SVC)

- SVC has electrical active myocardial connection which could trigger arrhythmia up to 5cm above RA-SVC junction
- 96% of patients showed SVC potential during Af ablation procedure Arruda M et al JCE 2007
- Close proximity to RSPV

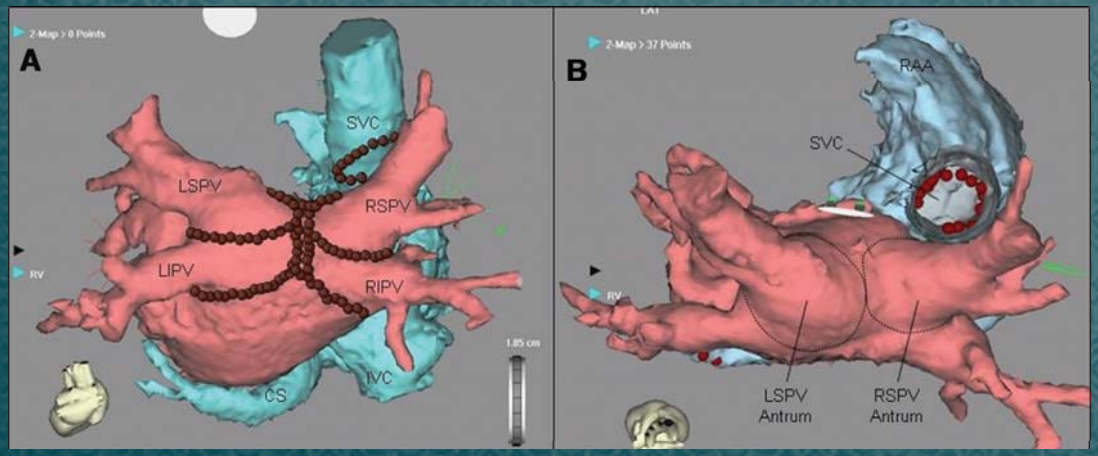


SVC in initiating Af

- Among 130 patients with paroxysmal Af, eight patients (6%) had spontaneous Af initiated from the SVC Tsai et al Circulation 2000
- Our data showed that ectopy from SVC triggers Af in 27% of paroxymal Af and 7.5% of persistent Af after PV isolation

SVC in maintaining Af

- Empirical isolation of SVC with PV antral isolation showed higher long term success rate (16% recurrence) Arruda M et al JCE 2007
- To date, there is no randomised studies.



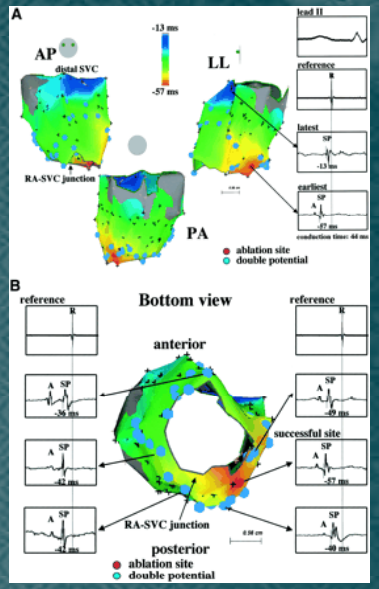
Ablation of SVC

- 1.4±0.5 RA-SVC break thorough per pt.
  →3.1±1.7 RF ablation per breakthrough

  Goya M et al Circulation 2002

- For SVC isolation, segmental ablation (50±12% of the SVC circumference) in 59% of pts, and entire circumferential ablation in 19% of pts.

  SVC isolation could not be done due to phrenic nerve stimulation in 18% of pts

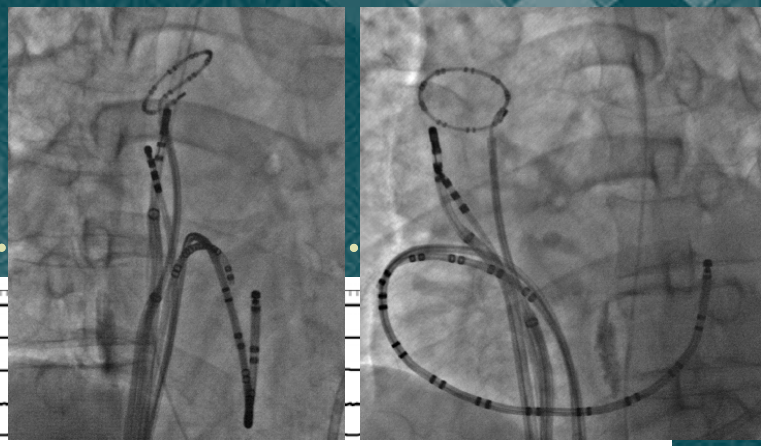


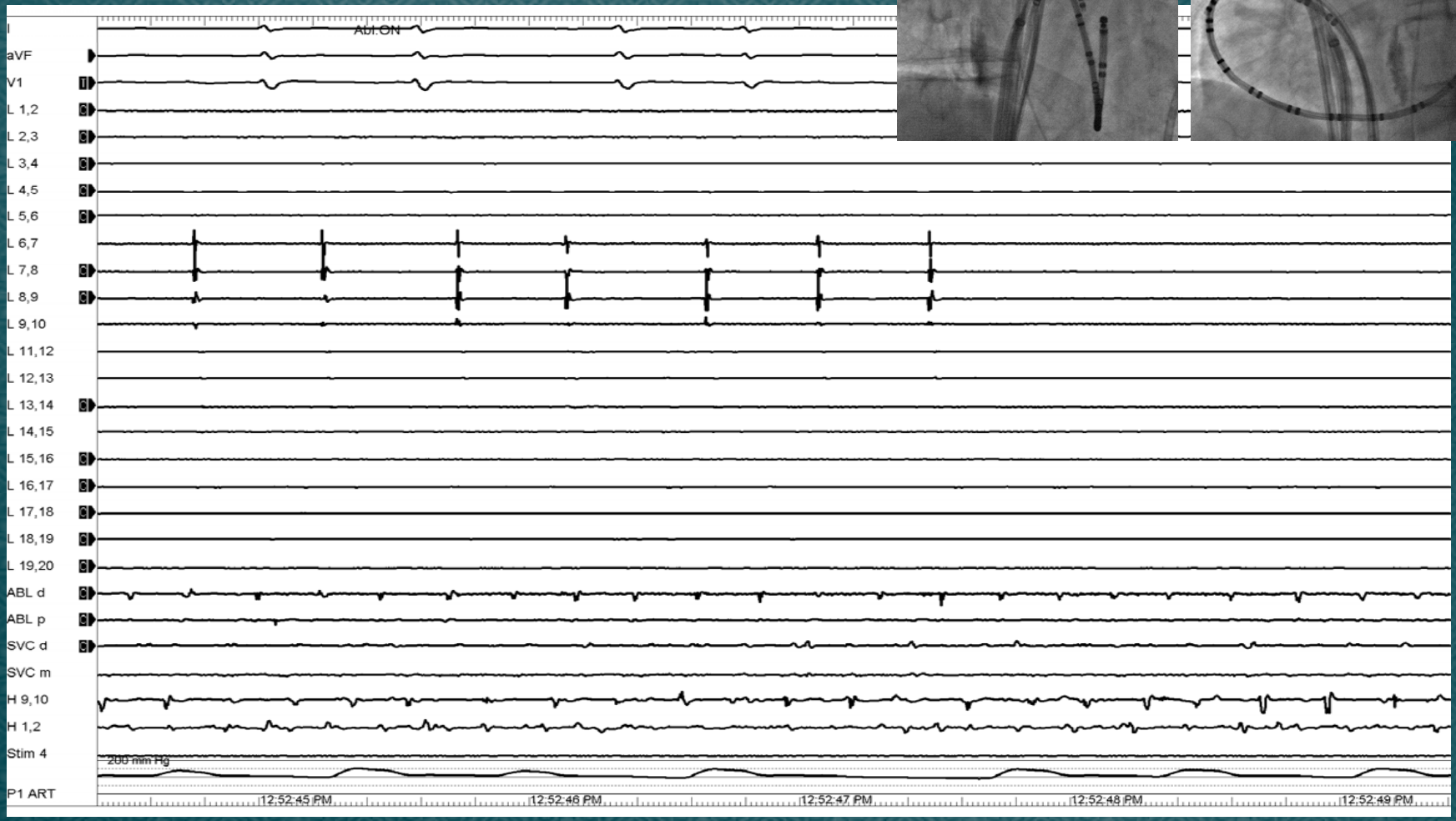
Arruda M et al JCE 2007

Complication of SVC Ablation

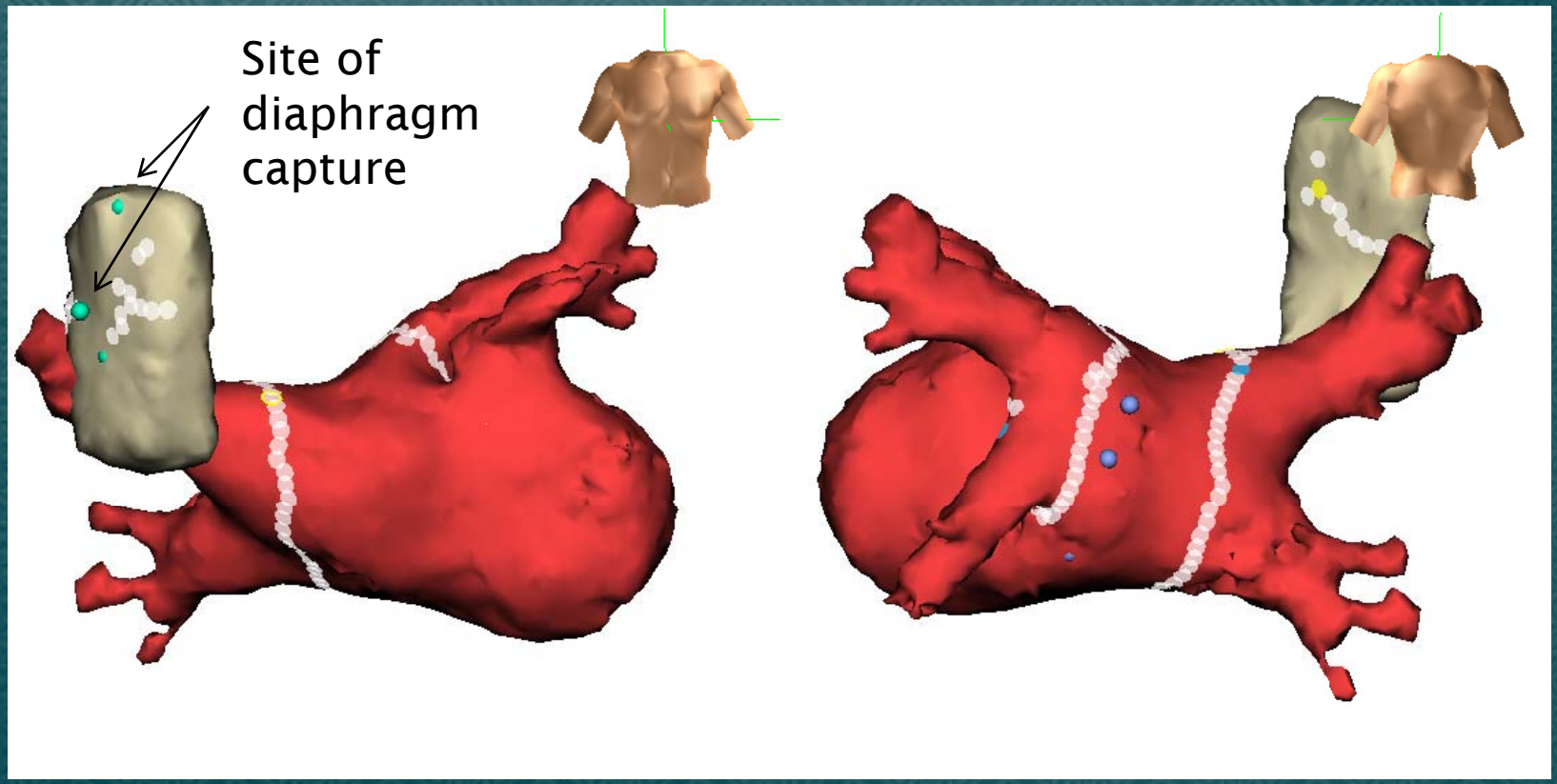
- Phrenic nerve injury (diaphragm palsy)
  - High current (upto 30mA) pacing within SVC to locate the diaphragm capture
- Sinus node injury
  - Rare, but problematic when associated with extensive RA ablation
- SVC stenosis
  - there was no reported SVC stenosis by the 3 months CT follow up

During SVC ABL

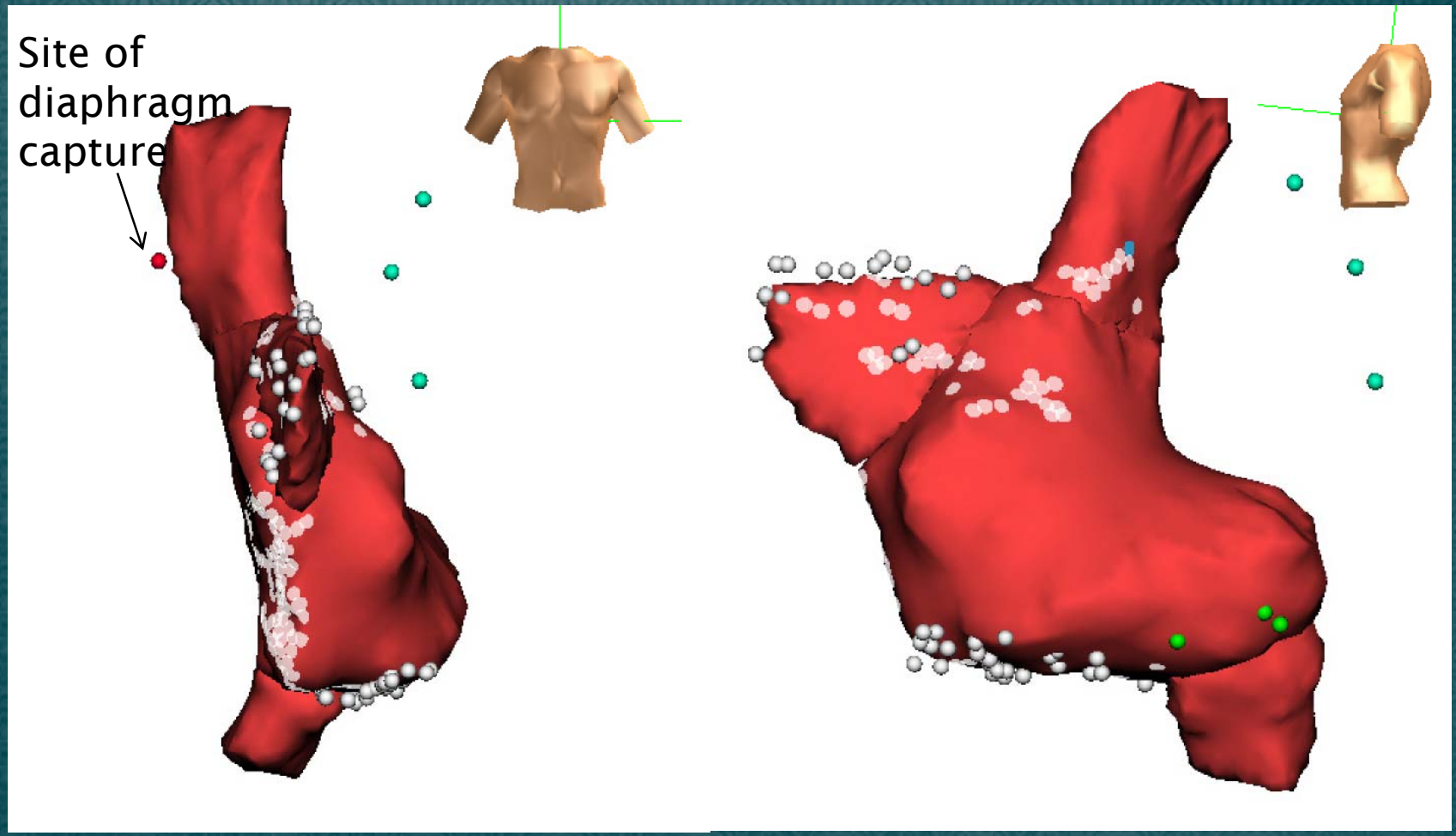




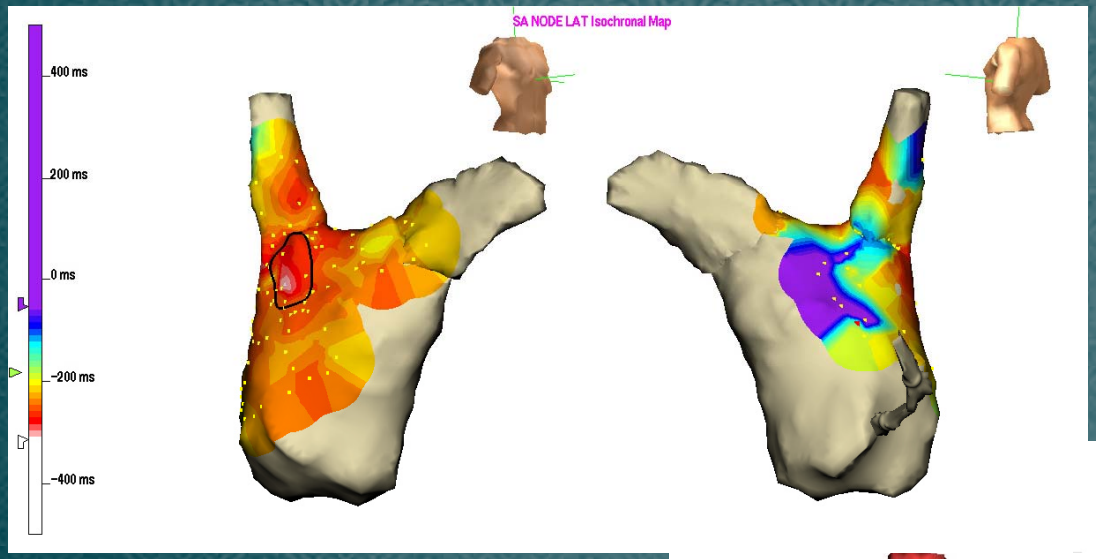
Segmental ablation for SVC isolation Using NavX

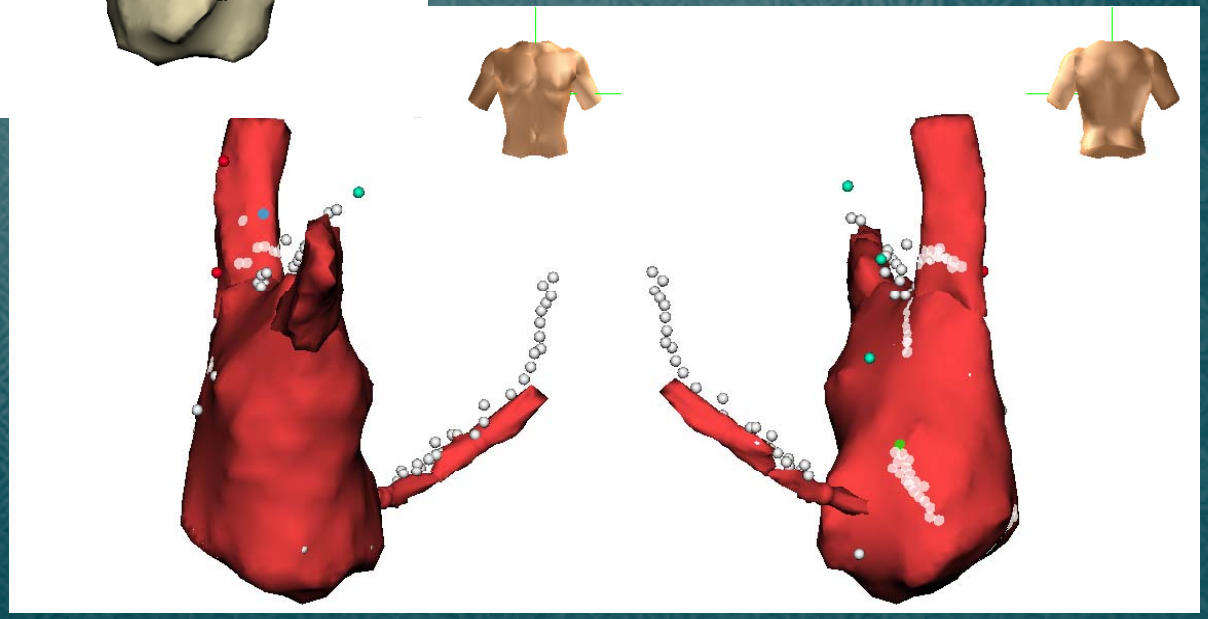


Segmental ablation for SVC isolation with Navx



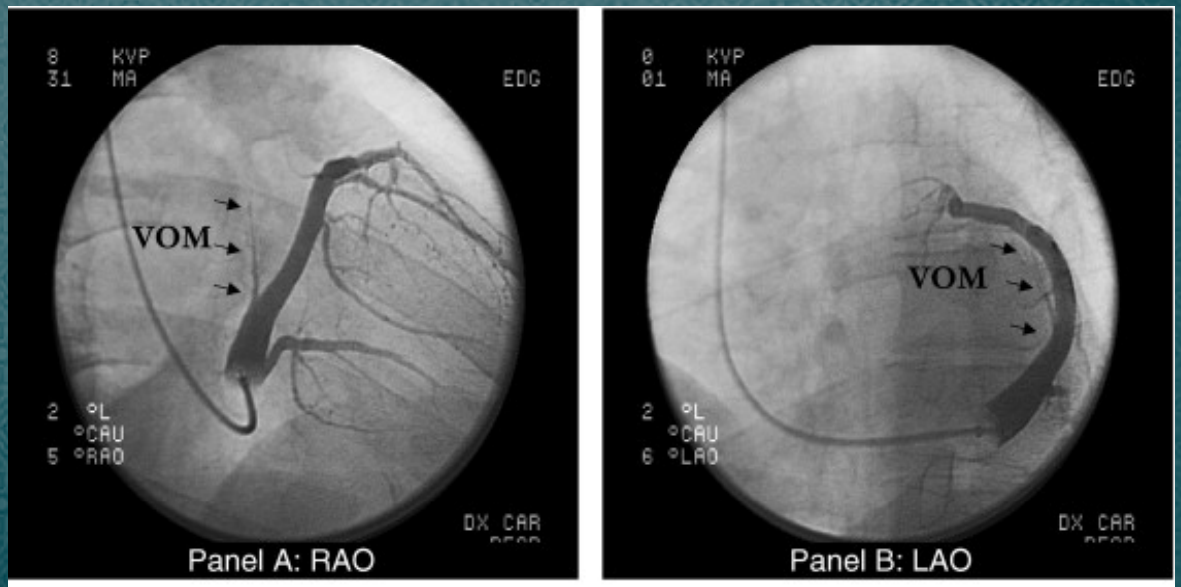
Activation map during sinus rhythm to avoid sinus node injury





Ligament of Marshall (LOM)

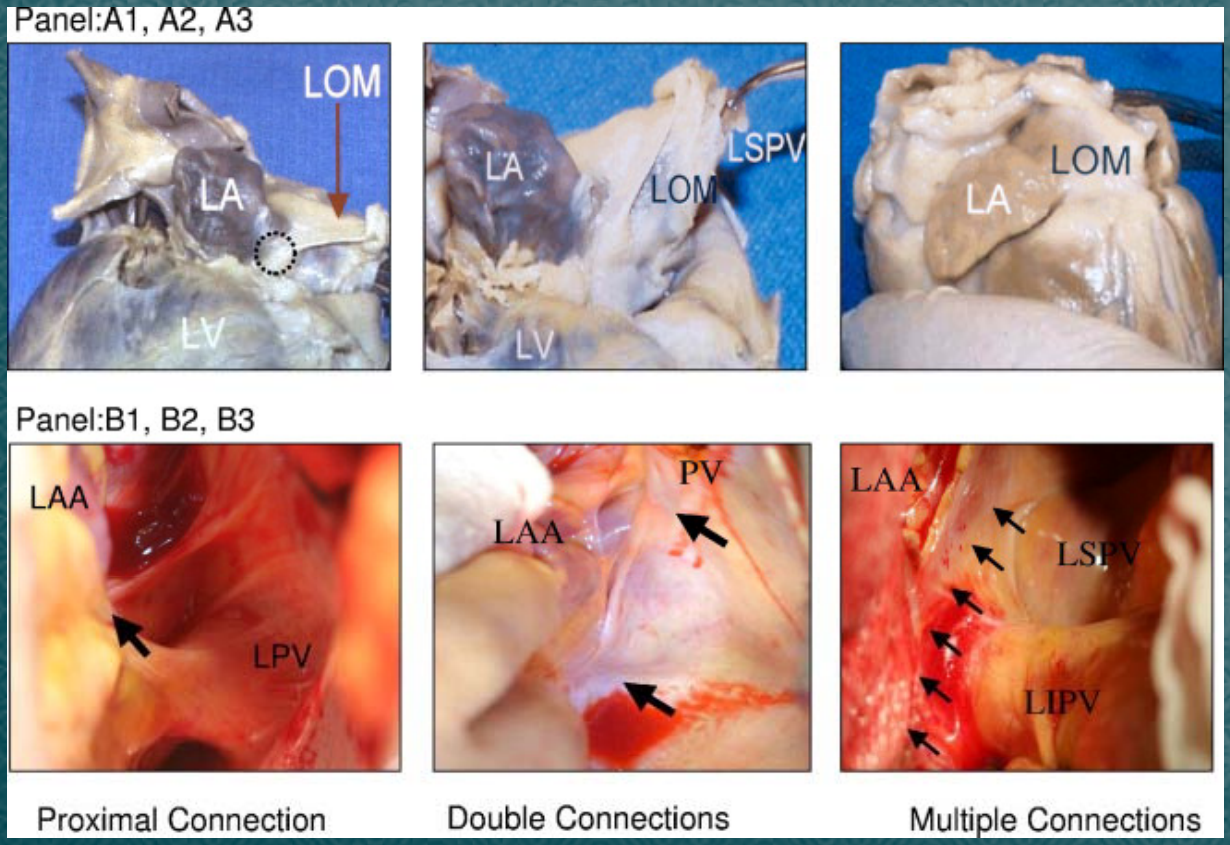
- Remnant of the left SVC
- Contains nerve, fibrous tissue and muscle bundle
- Serve as enhanced automaticity and reentry
- Frequent source of pAf in a young man with adrenergic Af



VoM Mapping: Occlusive CS Venogram &Vein of Marshall

LOM

- located in the epicardial aspect of the left lateral ridge and variable connection to LA free wall



Whang C. Heart Rhythm 2009

LOM potential at LIPV

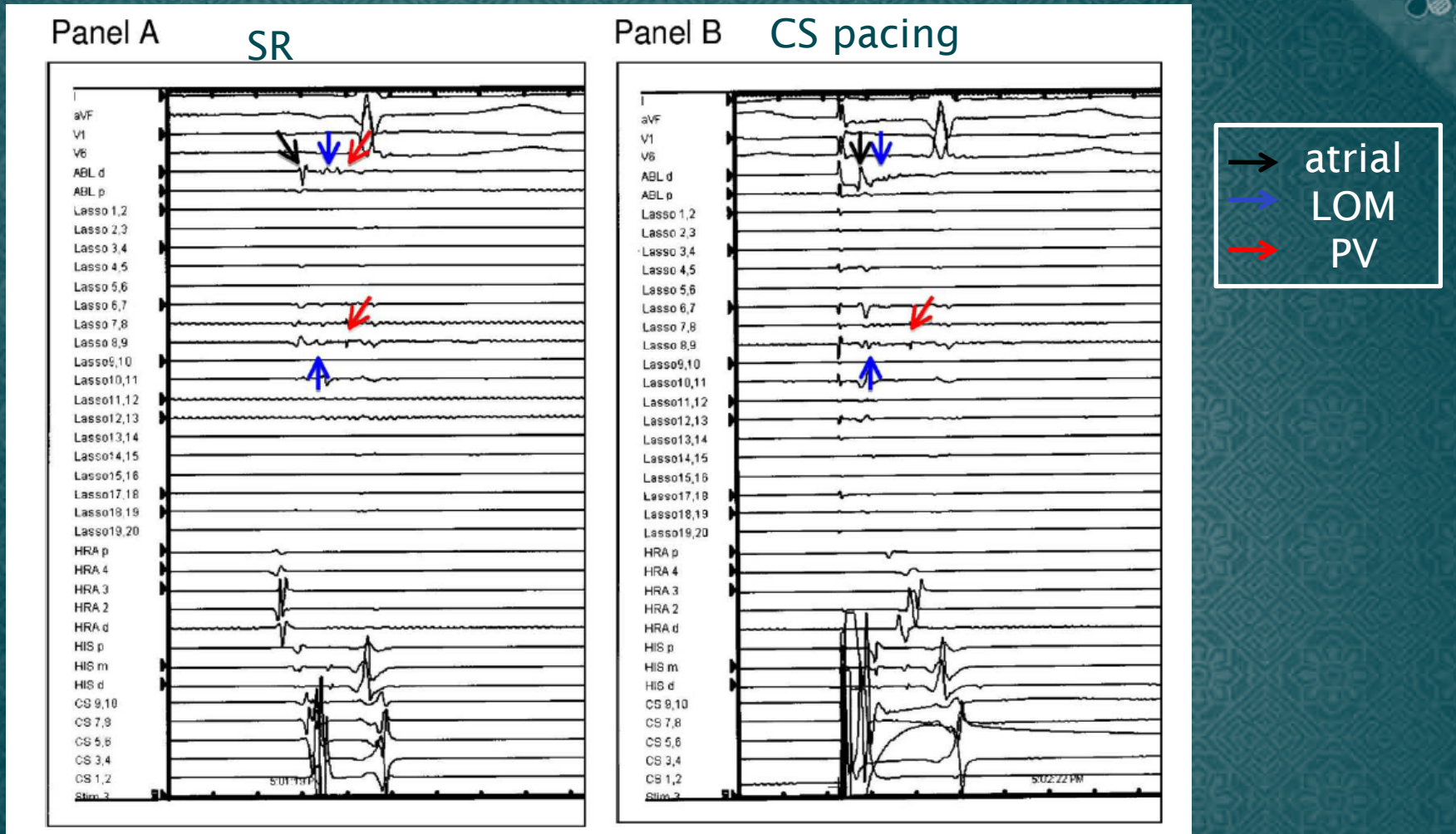
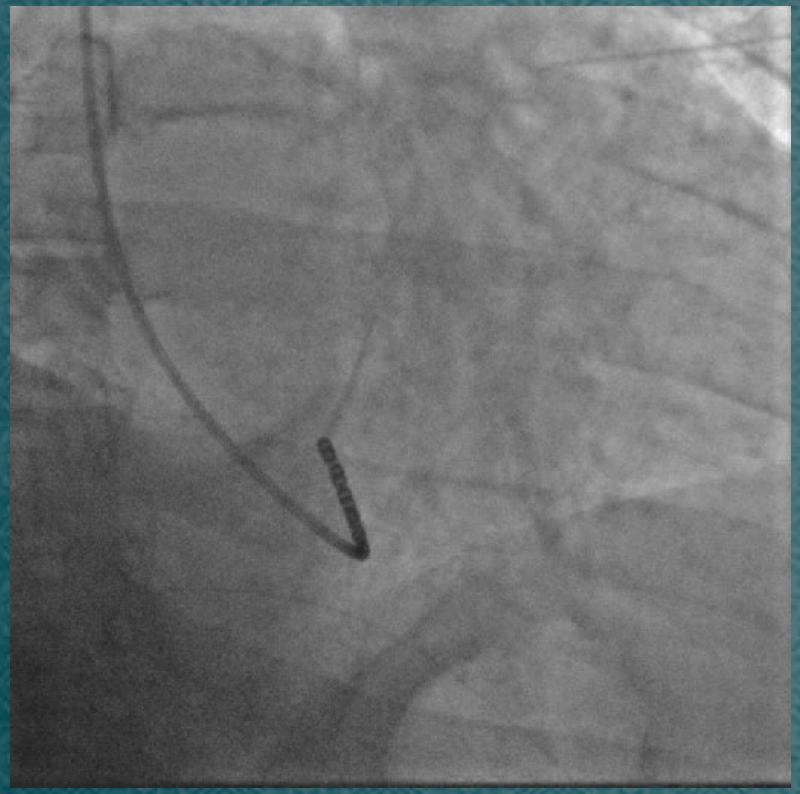


Figure 4 The LOM potential recorded from the left inferior pulmonary vein. **A:** Intracardiac electrograms during sinus rhythm from patients who had previously undergone unsuccessful ablation of AF. The ablation electrograms registered triple potentials. The local atrial electrogram (black arrows), LOM potentials (blue arrows), and residual PV potential (red arrows) are shown. **B:** Electrograms during CS pacing. Note that local atrial electrograms and LOM potentials are merged during pacing. However, the sequence and timing of the PV potentials are unchanged. Abbreviations as in Figure 1.

When to map LOM

- The earliest activation of ectopic beats is in the mid or distal CS, and double potentials are present at those sites.
- The earliest endocardial activation is located inside the left PVs but the PV potential during triggered beats precedes the LA potential by <45ms
- EP study after complete PV isolation shows that a left PV PAC seem to have triggered AF, but no left PV trigger can be found despite careful mapping.

Method of VOM cannulation



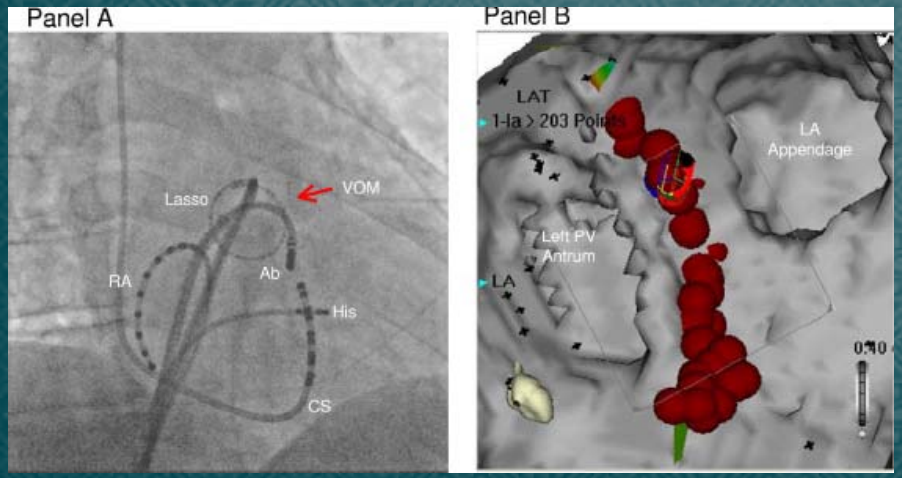
Right anterior oblique view of selective VOM angiogram

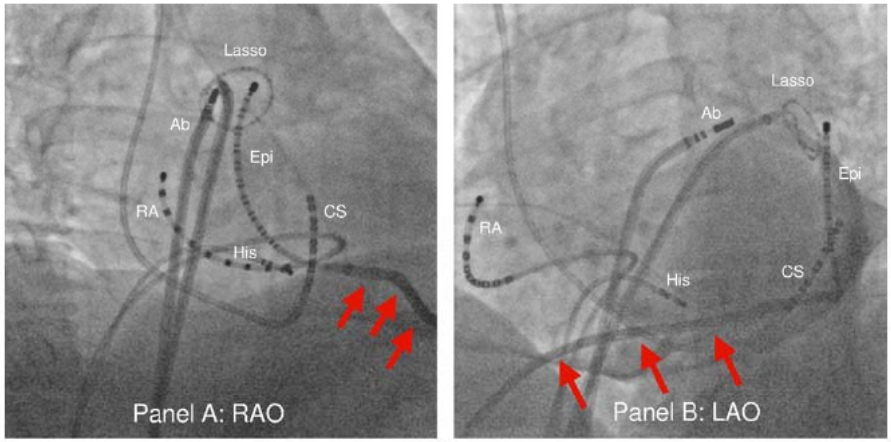
Advancement of a 1.4-F mapping catheter from the coronary sinus into the VOM under fluoroscopic guidance.

LOM Potentials Before and After Radiofrequency Catheter Ablation in a Patient with Multiple LOM Connections

Ablation of LOM

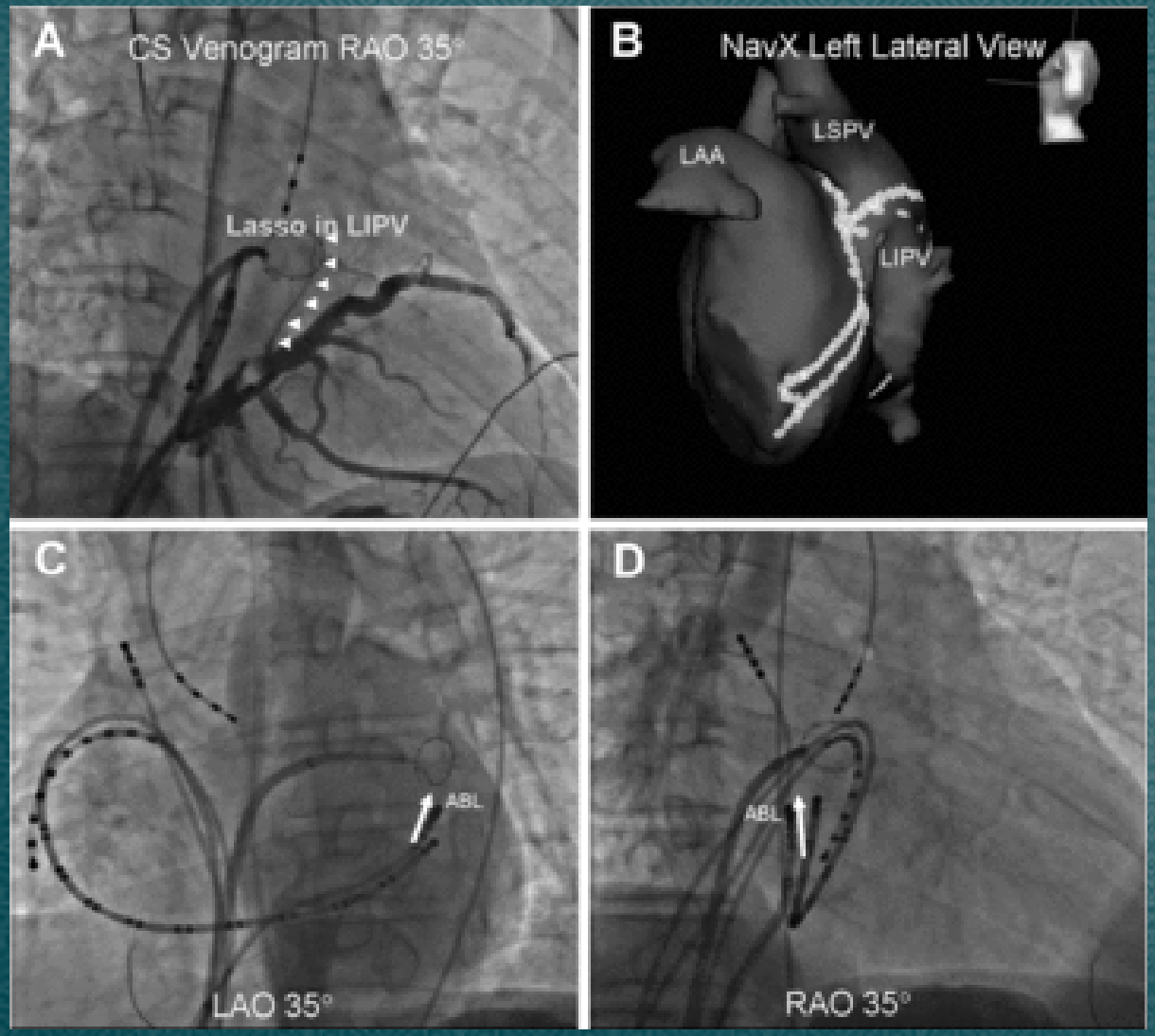
- LOM ablation could be performed endocardially along the VOM in most cases.
- Additional ablation within the distal coronary sinus (os of VOM) showed better clinical outcome.
- Sometimes it requires epicardial approach by pericardial puncture.





LOM Epicardial Mapping

VOM guided mitral isthmus ablation



Coronary Sinus (CS)

- Coronary sinus musculature connect between the right and left atrium by circumferential and oblique muscle cuff.
- Arrhythmogenic focus by automaticity, reentry and conducting pathway for macro-reentrant arrhythmia

CS in maintaining Af

- During stepwise approach for persistent Af, CS ablation prolong the Af CL by 8.9±9.7ms in 57% of pts Haissaguerre M et al. JCE 2005
- Other study for the effect of CS ablation on Af ablation showed that 35% of paroxysmal and persistent Af terminated during CS ablation

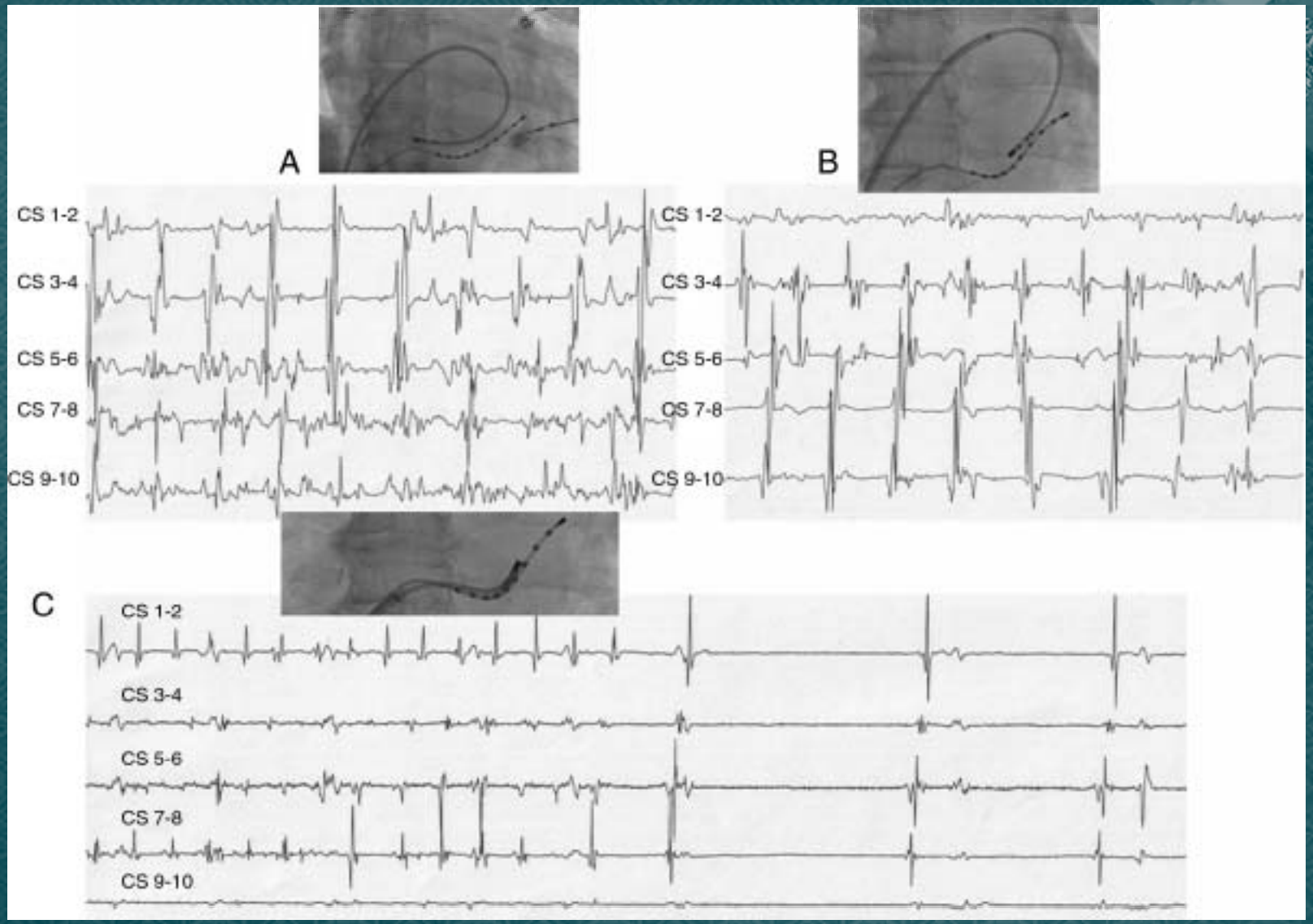
Haissaguerre M et al. JCE 2007

Ablation of CS

Haissaguerre M et al. JCE 2007

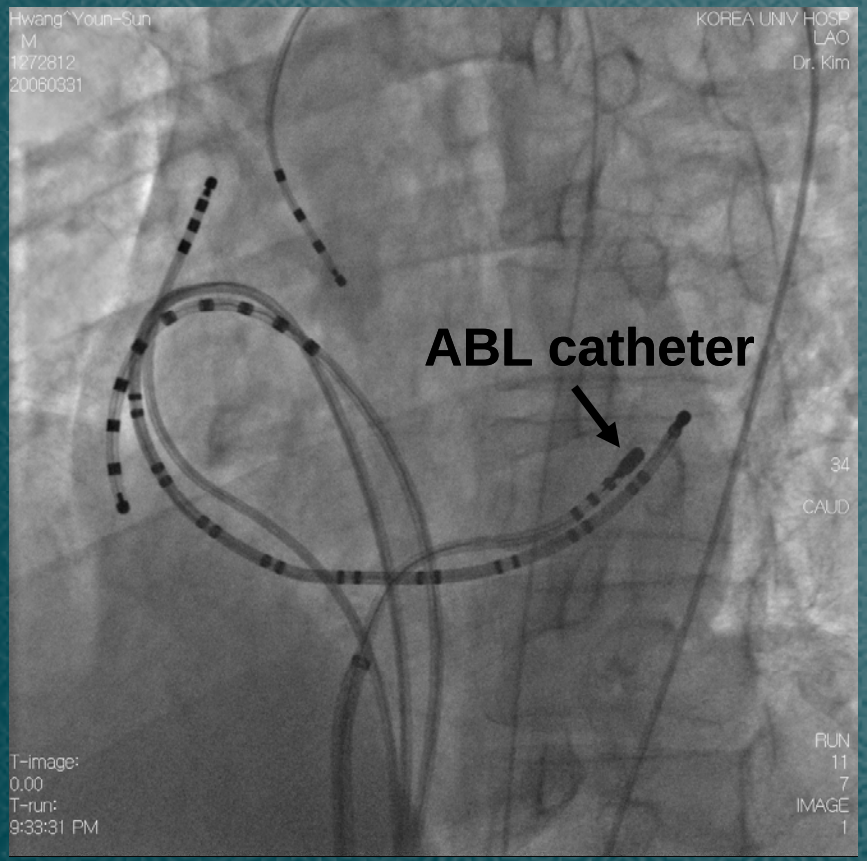
Ablation of CS

- Ablation within the CS is performed at all sites showing persistent rapid potential with a cycle length shorter than in the LA.
- RF energy is limited to 20W distally, often associated with high impedance requiring the maximal irrigation flow (60ml/min)

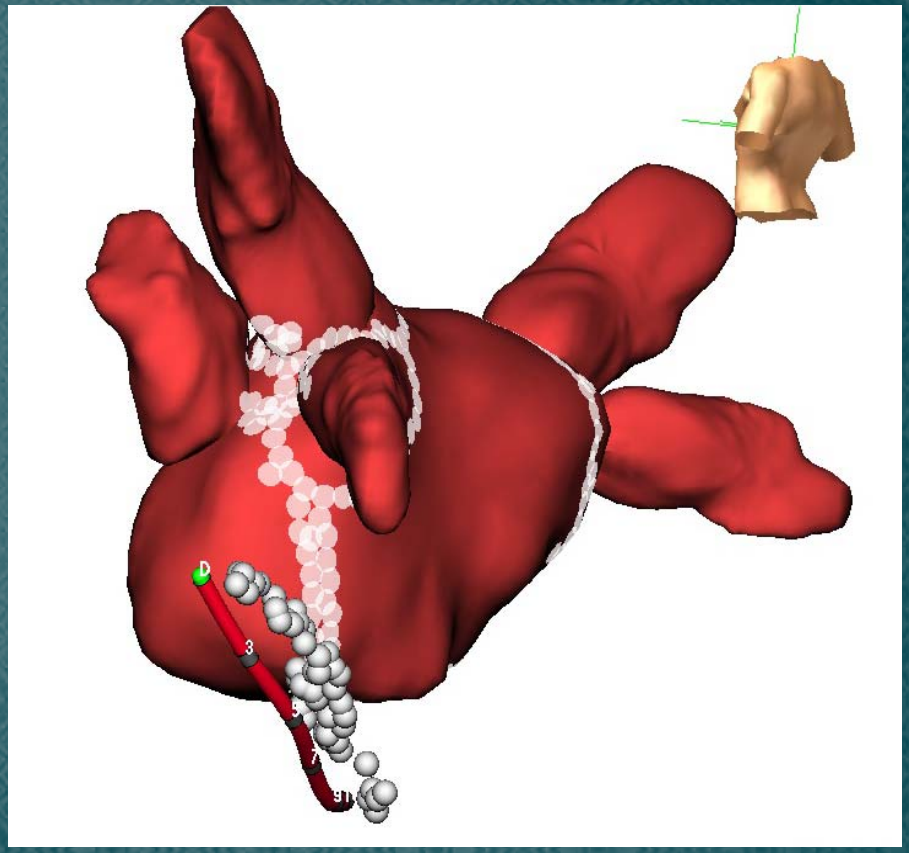


Haissaguerre M et al. JCE 2007

Ablation of CS

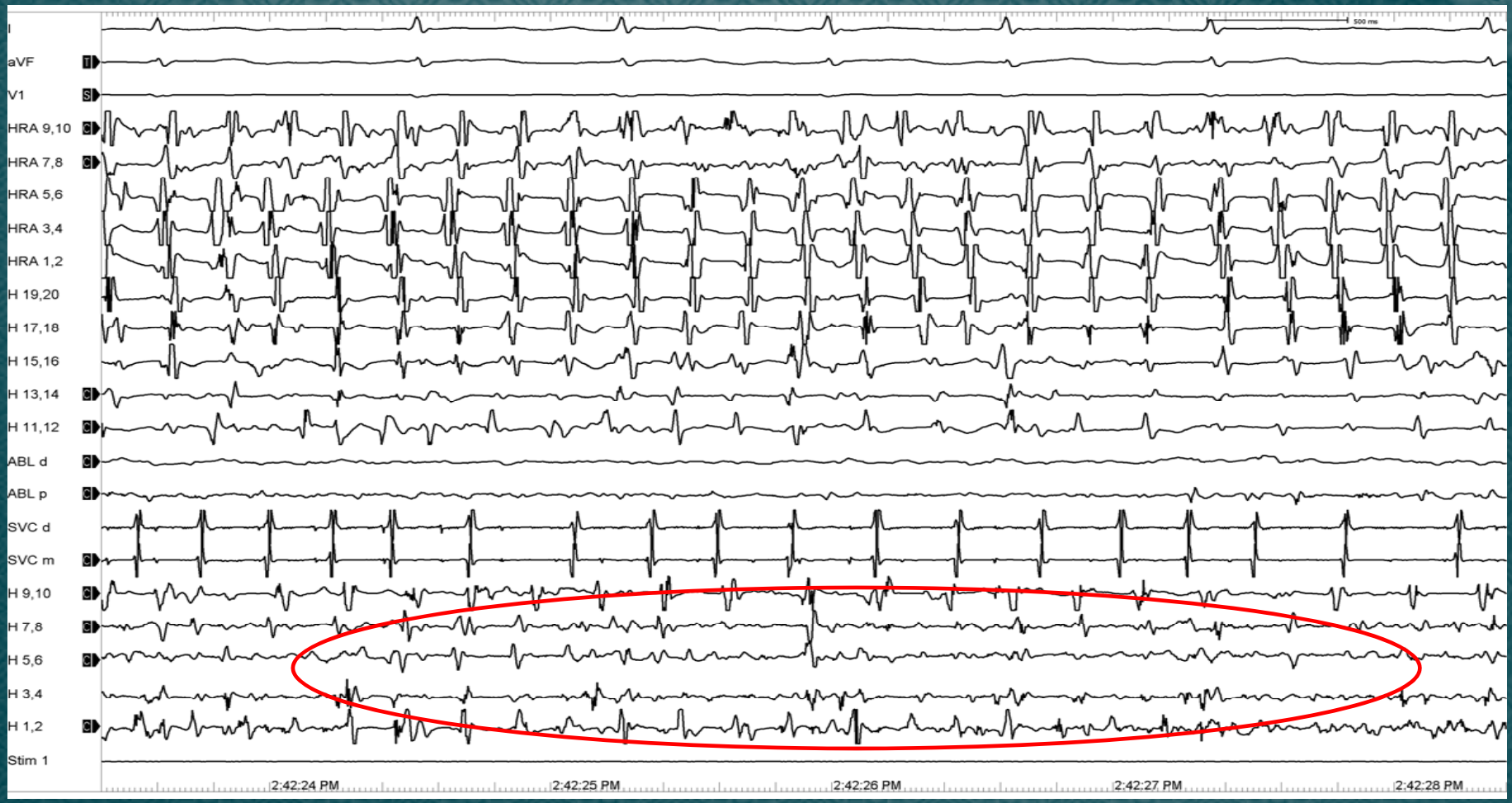


LAO 35°

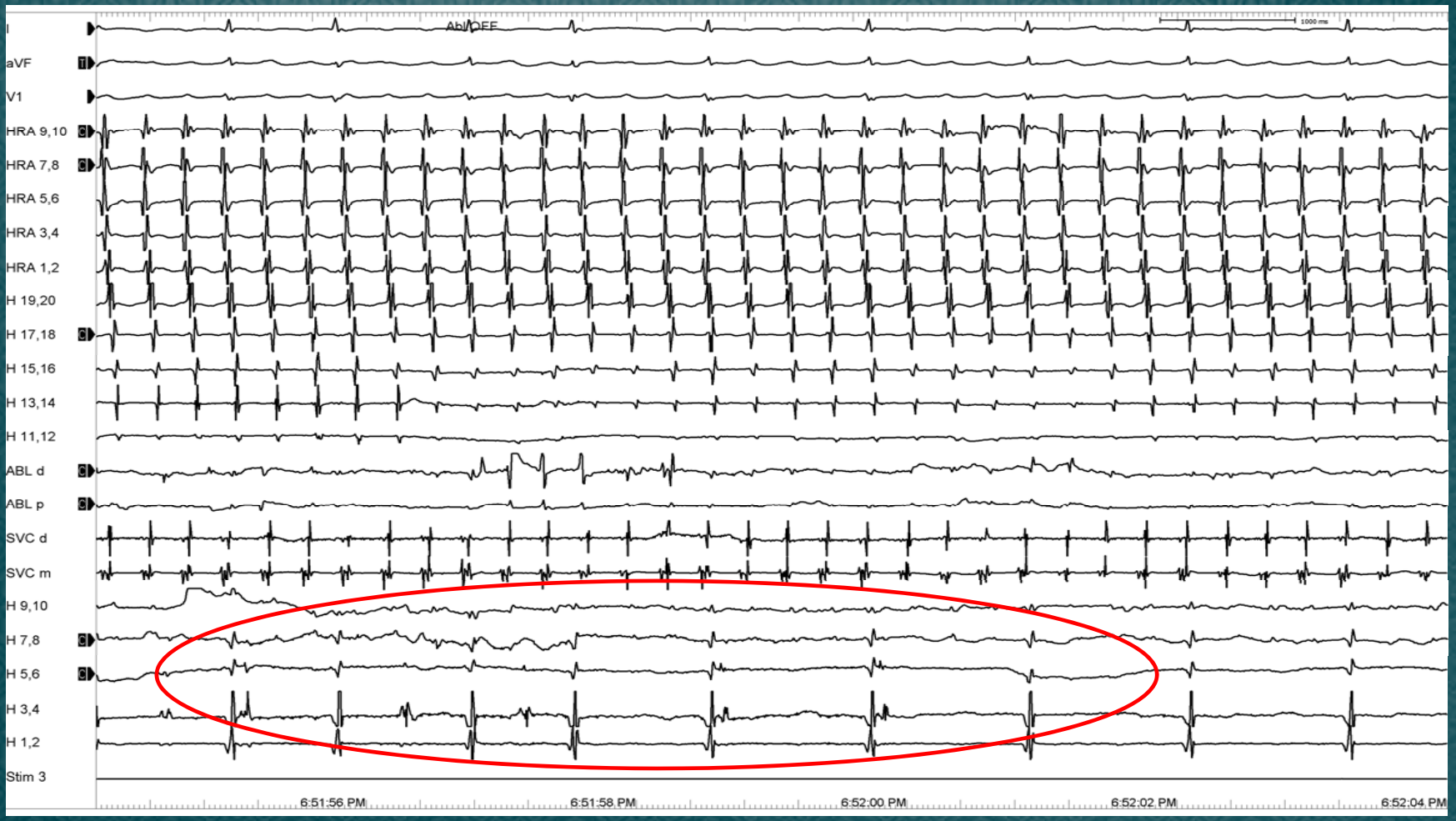


NavX

Rapid and fragmented potential in the CS during Af



Organized during ablation within the CS- CS potential disappeared



Endpoint of CS ablation

- The endpoint is slowing of CS potential below the LAA CL rather than abolition of potential, which showed little additional benefit.

Haissaguerre M et al. JCE 2005

- Ablation within the distal CS might injury to left circumflex artery.

Conclusion

- Non PV foci could initiate and maintain electrical activity that manifests as AT or Af.
- Identification and ablation of non-PV foci initiated/maintain AF increase the efficacy of RFCA for the various subsets of AF.

Thank you for attention