

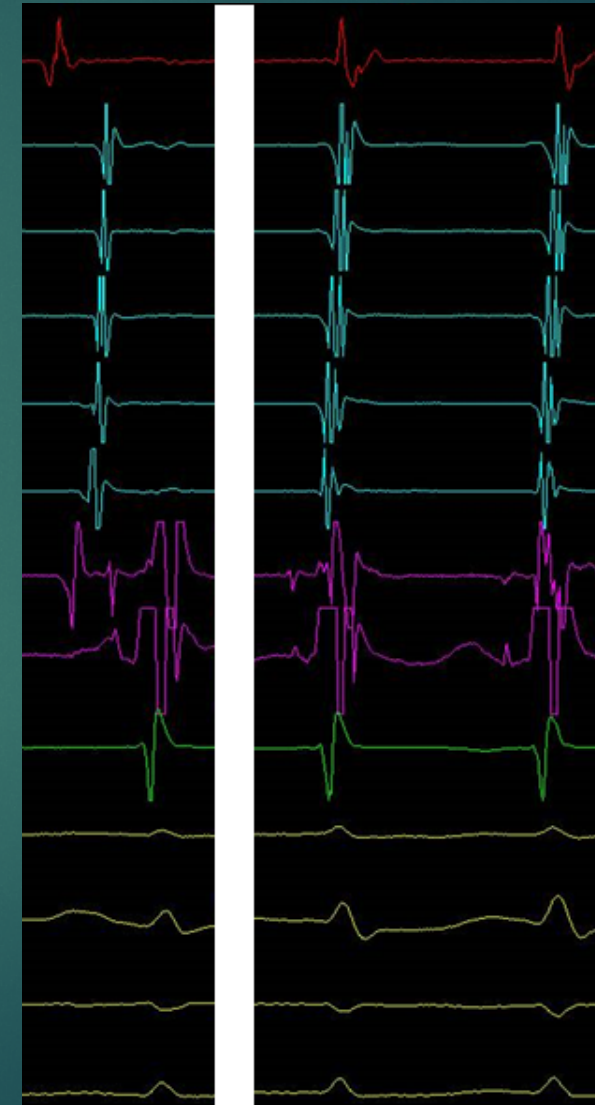
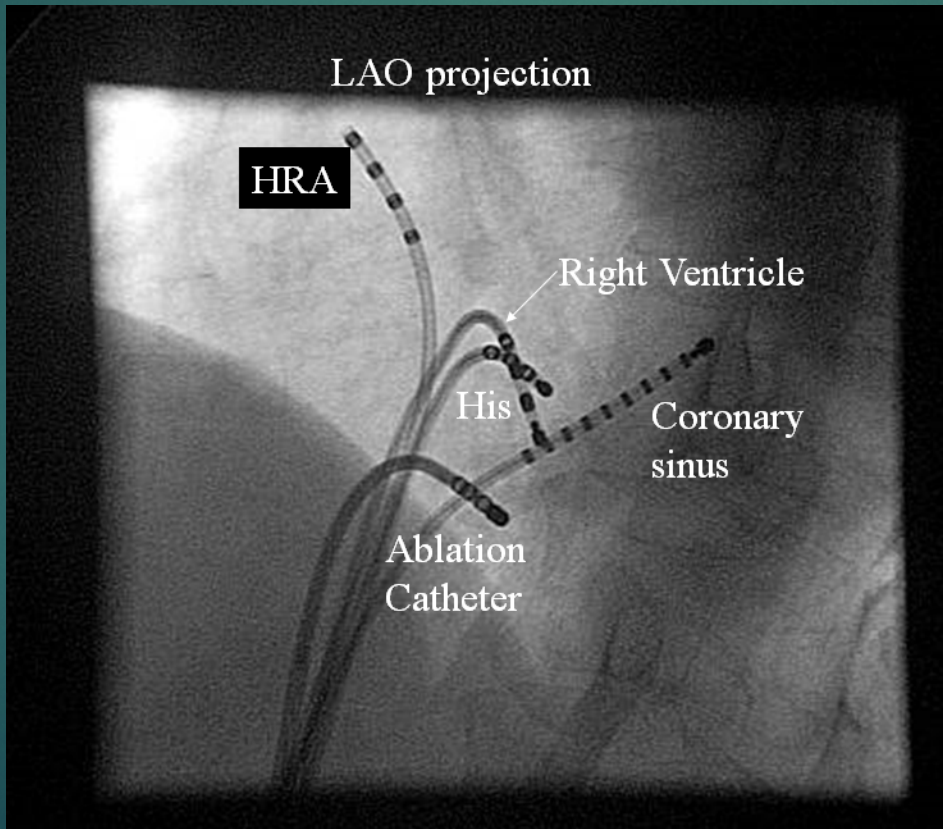


Complex Arrhythmias

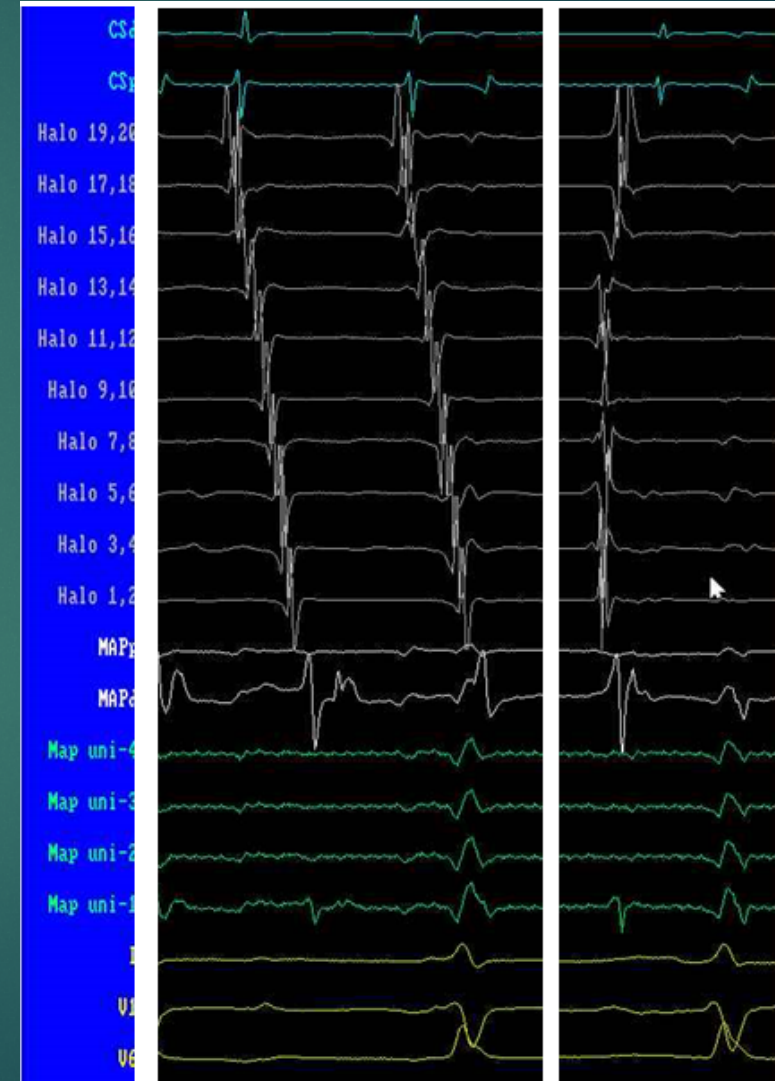
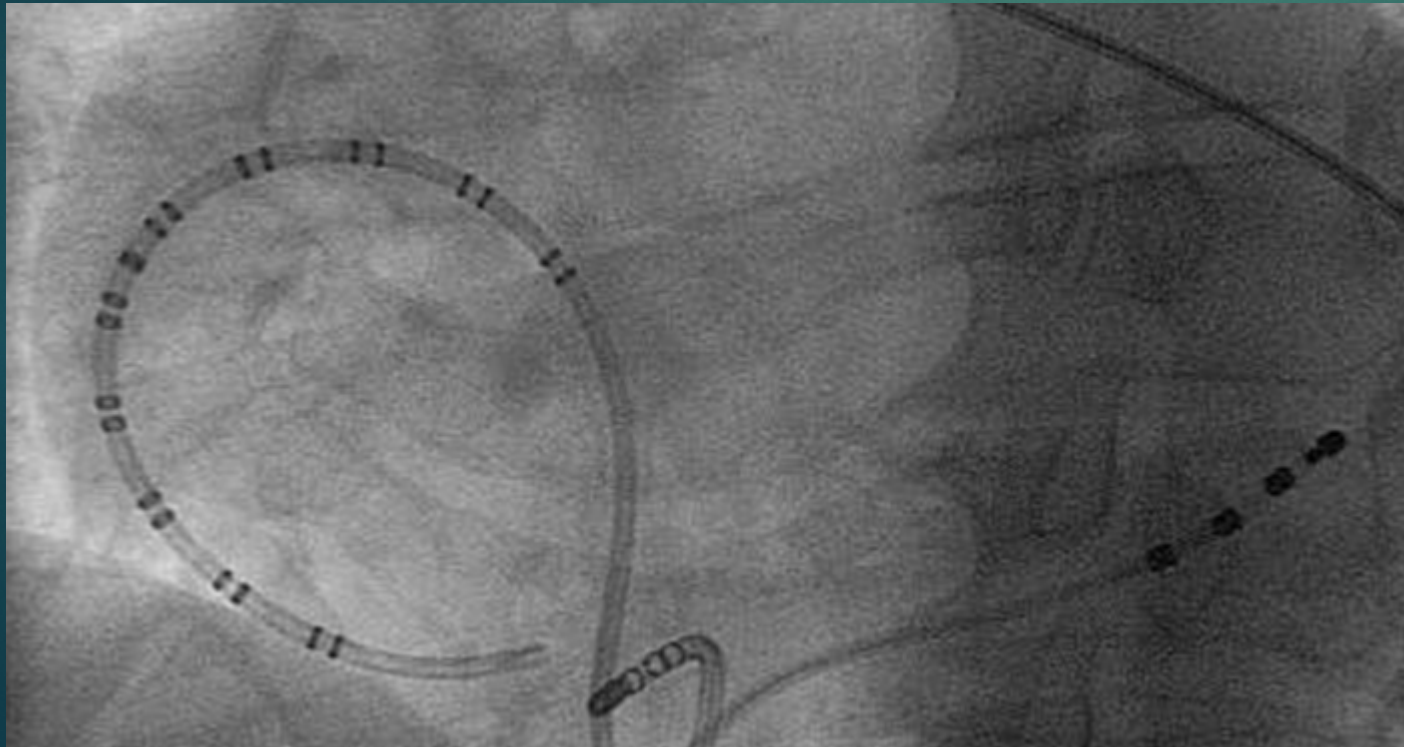
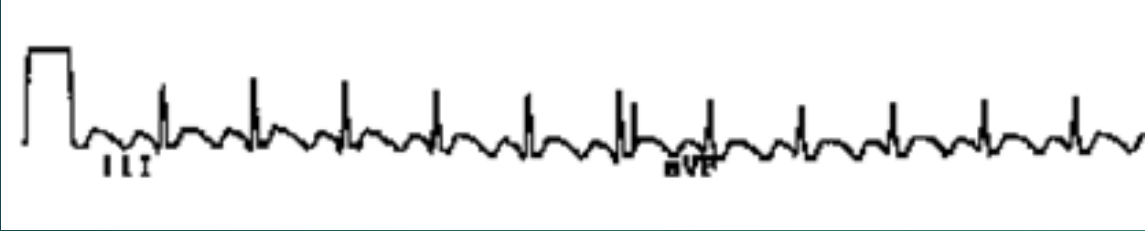
PRAPA KANAGARATNAM

IMPERIAL COLLEGE HEALTHCARE

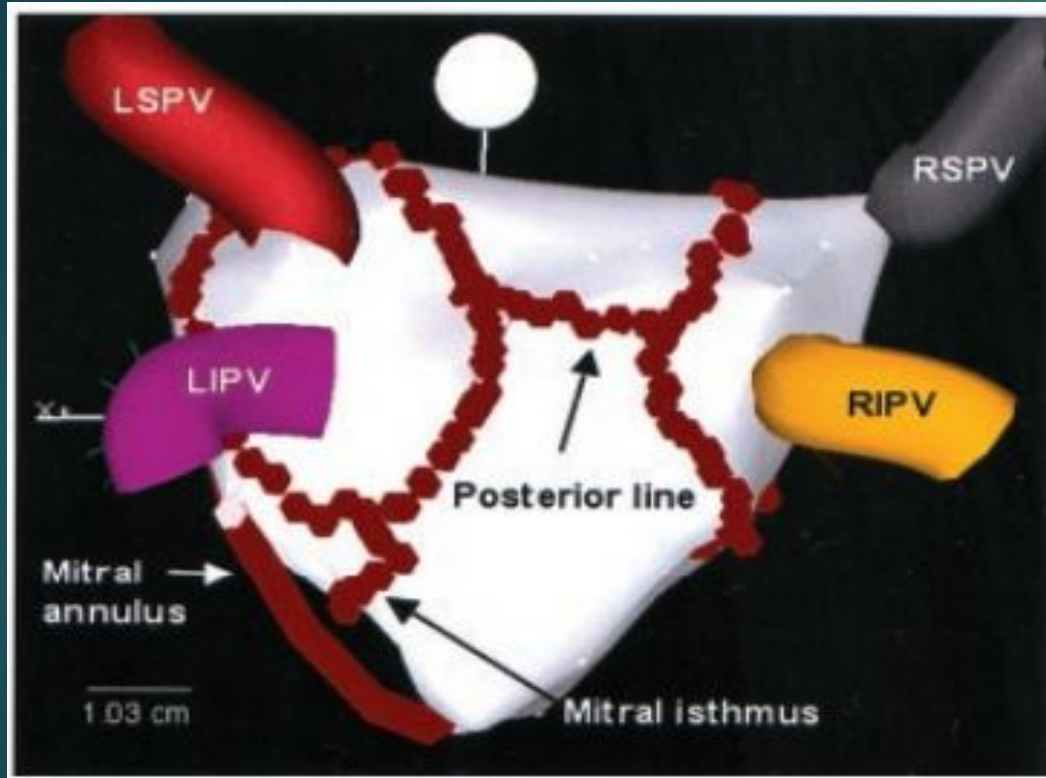
AVNRT- a 'simple' arrhythmia



CTI-dependent flutter – a ‘simple’ arrhythmia

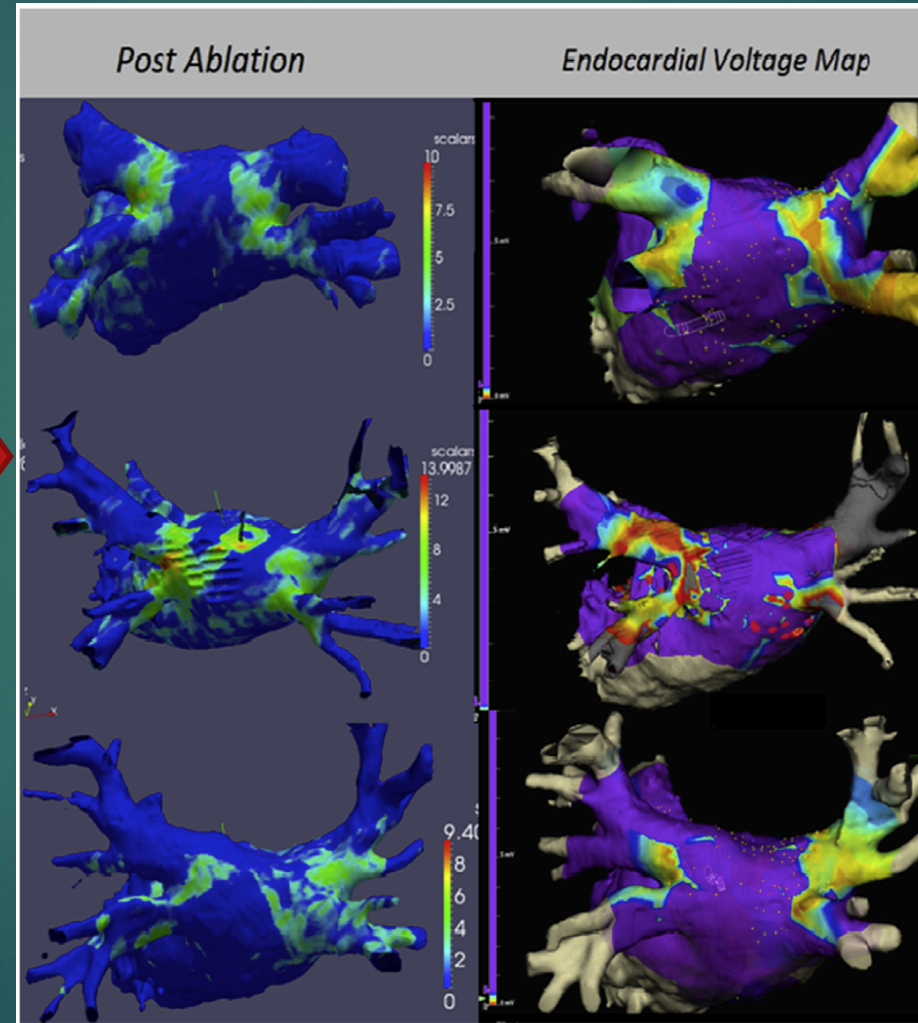
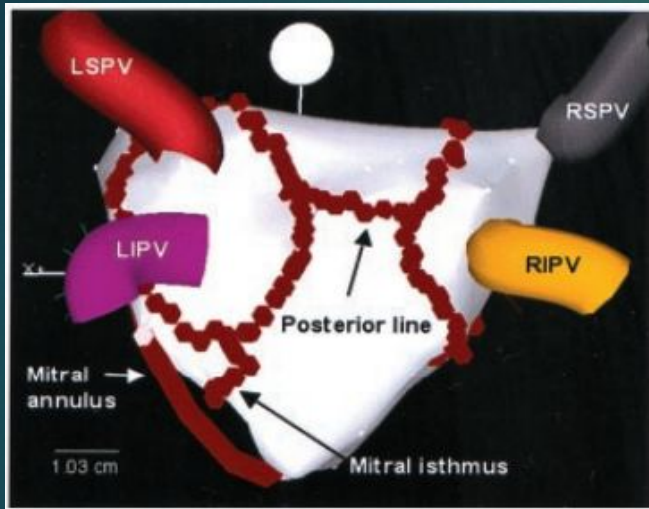


'Complex' Arrhythmias : 3D-Navigation Systems (CARTO, NavX)

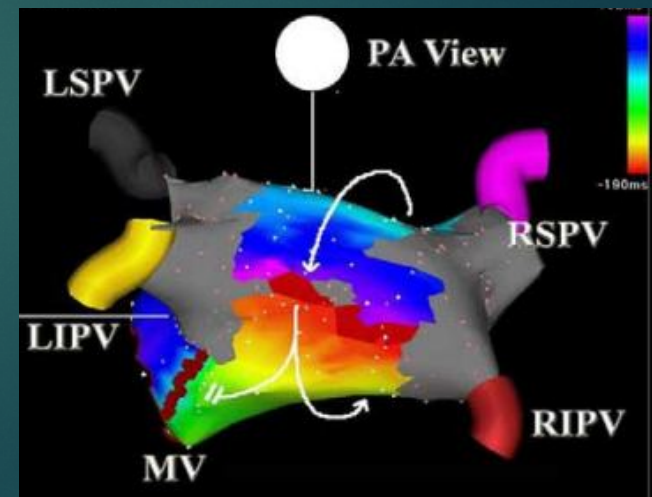
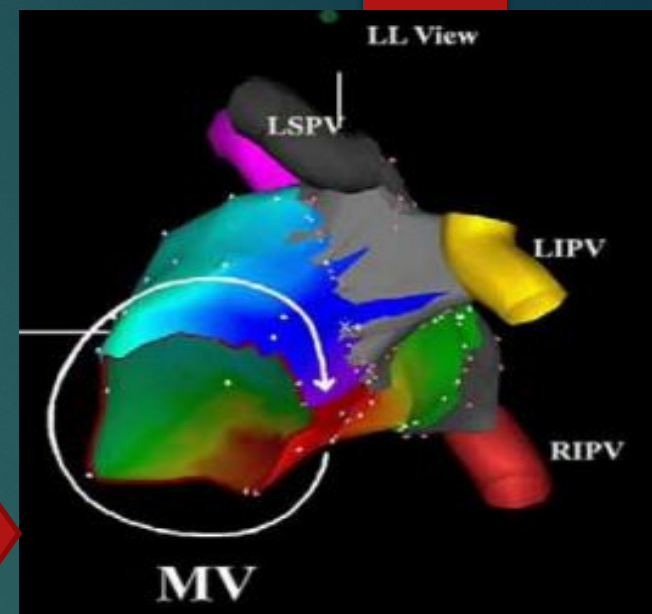
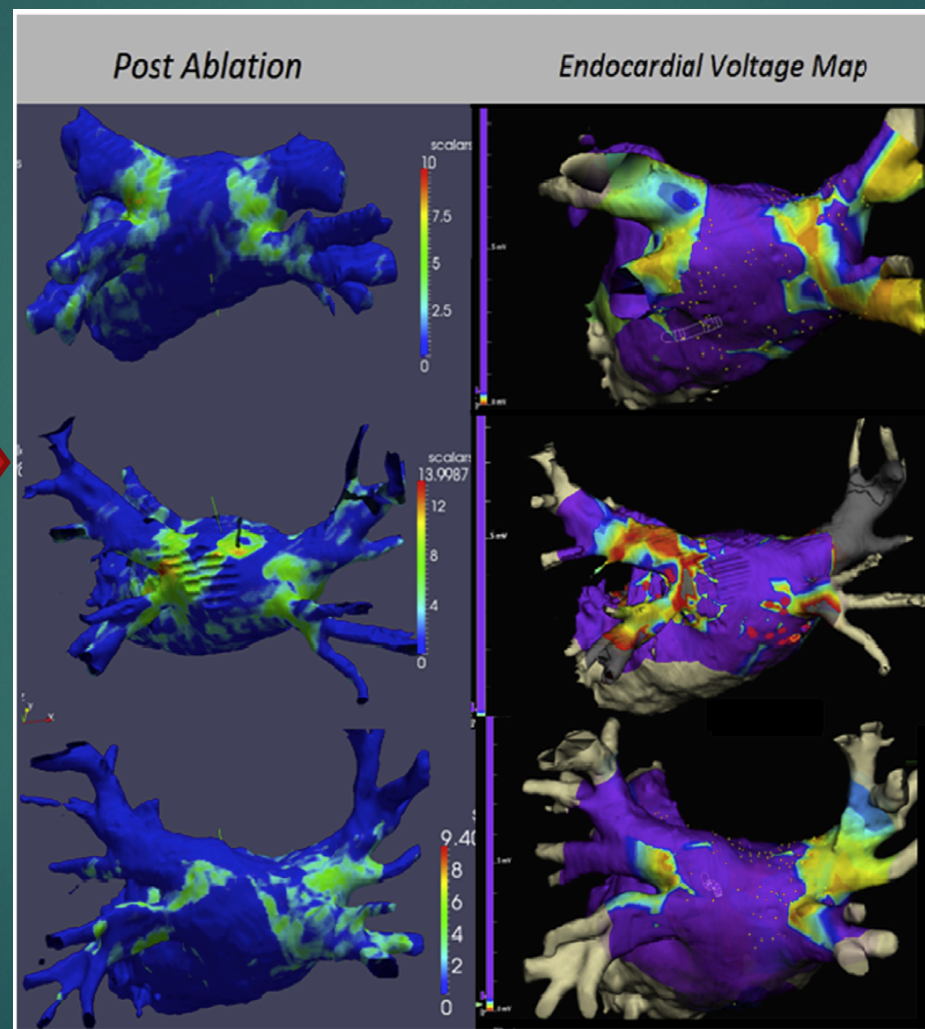
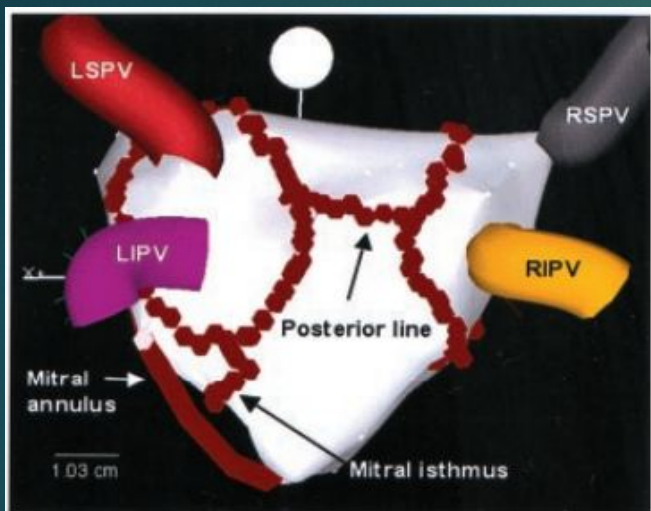


- 3D Catheter localisation enabled;
 - a) 3D geometry to be created
 - b) contiguous ablation lesions to be recorded
- Circumferential linear lesions to produce pulmonary vein isolation by antral ablation in the treatment of Atrial Fibrillation
- Rapid increase in number of AF ablations performed

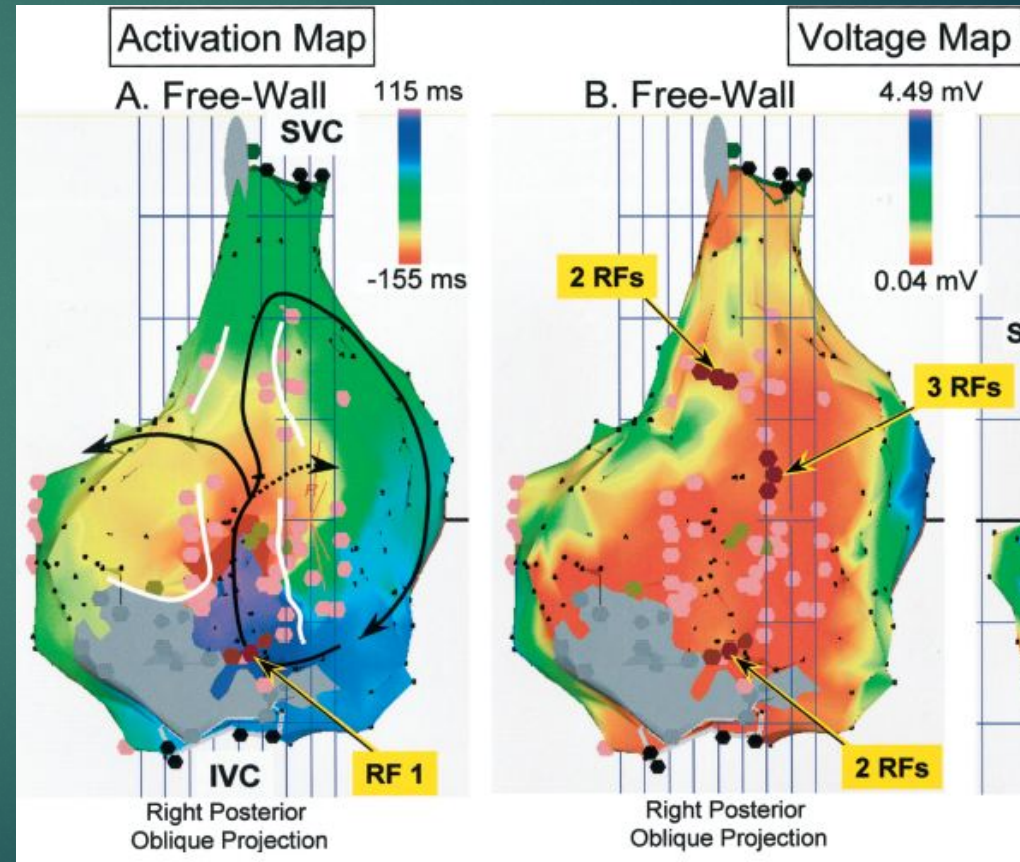
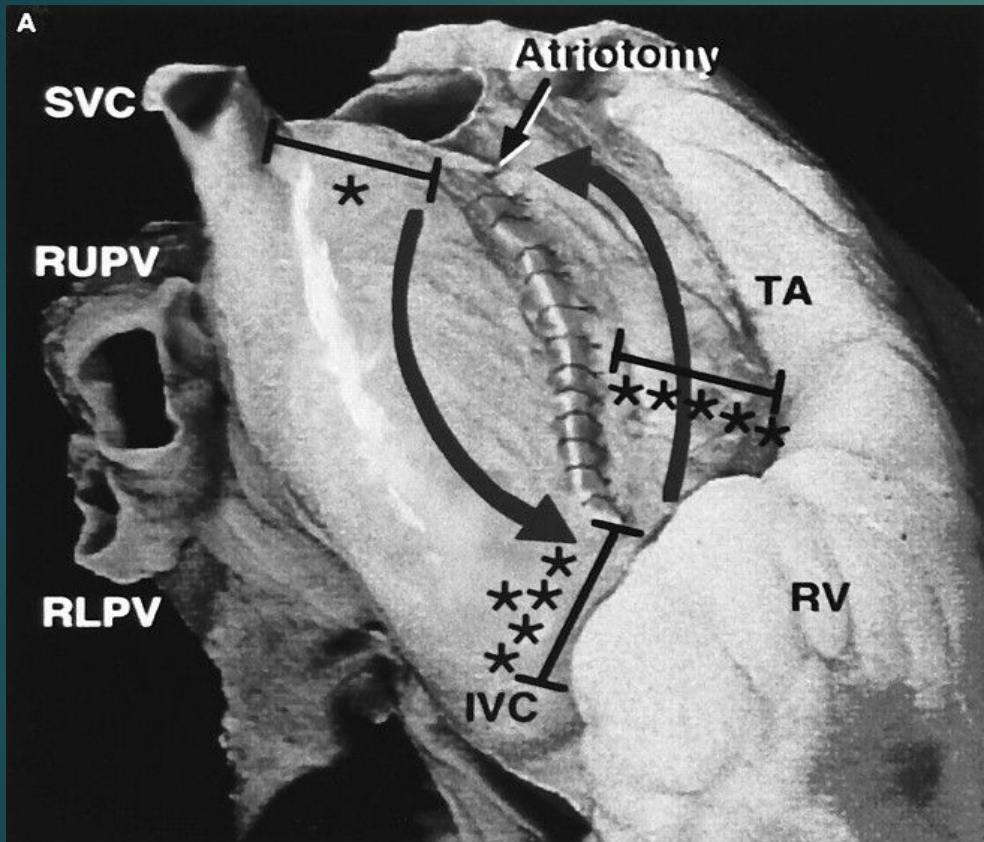
AF ablation produces unique scarring in every patient



Unique and iatrogenic scar-related tachycardias



Atrial surgery: Unique and iatrogenic atrial tachycardias mapped using 3D mapping system



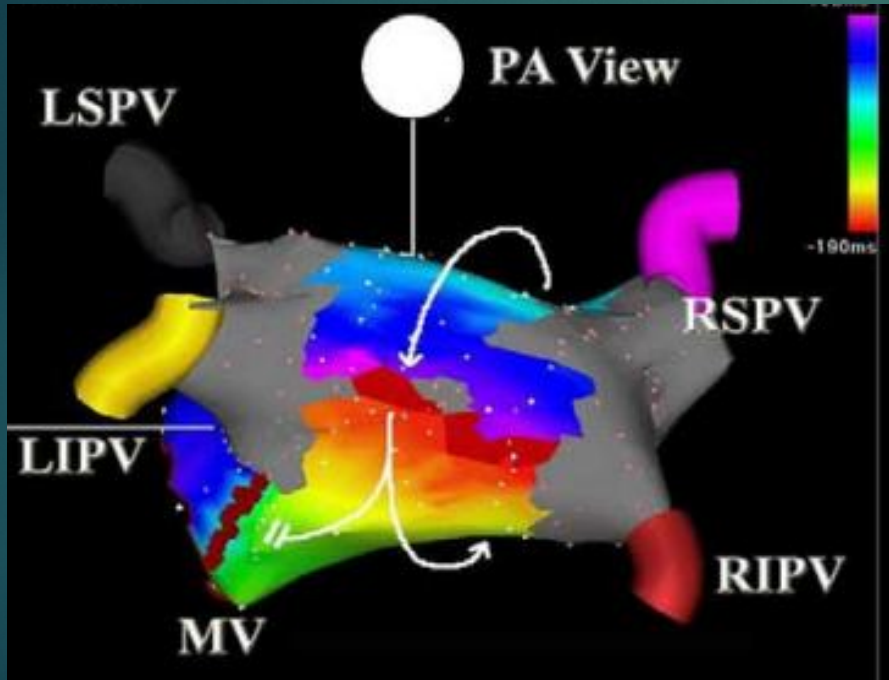
Is atrial tachycardia a complex arrhythmia?

- ▶ No randomised studies comparing techniques
- ▶ 2 multi-centre series (20 patients Anter 2016, 60 patients De Ponti 2005)
- ▶ Largest published series (91 pts) ~80% acute success in 'non-CTI cases' (Coffey, Reddy 2013)

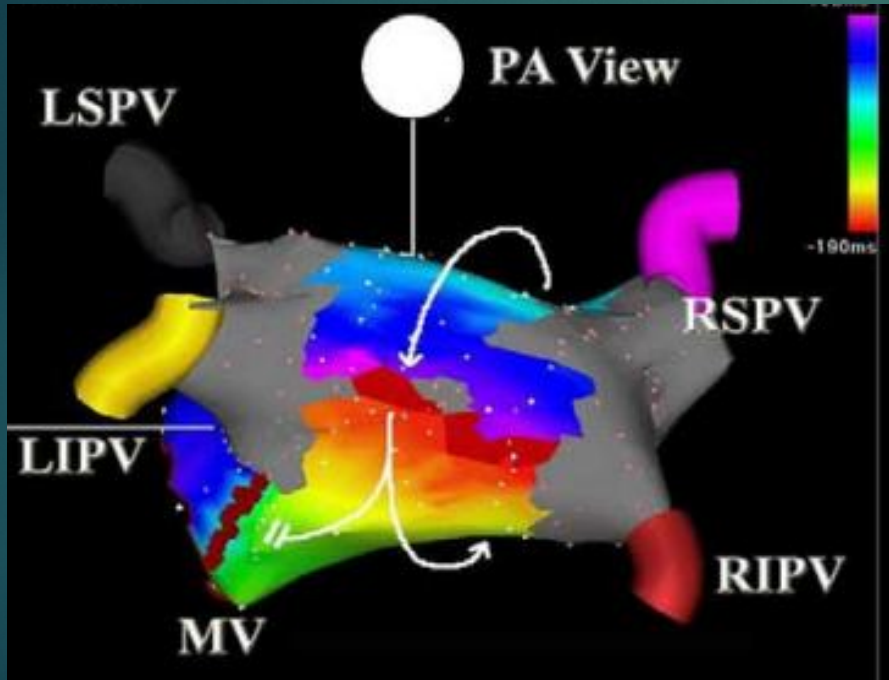
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- ▶ Largest published series (91pts) ~80% acute success in 'non-CTI cases' (Coffey, Reddy Europace 2013)
- ▶ However, we do not know how many;
 - ▶ ATs terminate before ablation
 - ▶ ATs terminate with ablation after 3D mapping diagnosis alone
 - ▶ ATs need additional diagnostic help from entrainment manoeuvres
 - ▶ ATs done with entrainment alone
 - ▶ ATs terminate after multiple sites of ablation

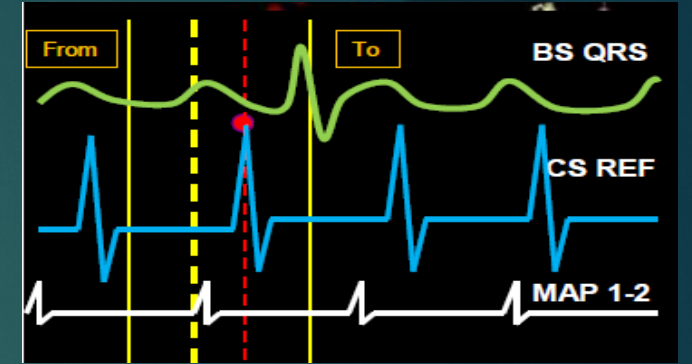
Pitfalls in diagnosing atrial tachycardia mechanism with 3D mapping



Pitfalls in diagnosing atrial tachycardia mechanism with 3D mapping

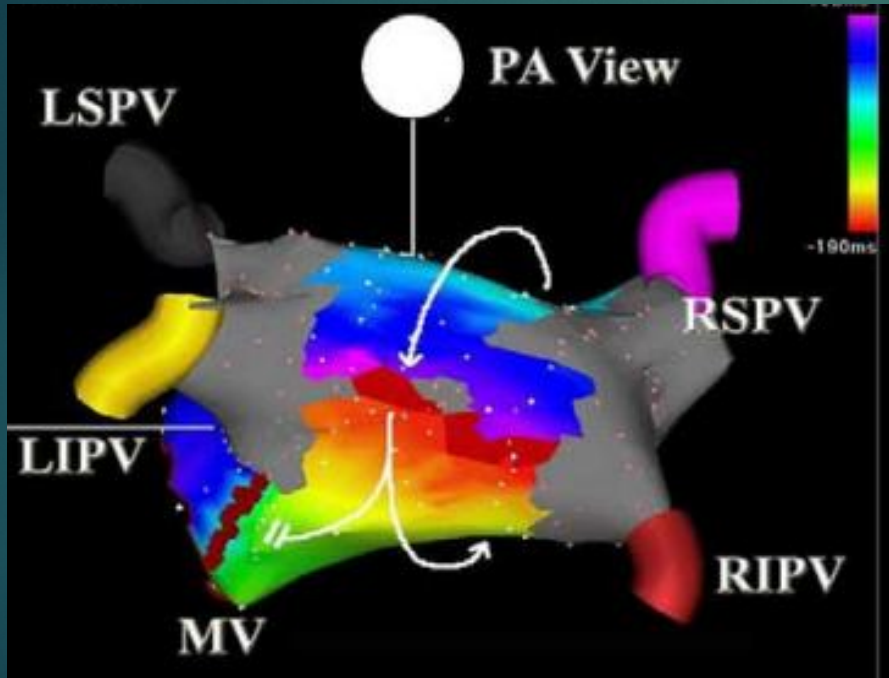


a) Window-of-interest



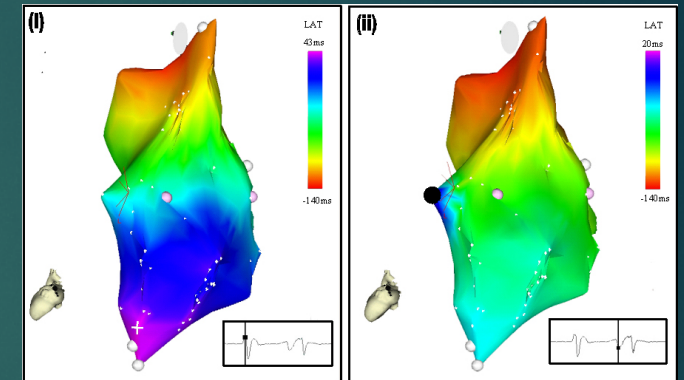
Gepstein, Circulation 1997

Pitfalls in diagnosing atrial tachycardia mechanism with 3D mapping



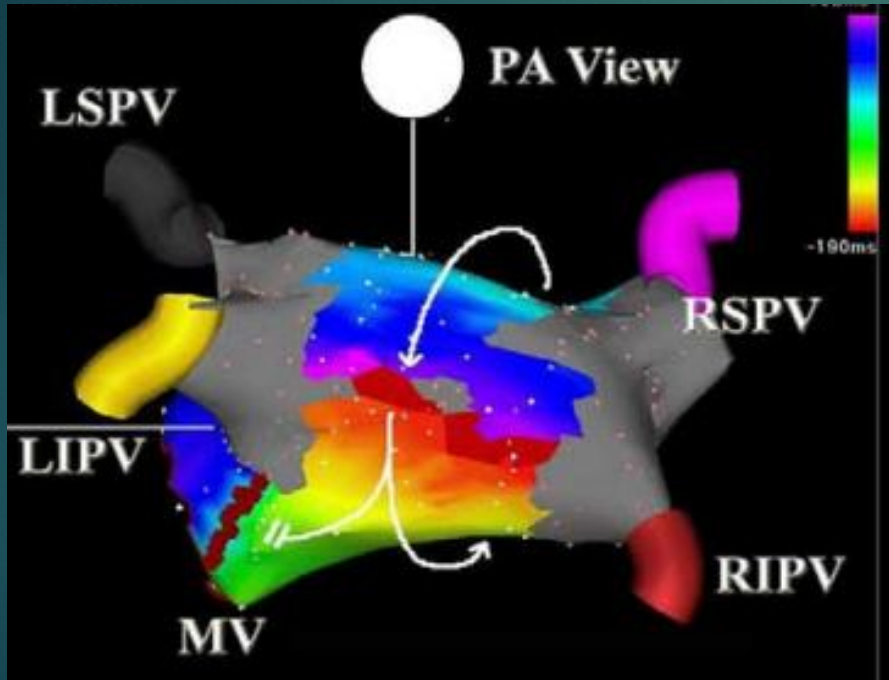
a) Window-of-interest

b) Annotation of LAT



Linton, Heart Rhythm 2009

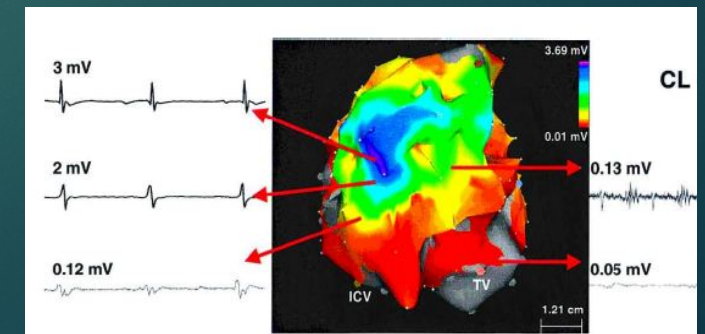
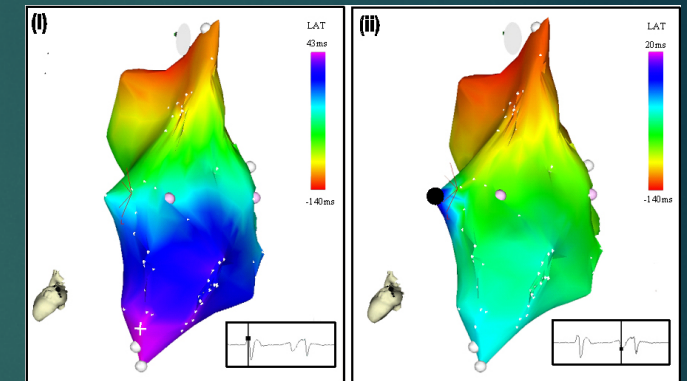
Pitfalls in diagnosing atrial tachycardia mechanism with 3D mapping



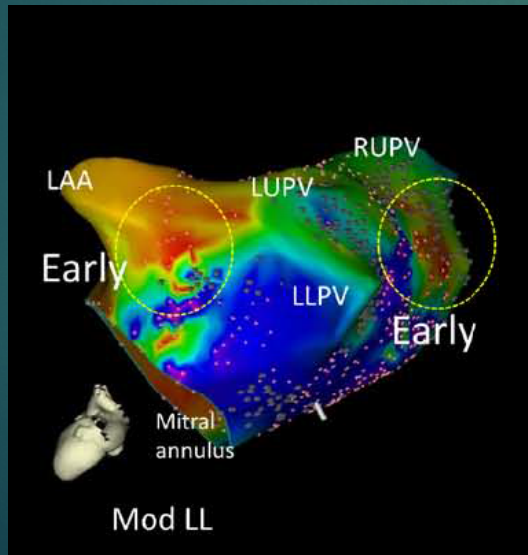
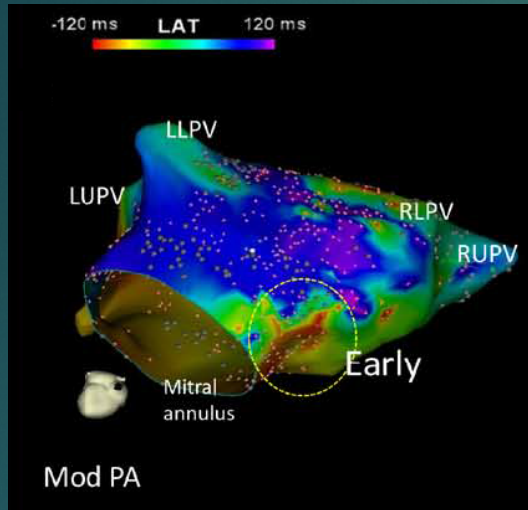
a) Window-of-interest

b) Annotation of LAT

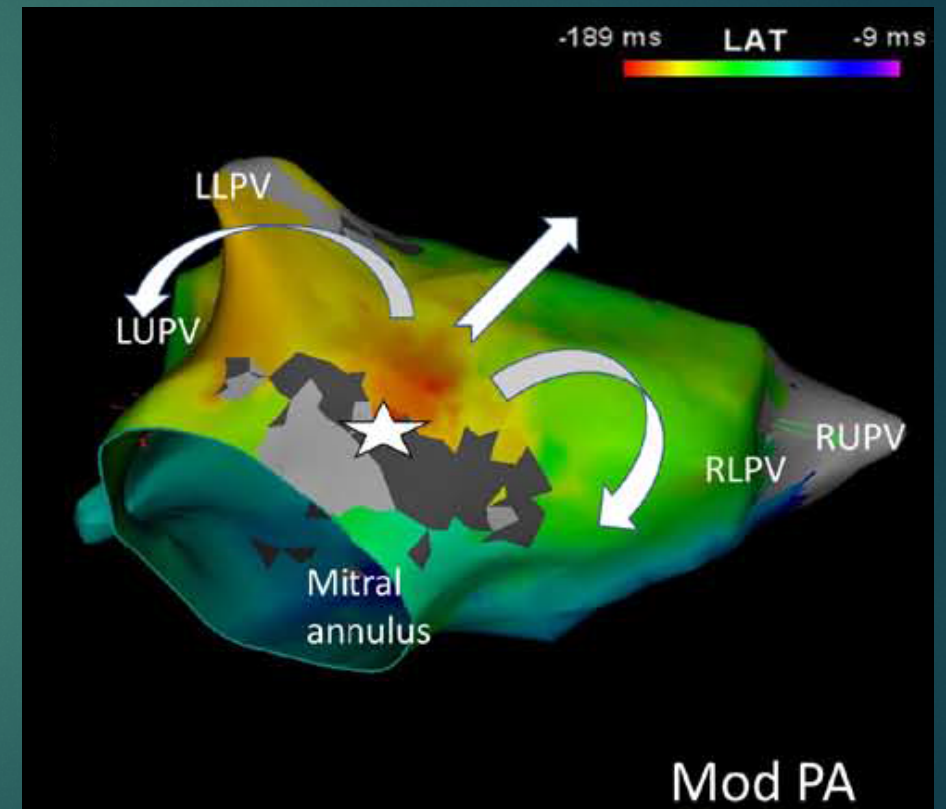
c) 'Functional' scar



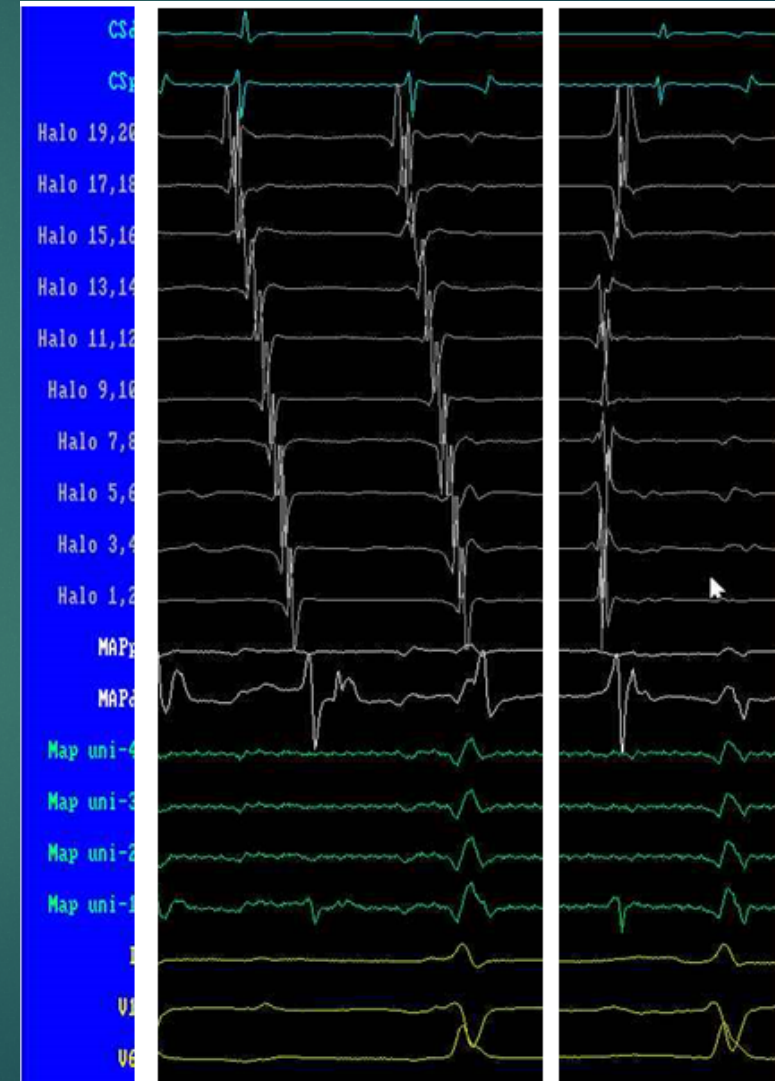
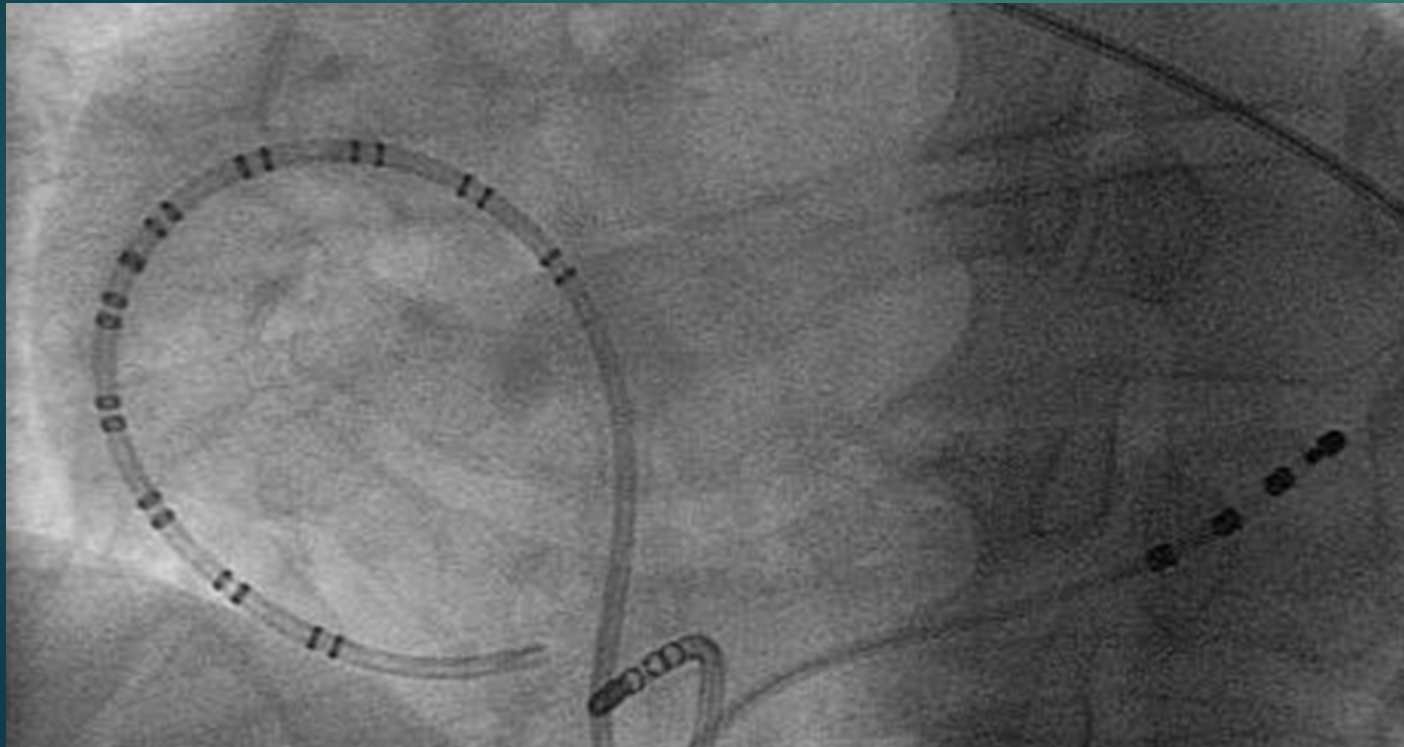
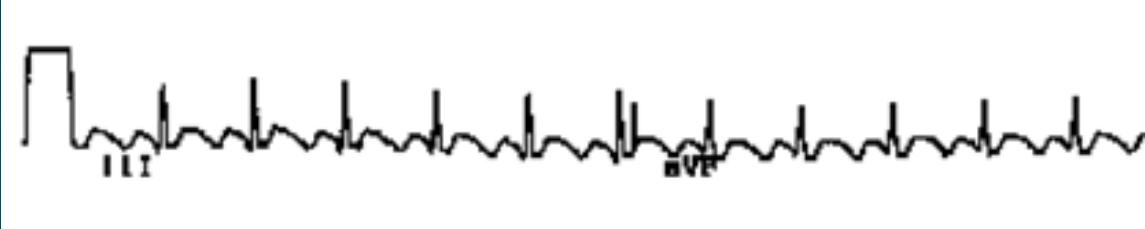
All LAT maps can be re-annotated to show correct diagnosis with enough time and expertise



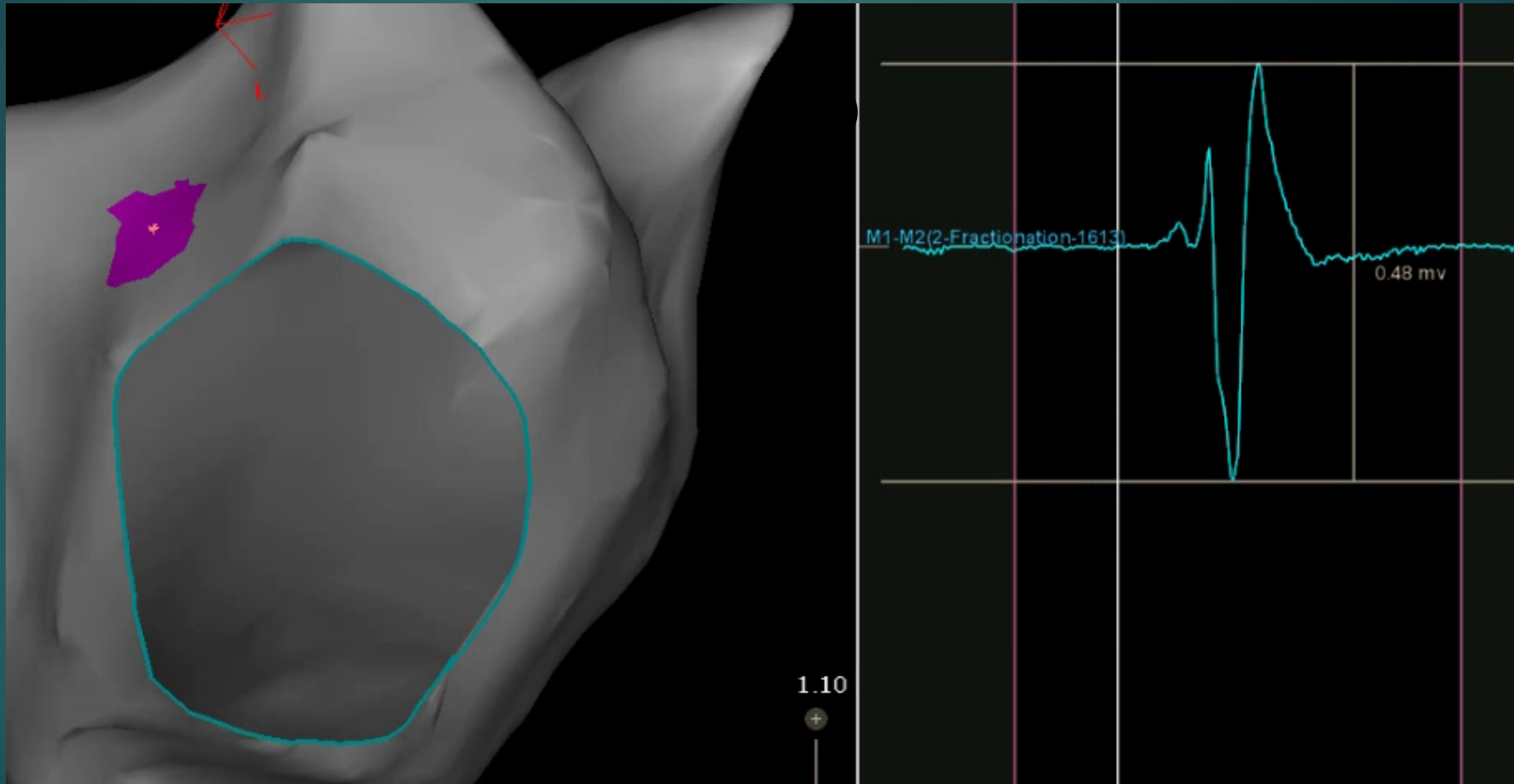
Complexity depends on operator skill at re-annotation



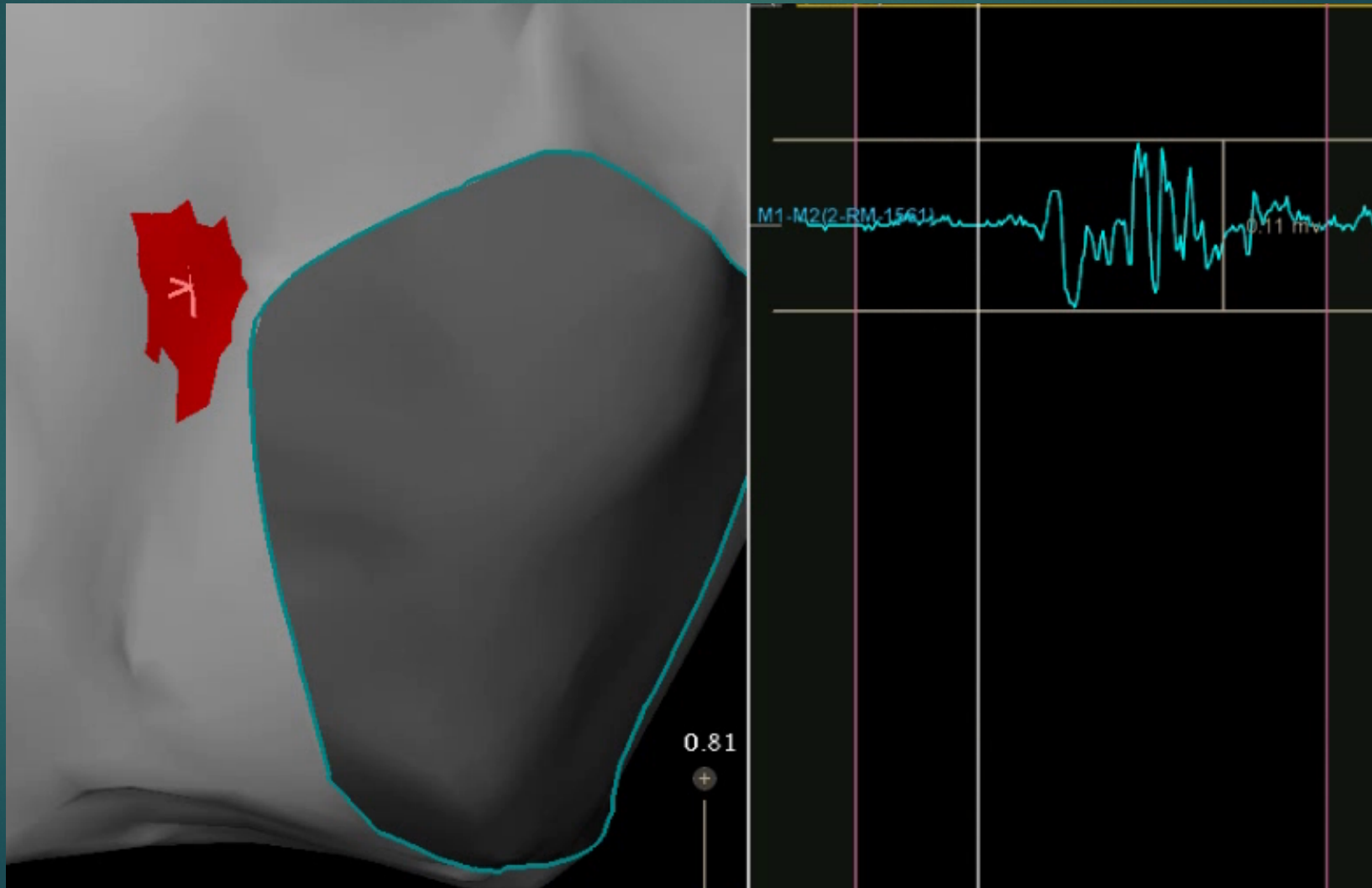
‘Simple’ because technology addresses clinical problem



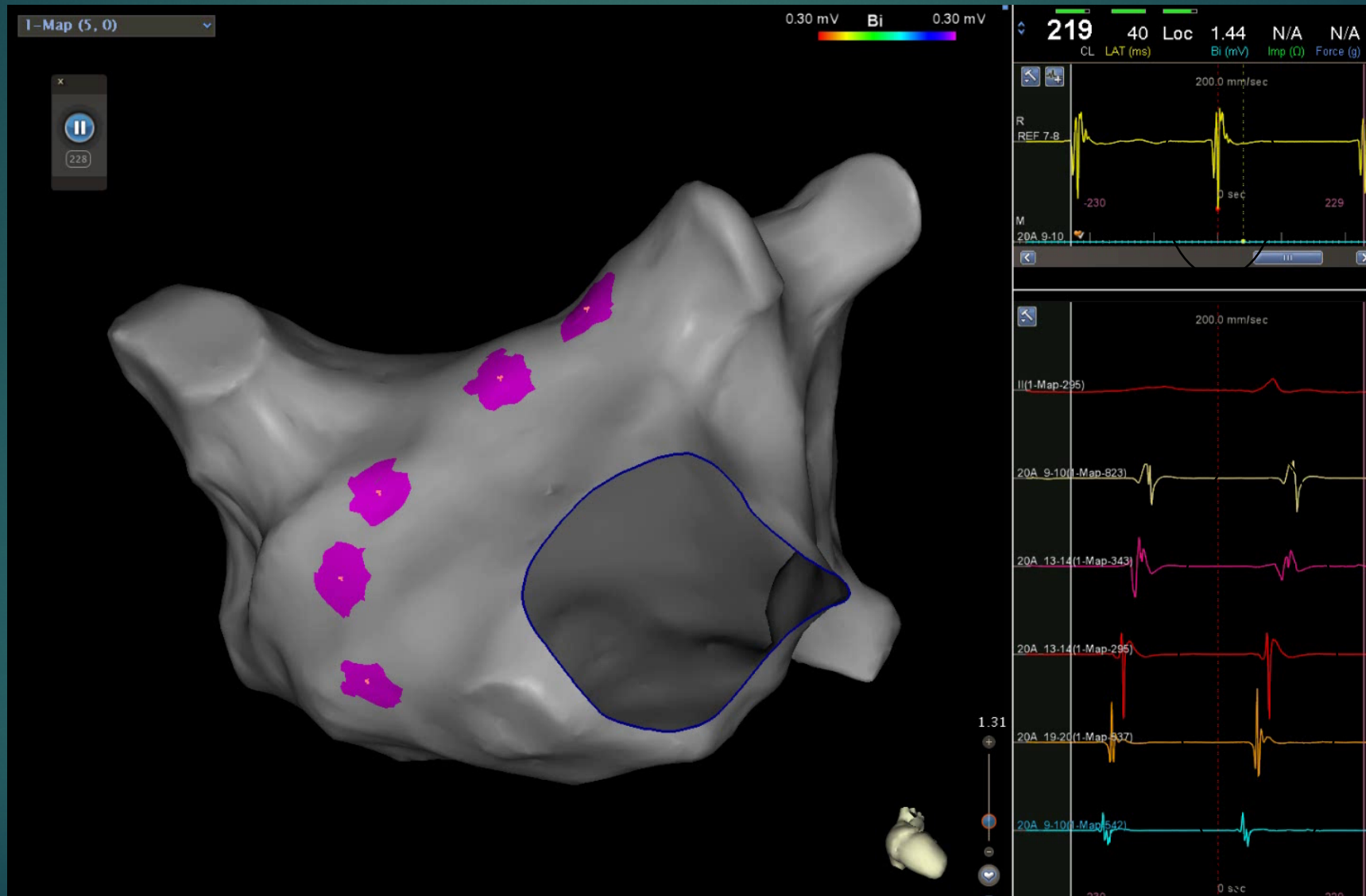
Ripple Mapping – NO NEED FOR LAT ANNOTATION



Ripple Mapping – NO NEED FOR LAT ANNOTATION



Ripple Mapping displays whole cycle lengths
– NO EARLY/LATE points

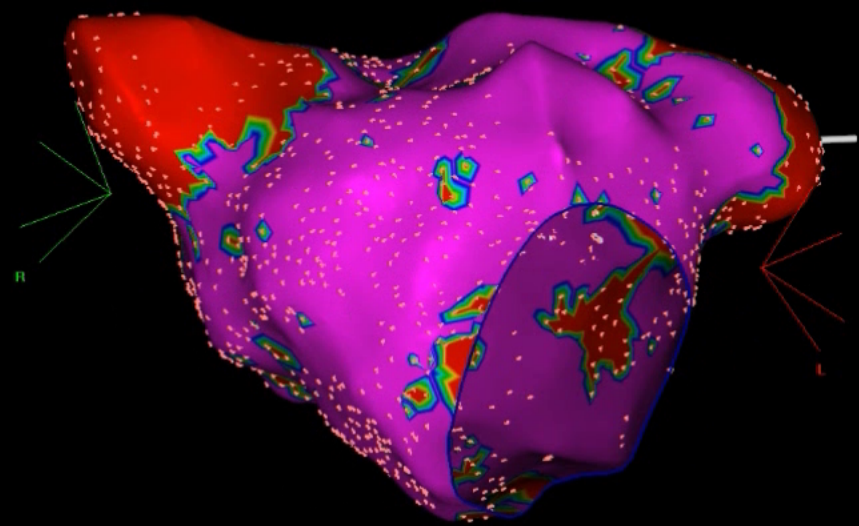




1-AT (1689, 0)

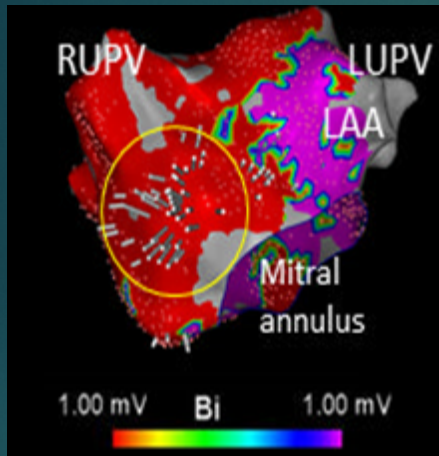


0.35 mV BI 0.35 mV

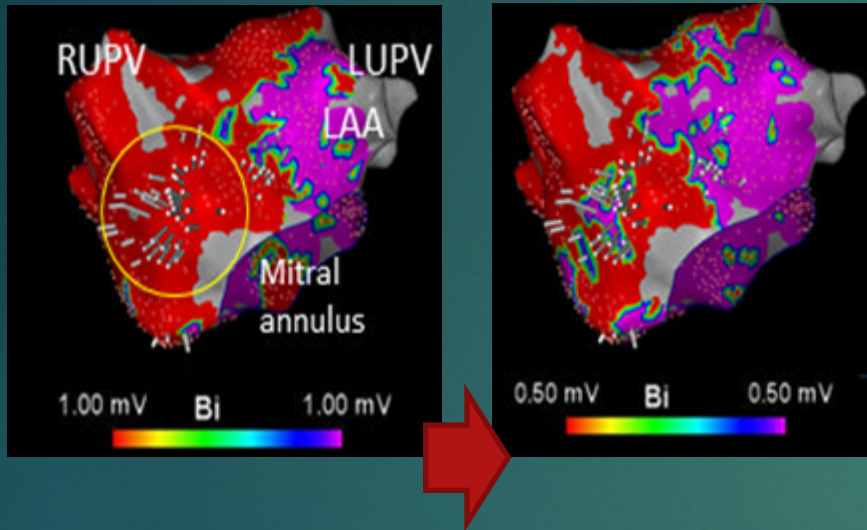


AP PA LAO RAO LL RL INF SUP

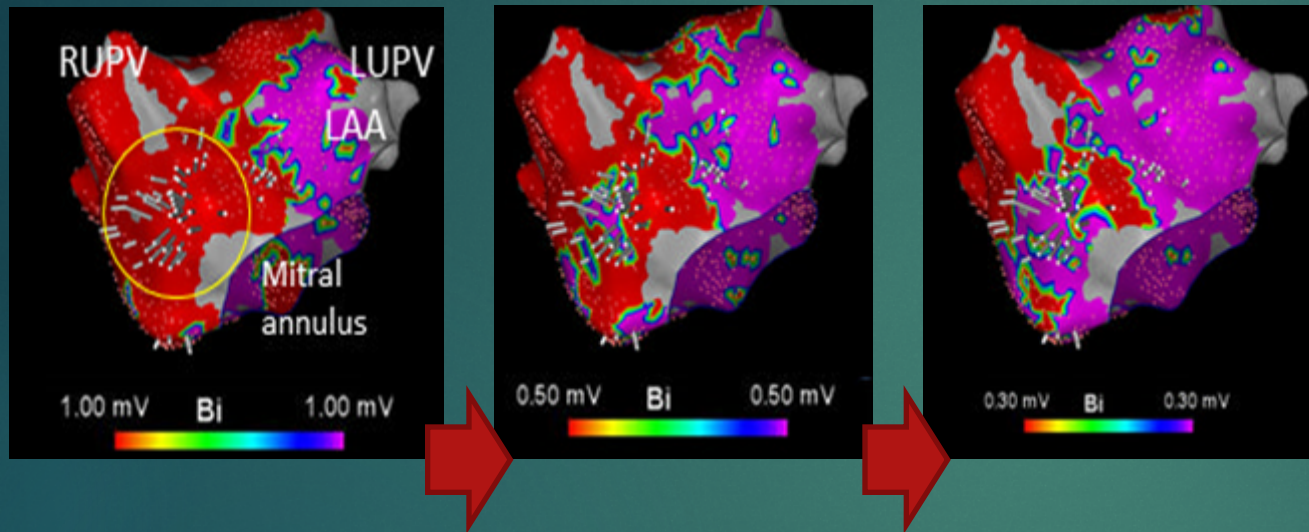
Scar- Thresholding to identify non-functional scar



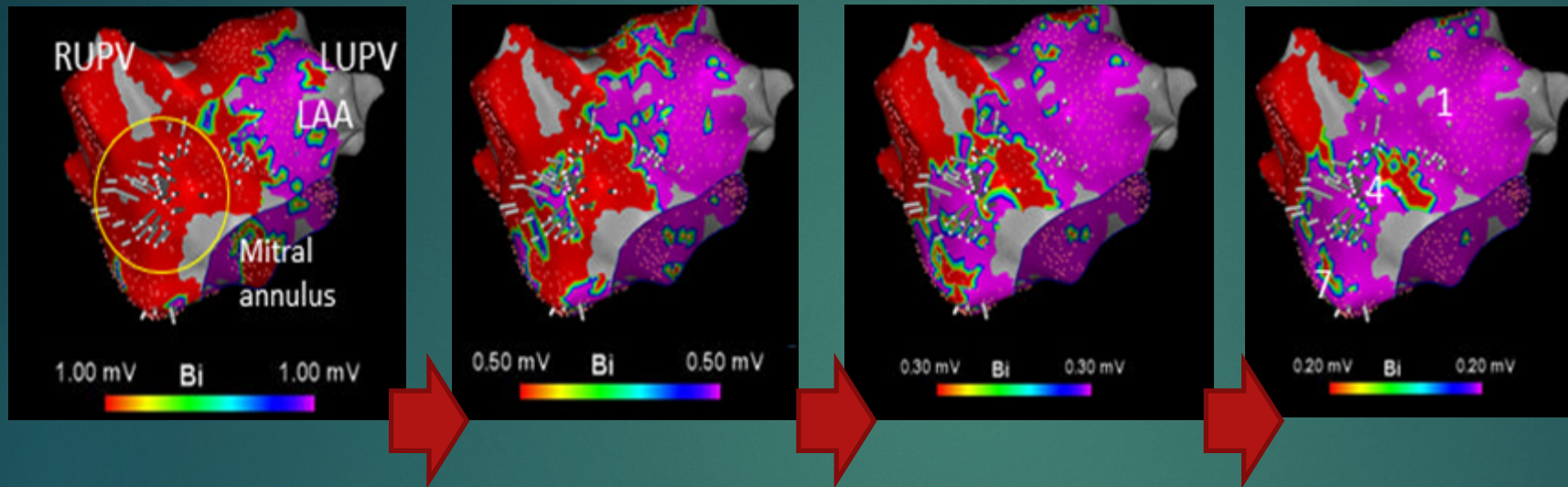
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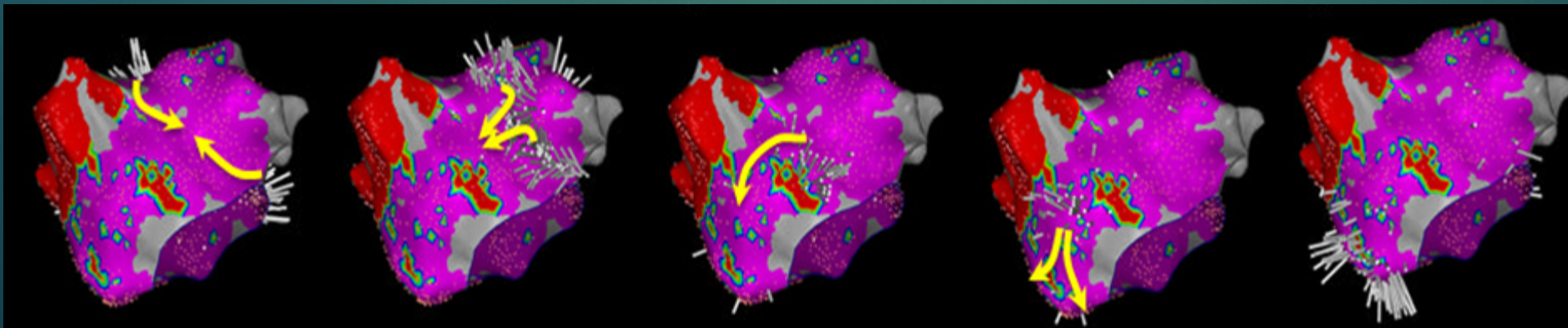
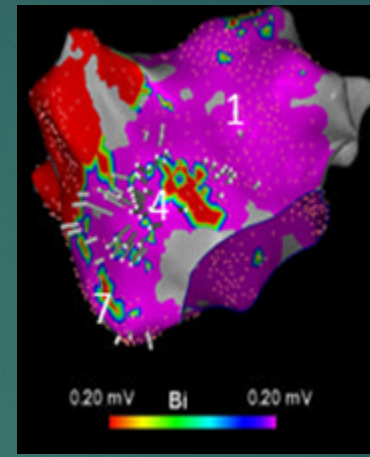
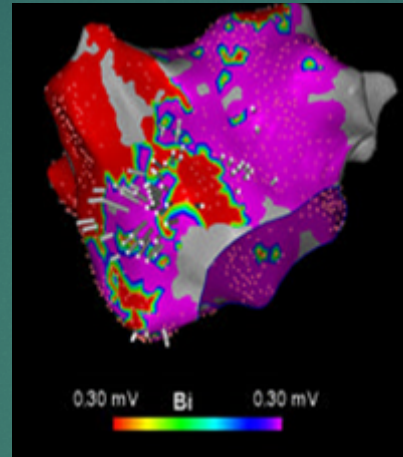
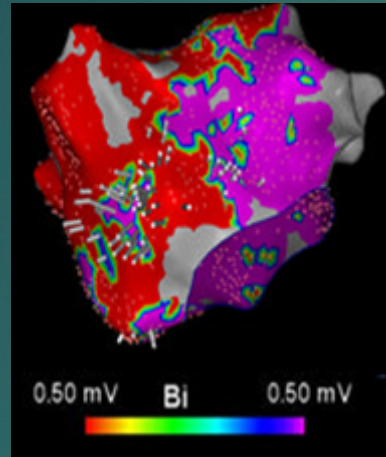
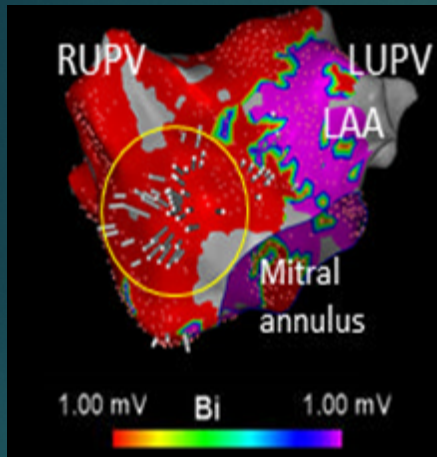
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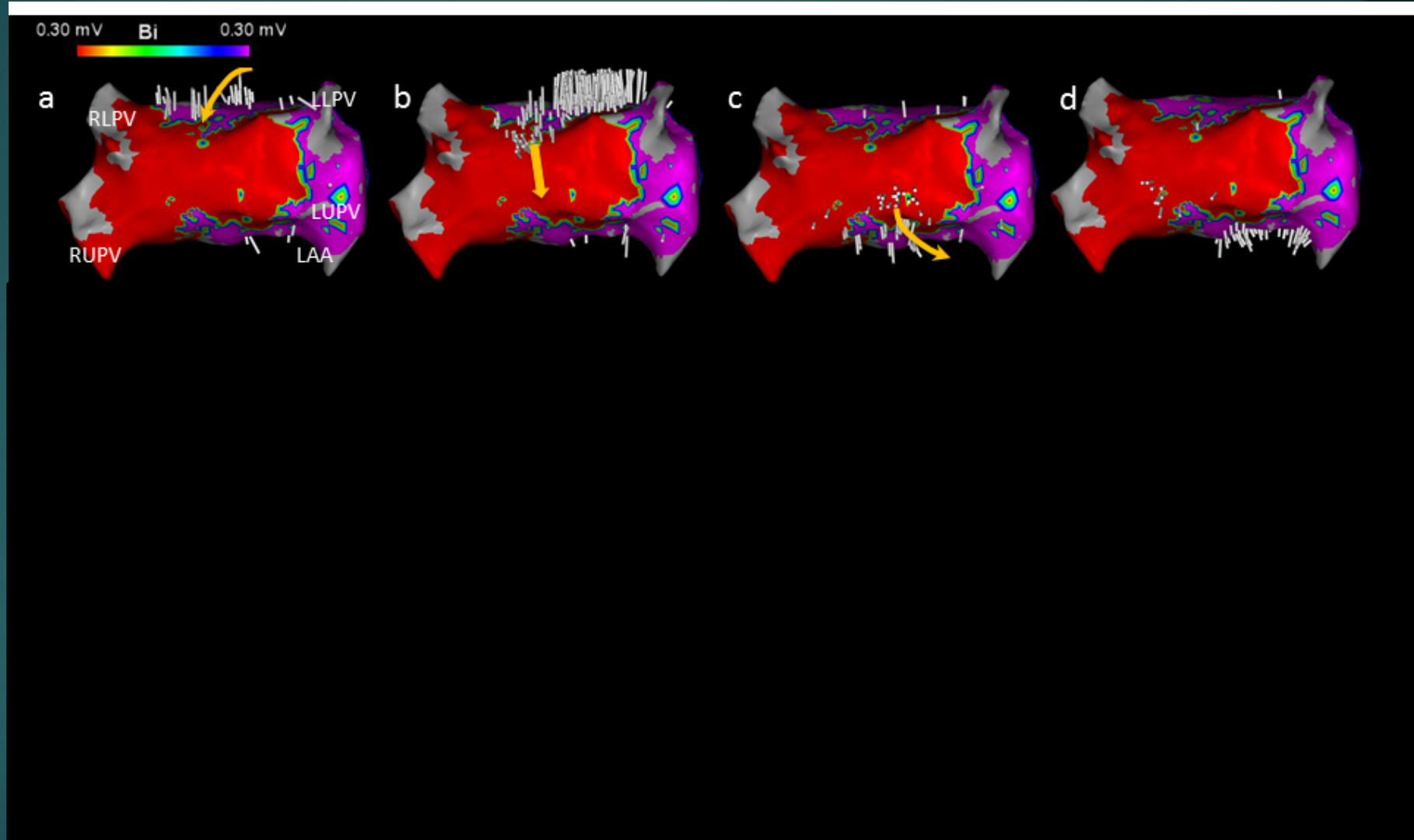
Scar- Thresholding to identify non-functional scar



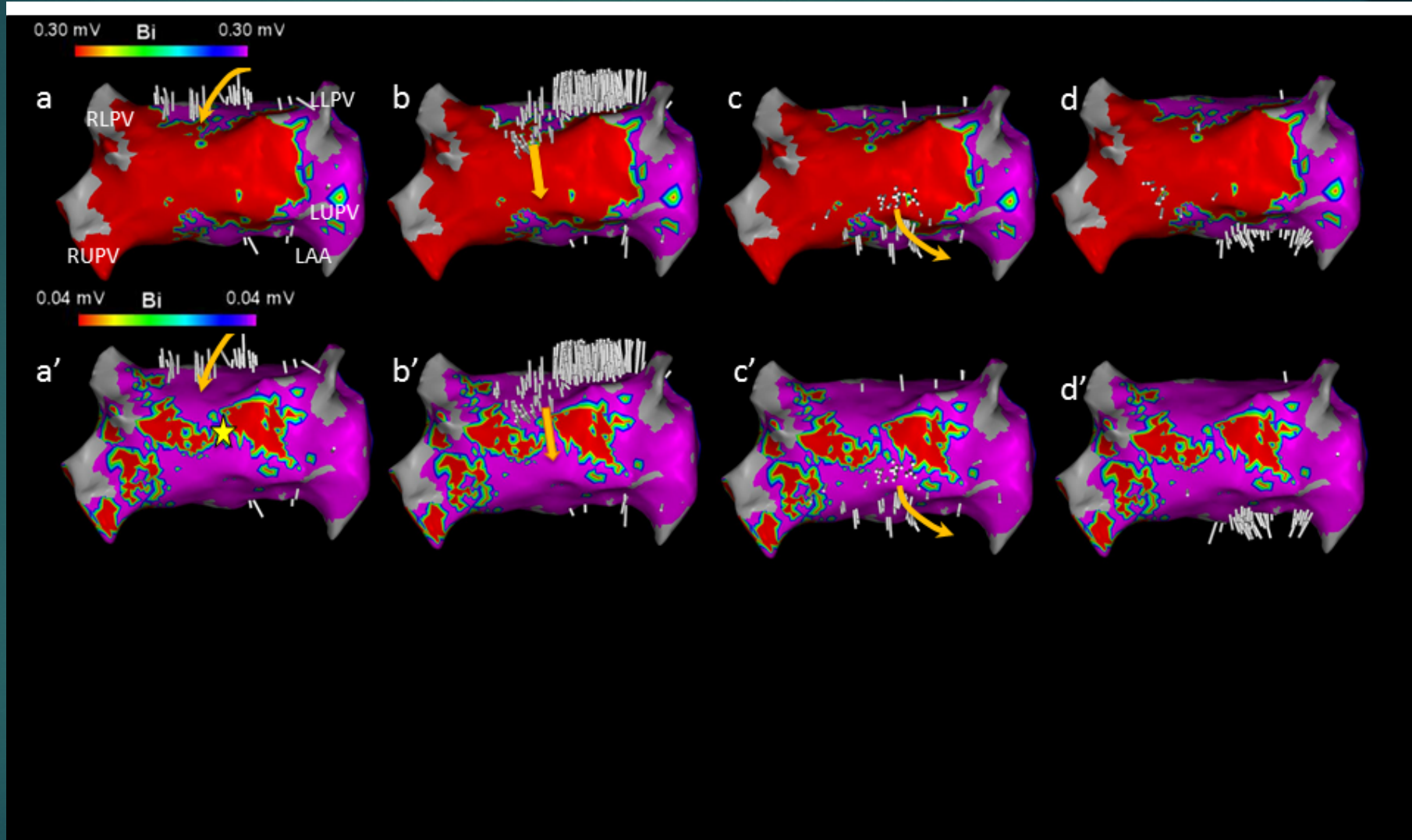
Scar- Thresholding to identify non-functional scar



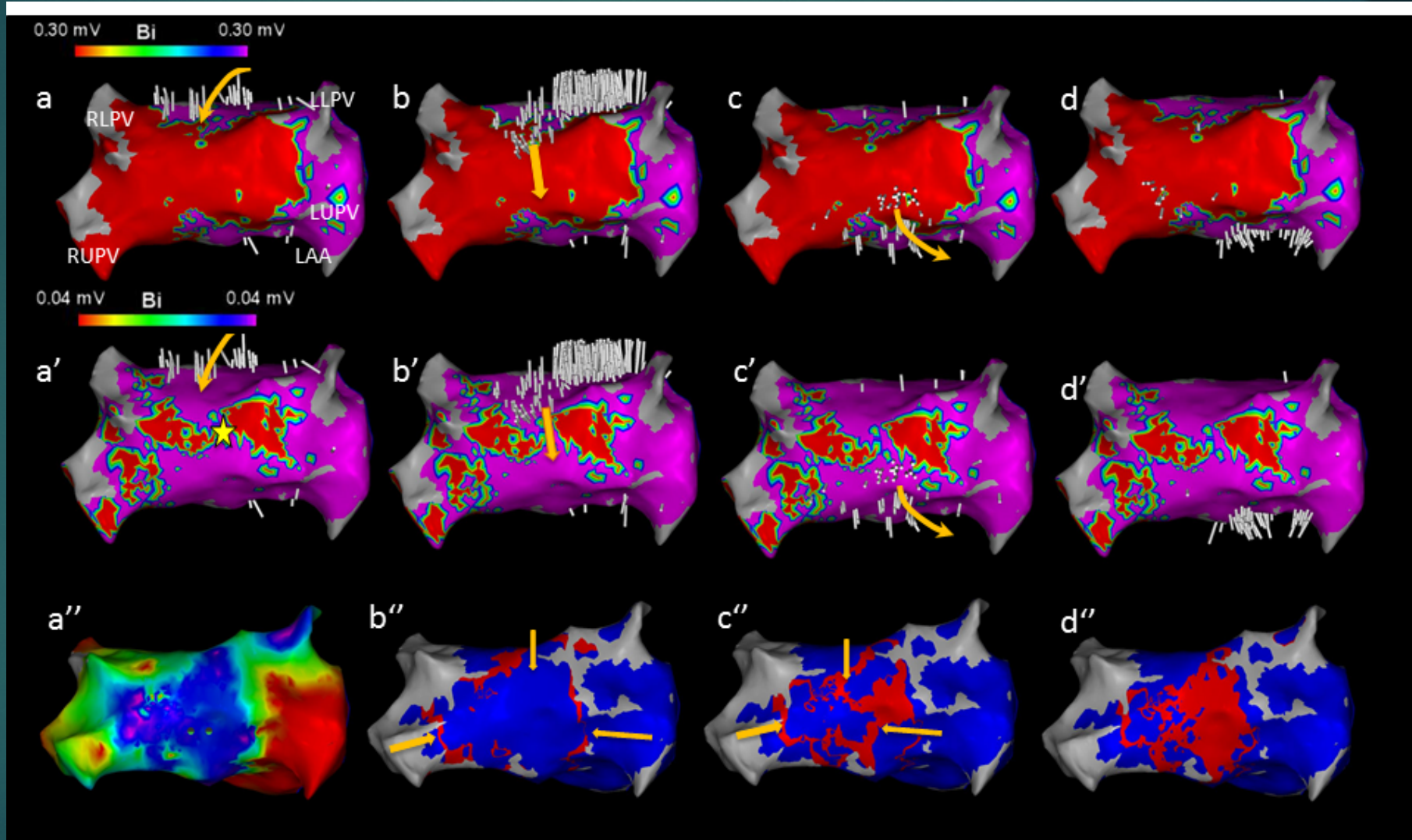
Scar- Thresholding to identify non-functional scar

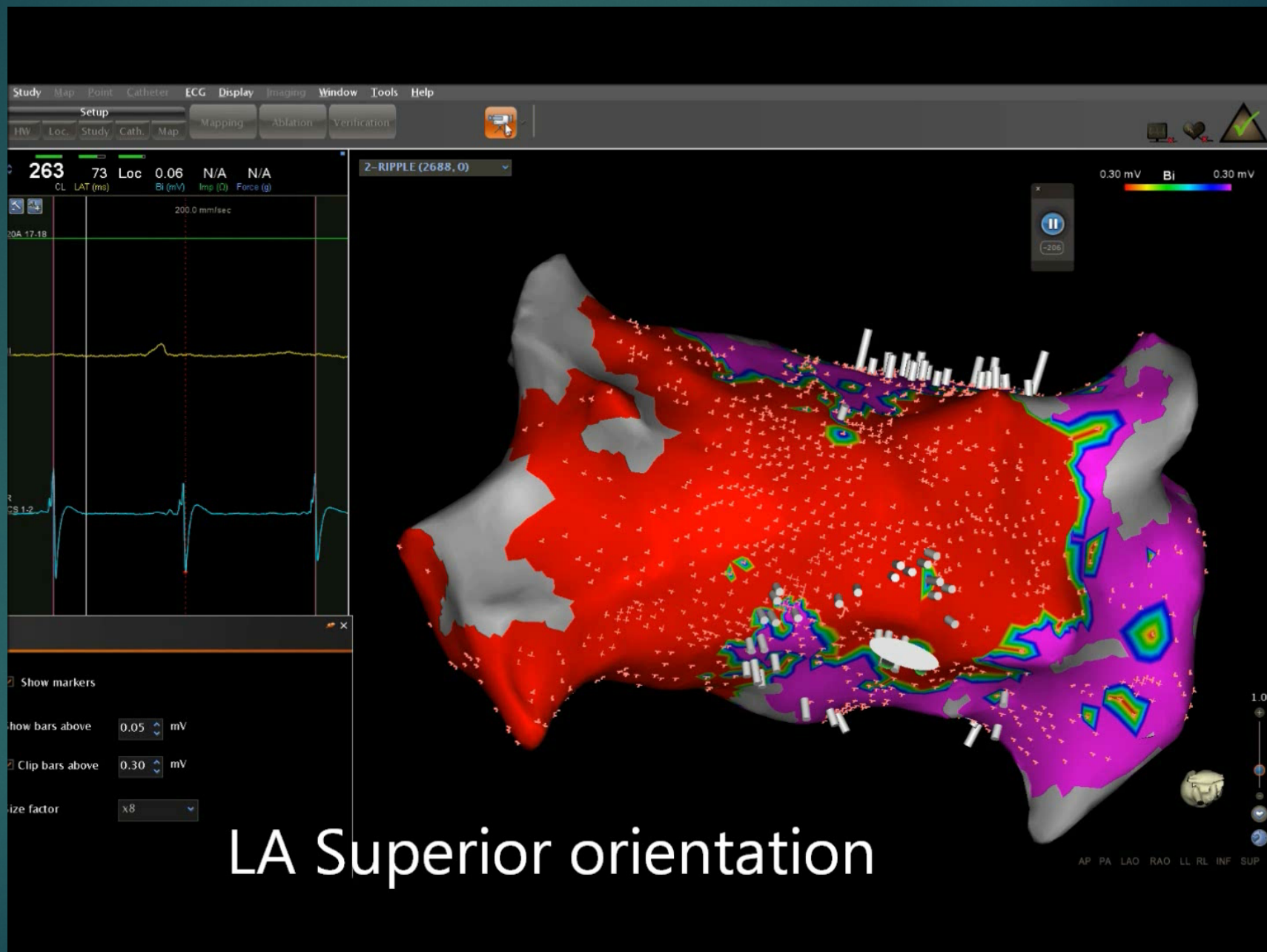


Scar- Thresholding to identify non-functional scar

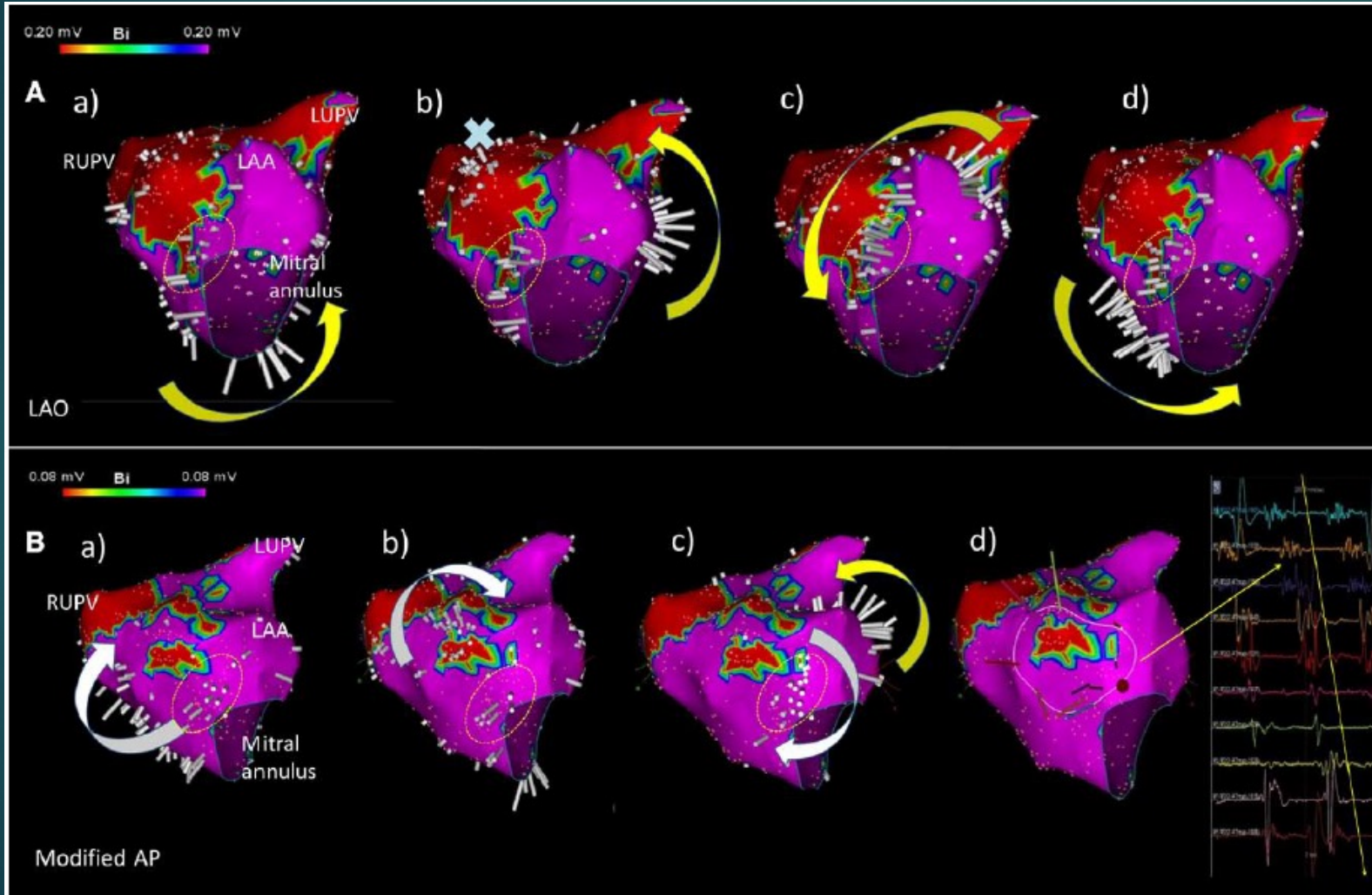


Scar- Thresholding to identify non-functional scar





Dual loop circuits can cause problems for entrainment



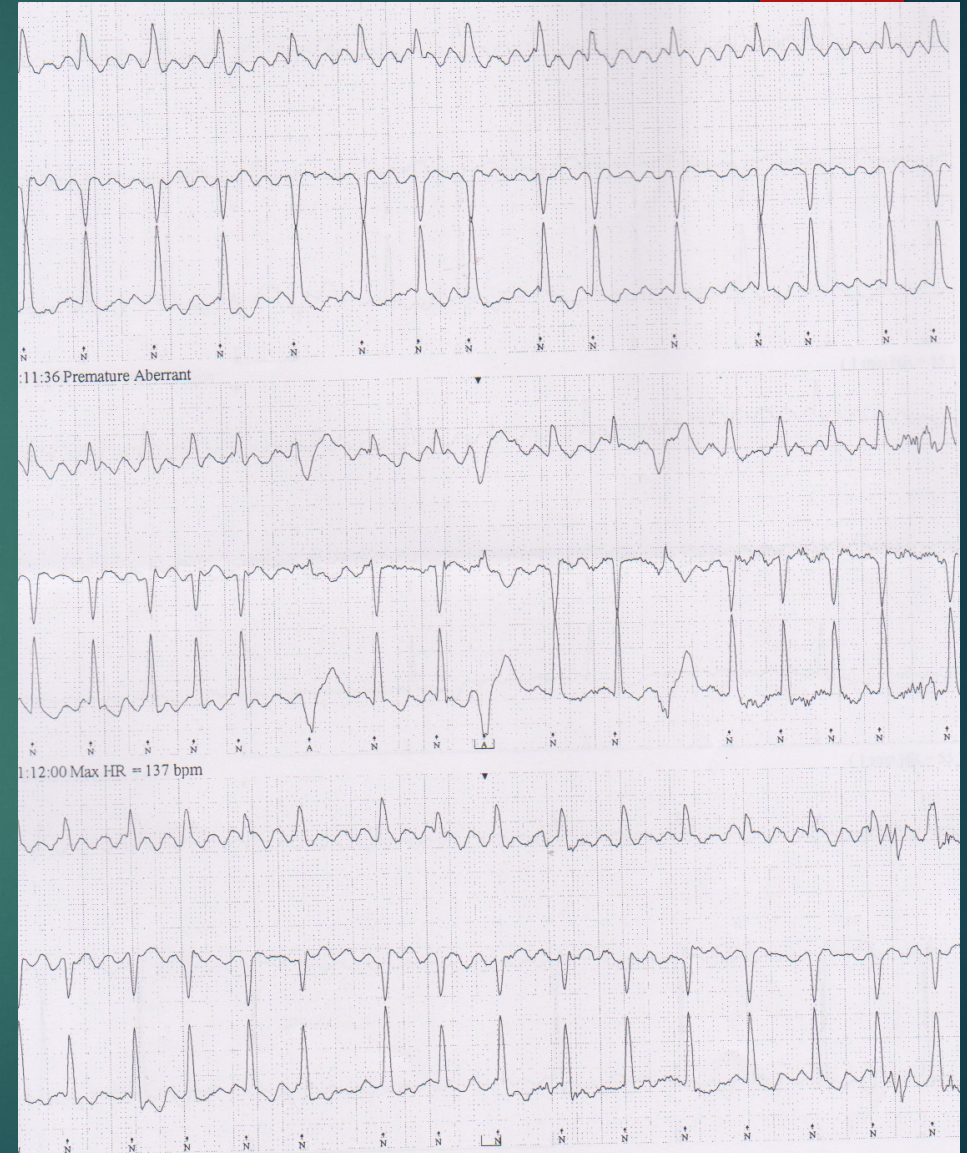
MV circuit PPI ~10

Localised re-entry around small scar enters common isthmus before MV circuit

Single RF terminated tachycardia

Case Study

- ▶ 62yr old lady
- ▶ Surgical ASD Repair 1973
- ▶ Presented in 2011 with atrial tachycardia
- ▶ LV impairment and severe MR
- ▶ Possible AT induced cardiomyopathy referred for ablation



Procedure 2011

- ▶ CS activation sequence was distal to proximal.
- ▶ Unable to entrain mitral isthmus due to ventricular capture.
- ▶ Right atrial entrainment at the septum, free wall and isthmus, all had long post-pacing intervals.
- ▶ The entire cycle length was mapped in LA
- ▶ CARTO map non-diagnostic
- ▶ Several localised regions which spanned the entire tachycardia cycle length.
- ▶ Shortest post-pacing interval at the intervenous ridge of LUPV.

- ▶ Ablation at intervenous ridge extended the tachycardia cycle length.

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- ▶ Limited re-mapping suggested peri-mitral tachycardia and extension of linear lesion from intervenous ridge resulted on further change in the cycle length

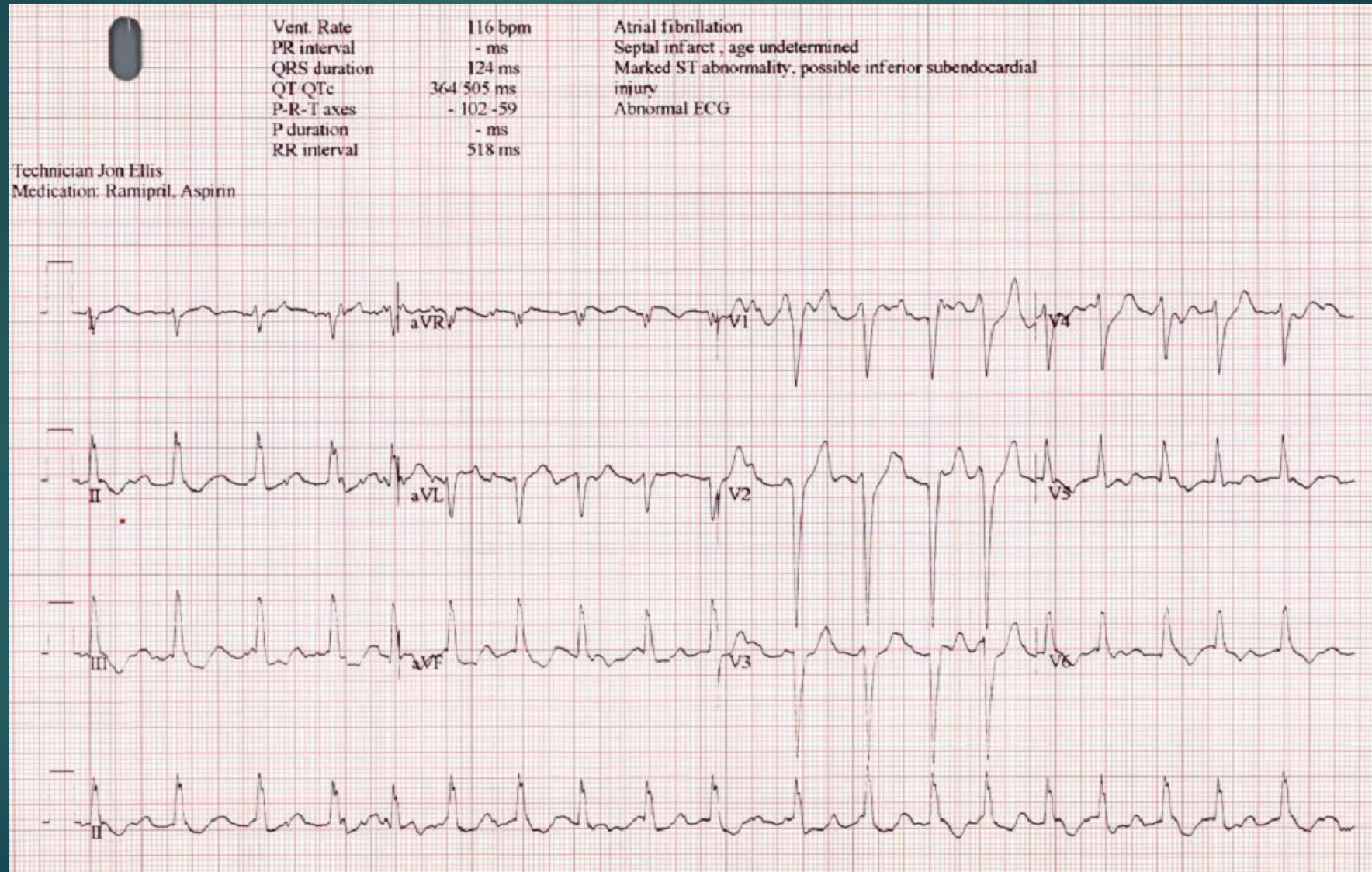
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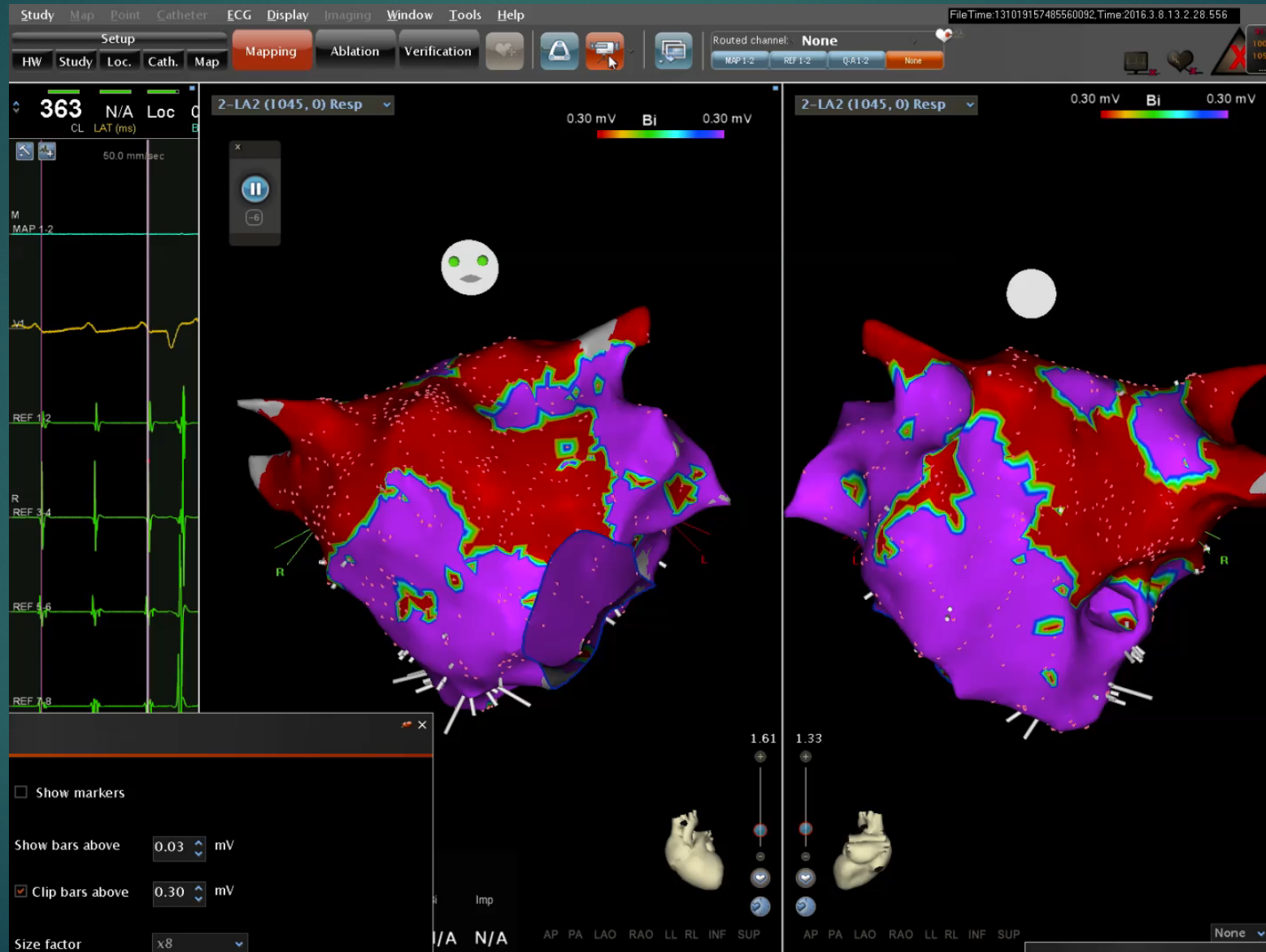
- ▶ Limited re-mapping suggested peri-mitral tachycardia and extension of linear lesion from intervenous ridge resulted on further change in the cycle length
- ▶ Re-mapping confirmed CTI flutter and ablation terminated to sinus rhythm

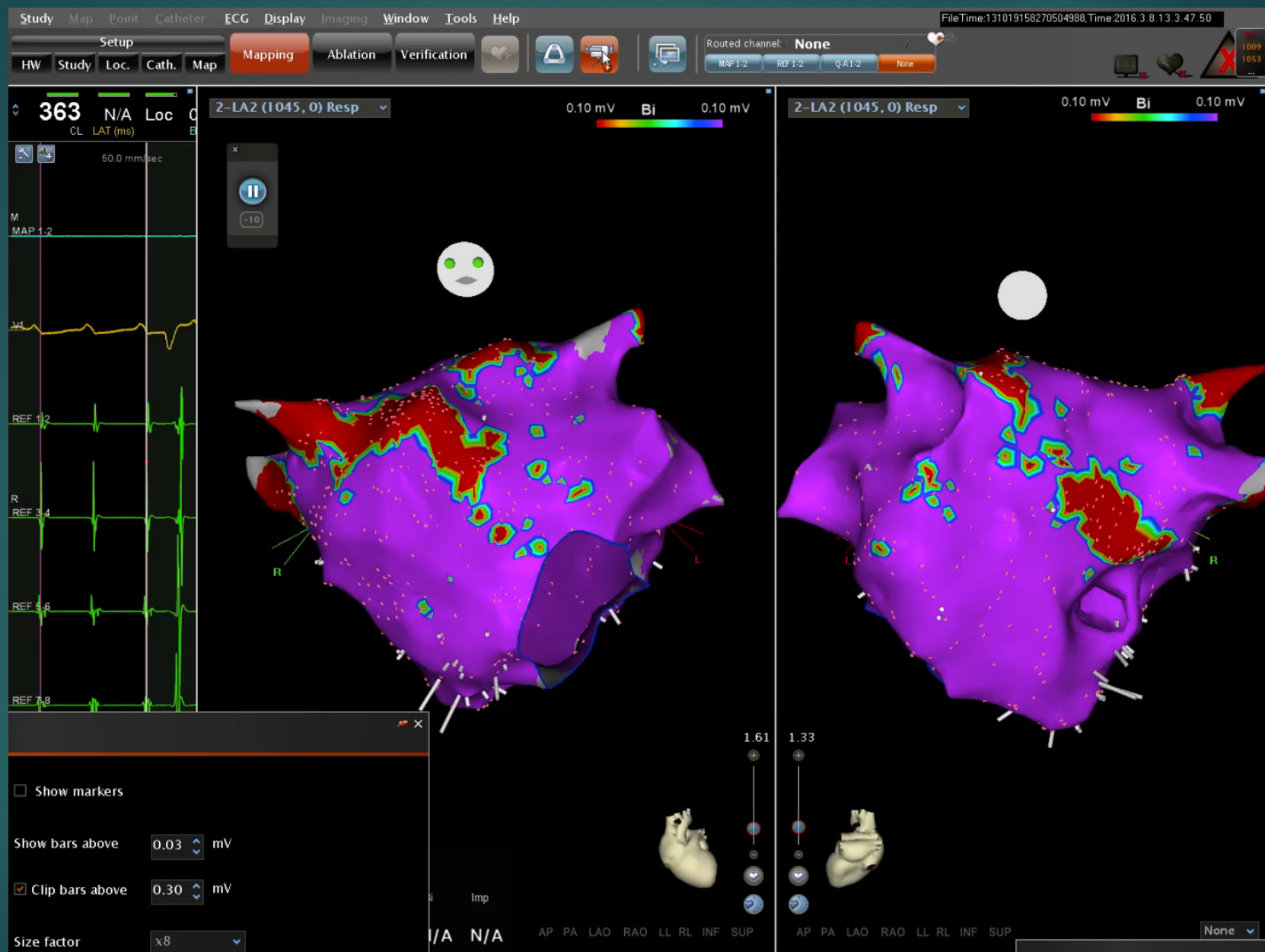
Recurrence in 2015

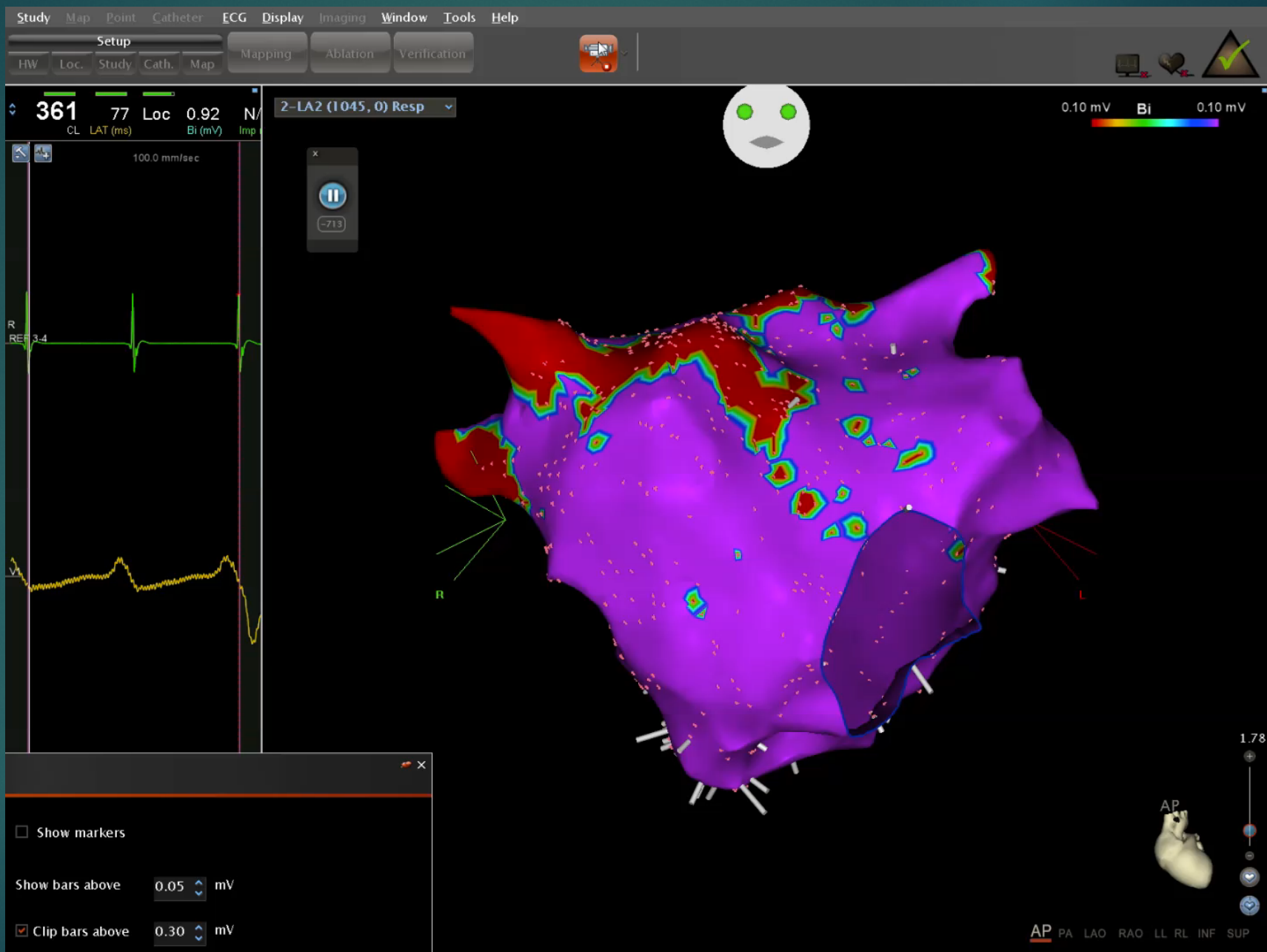


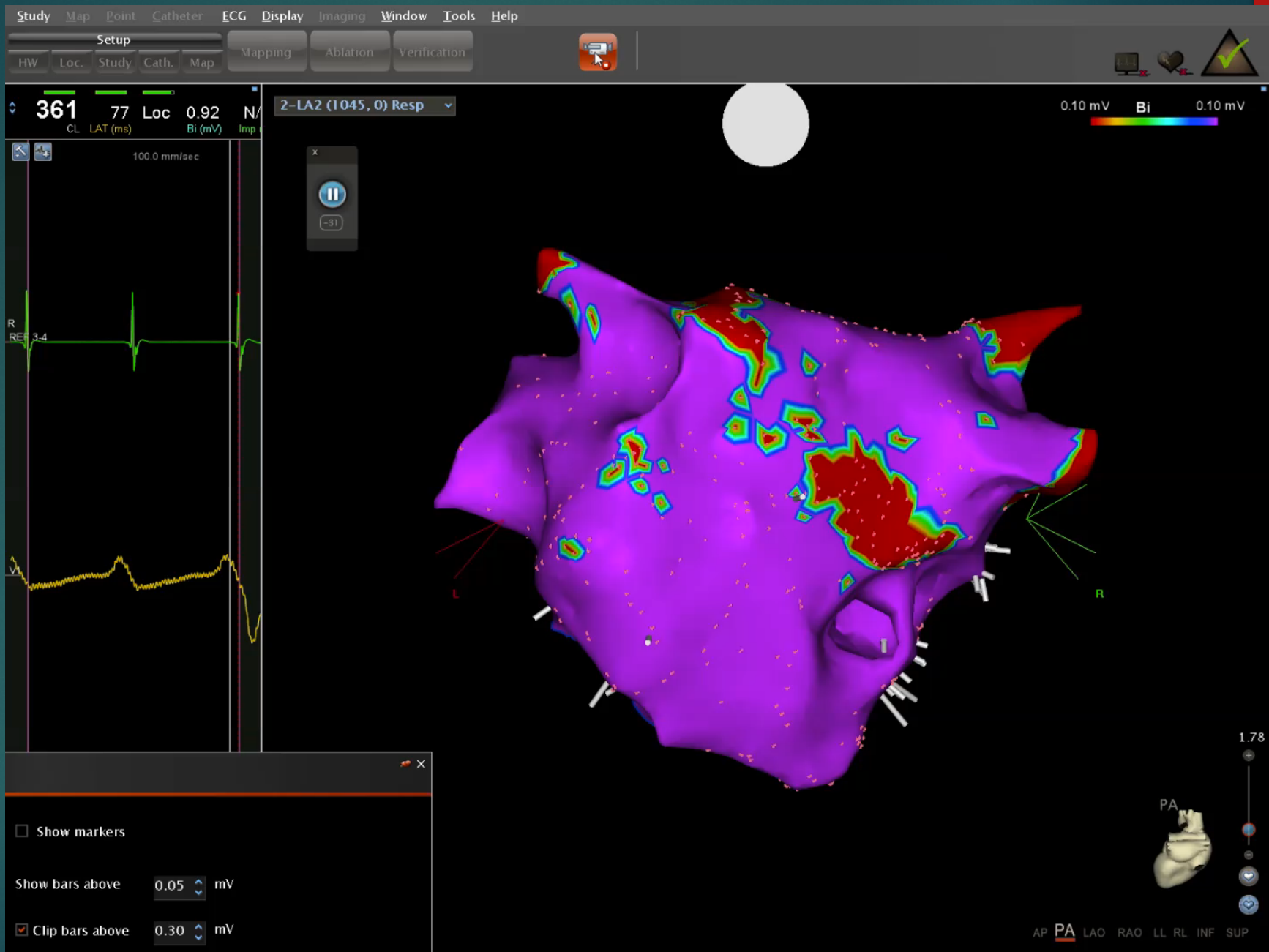
Ripple Mapping displays Activation and Voltage on same geometry

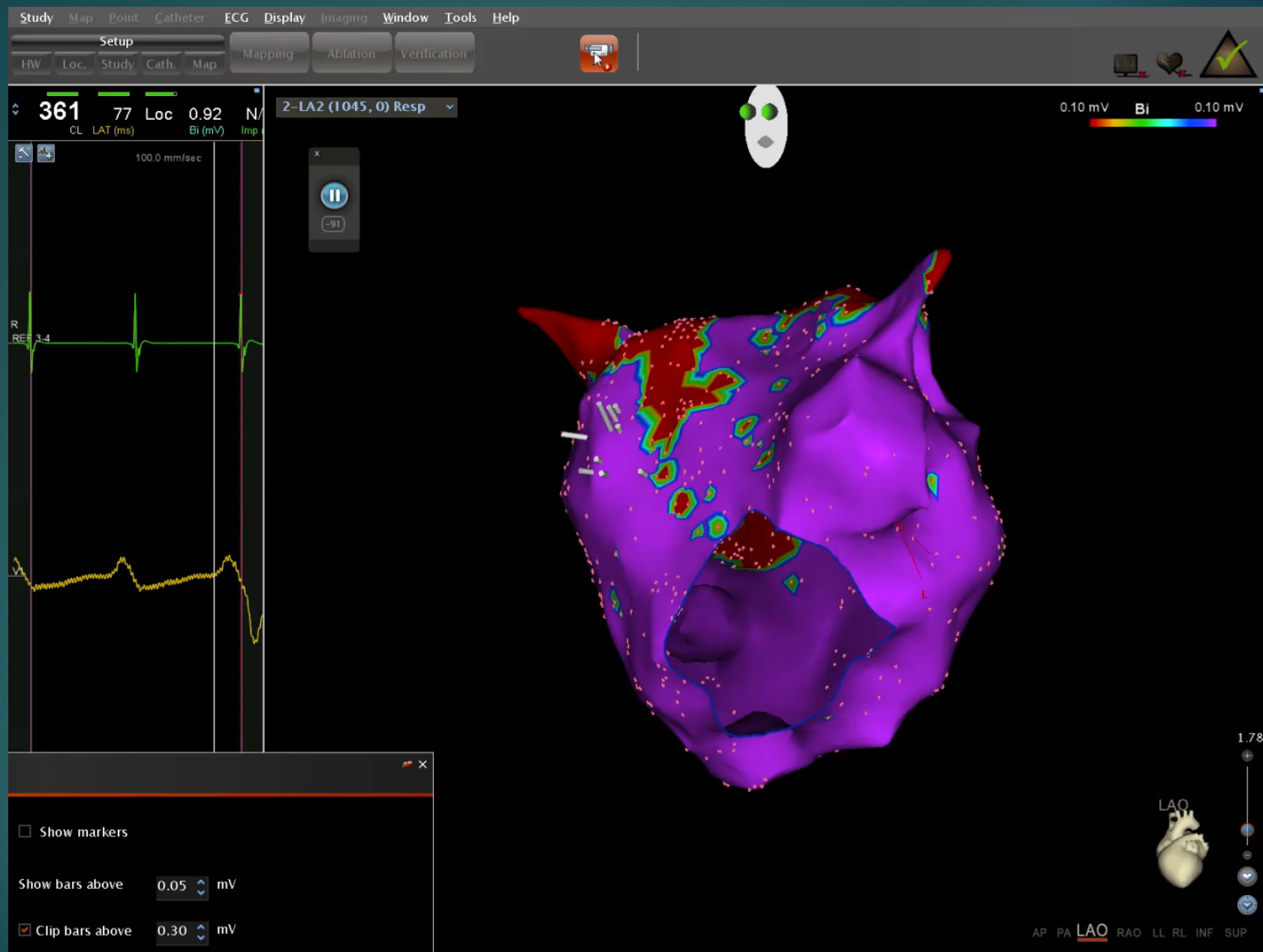
-SCAR THRESHOLDING

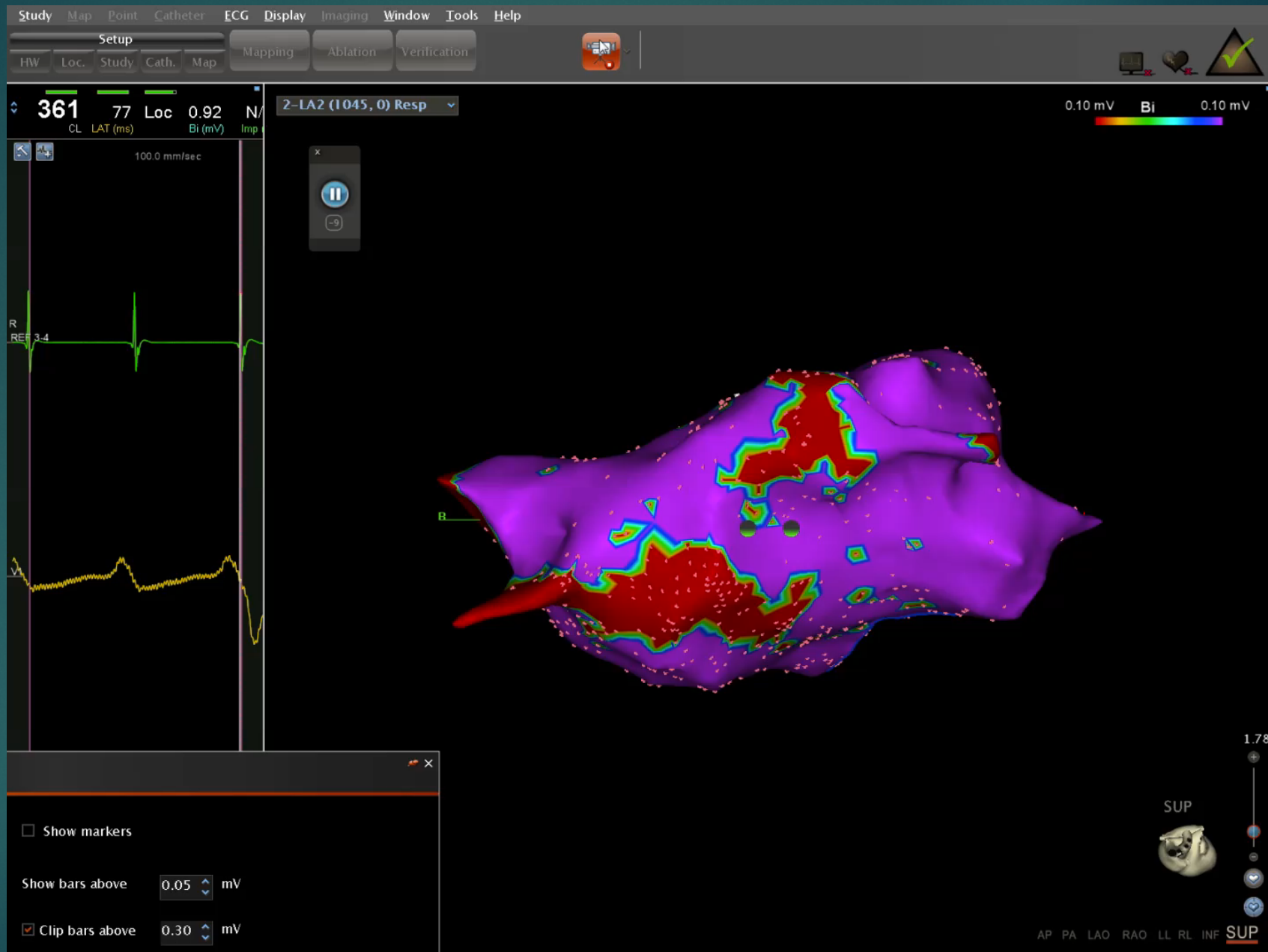


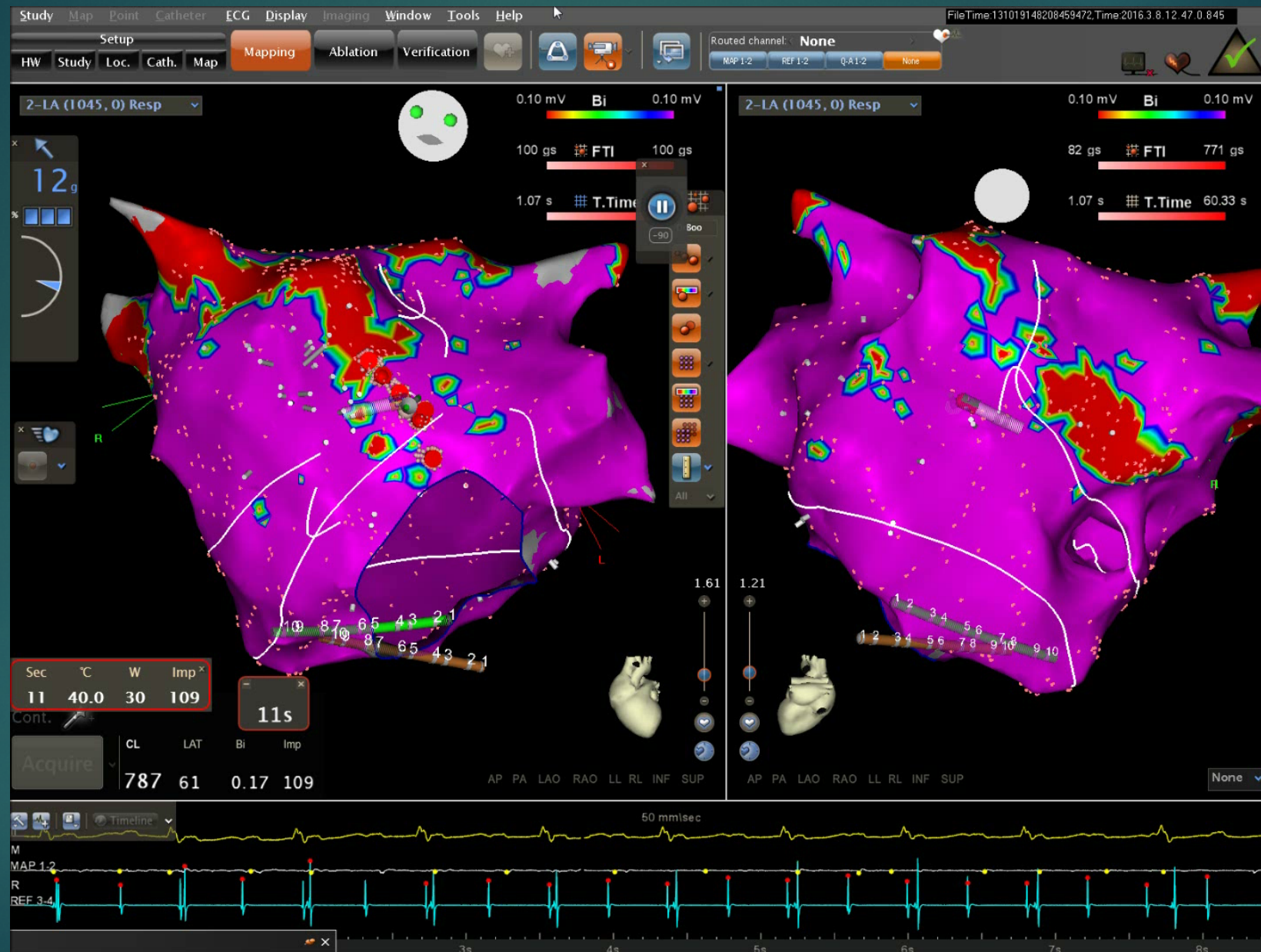


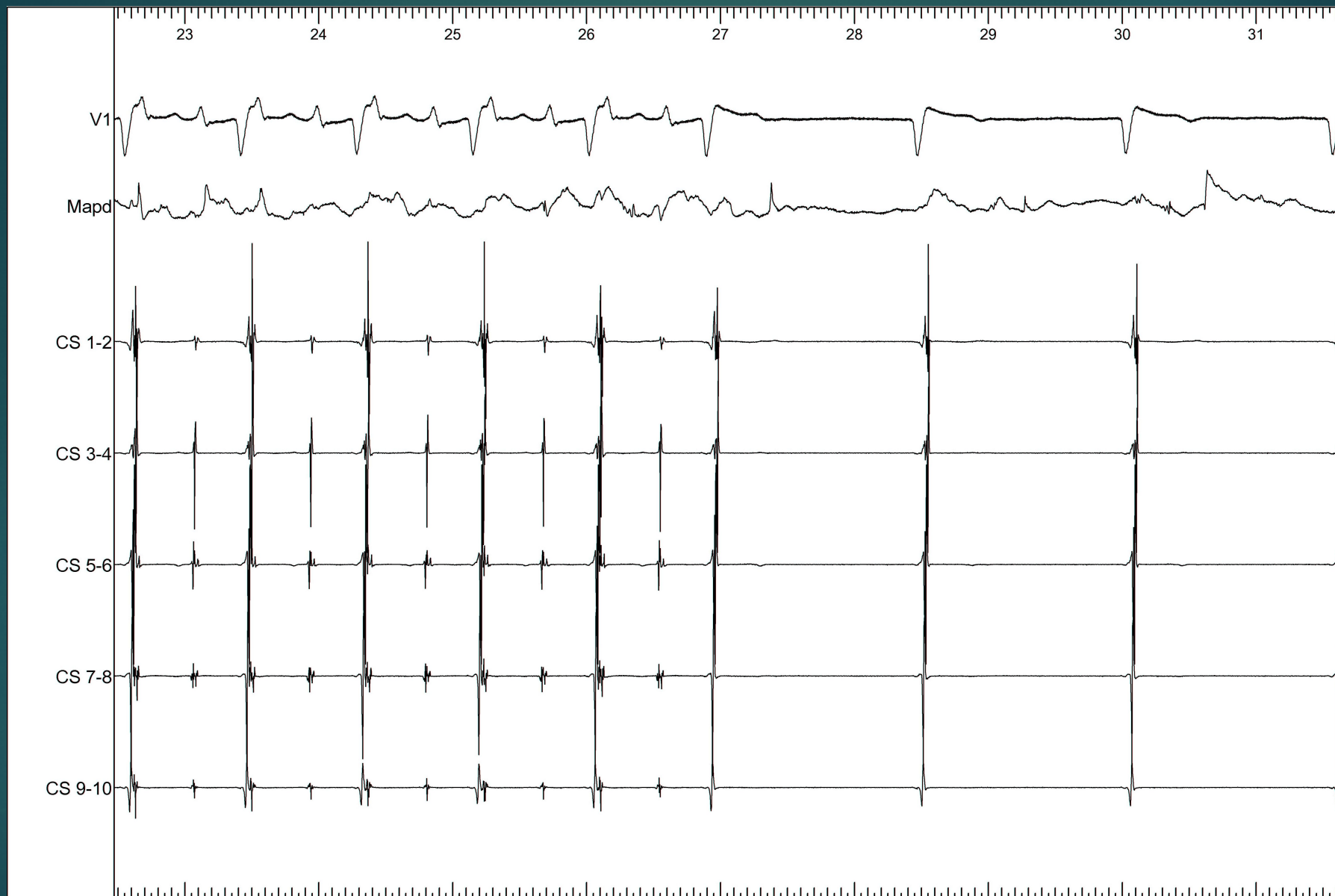










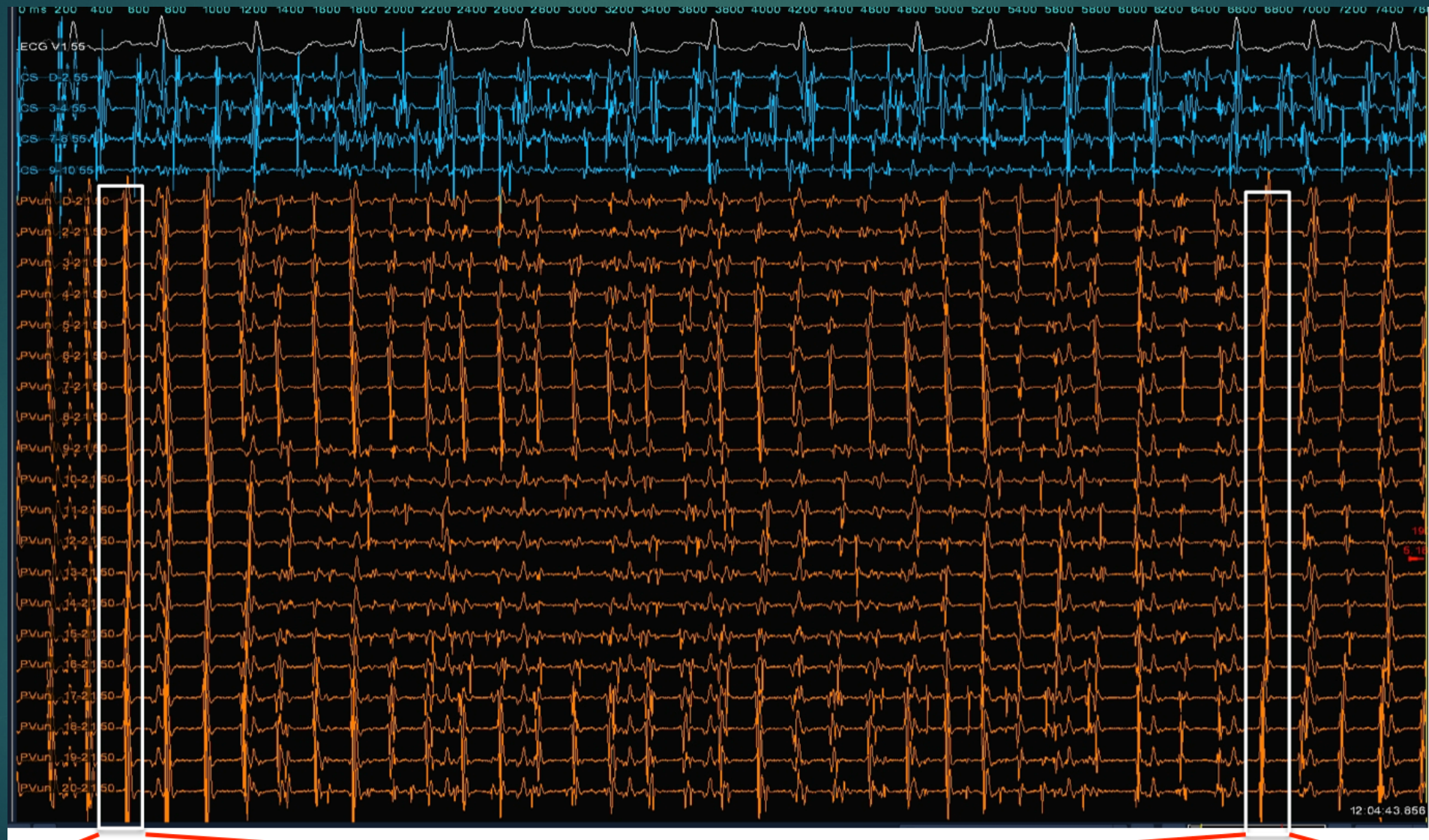


Ripple Mapping – Can it make AT a ‘simple’ arrhythmia ?

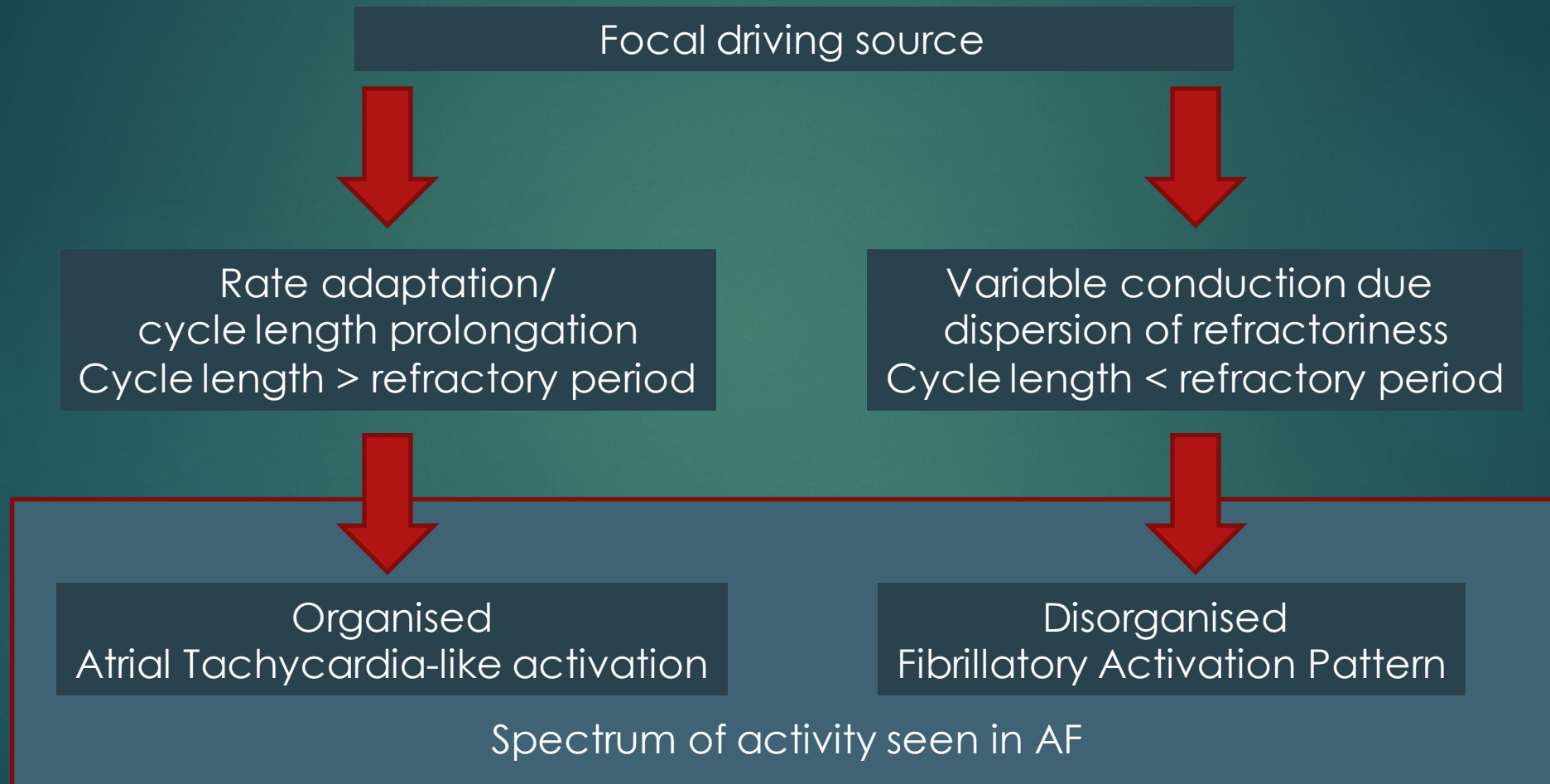


- ▶ Defines a detailed mechanism of the atrial tachycardia
- ▶ Enables diagnostic confidence to ablate without entrainment
- ▶ RIPPLE-AT study (>60 recruited to multicentre randomised study)
 - ▶ Hospital de Santa Maria, Lisbon, Portugal
 - ▶ Royal Bournemouth & Christchurch Hospital, Bournemouth, UK;
 - ▶ Essex Cardiothoracic Centre, Basildon, UK
 - ▶ Barts Heart Centre, London, UK
 - ▶ Imperial College Healthcare, London, UK

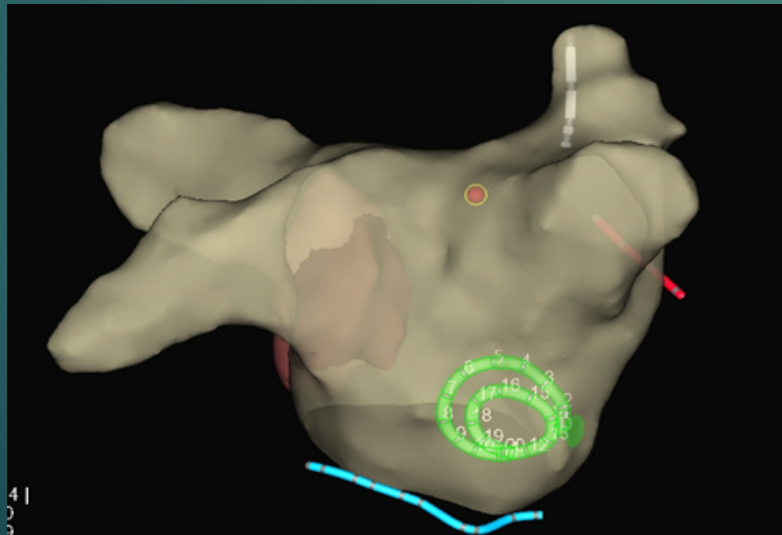
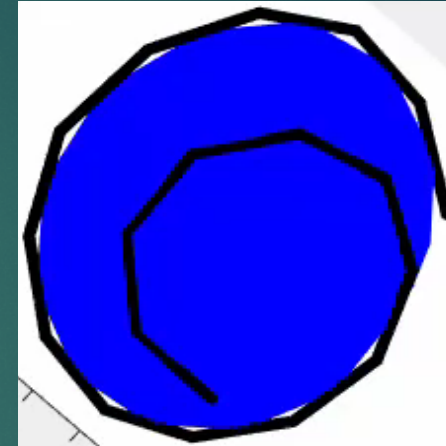
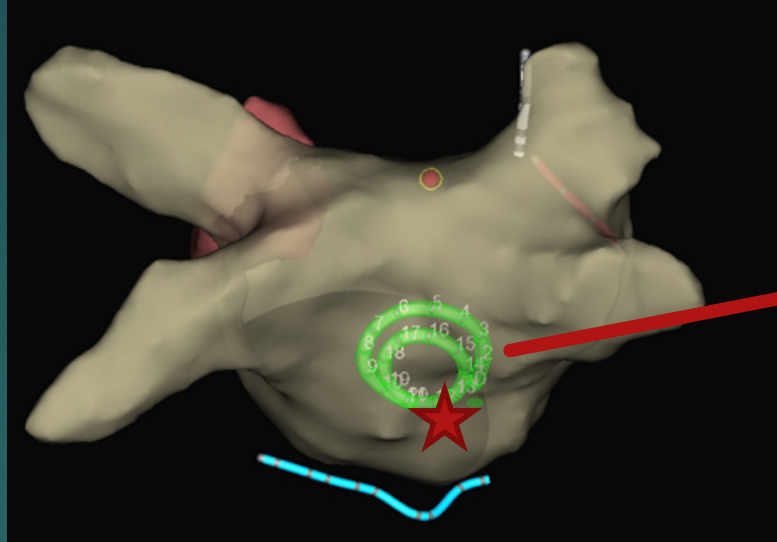
Atrial fibrillation: A truly complex arrhythmia?



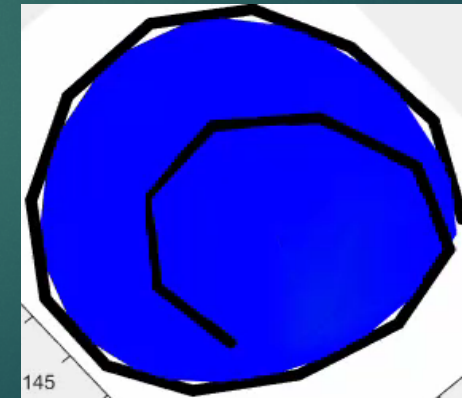
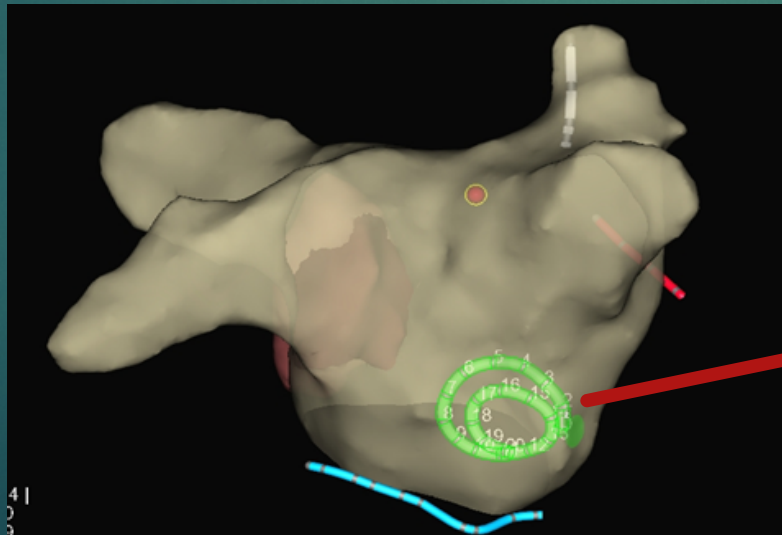
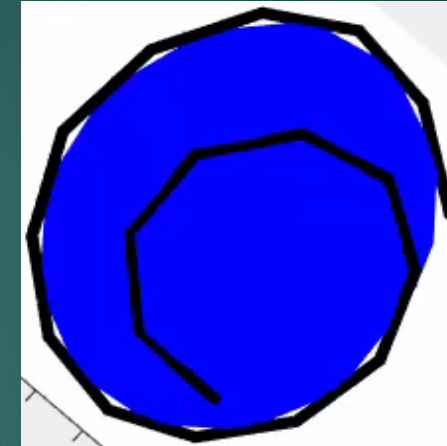
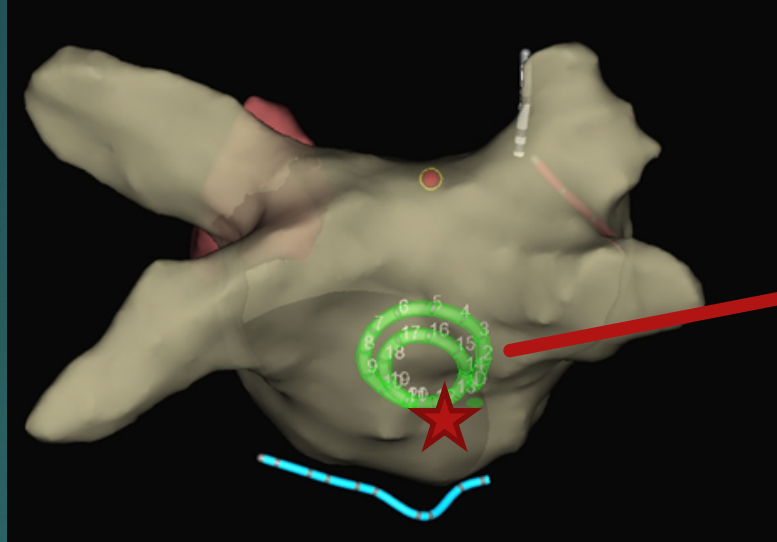
A unifying theory to explain electrogram findings in AF



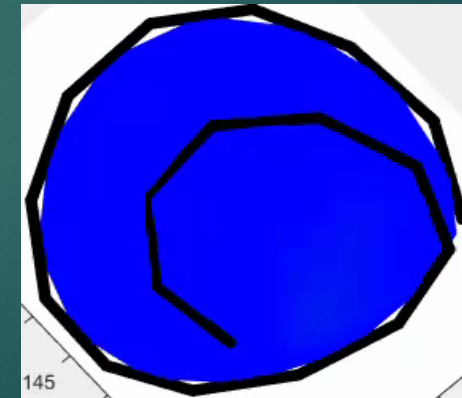
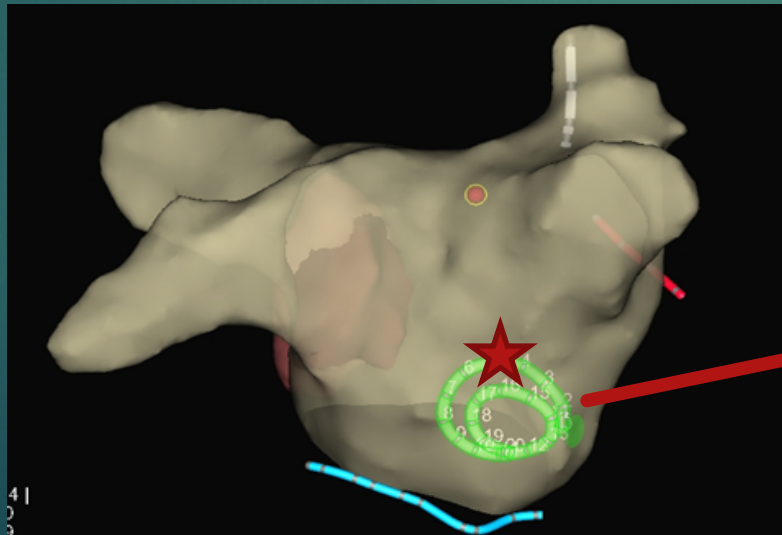
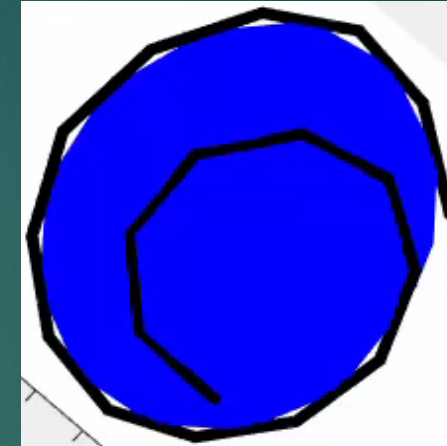
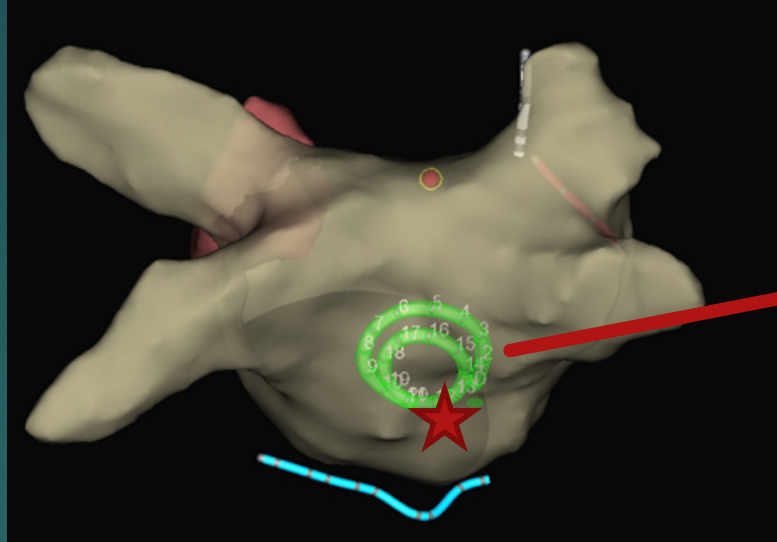
Workflow: Remap in new location



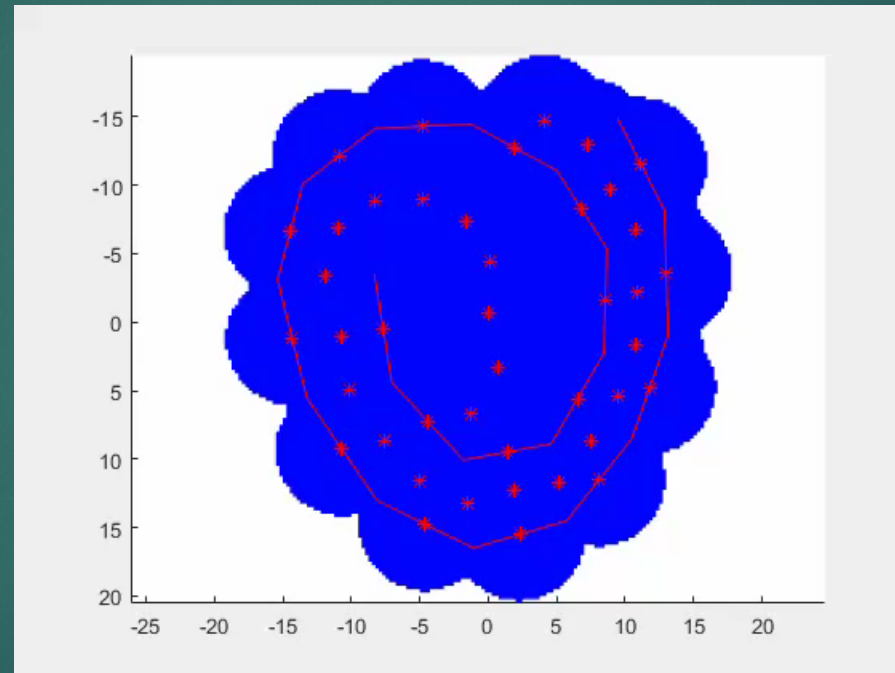
Workflow: Reversal of uniform wavefront indicates proximity of source



Workflow: Remap at potential source for evidence of focal activation



Evidence of focal activation during AF in persistent AF



Complex Arrhythmias



- ▶ Arrhythmias generally have a simple core mechanism
- ▶ The challenge is removing all the 'noise' that does not contribute to the arrhythmia
- ▶ Technological advances need to be mindful of the problem that needs to be solved and this requires physicians to be uncompromising in their search for the underlying mechanisms

‘Simple’ because technology addresses clinical problem

