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Innovative techniques for durable linear ablation in AF treatment

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Conflict of interest

- Research grants from Medtronic, Abbott and Boston Scientific

Linear ablation #1

Contiguous lesions delivered to electrically excitable areas connecting an annulus to an anatomic structure or between anatomic structures (electrically unexcitable areas).

Linear ablation #2

Linear ablation should preserve normal atrial activation (=not disturb intrinsic atrial activation sequence).

Linear ablation #3

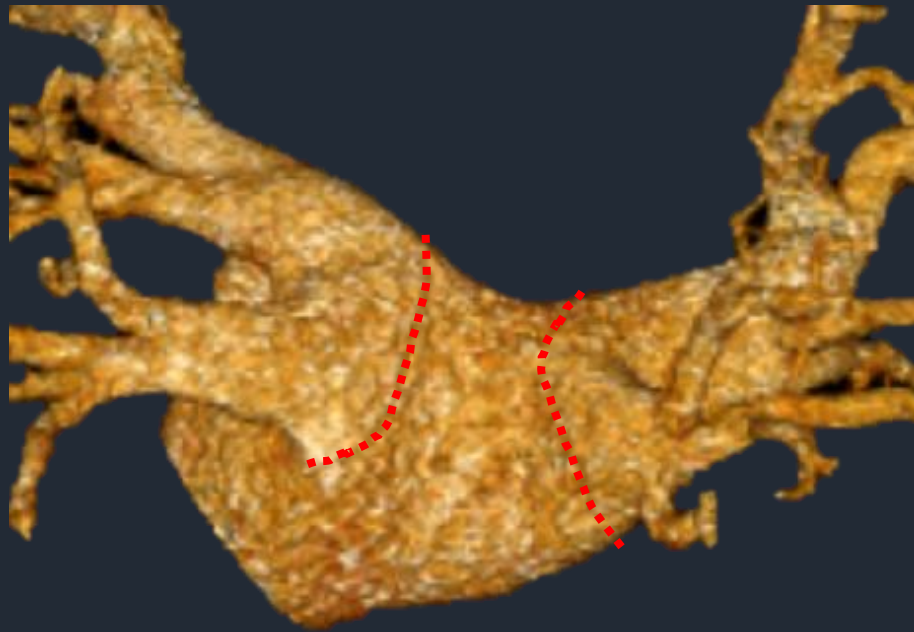
Conduction block across the linear ablation *could be and should be* assessed by an electrophysiologic criteria.

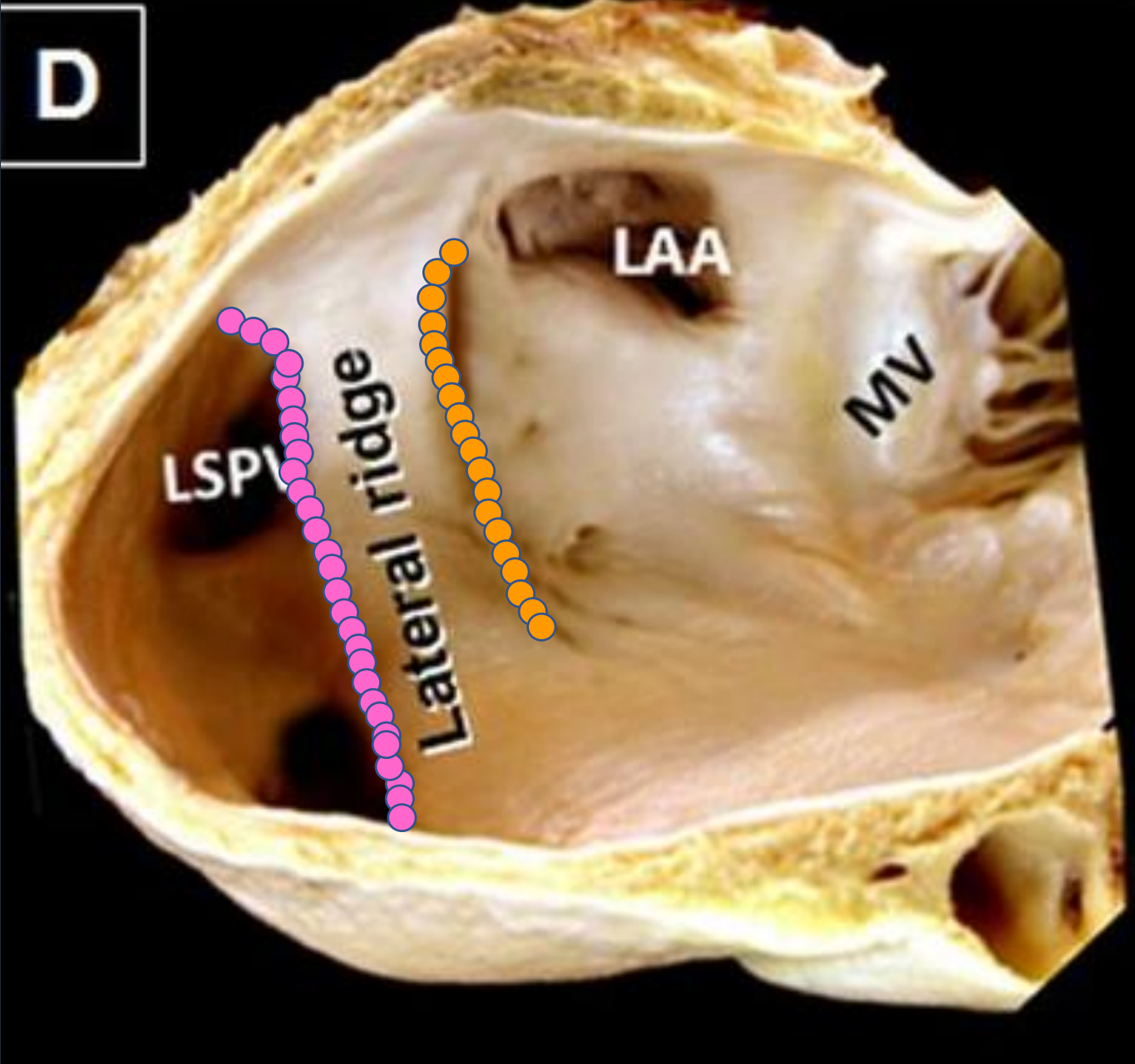
Linear ablations

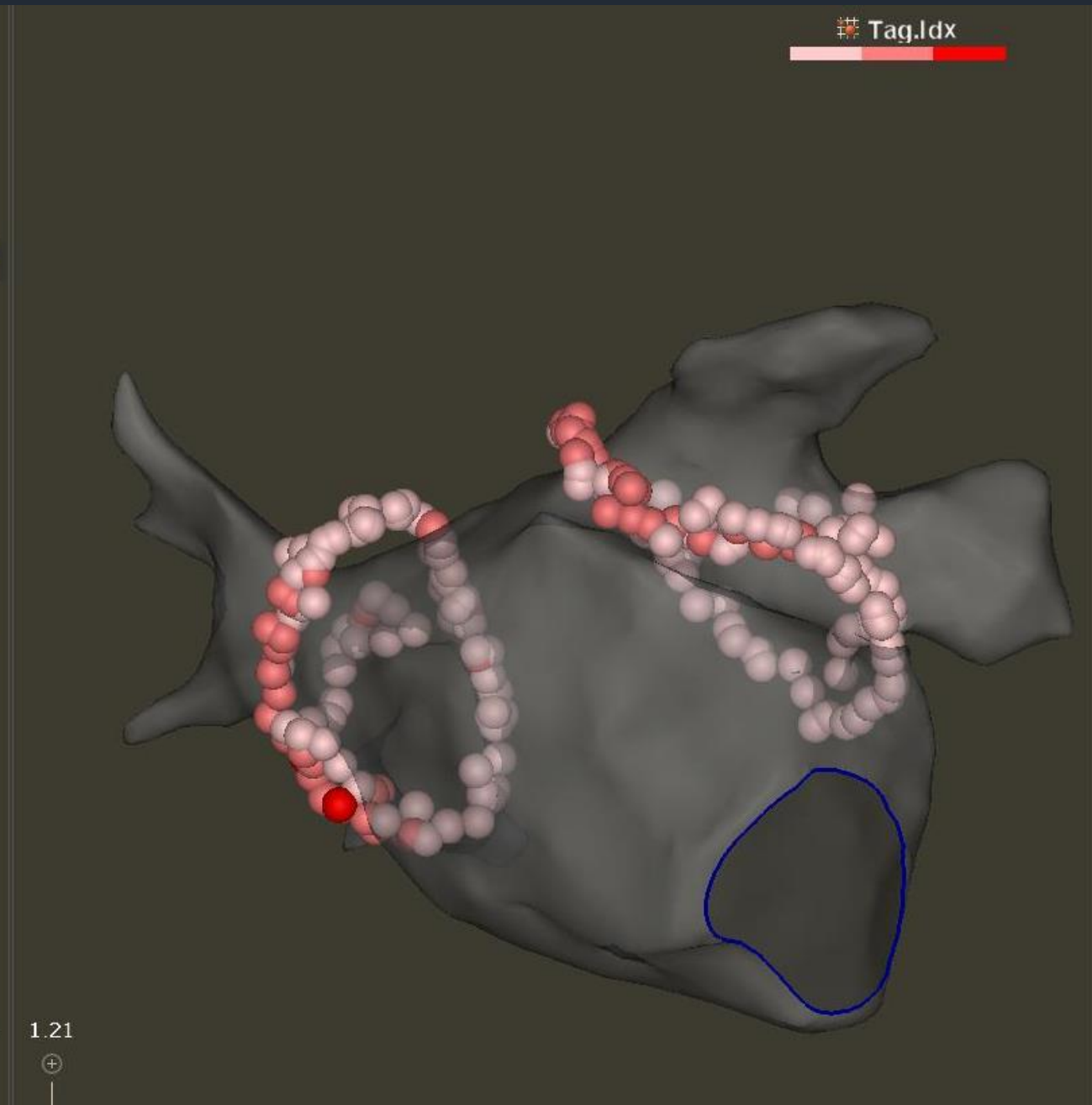
- Left atrial roof line
- Lateral mitral isthmus line
- Anterolateral mitral isthmus line
- Anterior left atrial line
- Cavotricuspid isthmus line

1. Requirement for successful left atrial linear ablations

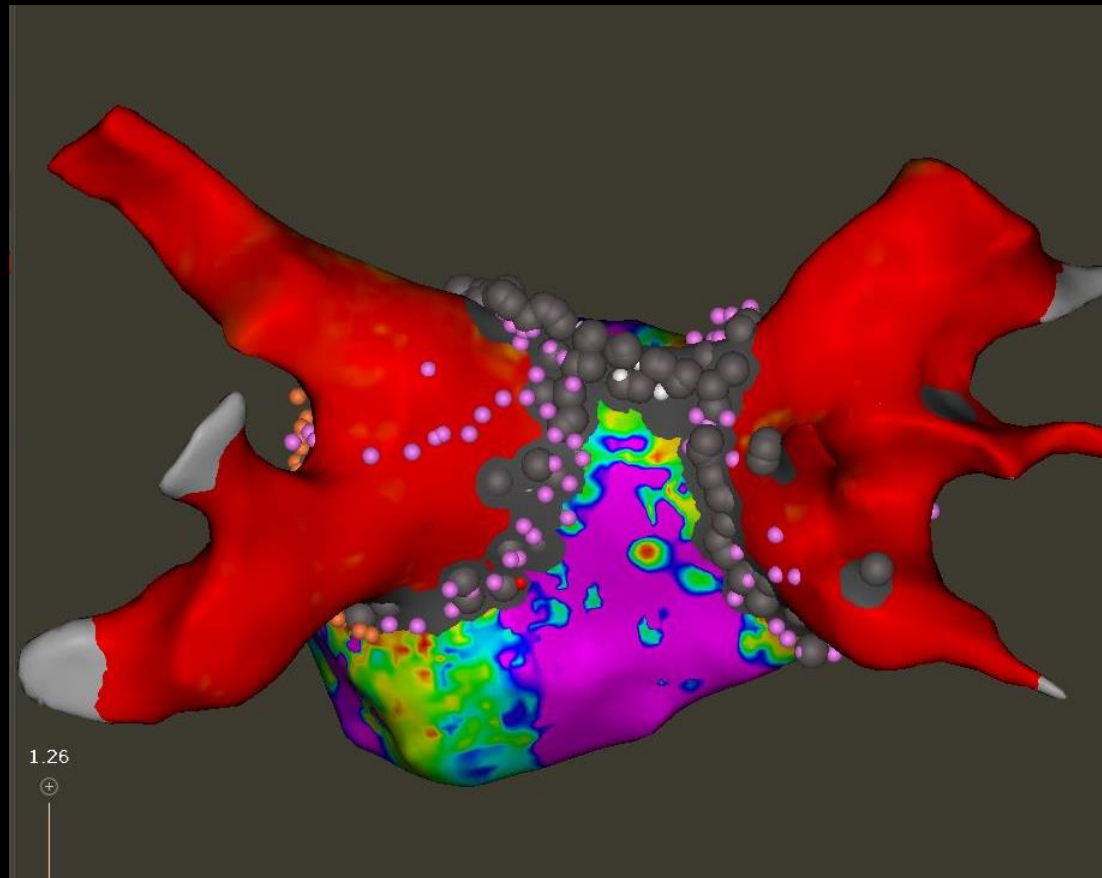
- Complete contiguous pulmonary vein isolation
- Electrical unexcitability along the lesion as well as inside the veins



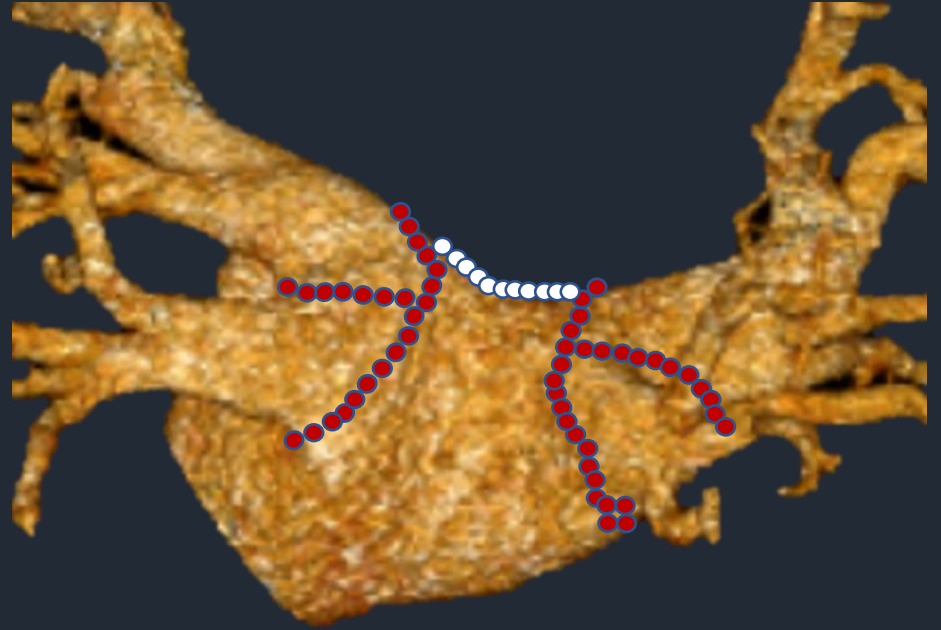




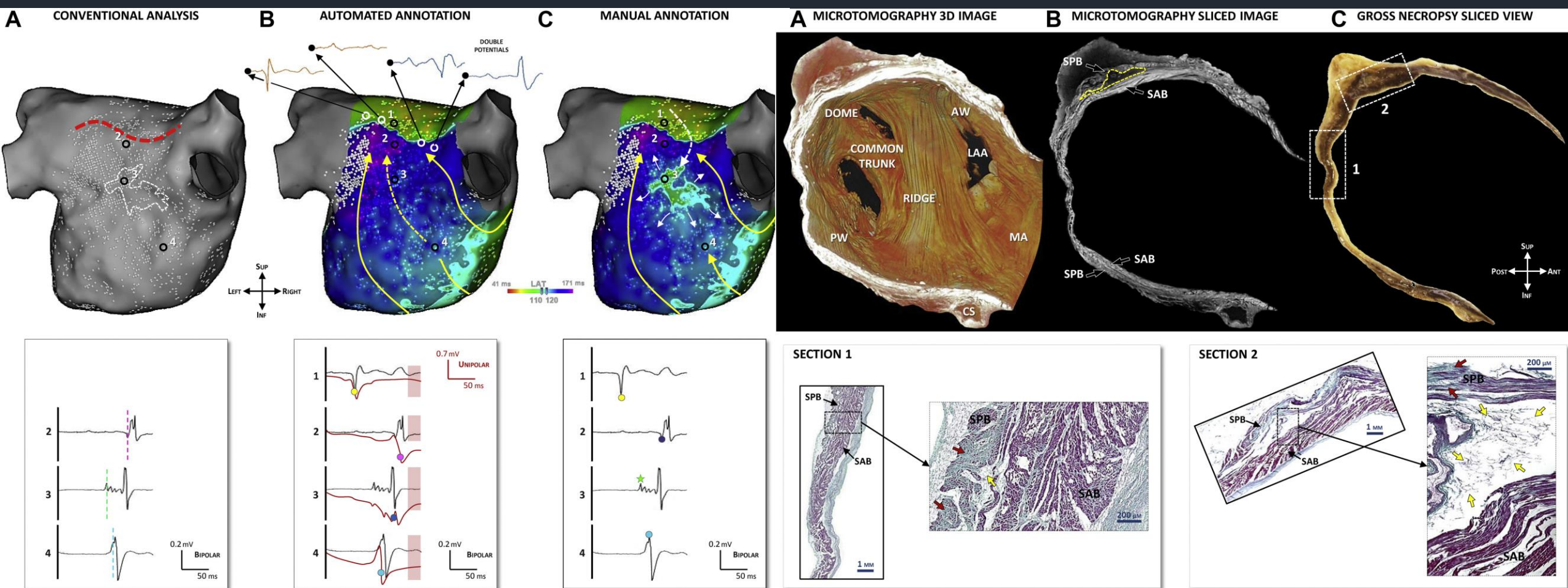
Electrical unexcitability

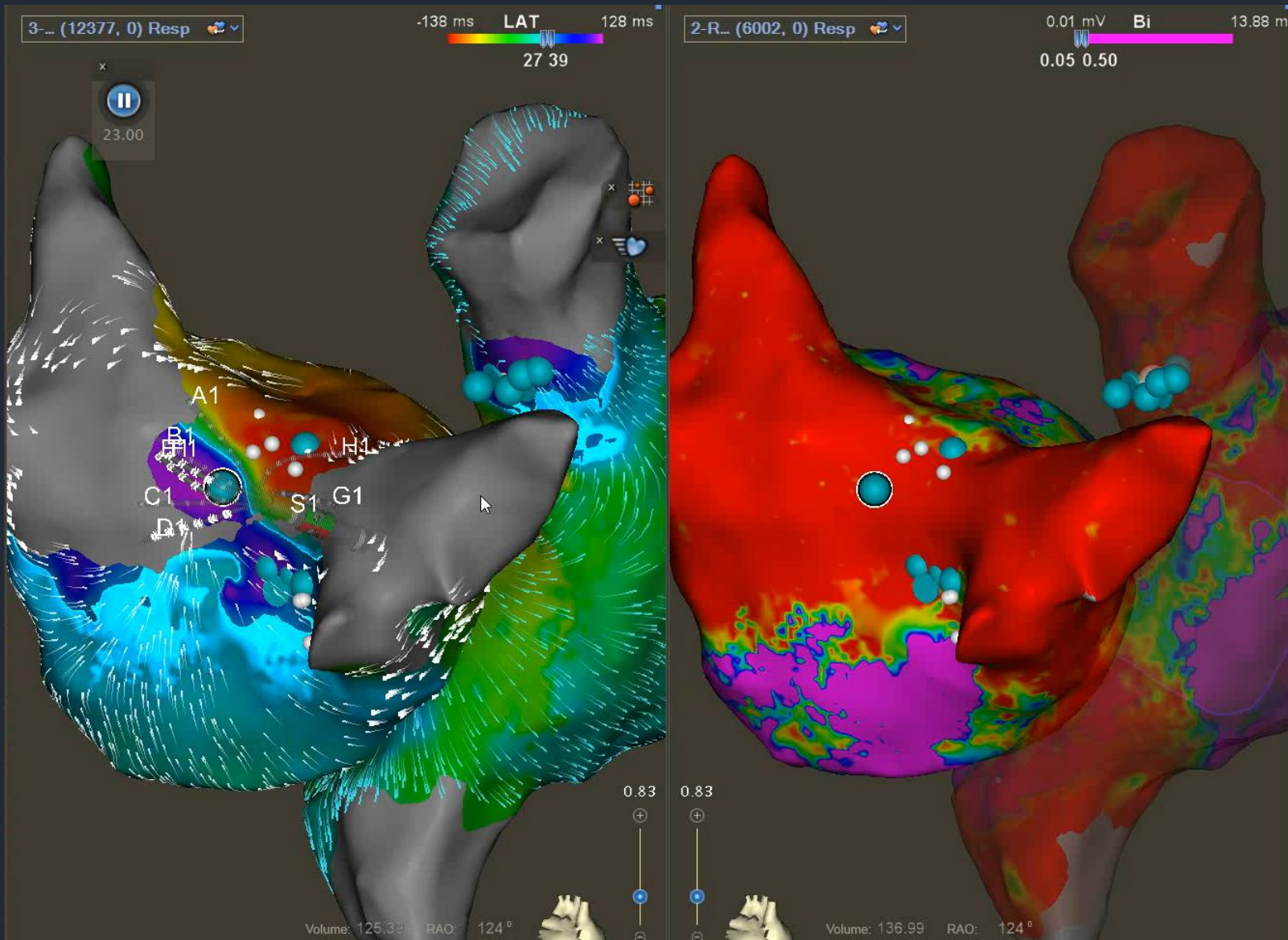


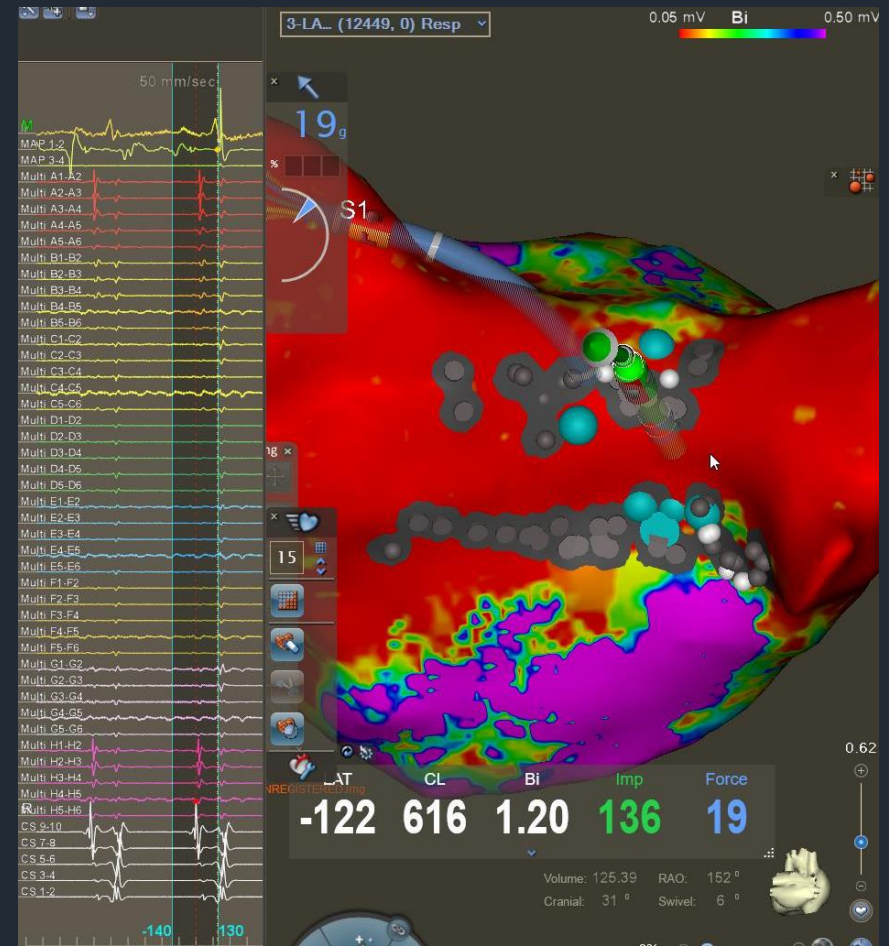
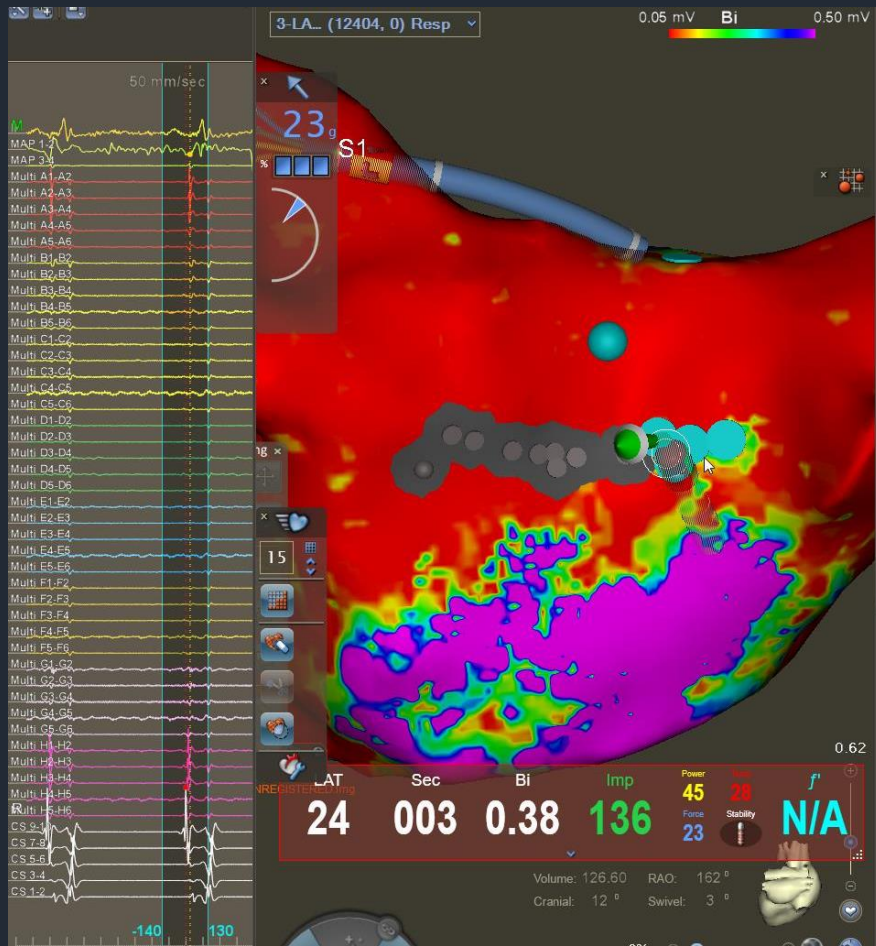
2. LA roof (Dome) line



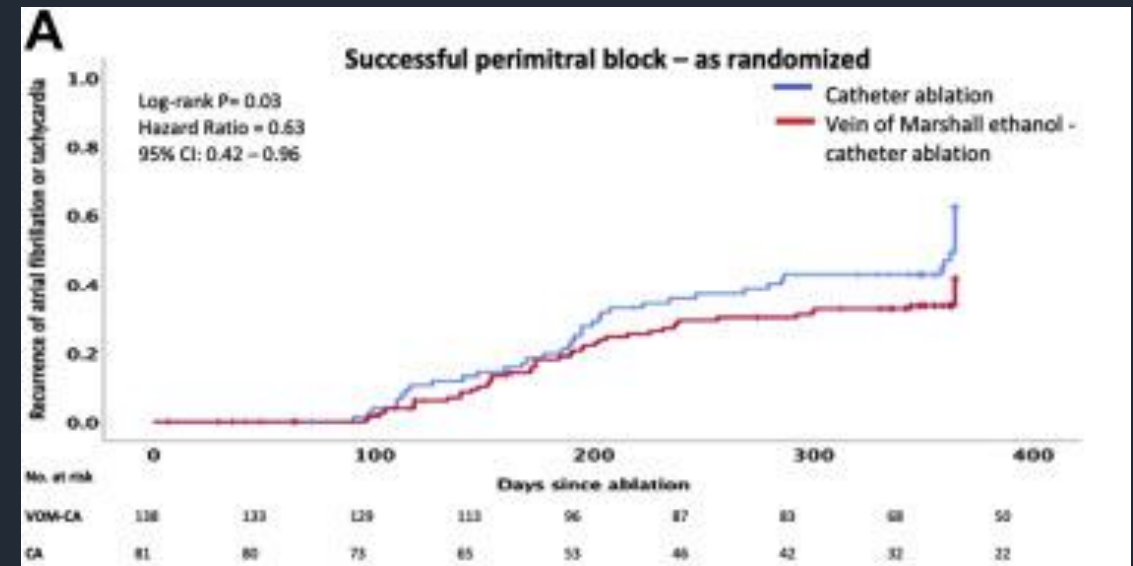
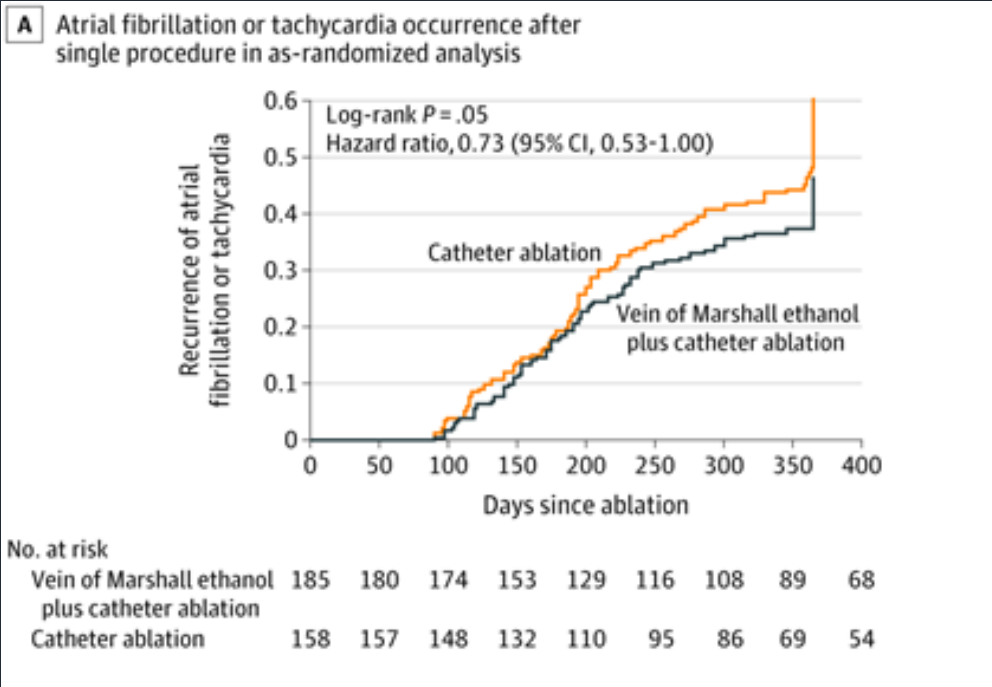
Roof line ablation is not easy





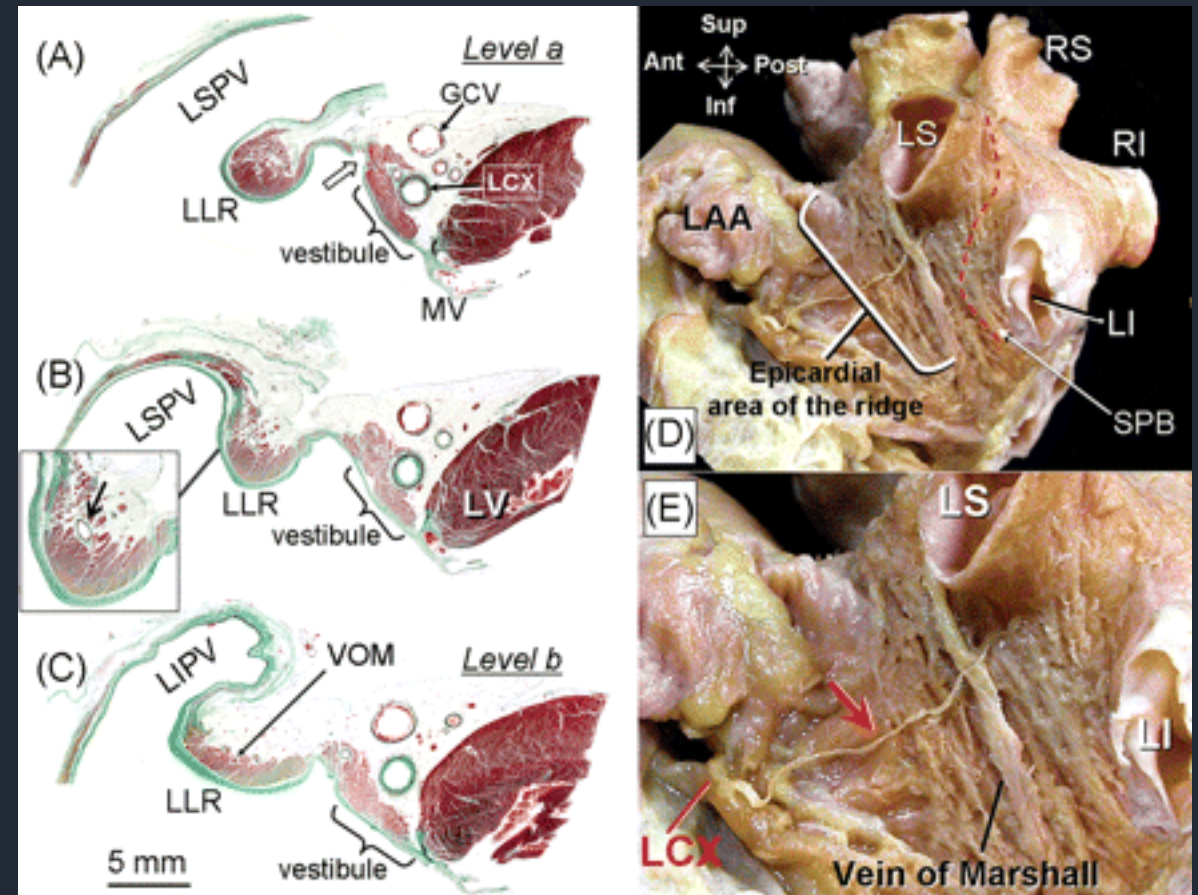


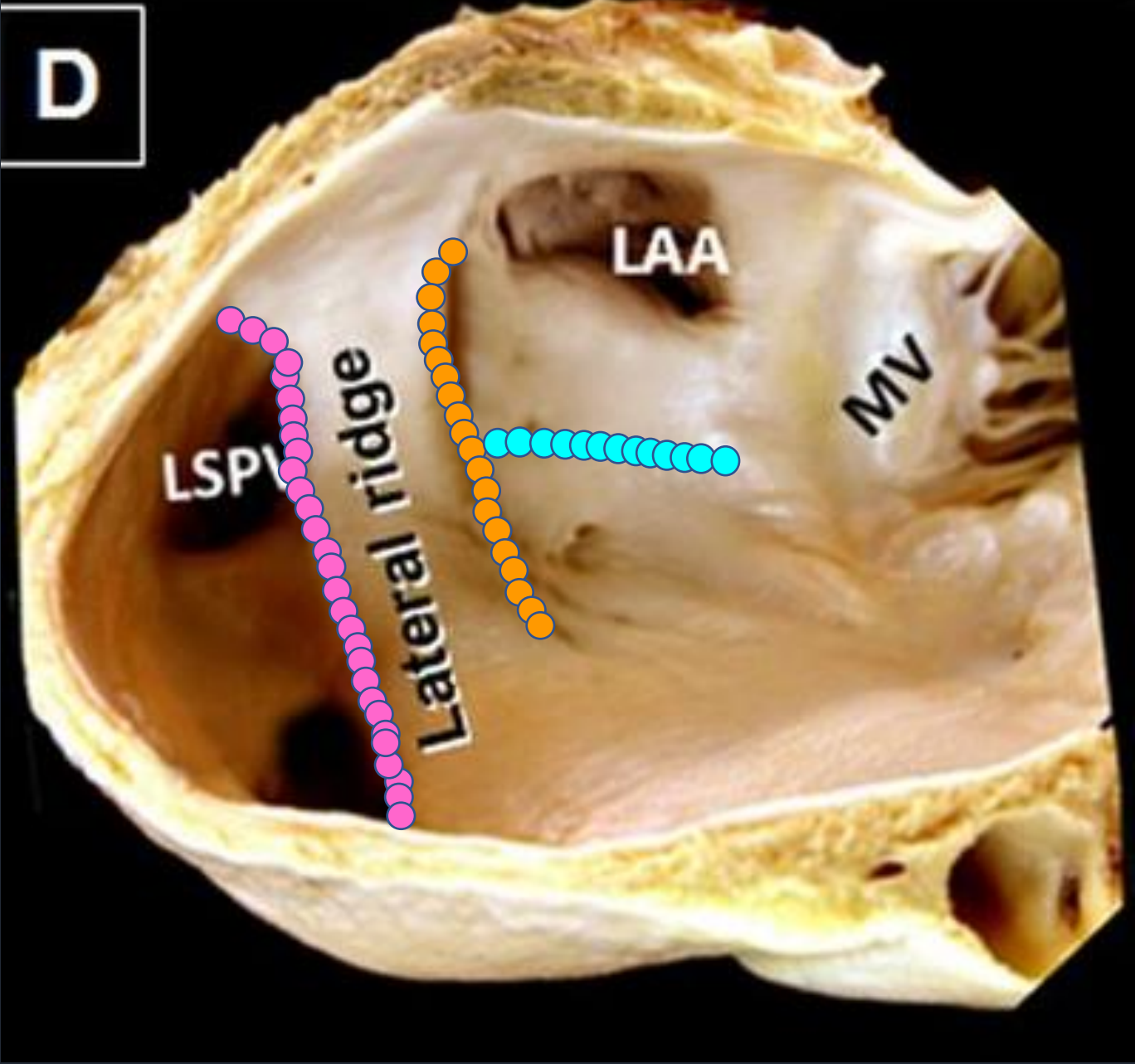
3. Block across mitral isthmus is the only treatment option for persistent atrial fibrillation



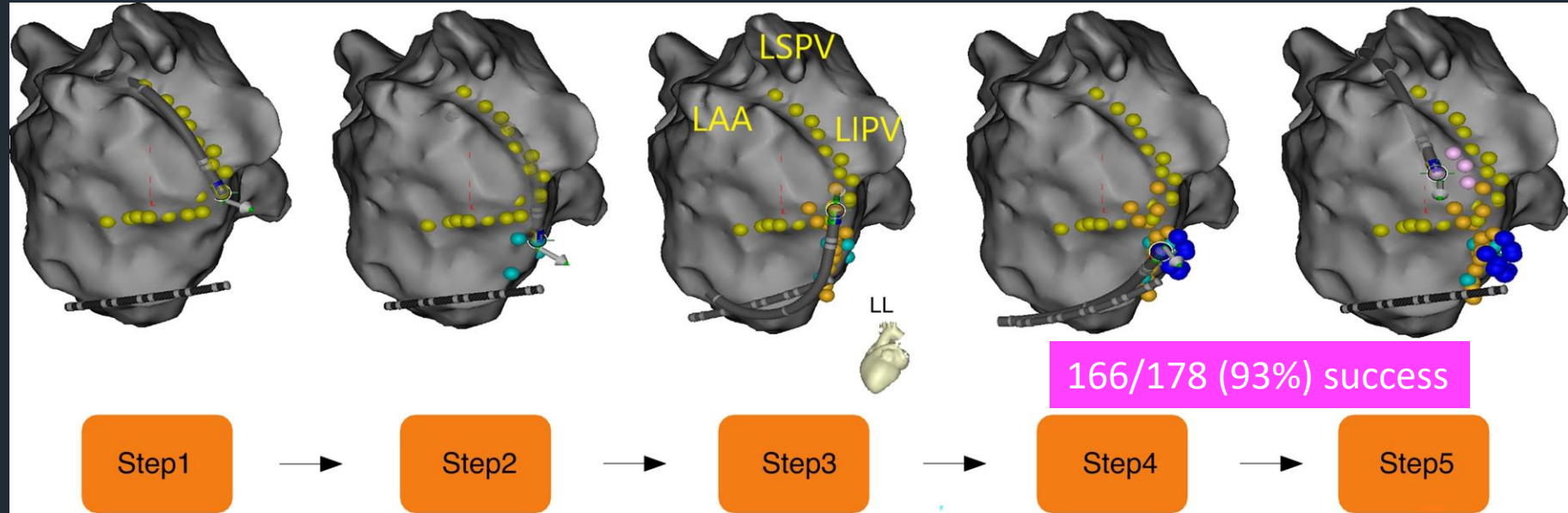
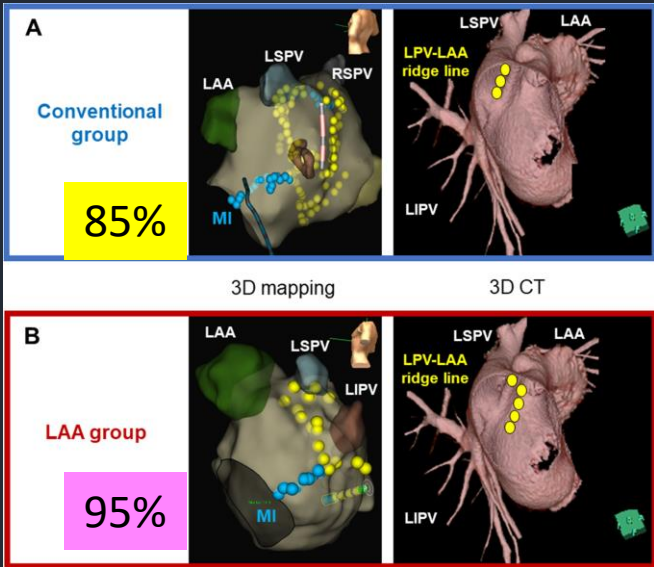
3. Mitral isthmus ablation

	Mean (mm)	Range (mm)
Left common PVs (major axis)	31.4 ± 4.5	22.5–37.6
Left superior PV (major axis)	19.3 ± 2.5	13.1–24.3
Left inferior PV (major axis)	17.3 ± 1.5	12.5–22.3
LLR width (superior level)	5.6 ± 0.4	2.2–6.5
LLR width (inferior level)	10.2 ± 0.5	6.2–12.5
LLR length	25.3 ± 5.5	14.2–33.5
LLR myocardial thickness (superior level)	2.8 ± 1.1	1.5–4.2
LLR myocardial thickness (inferior level)	1.7 ± 0.8	0.5–3.5
Longitudinal axis of LAA	24.5 ± 3.5	18.3–28.5
Sagittal axis of LAA	19.4 ± 2.5	12.5–23.2
Longitudinal axis of LAA in structural heart disease	33.8 ± 4.5	26.4–41.5
Sagittal axis of LAA in structural heart disease	26.5 ± 3.5	17.5–34.5

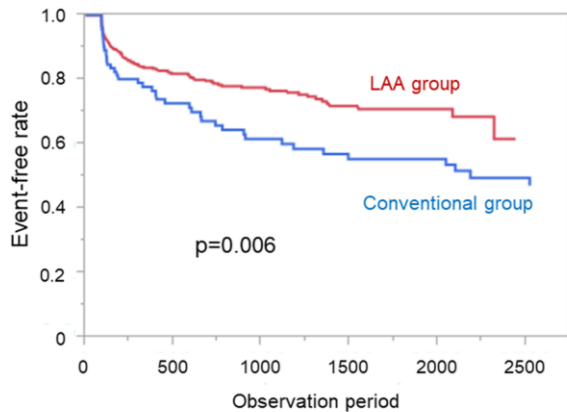




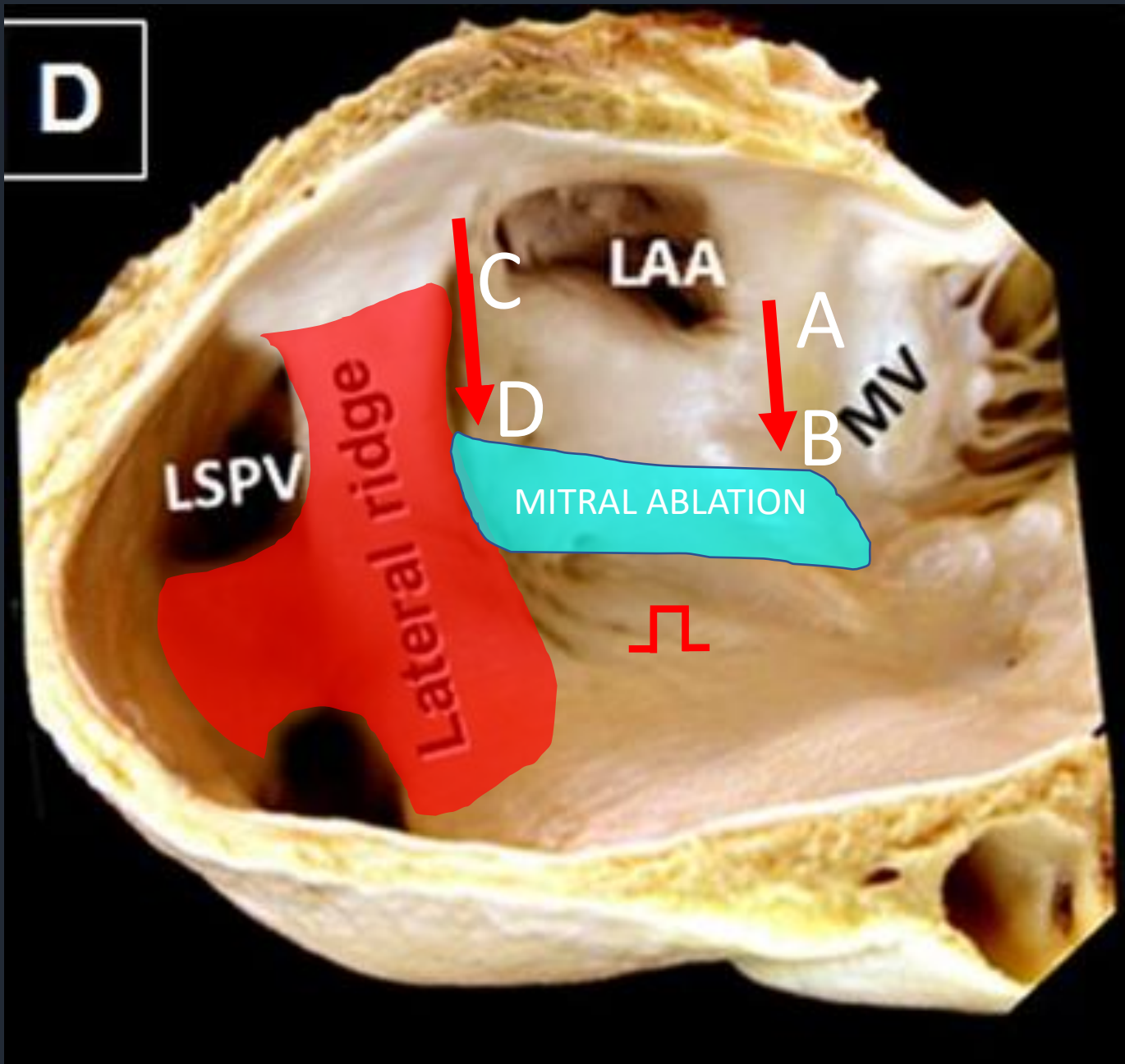
Ablation along the anterior ridge is a key to success for block across the isthmus

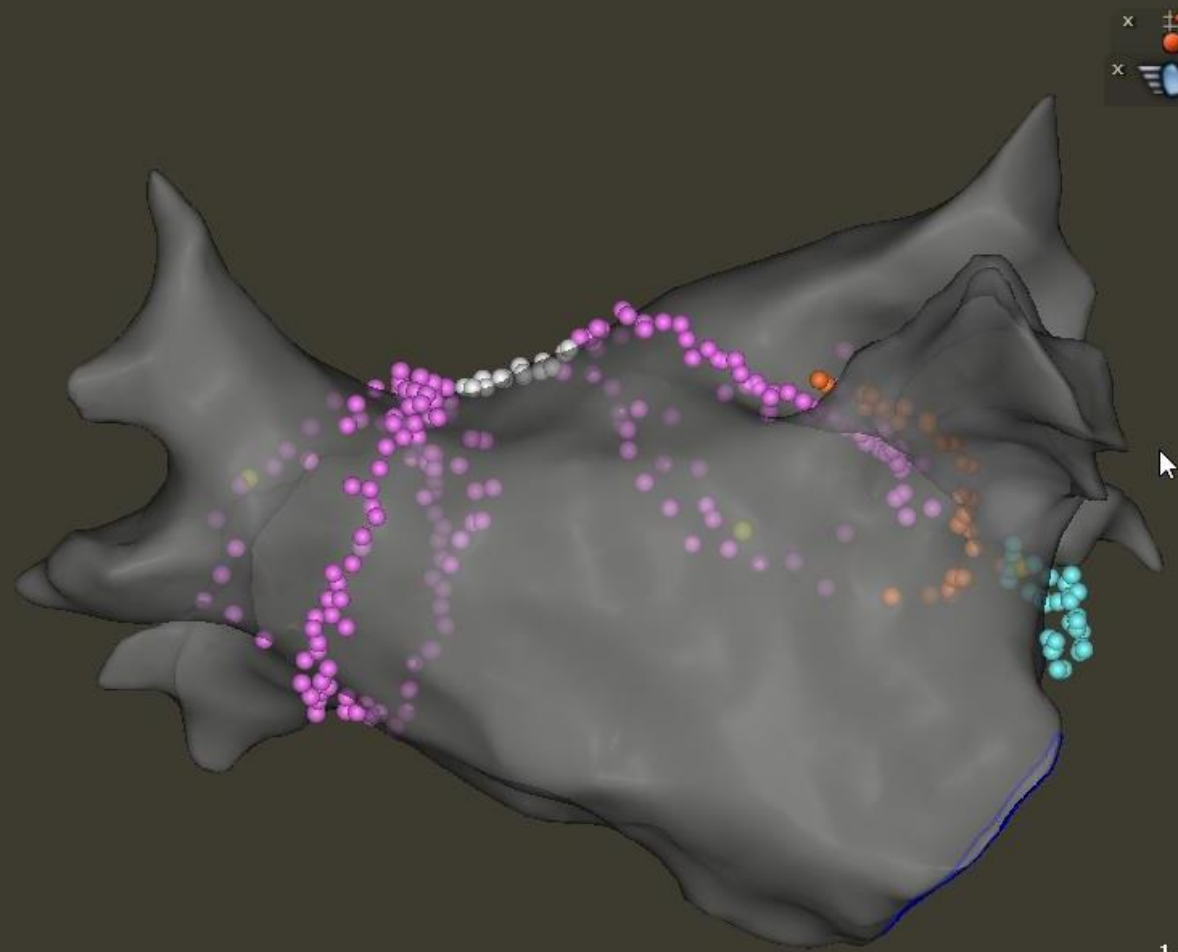


(a) AT/ AFL recurrence



Conventional group	92	56	41	36	32	22
LAA group	467	238	155	85	36	1

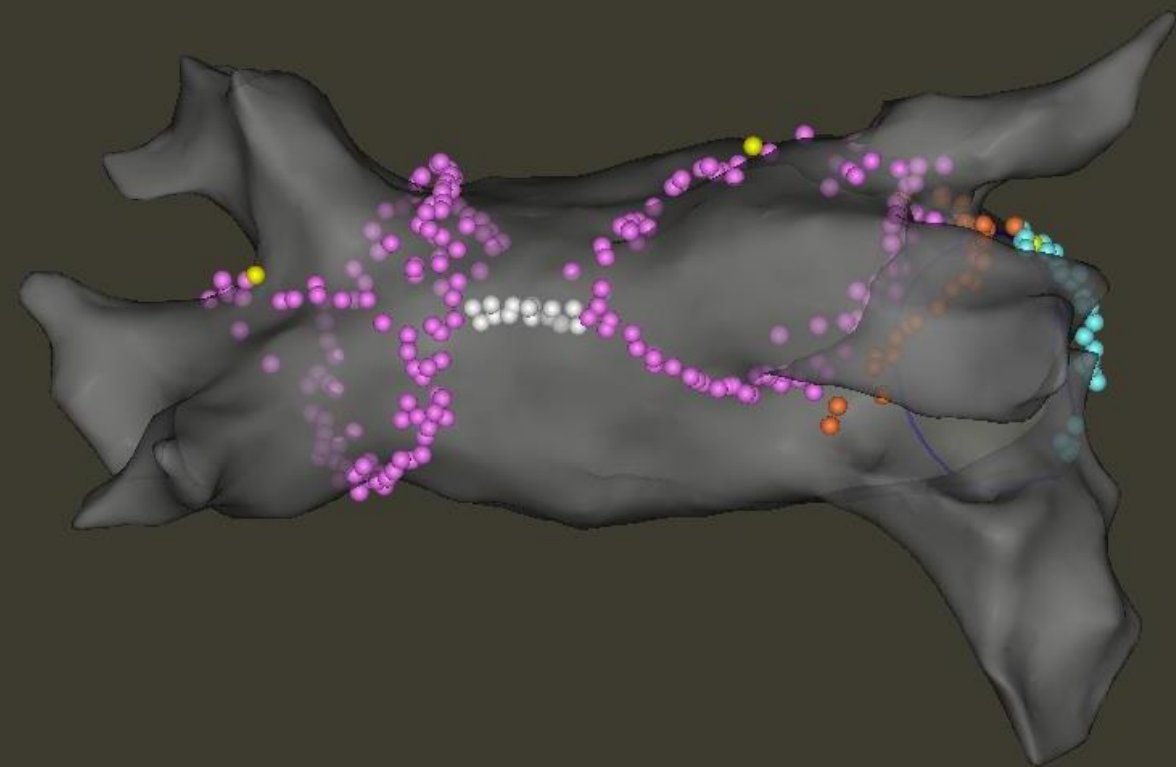




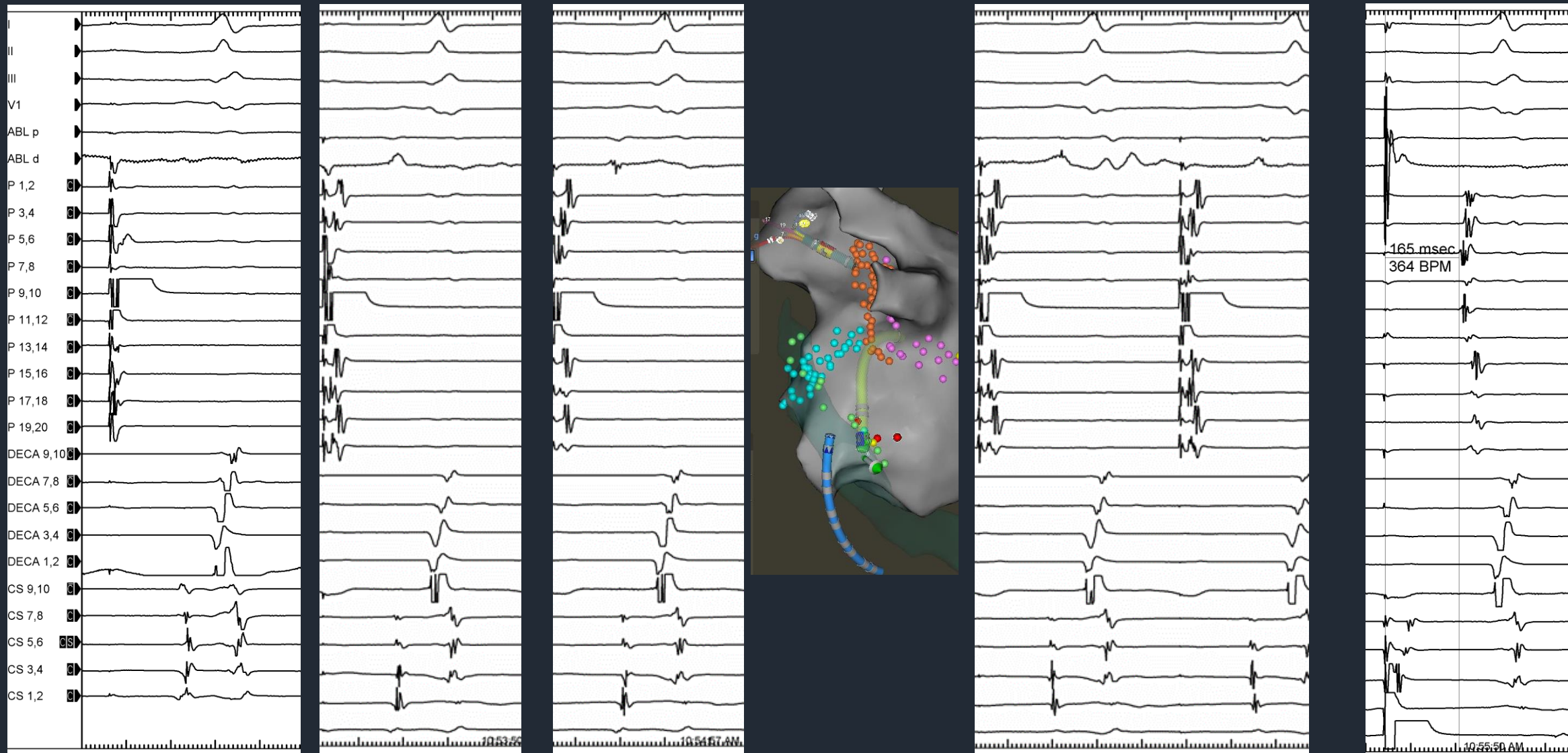
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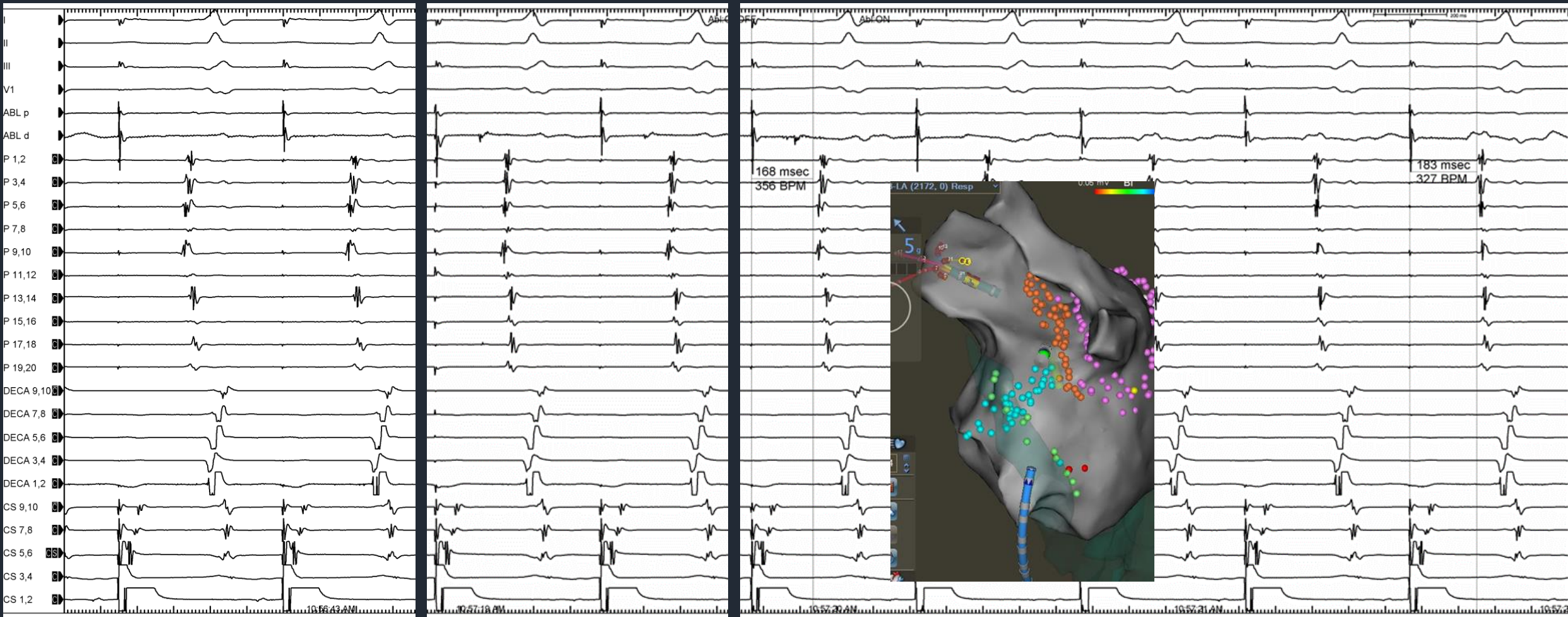
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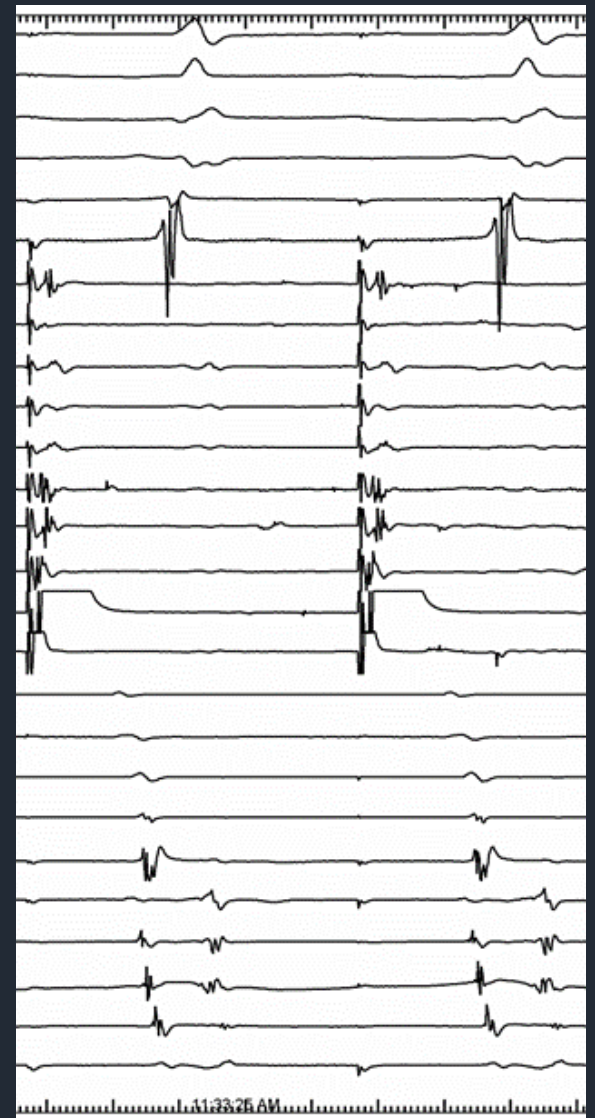
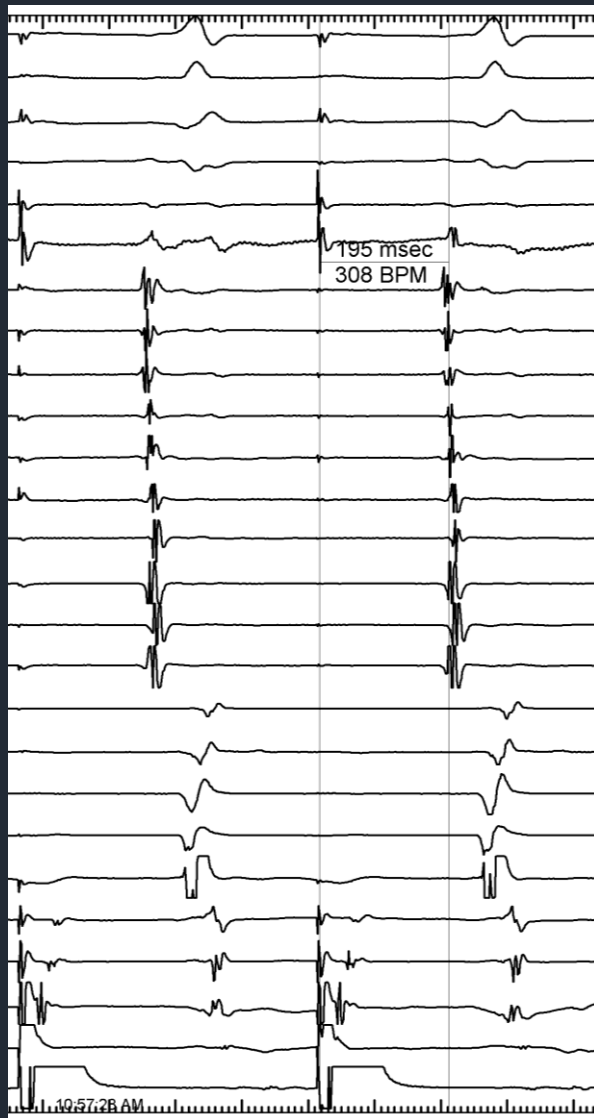
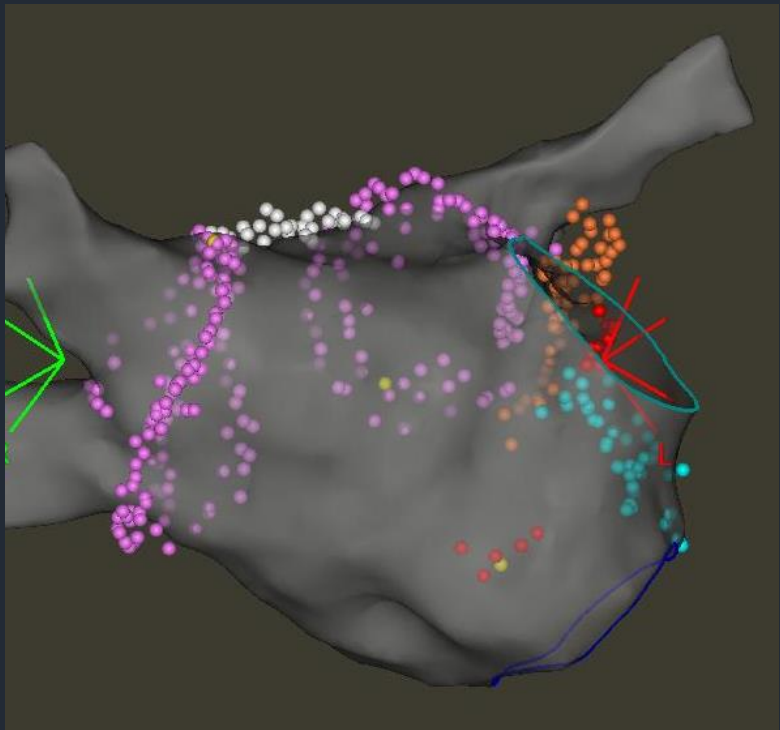


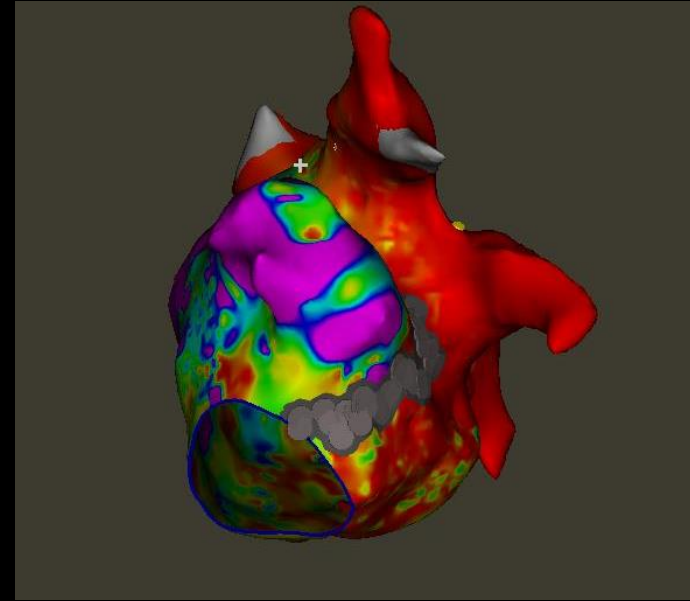
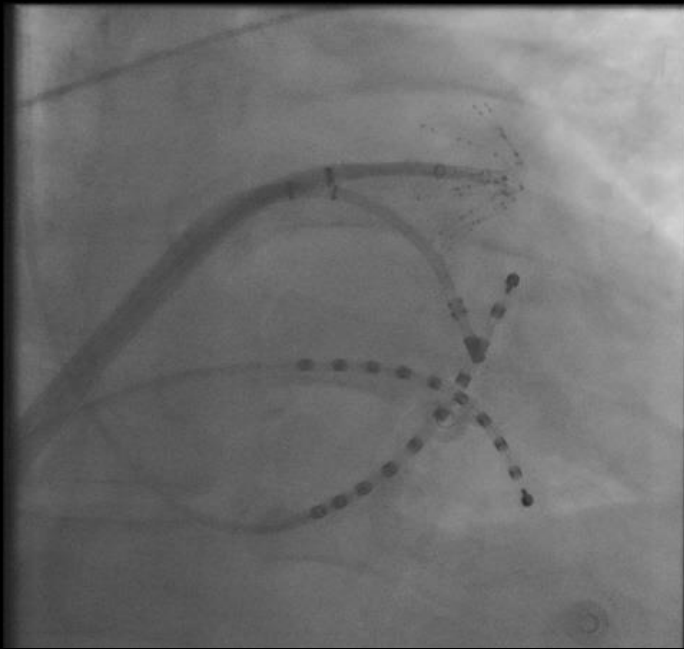
Is the mitral isthmus blocked?



mapping of ridge





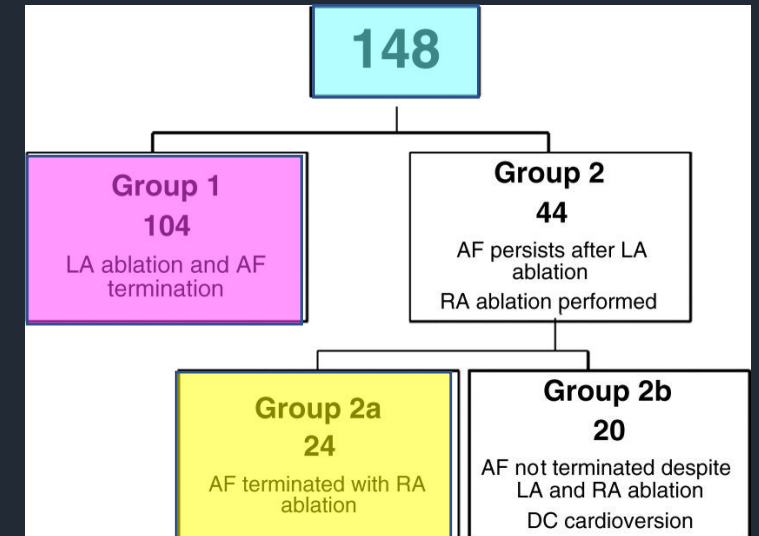
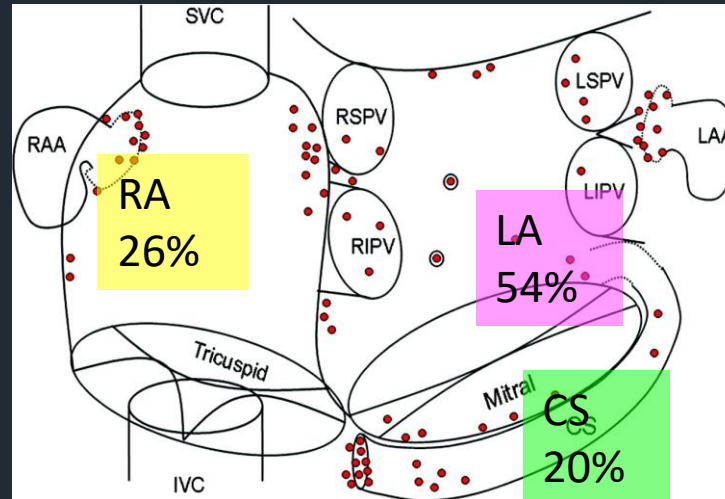
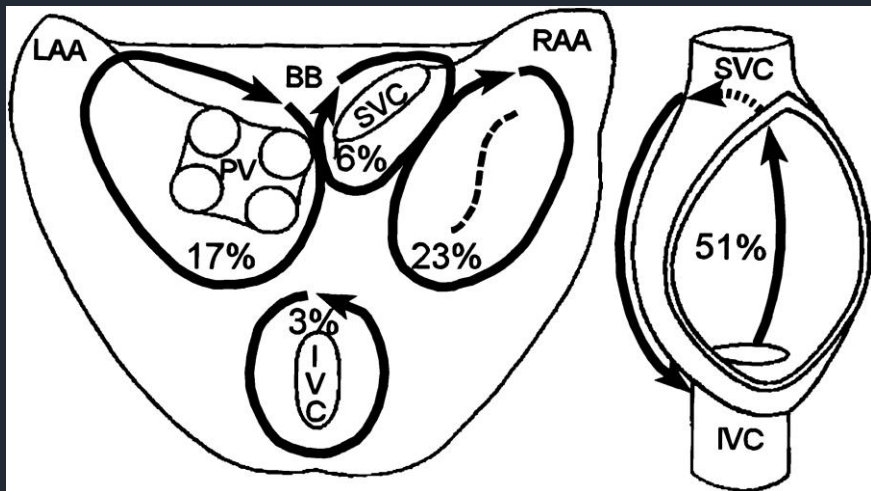


Contraindications to left linear ablations

- Segmental ostial pulmonary vein isolation
- Difficulty in pulmonary vein isolation
- Unstable erratic respiration
- Inability to position a multielectrode catheter in the great cardiac vein (lateral mitral line)
- Inability to two separate transseptal catheterizations for an ablation catheter and a mapping catheter (lateral and anterolateral mitral lines)
- Inability to position an ablation catheter in the great cardiac vein (lateral mitral line)

Right atrium is as important as left atrium in AF maintenance

Locations of unstable reentrant circuits

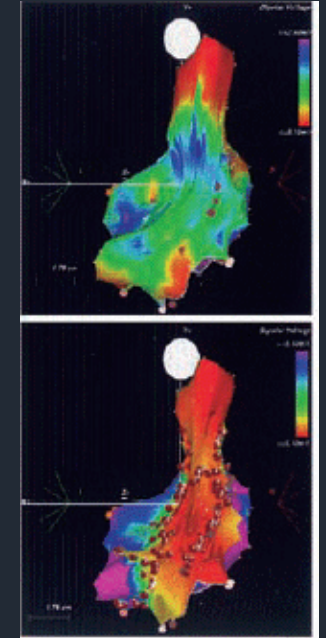
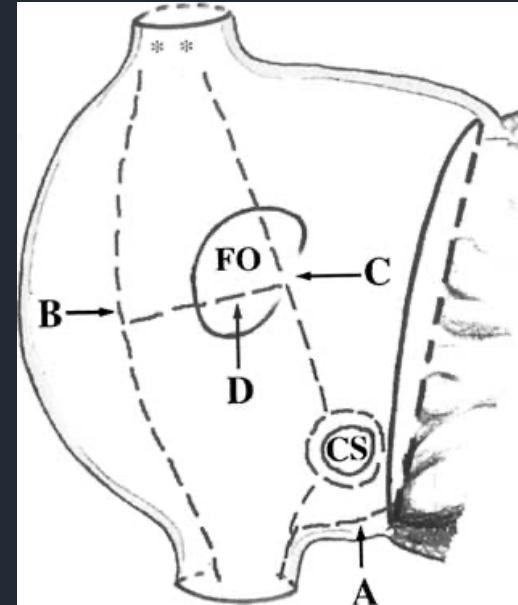
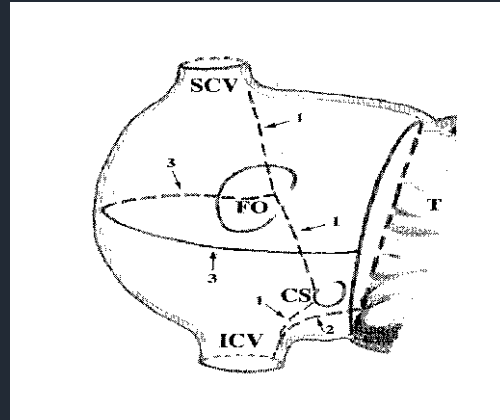
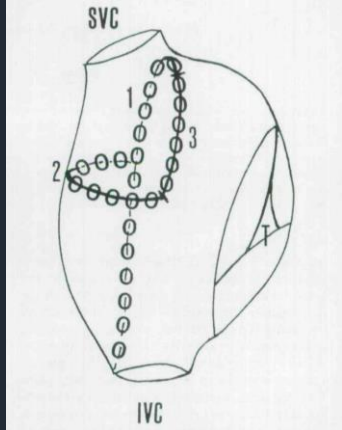


Kumagai K, Waldo AL, Circulation 1997;95:511-21

Rostock T Circulation: Arrhythmia and Electrophysiology. 2008;1:344-353

Hocini M. J Am Coll Cardiol 2010;55:1007-1016

linear RA ablation



- First case report

- 46/M

- s/p CTI ablation

- Symptomatic PAF refractory to drugs

- AF termination by 3 linear

RA lesions

- AF noninducible

- No AF for 3 months after

RFCA

- N=16
- 56% AF free

- 74 patient (PAF, 49)
- Carto
- 66% SR with AAD

8/18 had complication :

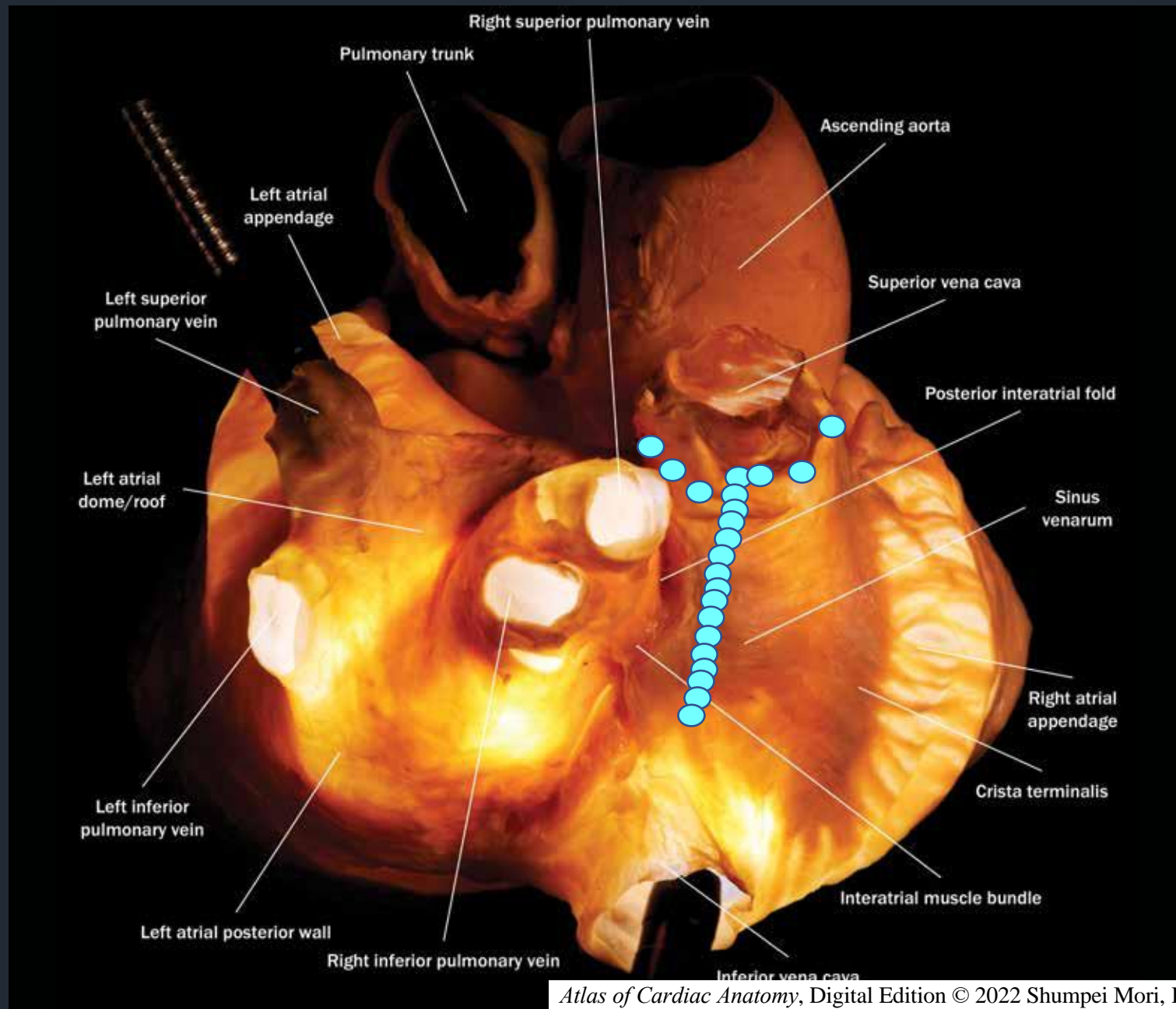
- phrenic nerve paralysis
- sinus node dysfunction
- PR prolongation

Haissaguerre M et al. JCE 1994;5:1045-52

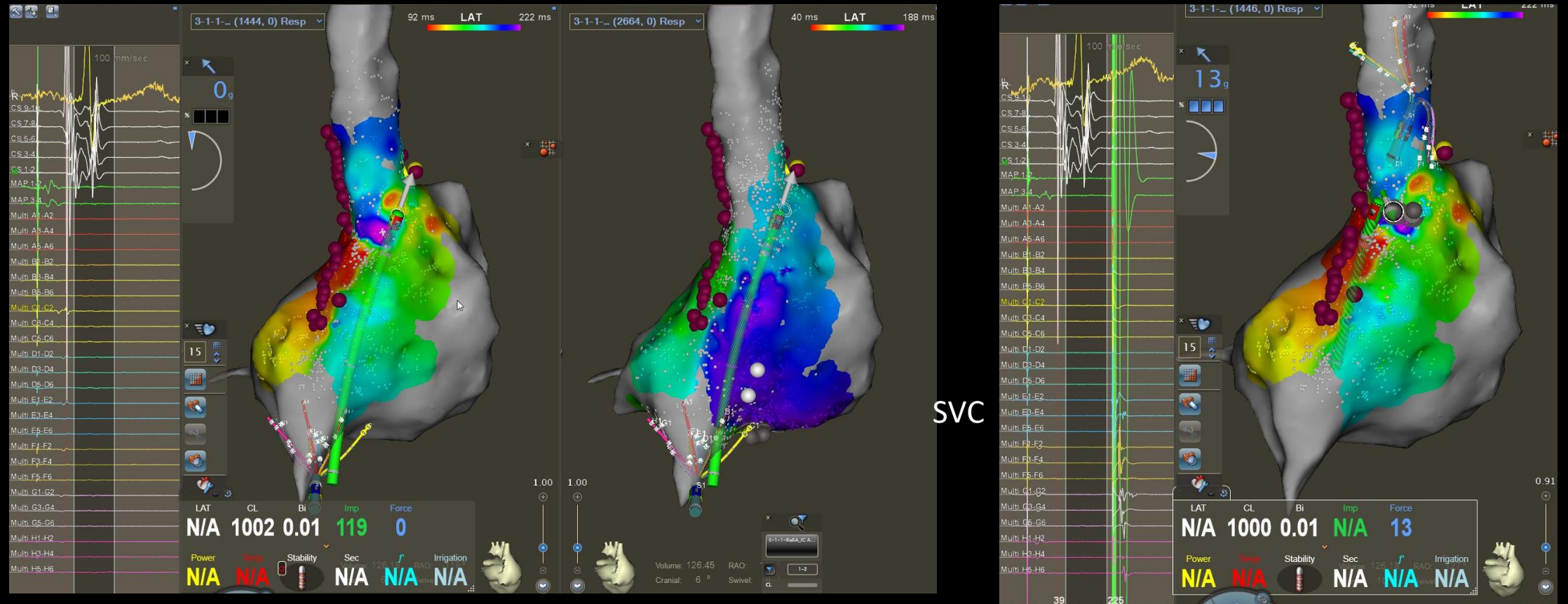
Gaita F et al. Circulation 1998;97:2136-45

Calo L. J Cardiovasc Electrophysiol. 2004;15:37-43.

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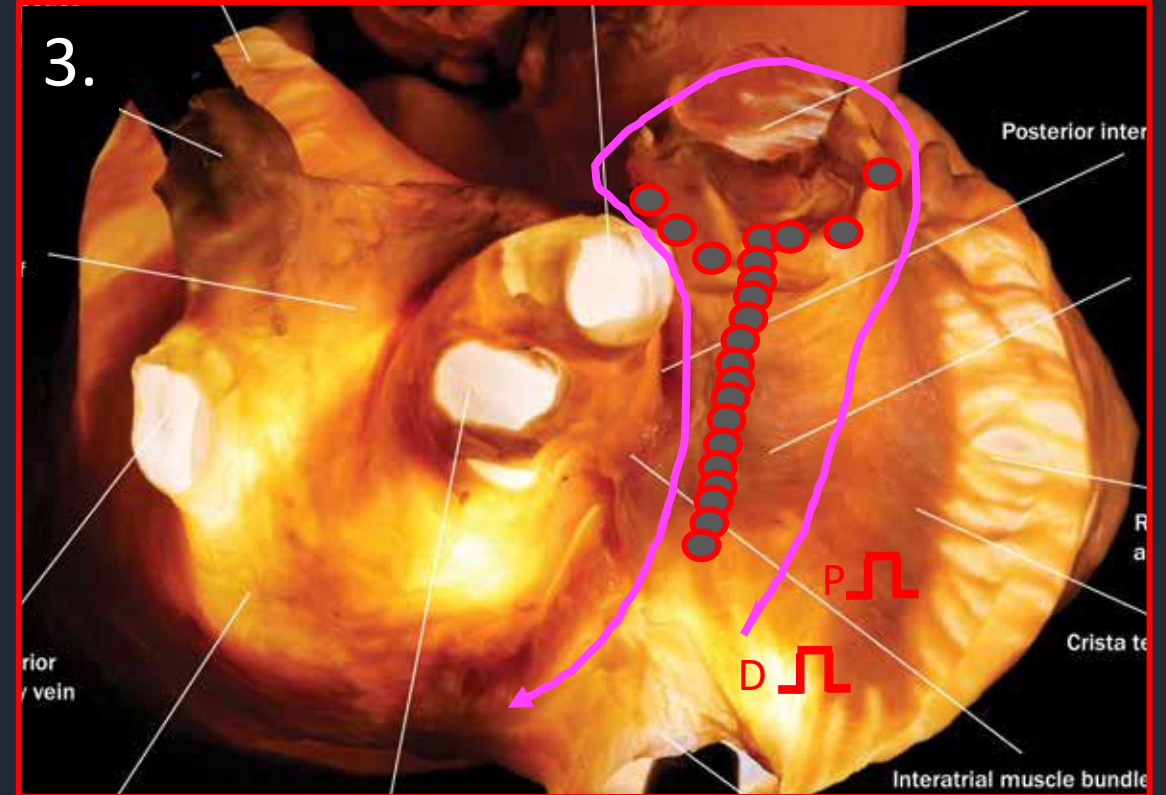
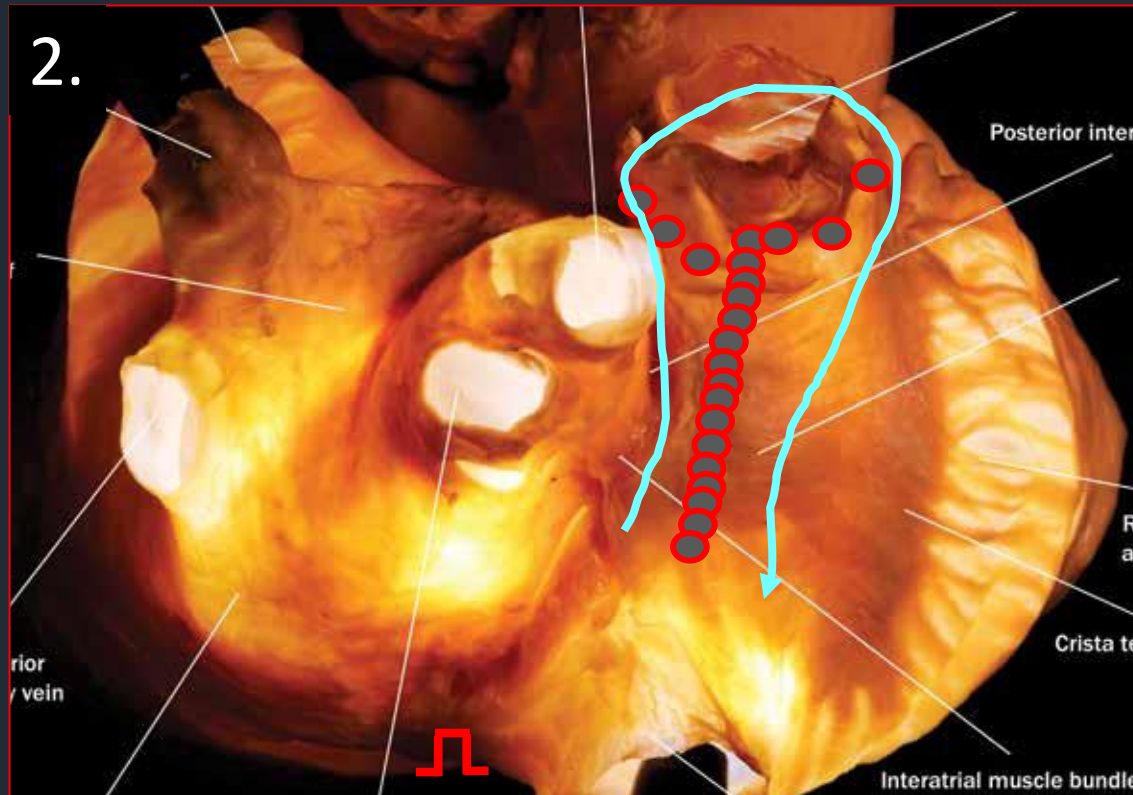


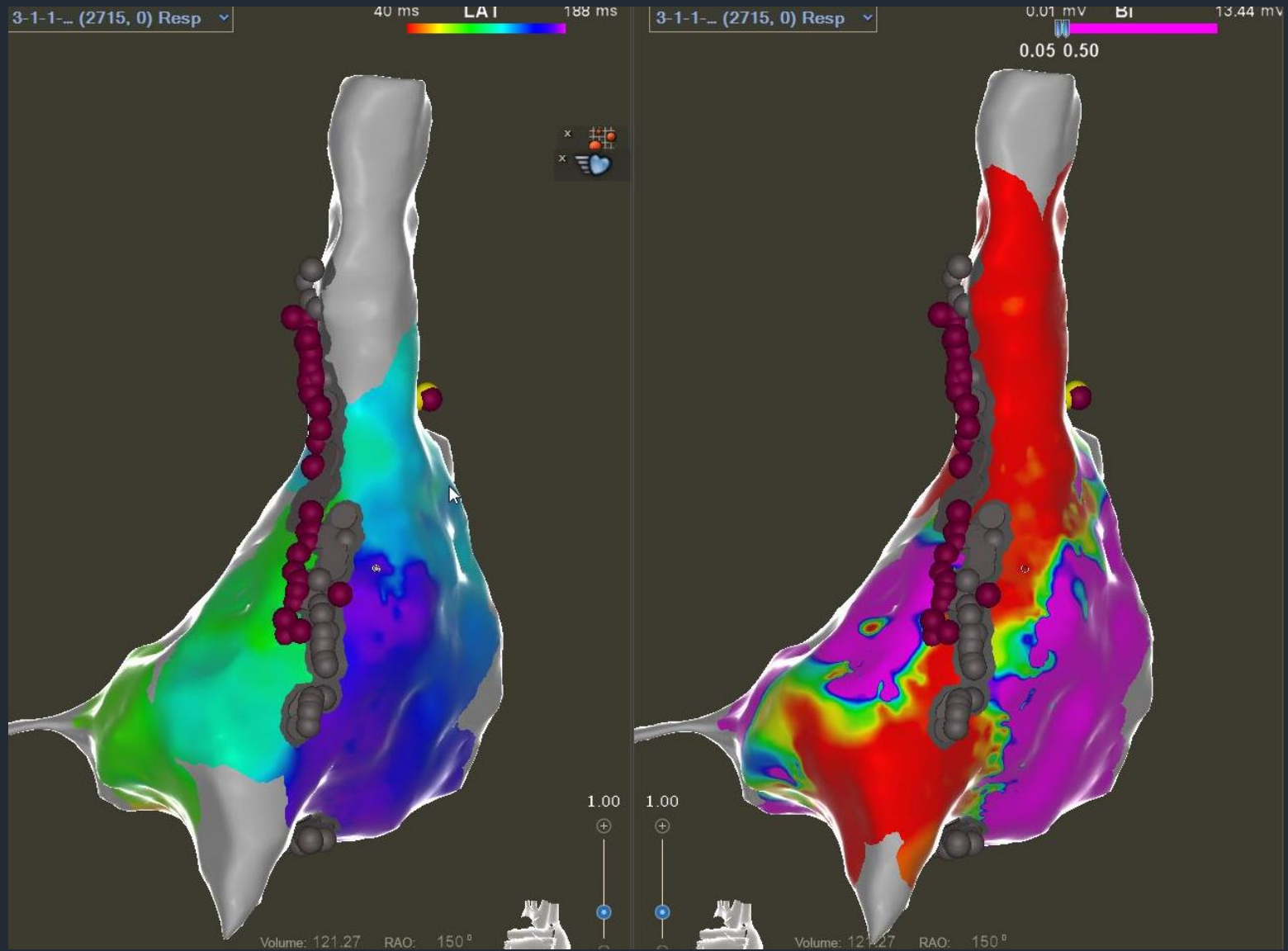
non-capture and SVC capture with atrial exit block



Validation of bidirectional block

1. electrical unexcitability along the line @ 10 mA



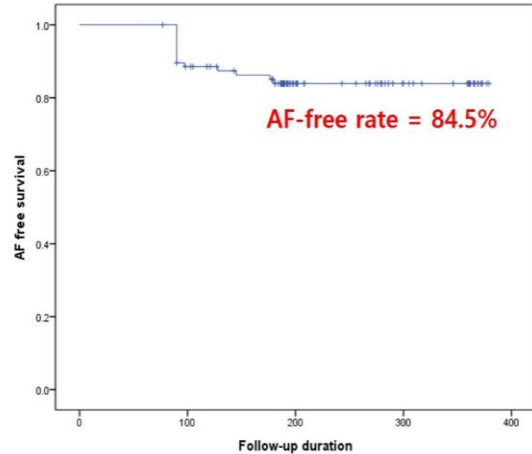


Preliminary result of bi-atrial ablation for persistent atrial fibrillation

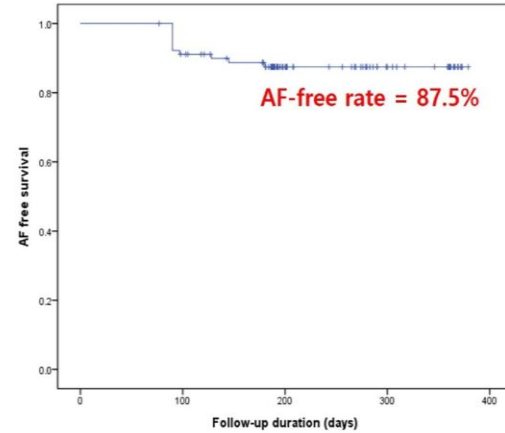
- Total enrolled patients = 97
- Mean AF duration = 3.13 ± 3.21 years
- Age = 62.6 years old (32 – 80 yo)
- Male : Female = 80:17
- Completed study lesion set (Per-protocol) = 91 (93.8%)
- Reasons for incomplete biatrial ablation:
 - recurrent transient AV block during CTI ablation (n = 1),
 - Ablation for right septal focal AT (n=1) and risk of AV block after CTI and intercaval line ablation
 - Extreme obesity and erratic respiration resulting in excessive ablation time in LA and abandoned RA ablation(n = 4)

Primary efficacy & safety endpoints

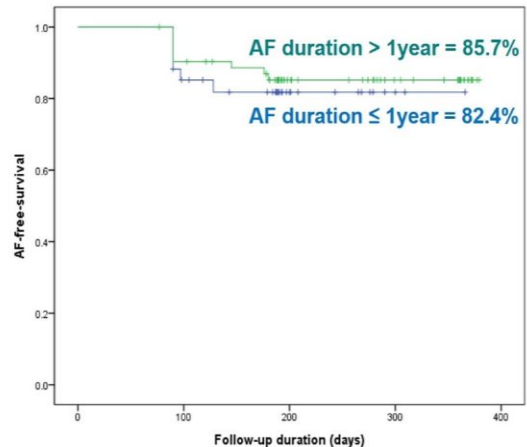
A. Total population (ITT, n=97)



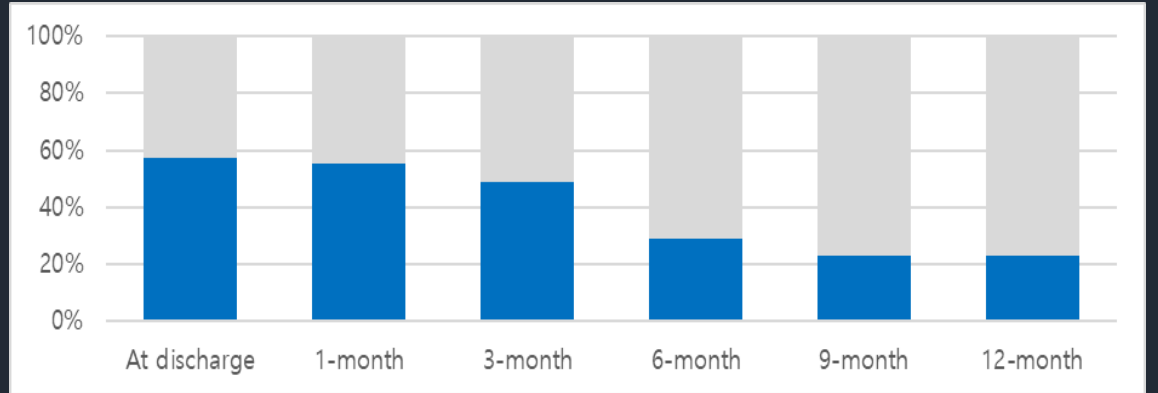
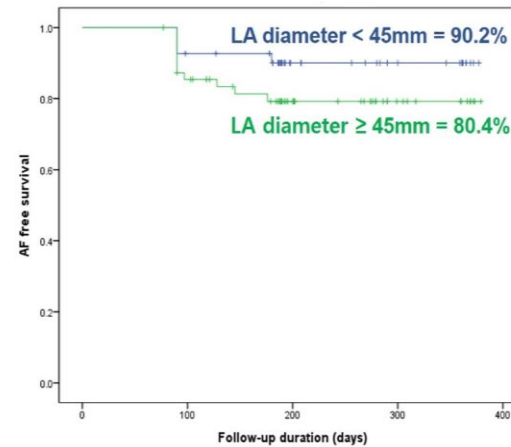
B. Patients completed biatrial ablation (PP, n=91)



C. AF duration (≤ 1 year versus >1 years)



D. Left atrial diameter (mm)



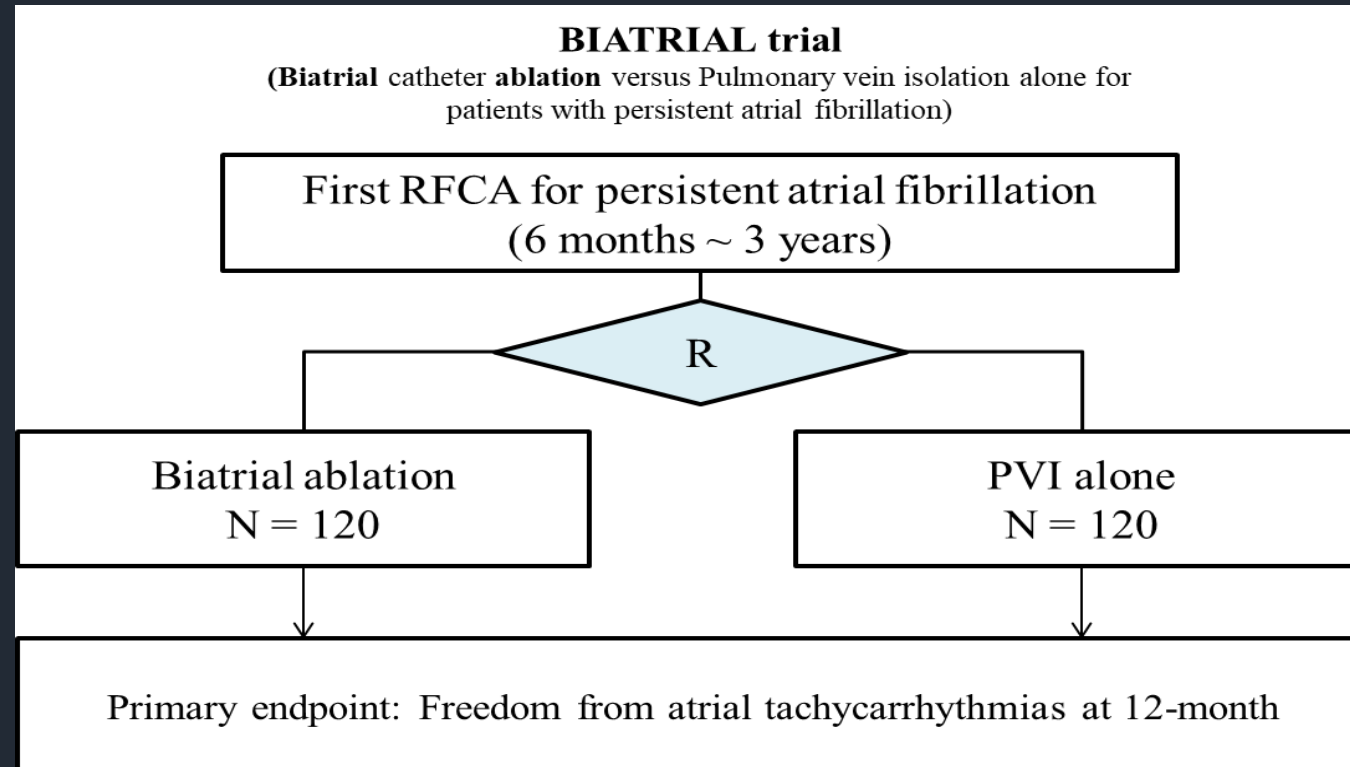
• Complications

- pseudoaneurysm (N=1)
- transient sinus node dysfunction (N=1)
- pericarditis (N=1)
- phrenic paralysis (N=0)
- pacemaker implantation (N=0)
- Stroke (N=0)
- Atrioesophageal fistula (N=0)

Preliminary data Cha MJ et al.

Cha MJ et al KHRS 2023 ePoster 77

Multicenter RCT for persistent atrial fibrillation



Contact Information: junkim@amc.seoul.kr

Conclusion

- Creation of durable linear ablation in either left or right atrium is a routine procedure that every electrophysiologists must master.
- The only source of energy that have been used for linear ablation is radiofrequency energy.
- The only ablation lesion that improve persistent AF ablation outcome is to create mitral isthmus ablation with block.
- Assessment of electrical excitability along the line is useful adjunct to improve rate of conduction block.