What Should We Do At Re-do Ablation Procedure?

고신의대

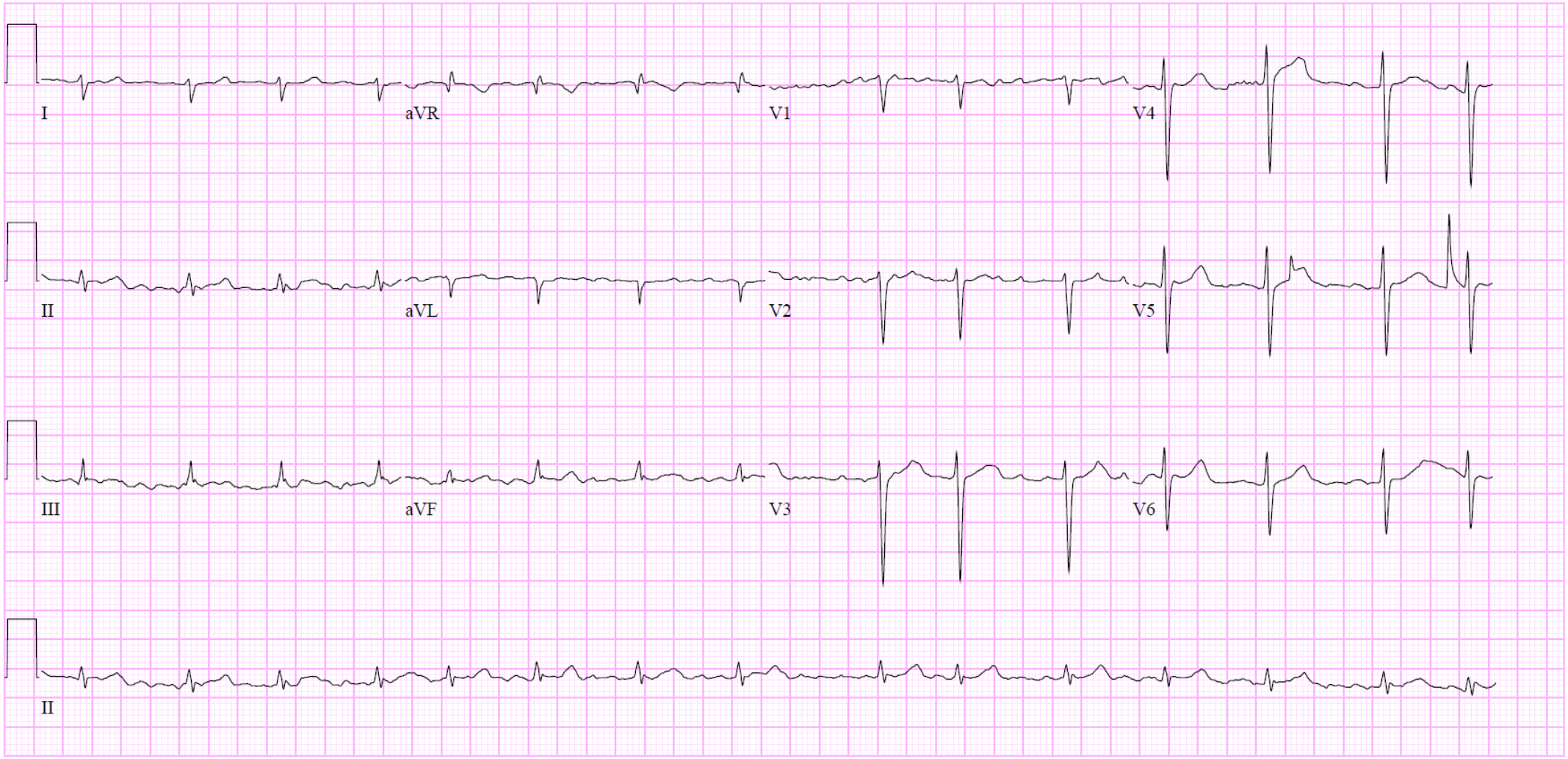
차태준

It is contact! Whether Re-do or First

36 years old female patient, intermittent palpitation for 10 years

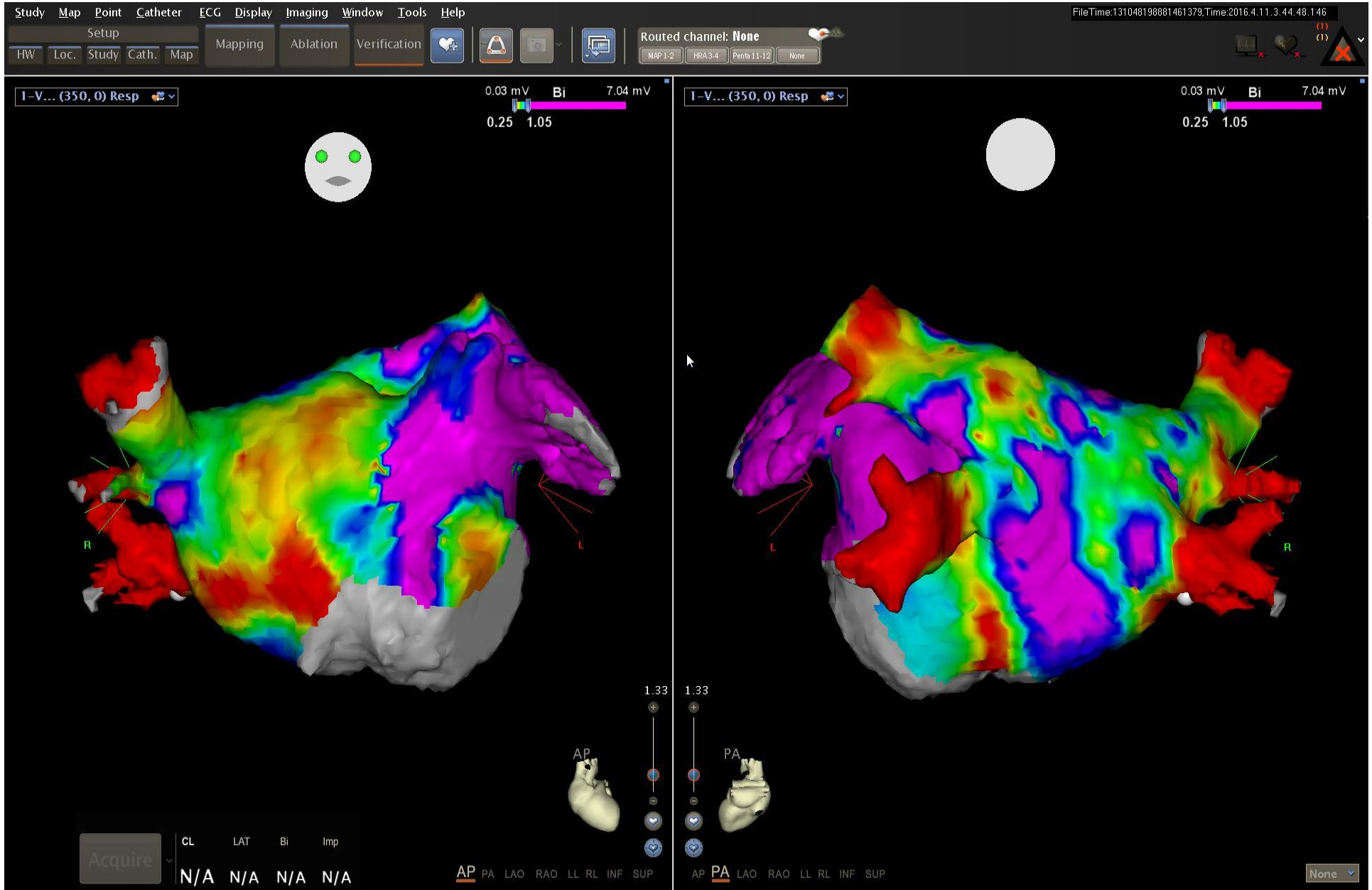
- Previous medication propafenone 300 mg tid.
- Concor 2.5 mg qd

05/Apr/2016

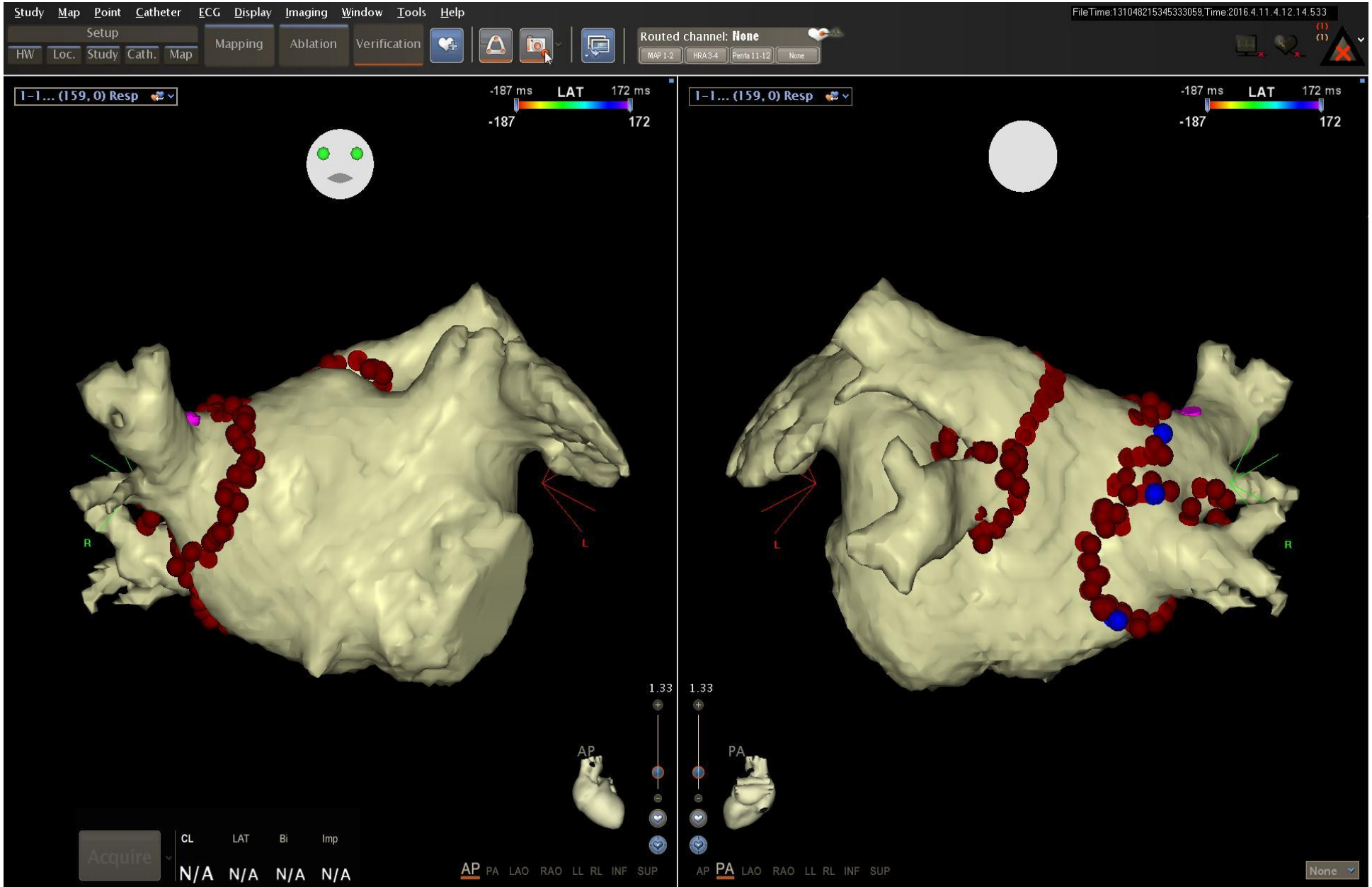


25mm/s 10mm/mV 40Hz 9.0.0 12SL 237 CID: 1 EID: EDT: ORDER:

Initial Voltage map



Ablation Line_CPVI



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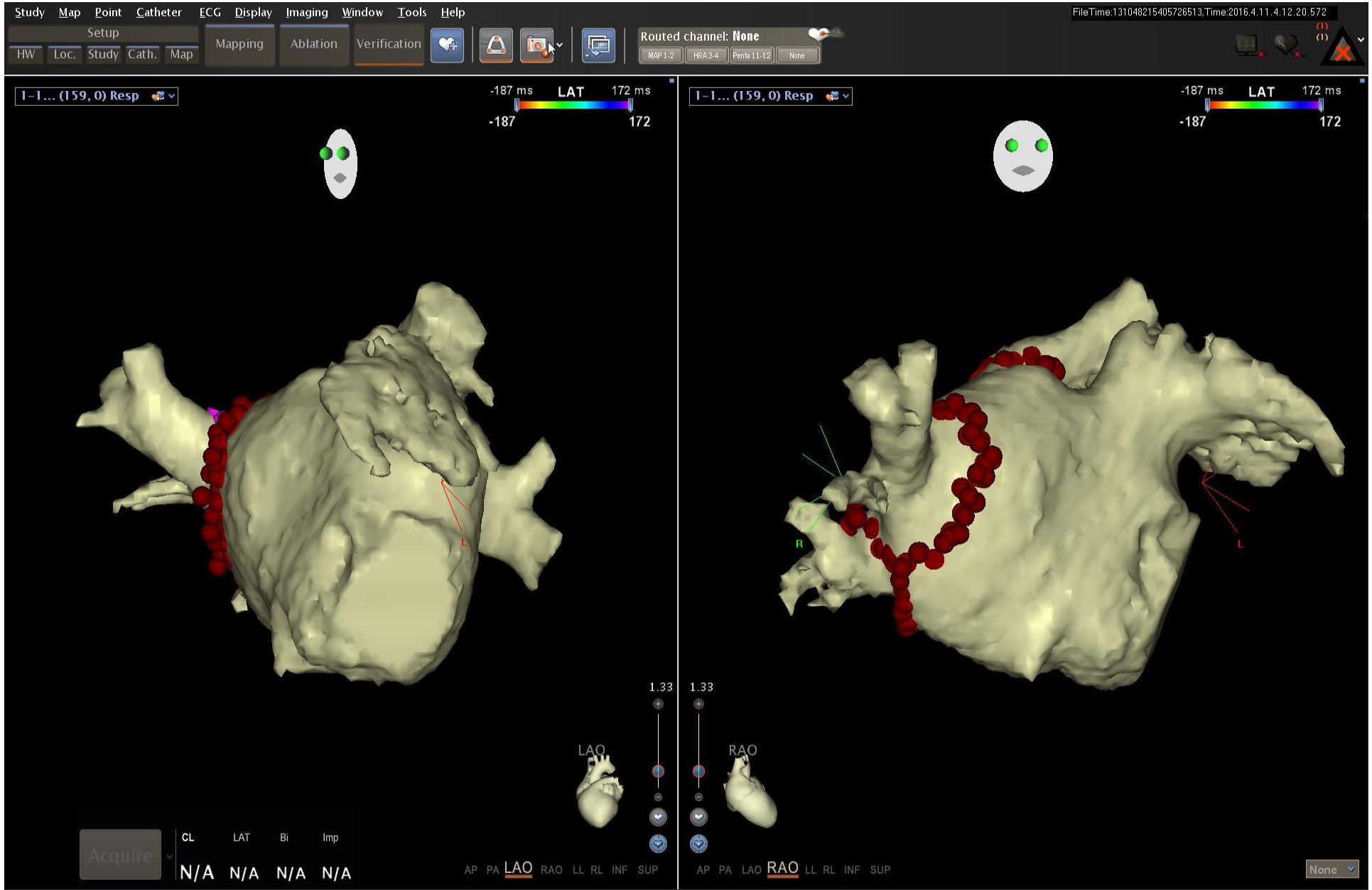
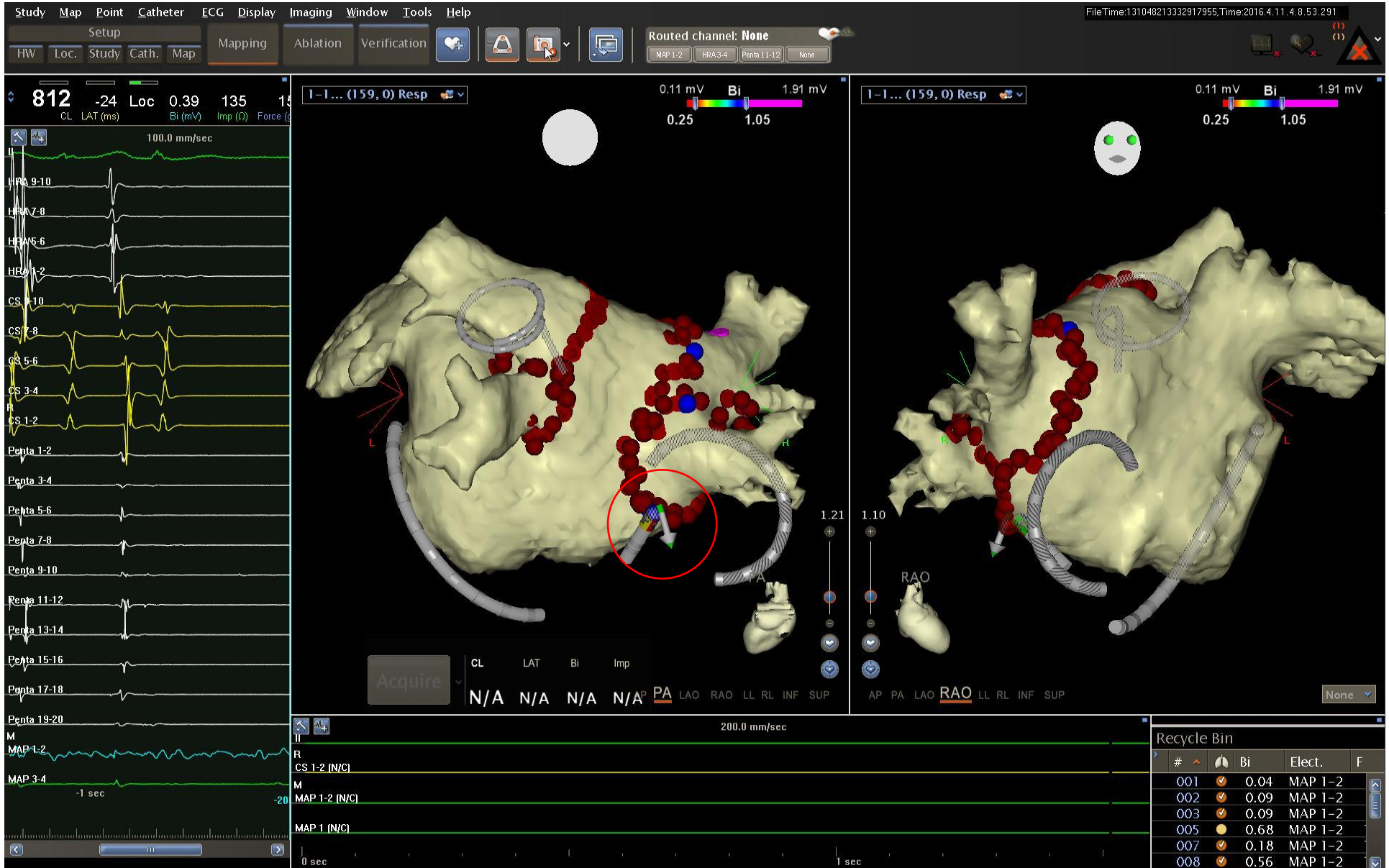


1st Termination Site_Catheter Postion & Signal



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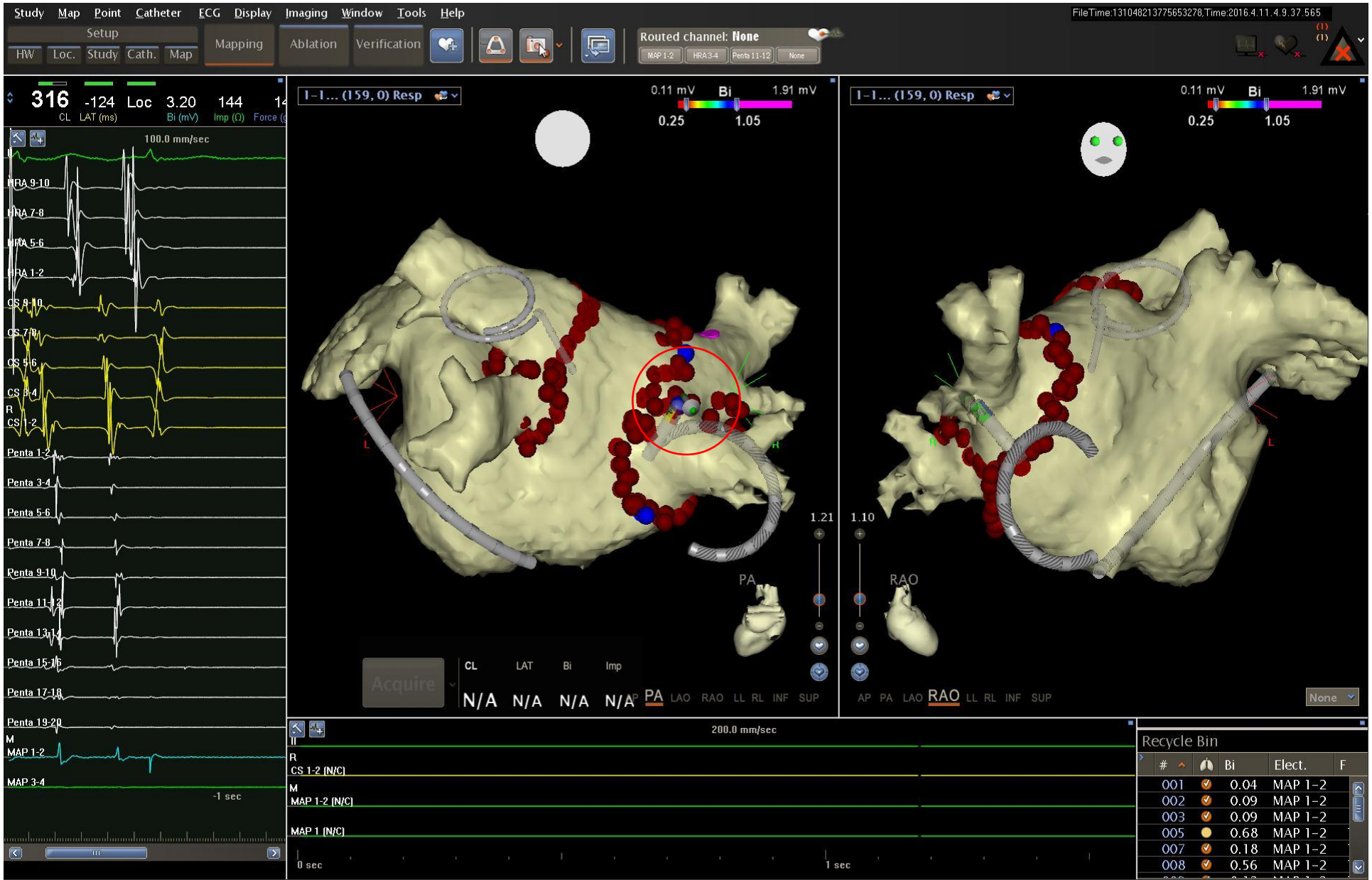

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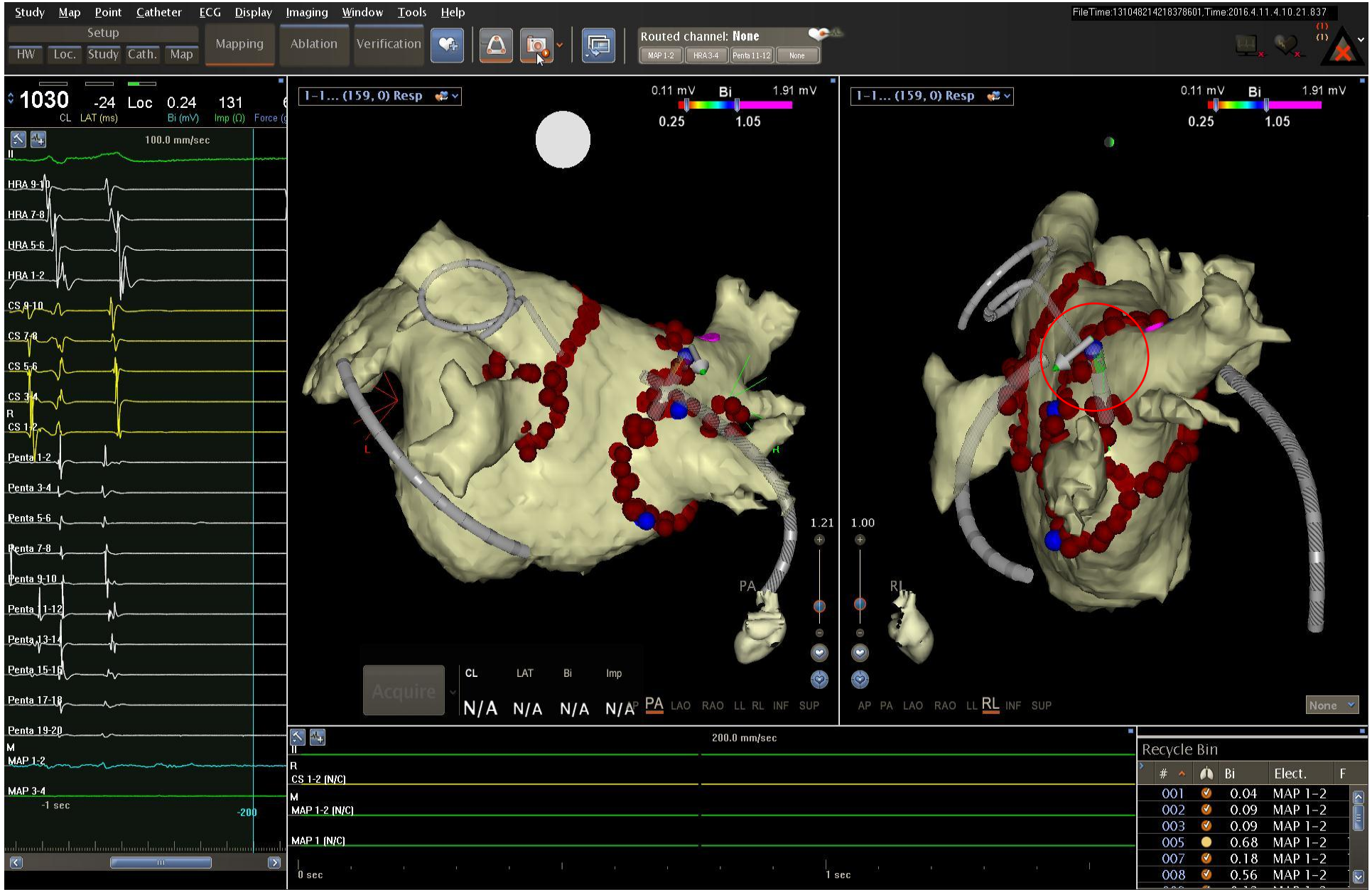
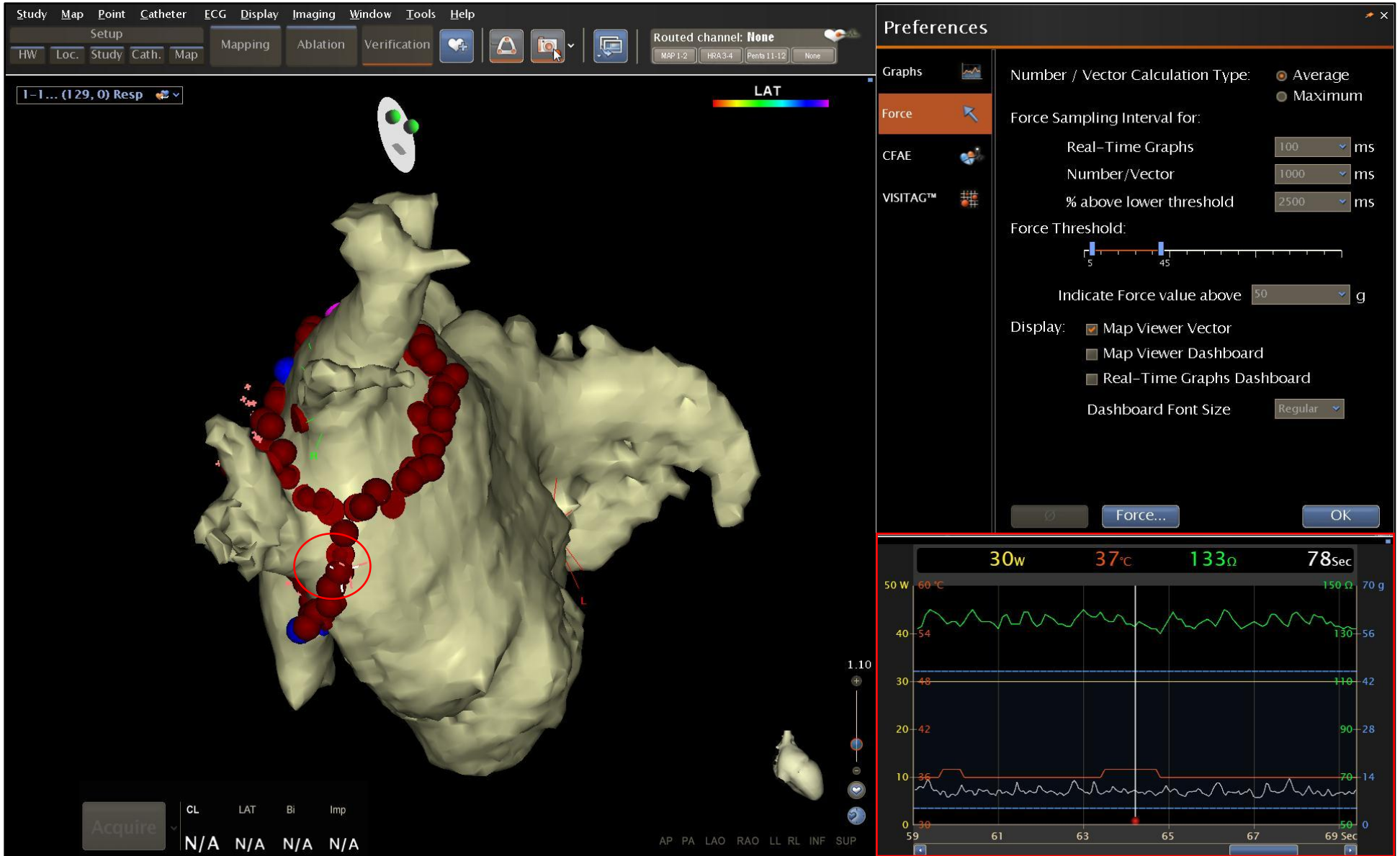
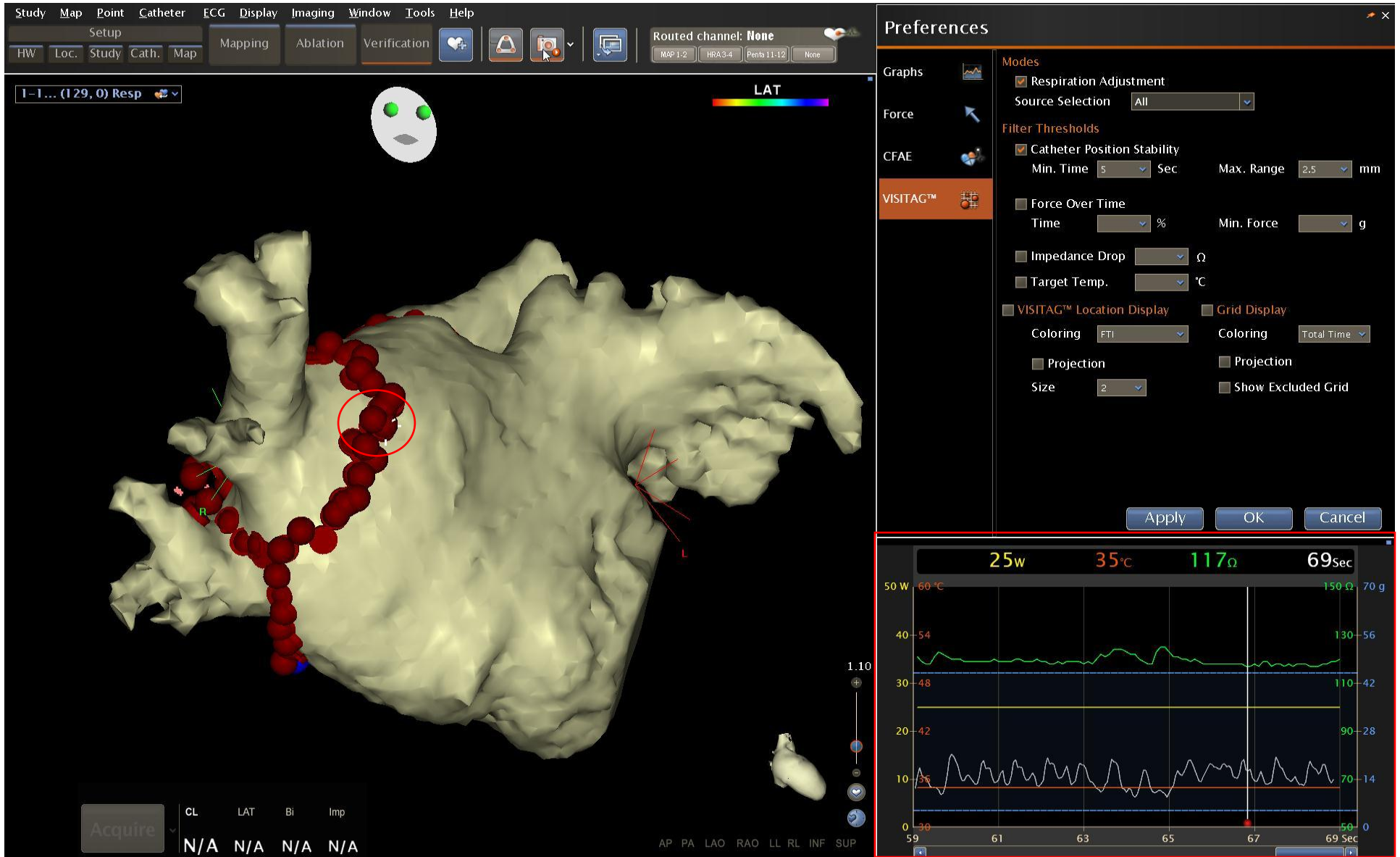



Force Value
Force Direction
Vector
Vector
Force Dashboard
Real Time Graphs Dashboard
21
21
Time
°C (Avg.)
W (Avg.)
O (Avg.)

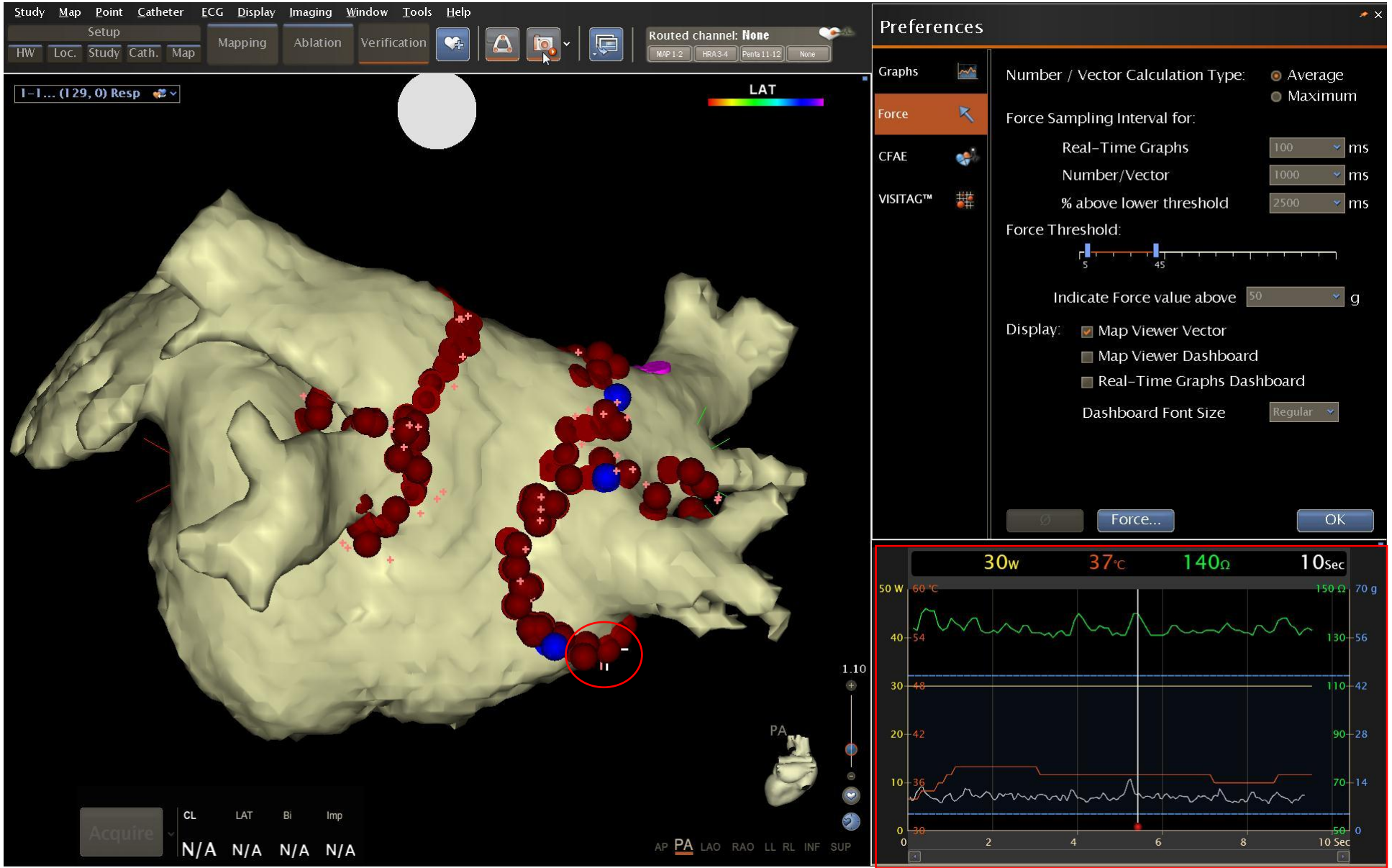
RIPV anterior_
Contact Force 10g Point, Catheter stability



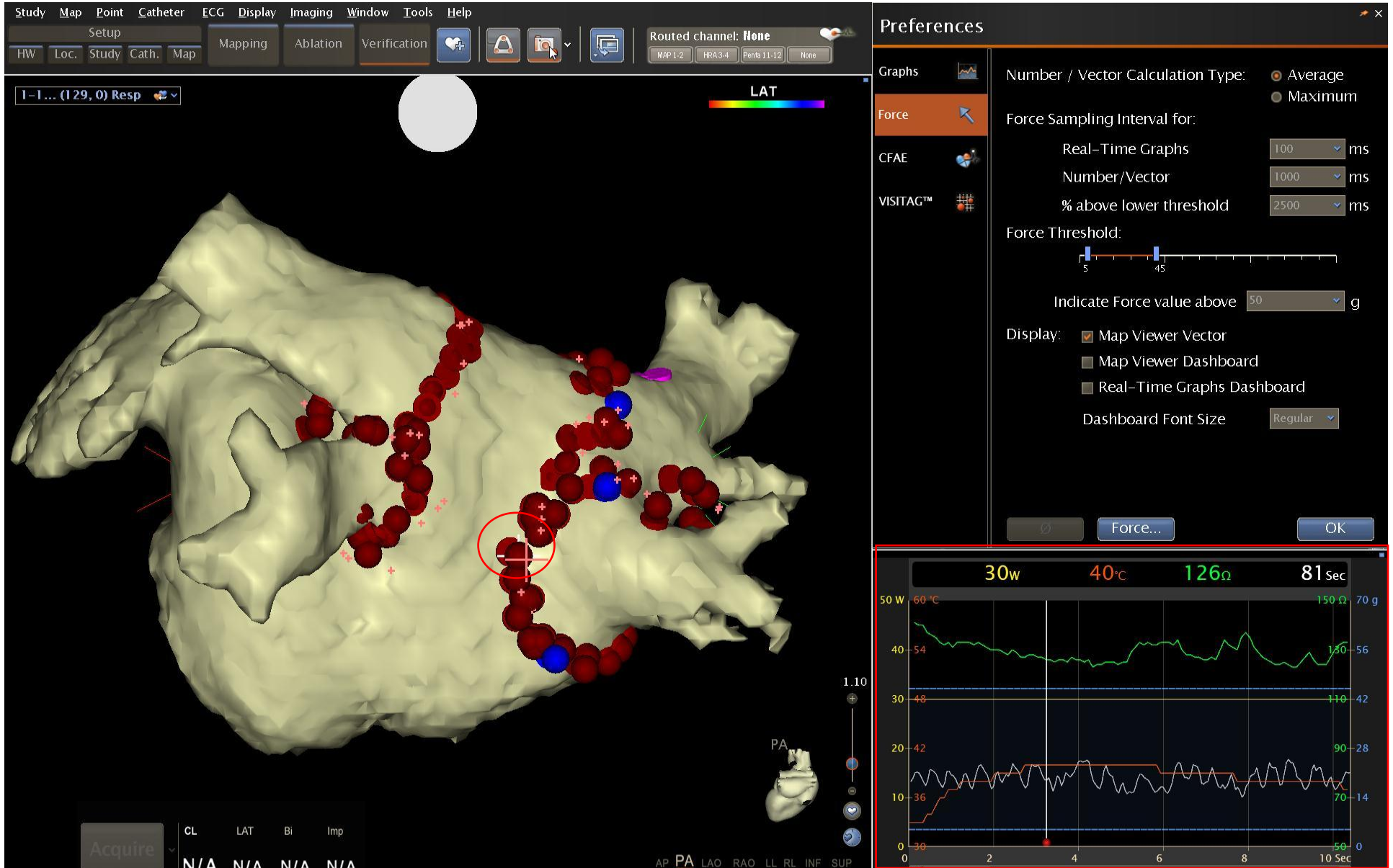
RSPV anterior_
Contact Force 16g Point, Catheter stability



RIPV Inferior_
Contact Force 10g Point, Catheter stability



RIPV Inferior_
Contact Force 19g Point, Catheter stability



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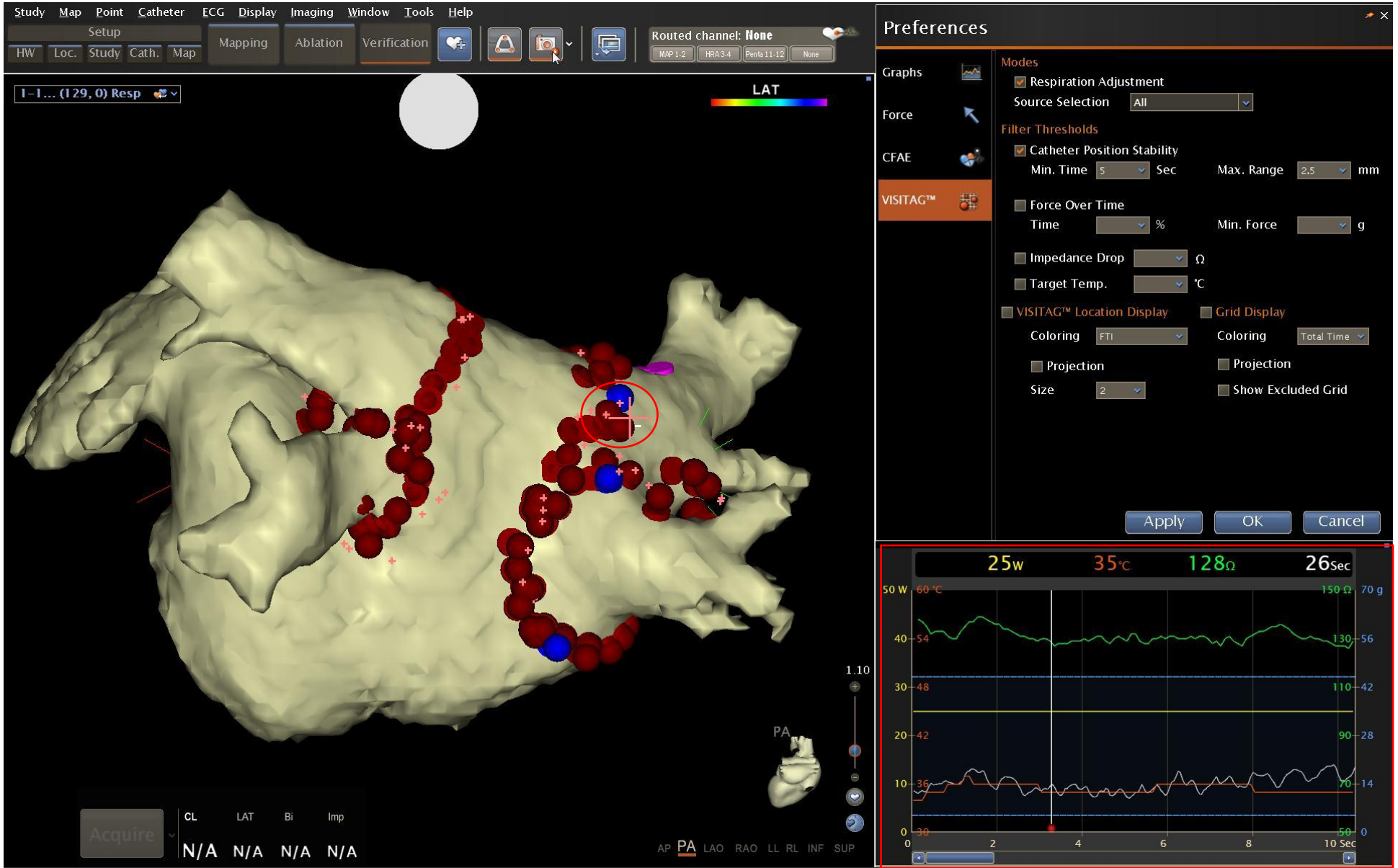
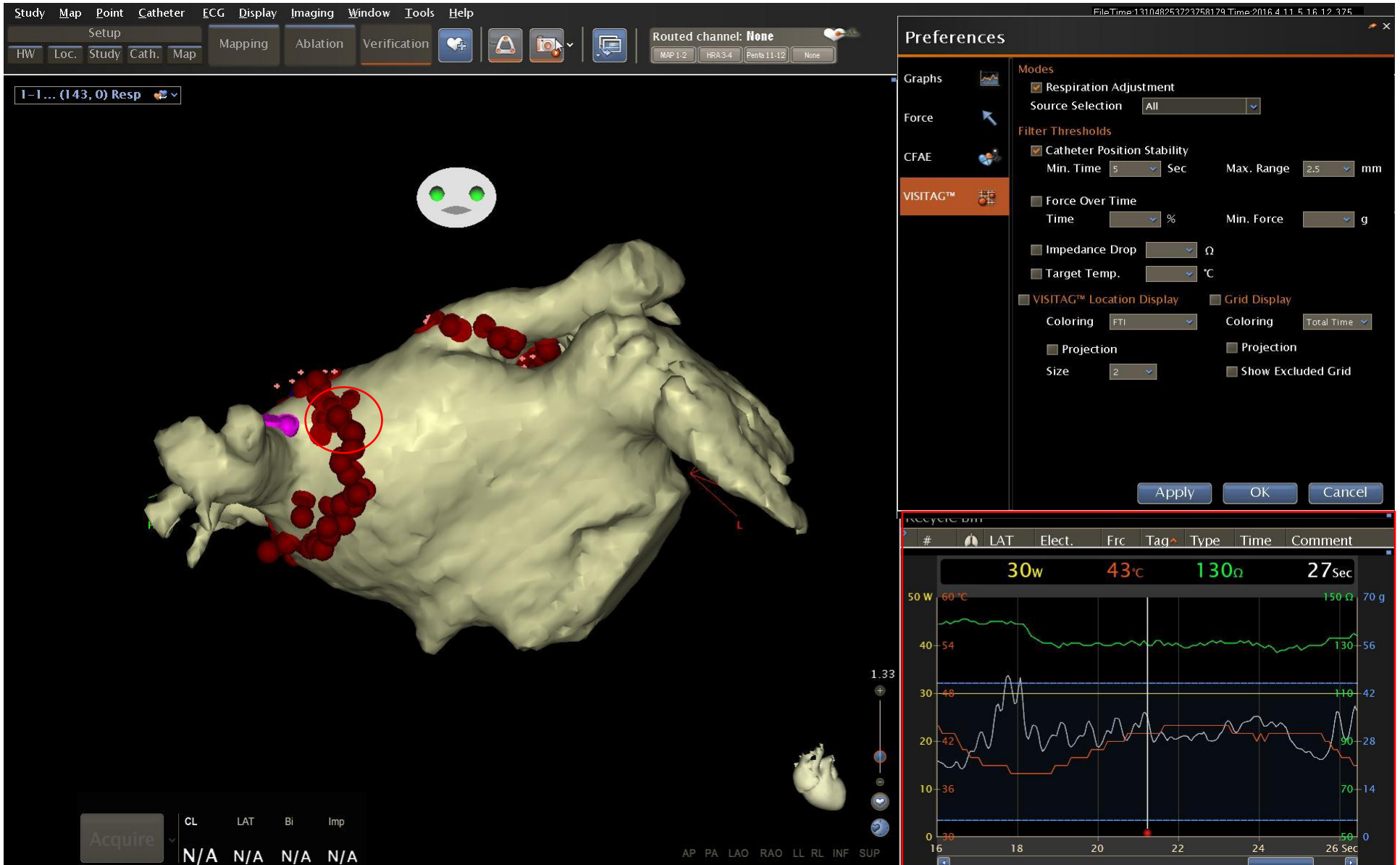
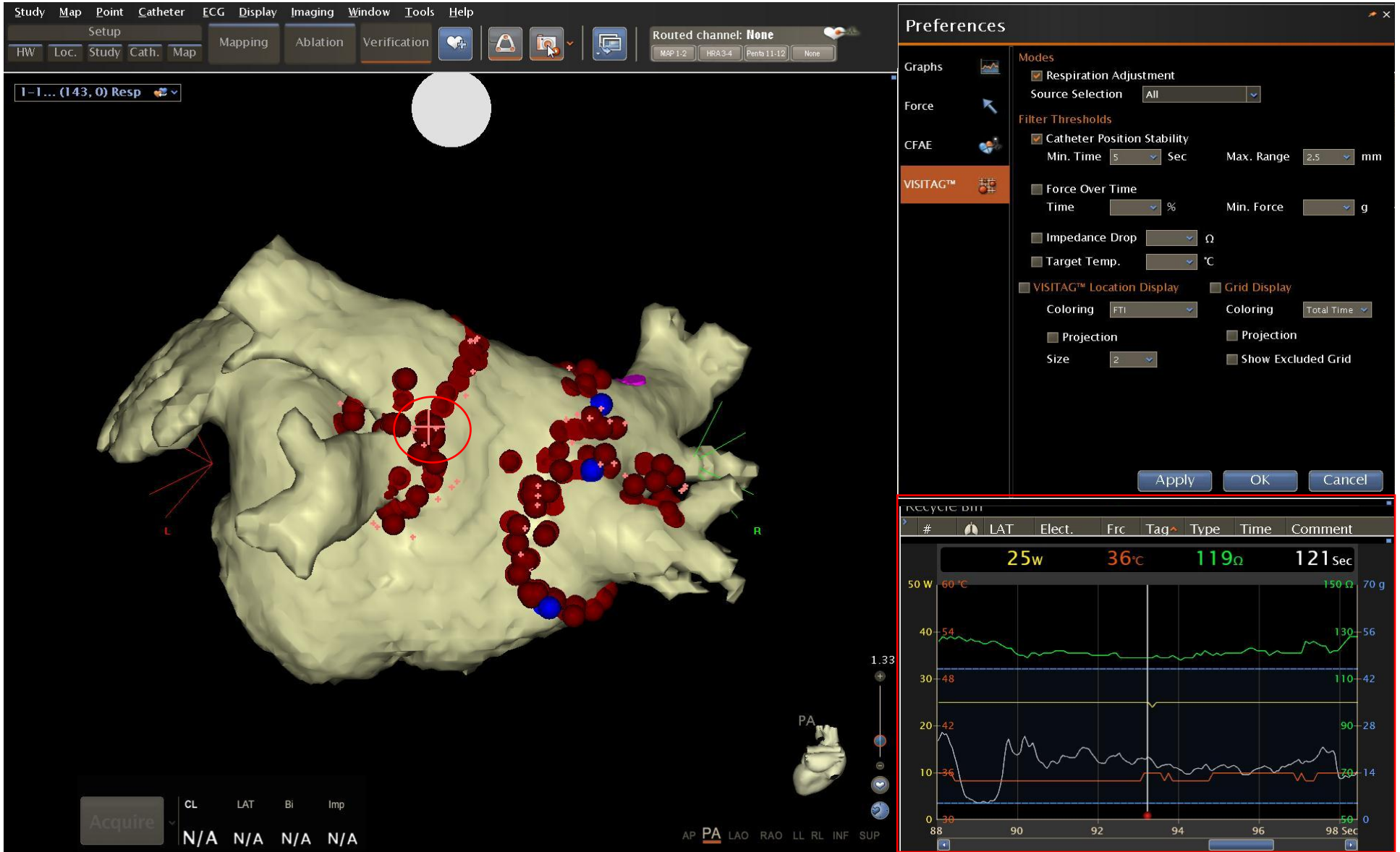


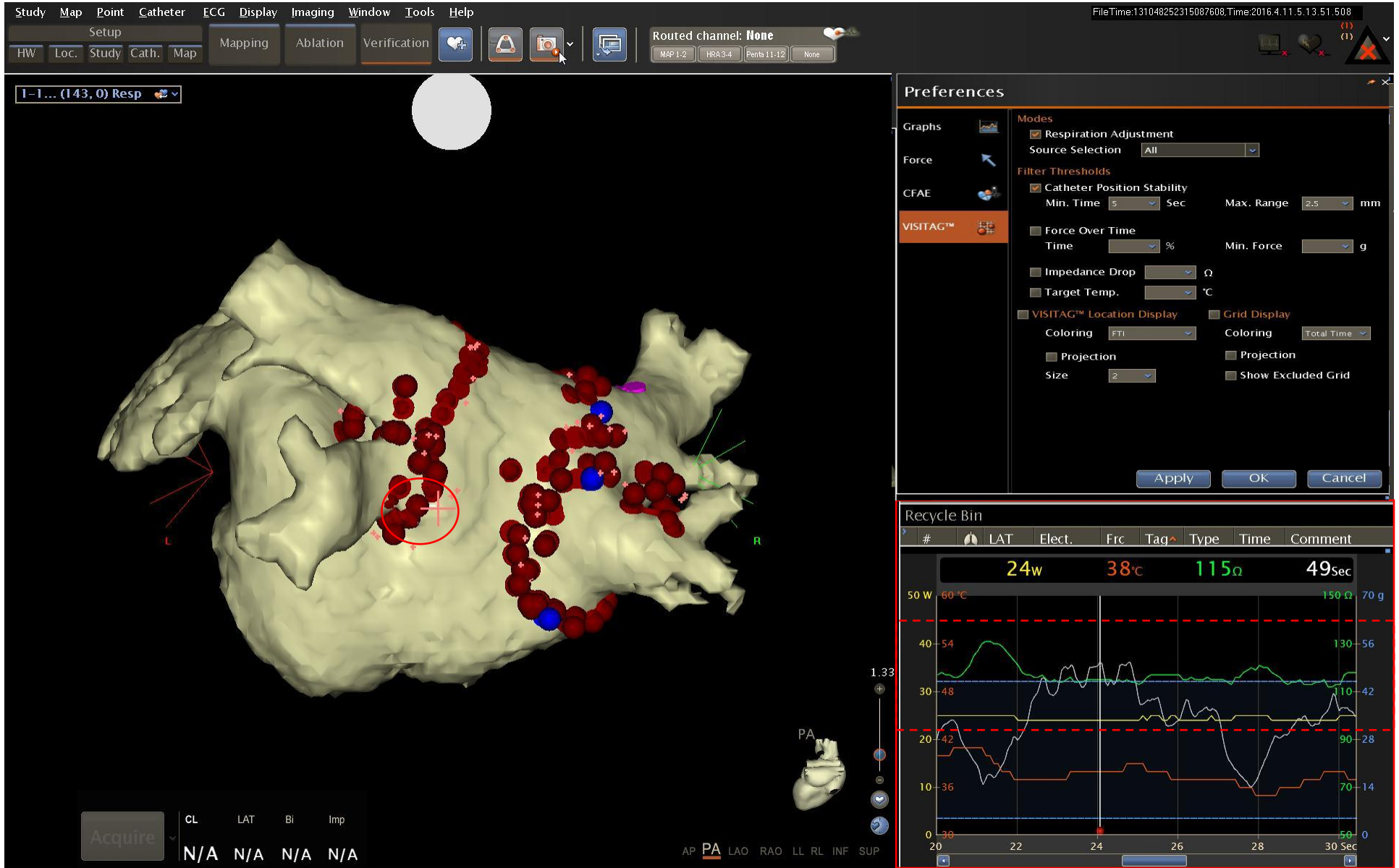
Righst Roof_
Contact Force 31g Point, Catheter stability



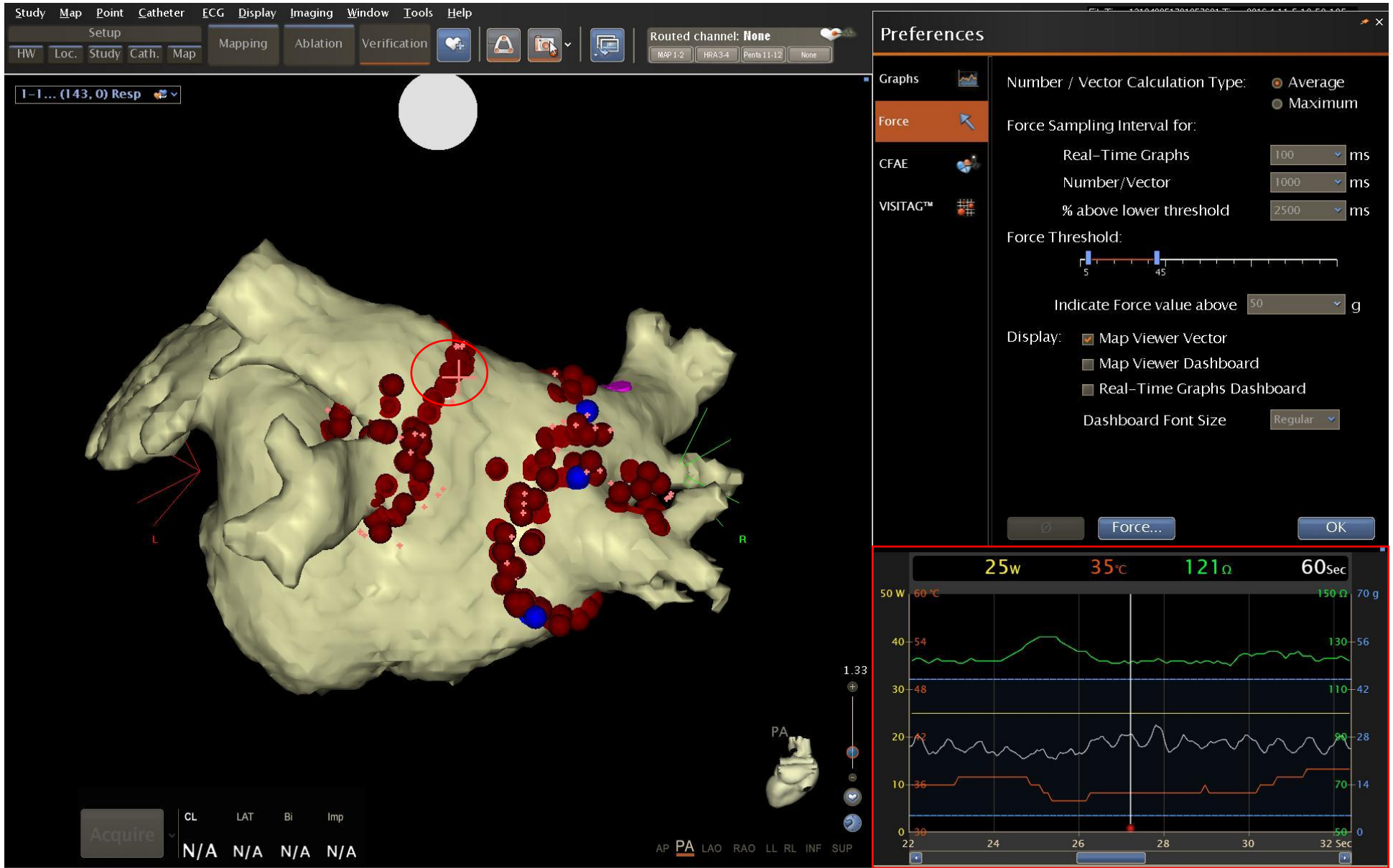
LIPV posterior_
Contact Force 17g Point, Catheter stability



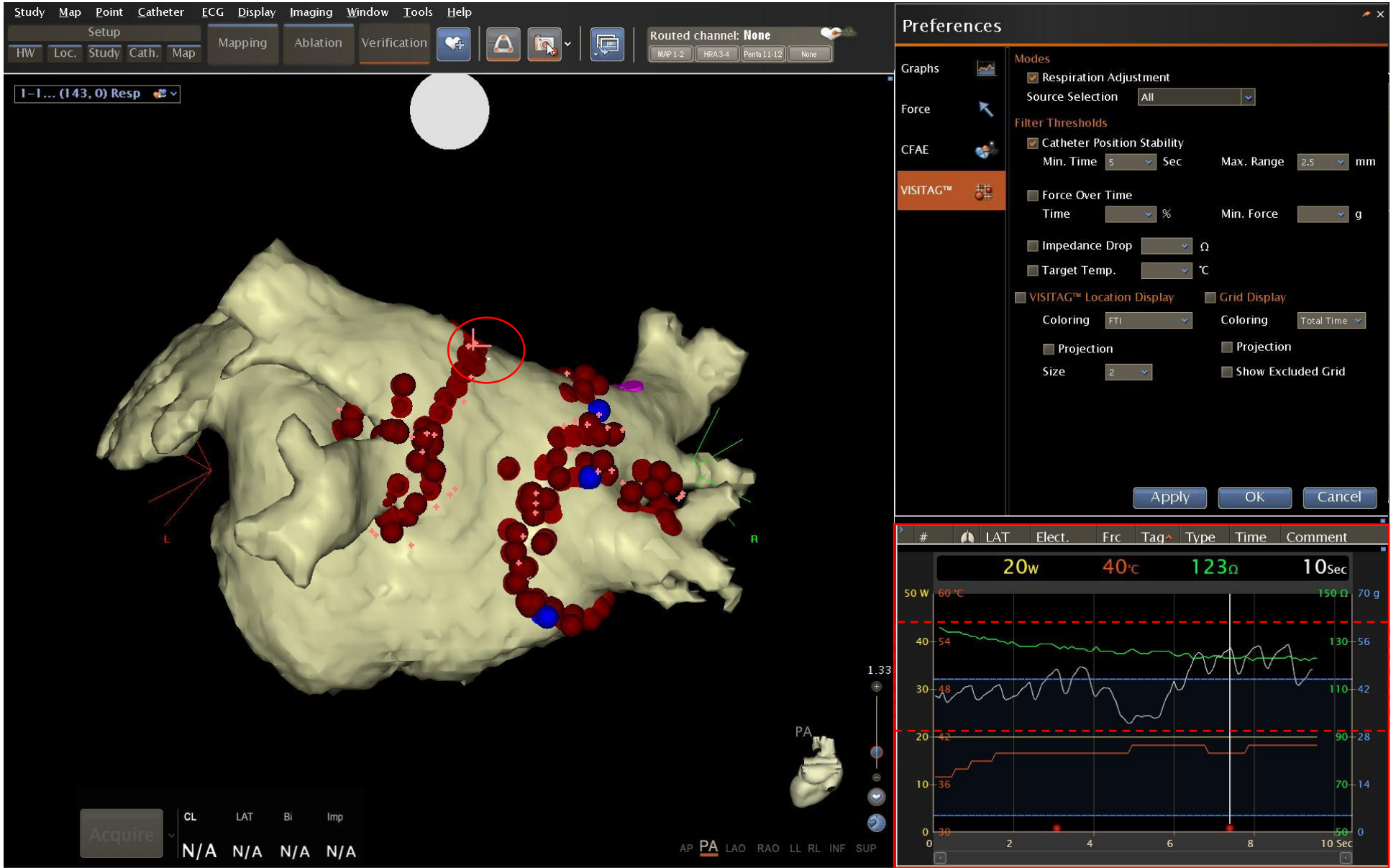
LIPV posterior_
Contact Force 46g Point, CF Graph change



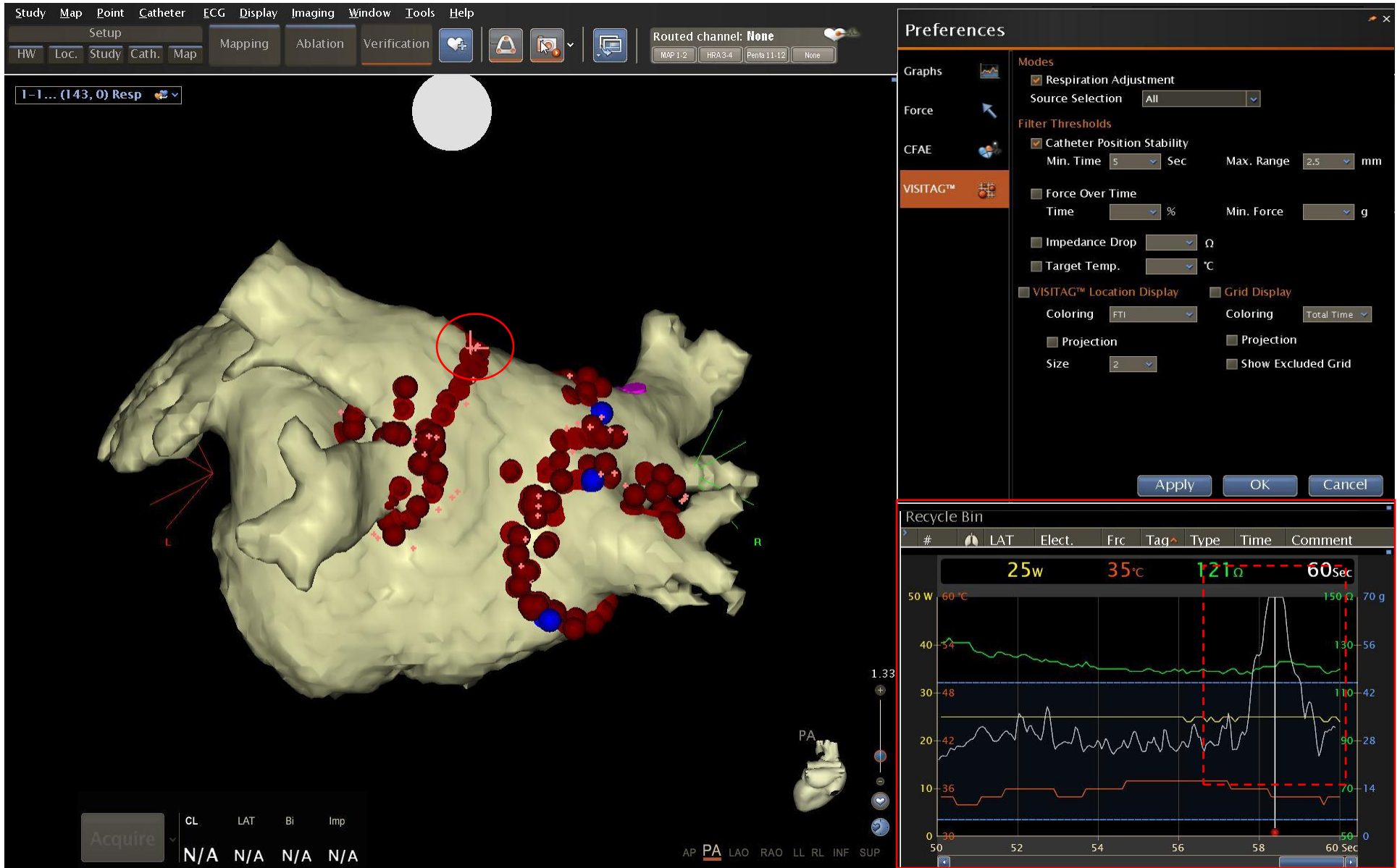
LSPV posterior_
Contact Force 27g Point, CF stability



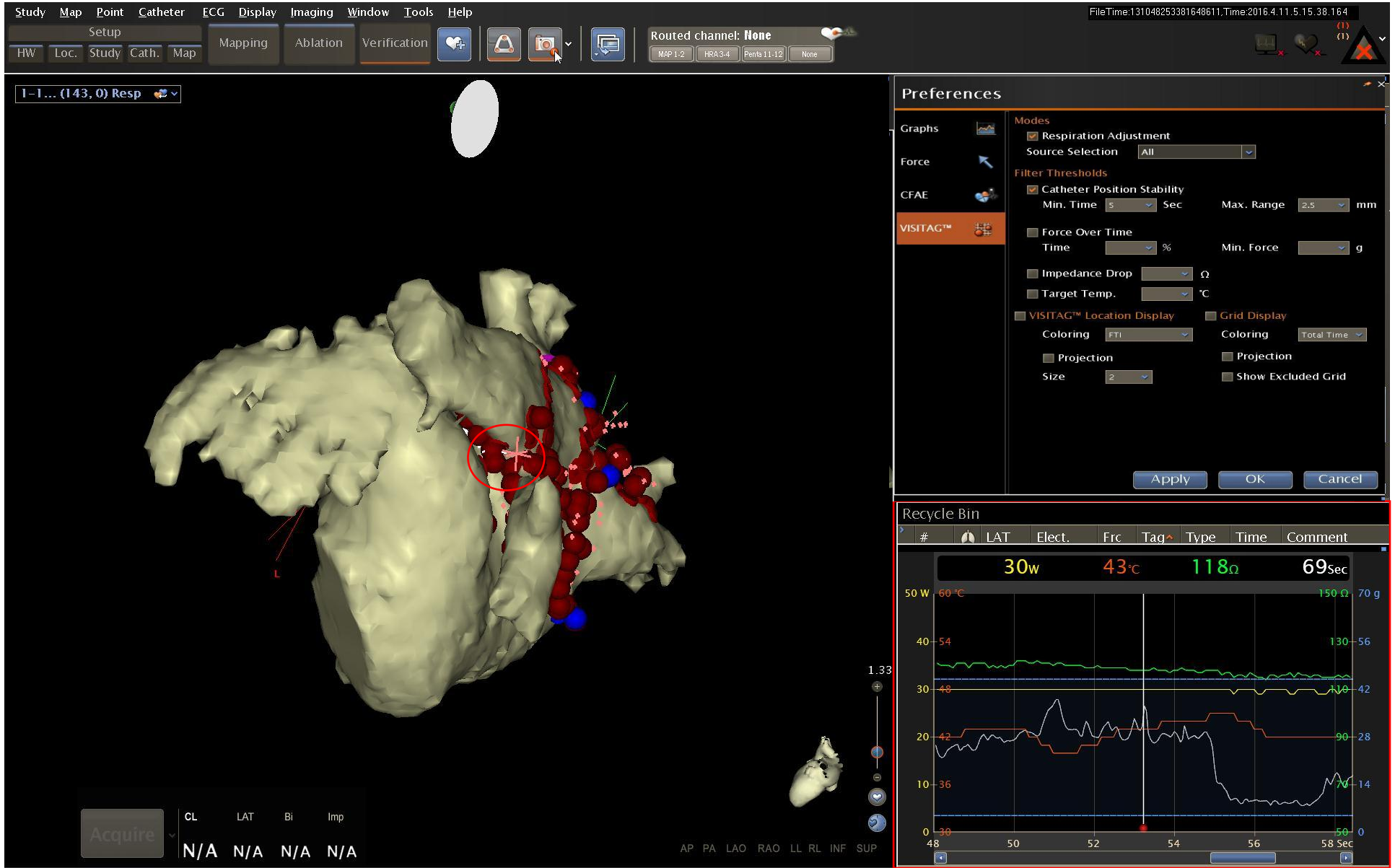
LSPV posterior_
Contact Force 50g Point, CF Graph change



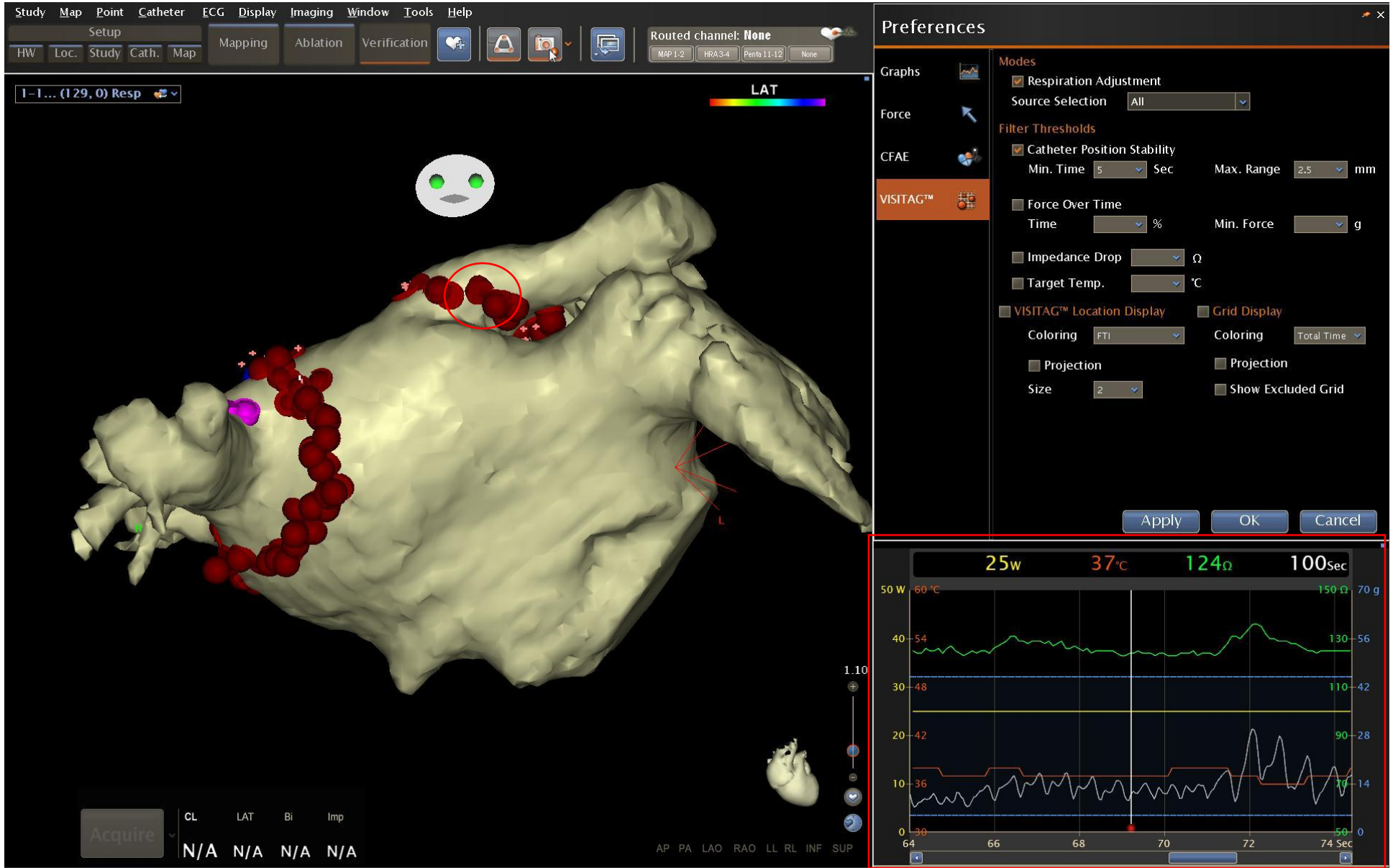
LSPV posterior_
Contact Force 65g Point, CF Too High

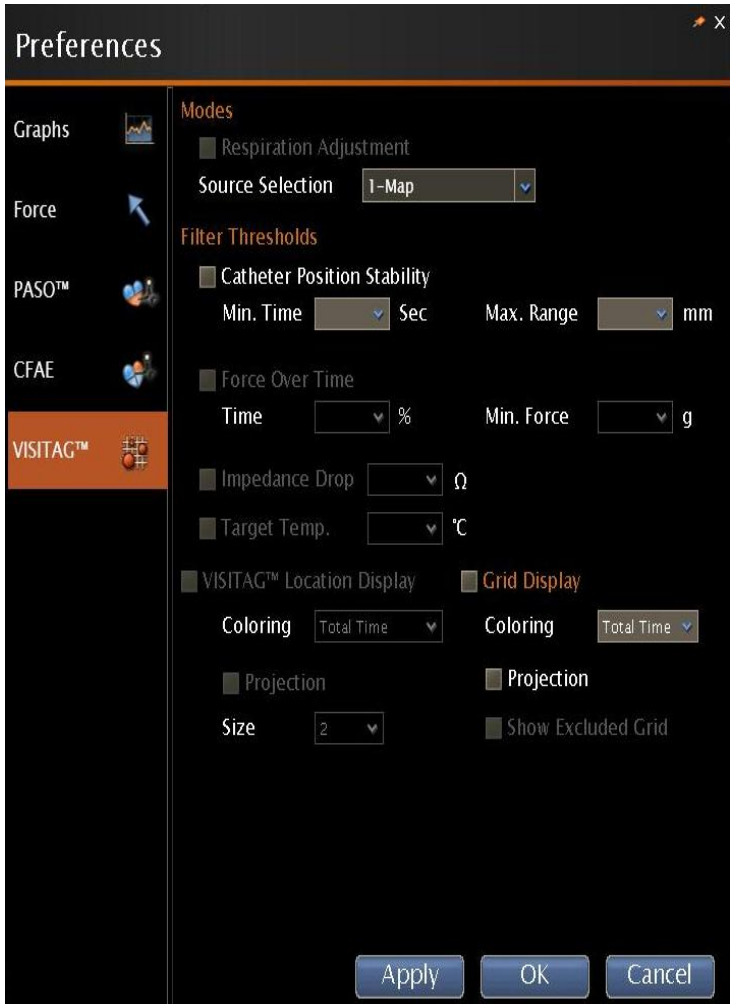


Ridge-Carina_CF Stability
Contact Force 29g Point



Ridge-Carina_CF Stability
Contact Force 12g Point

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Ω
Target Temp.
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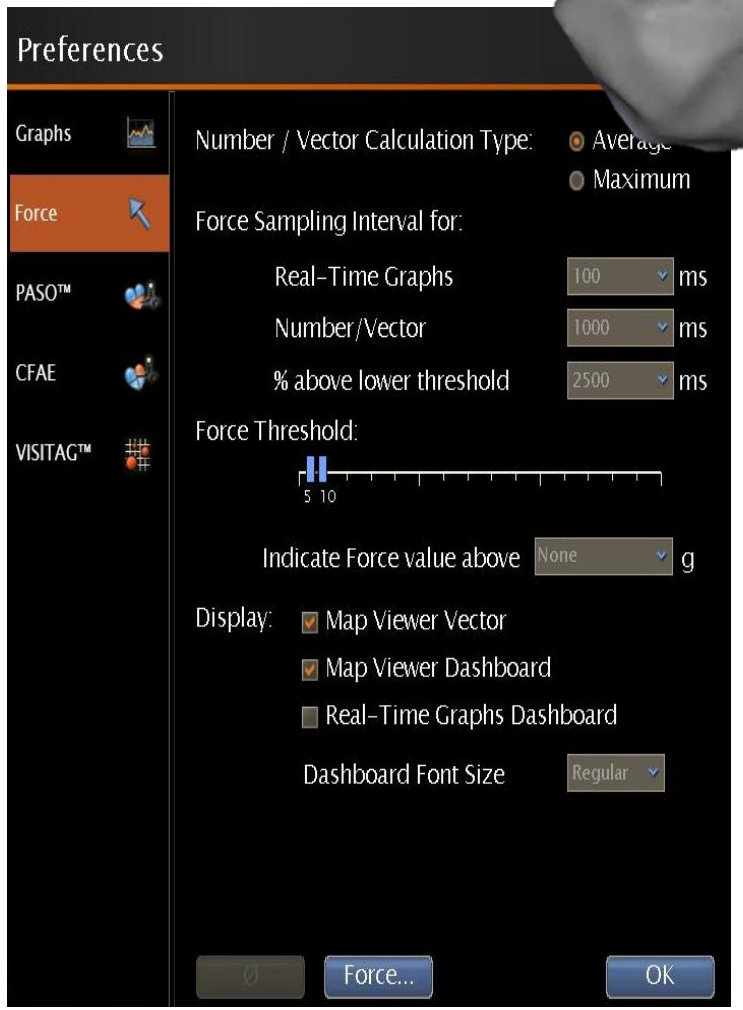
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Graphs
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PASO™
CFAE
VISITAG™
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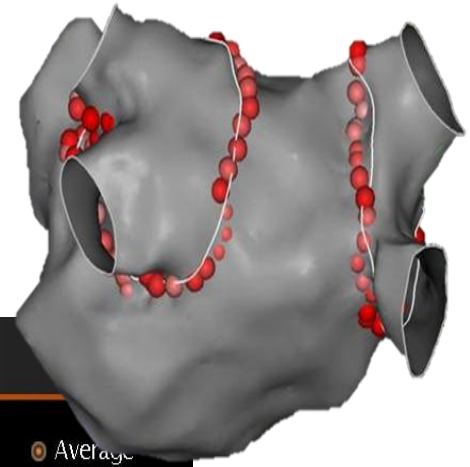

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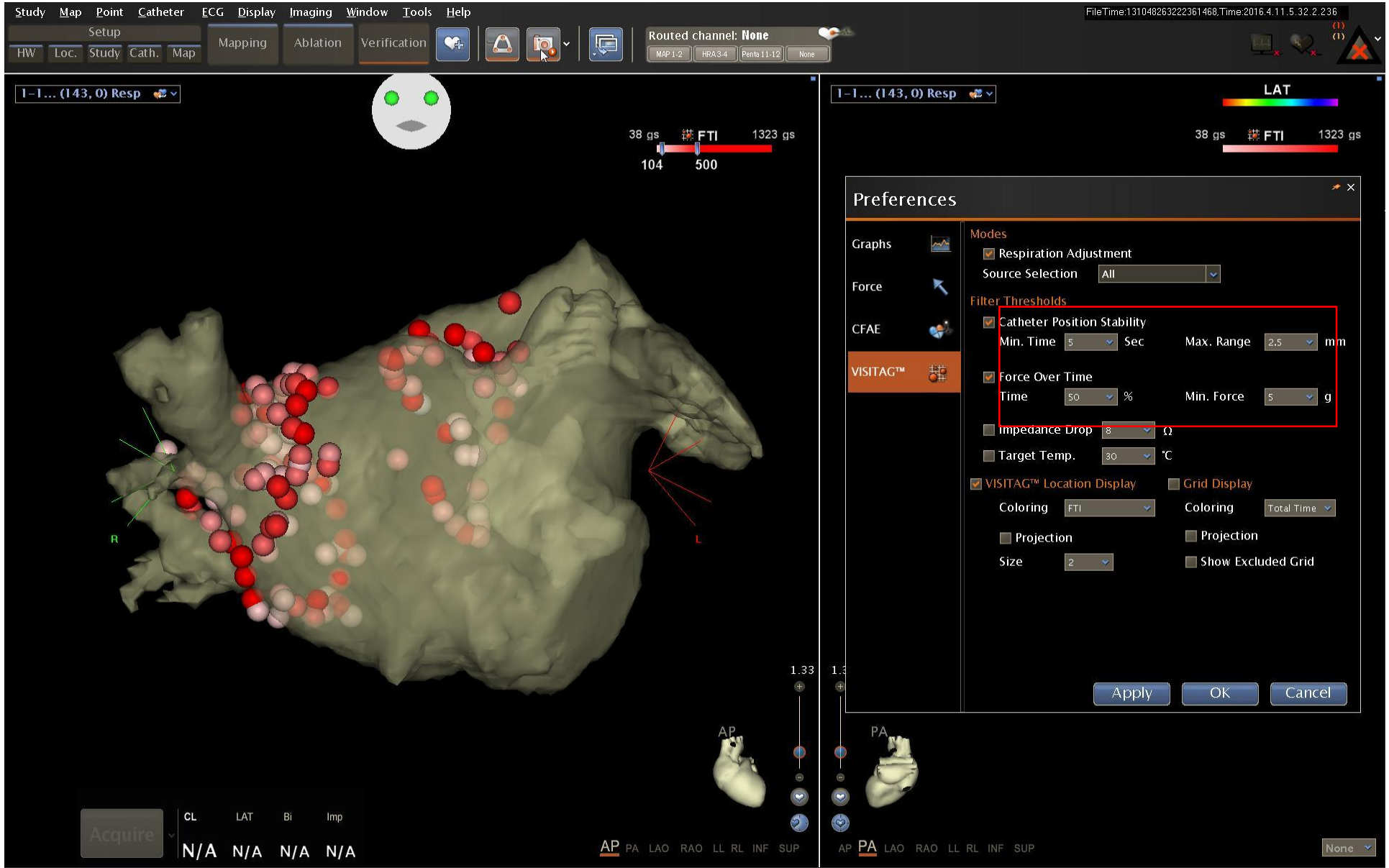

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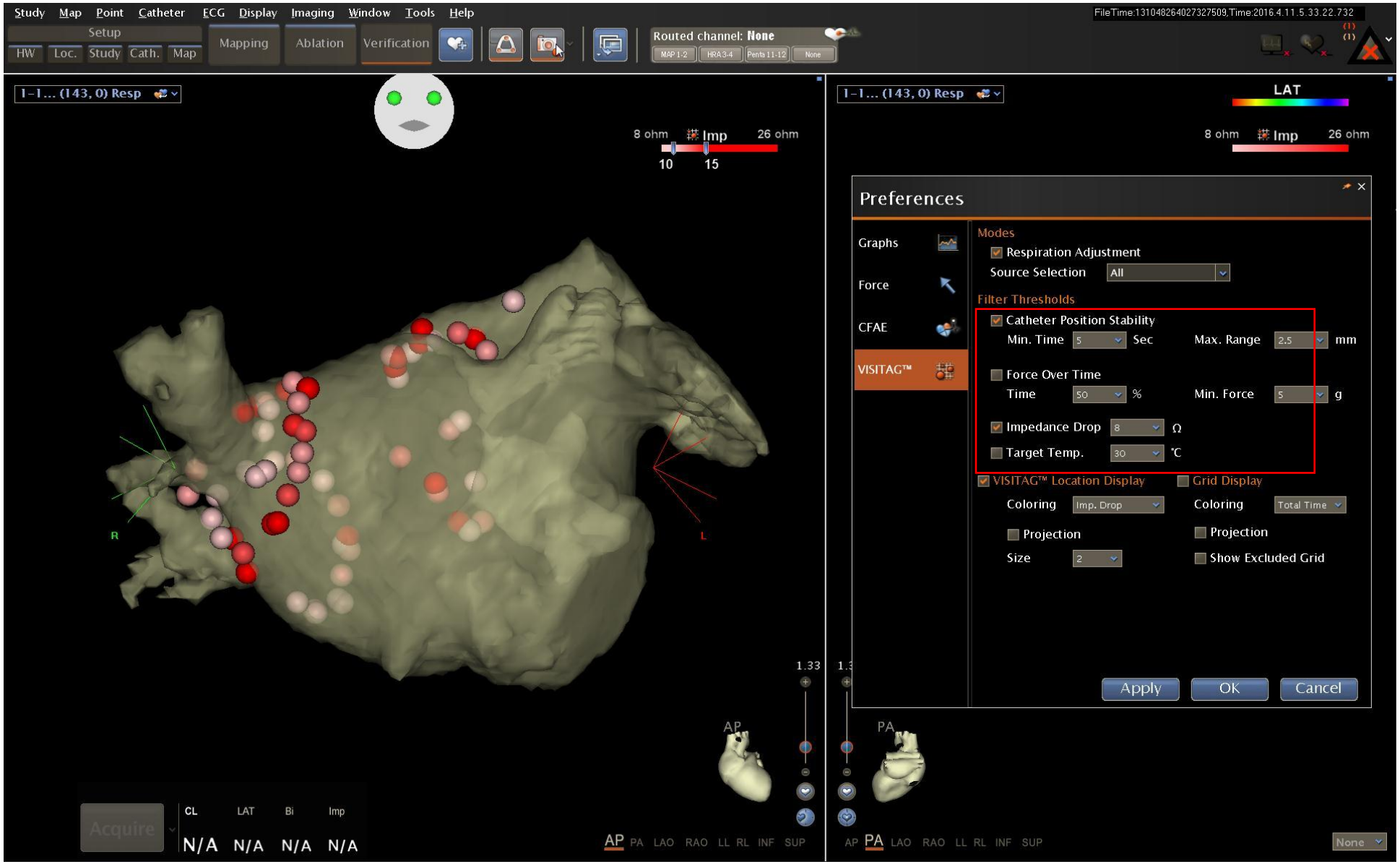
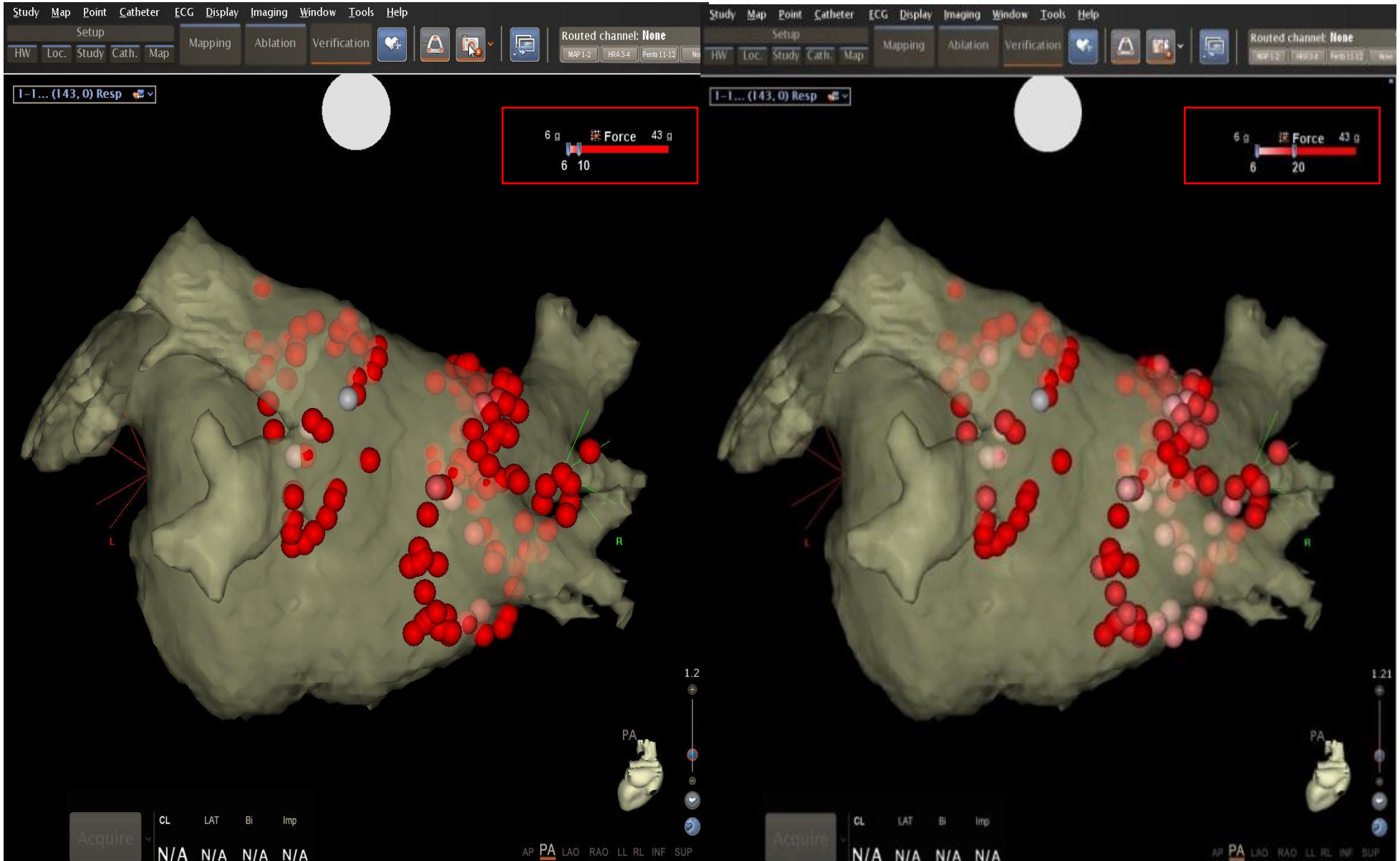
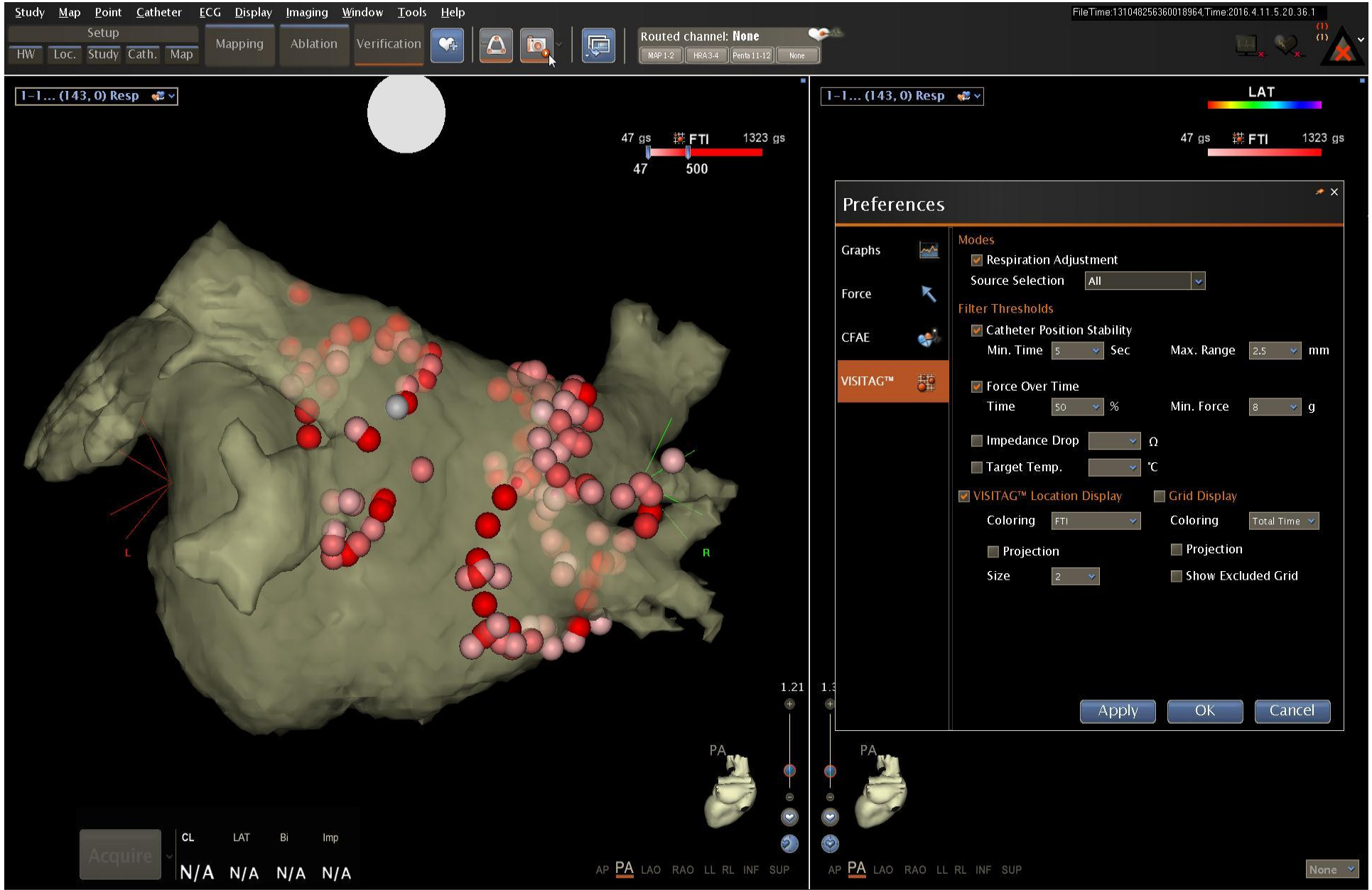


VISITAG_Grid(Catheter movement range display)

VISITAG_ Coloring Option Change



VISITAG contact 8g, Stability 5sec



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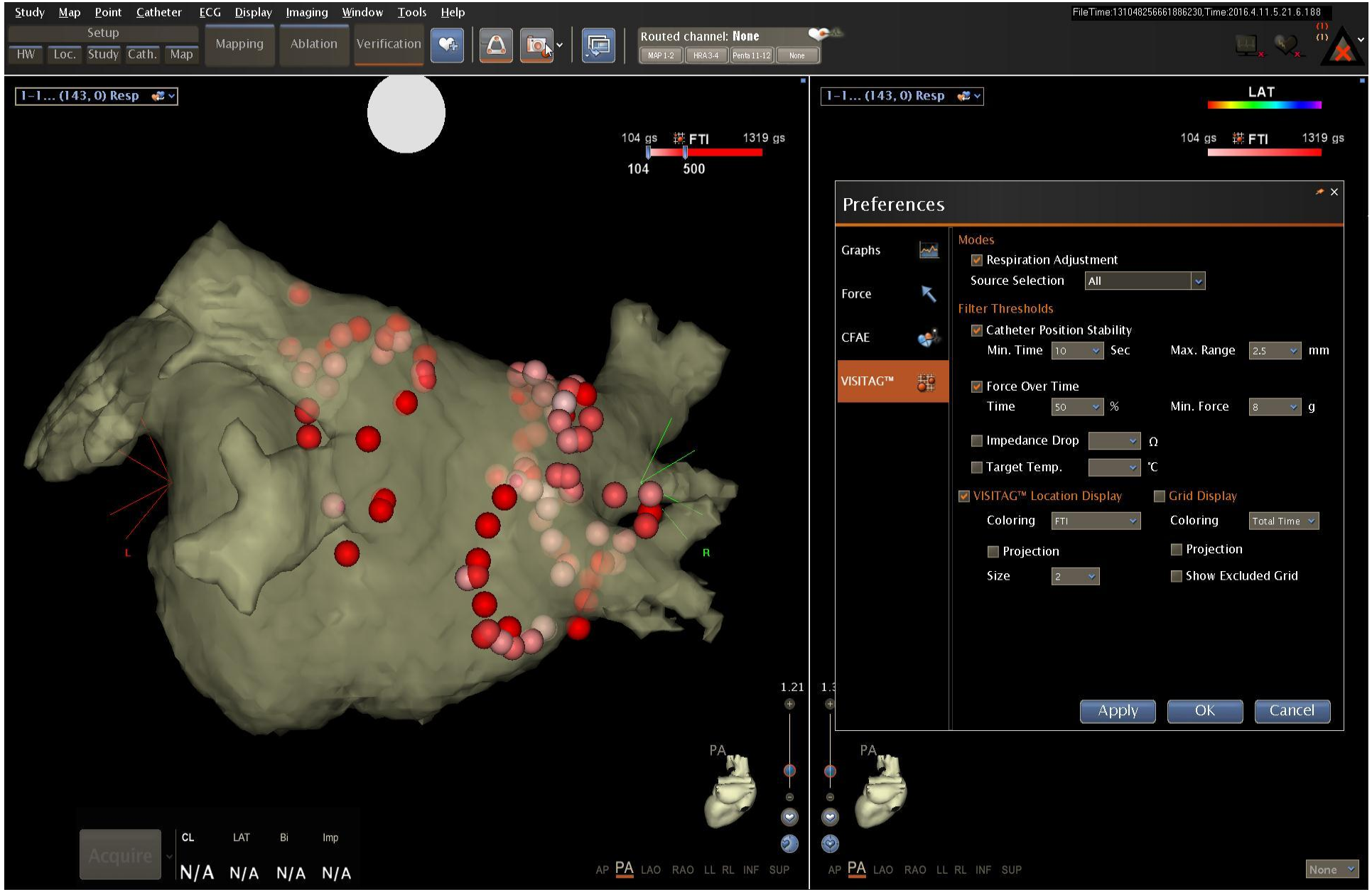
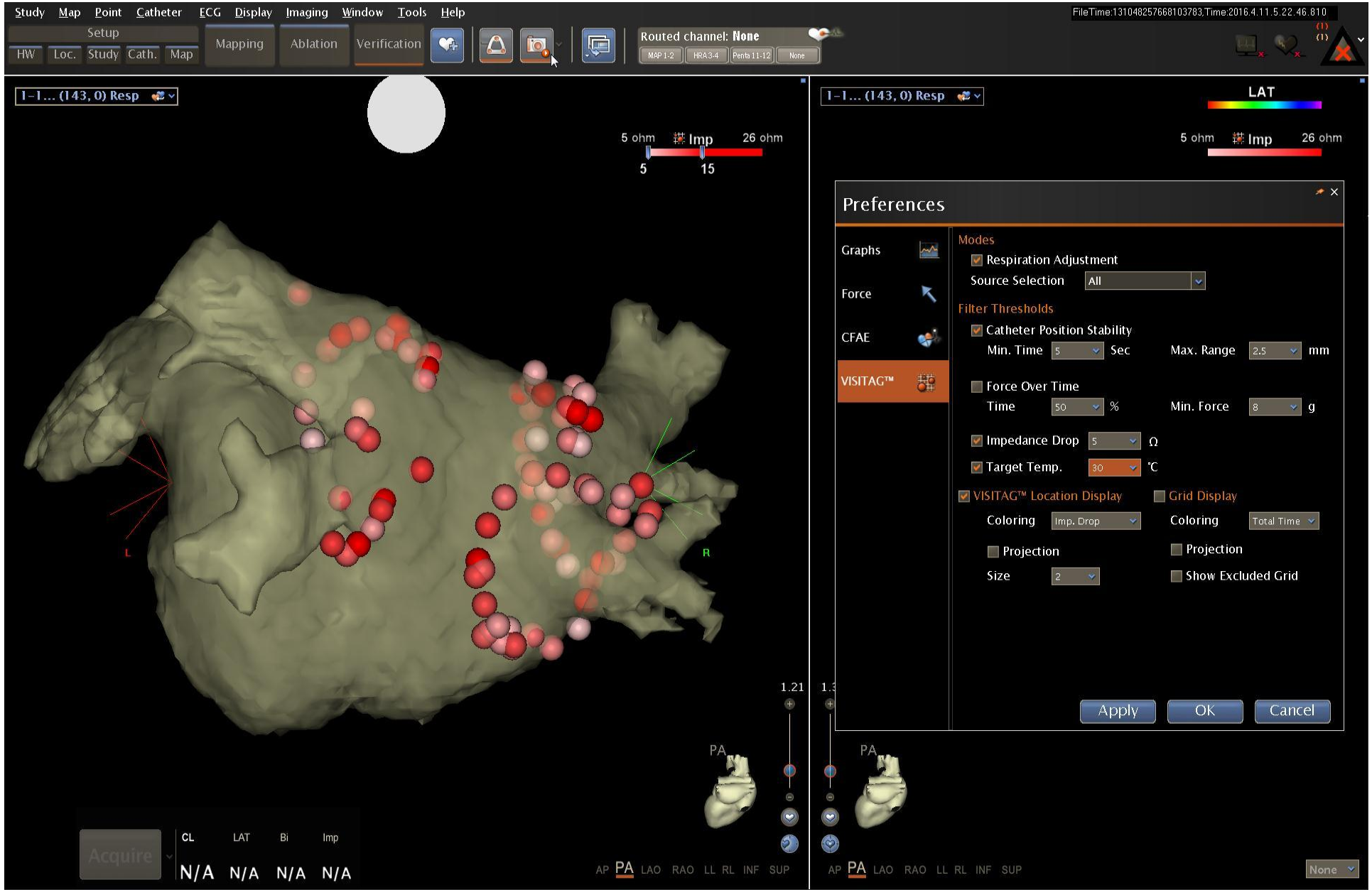


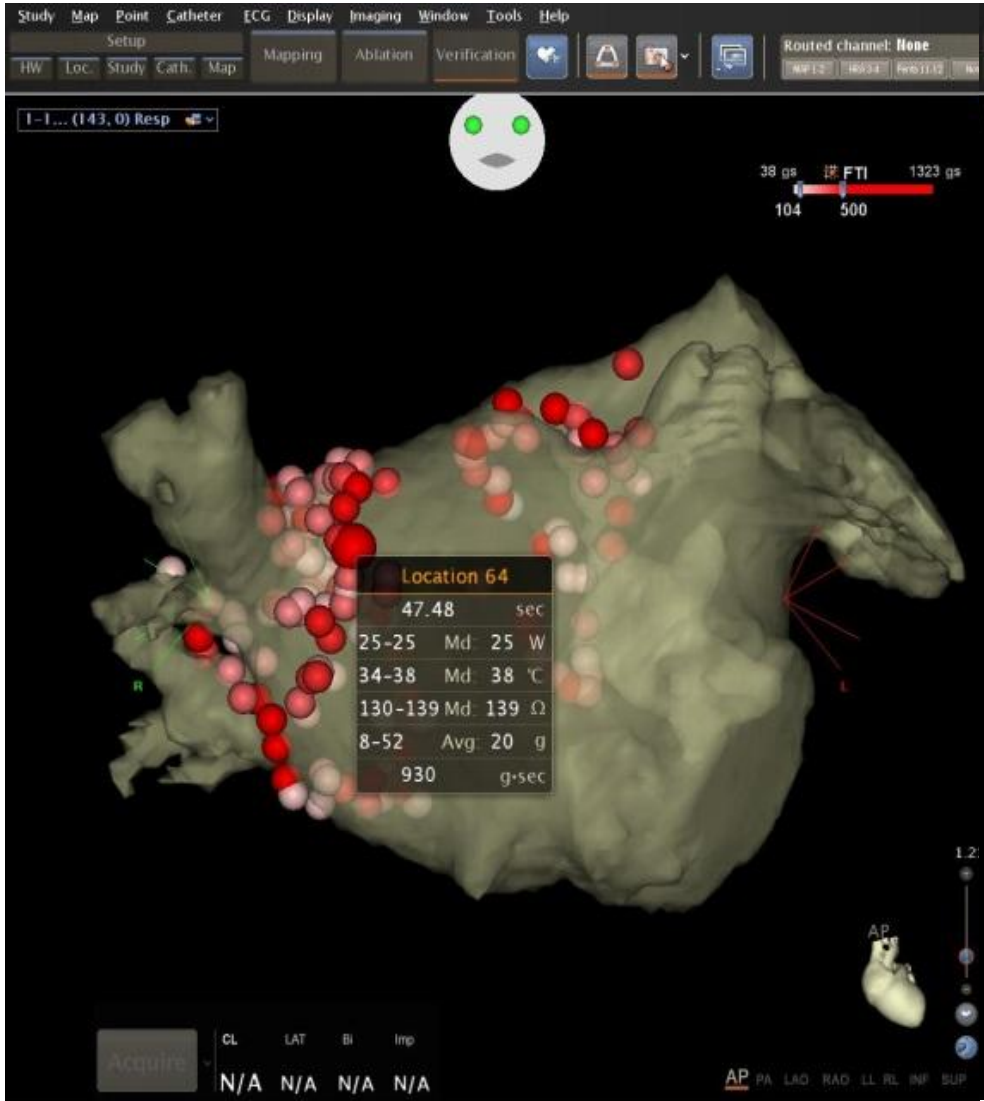
VISITAG Impedance drop 5Ω, Stability 5sec



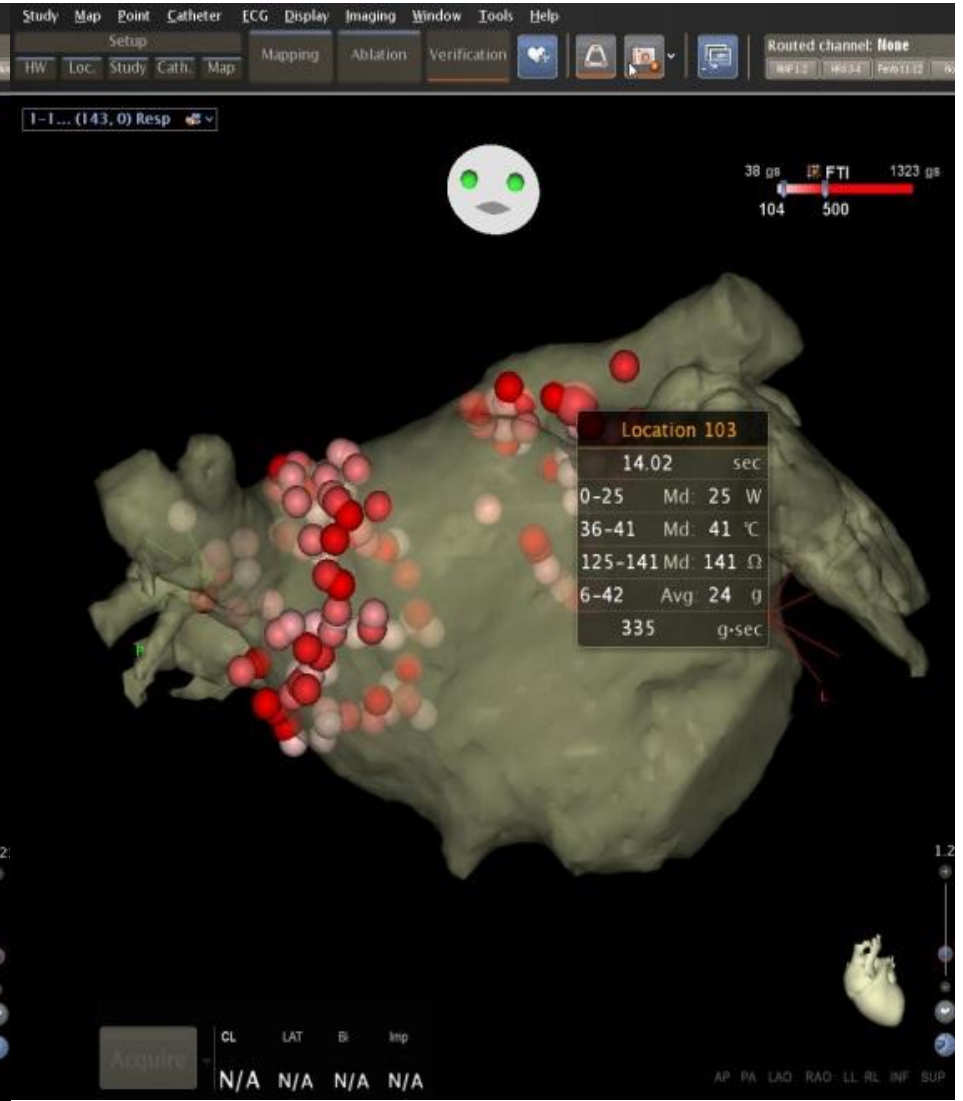
VISITAG Impedance drop 10Ω, Stability 5sec

VISITAG information

RSPV anterior

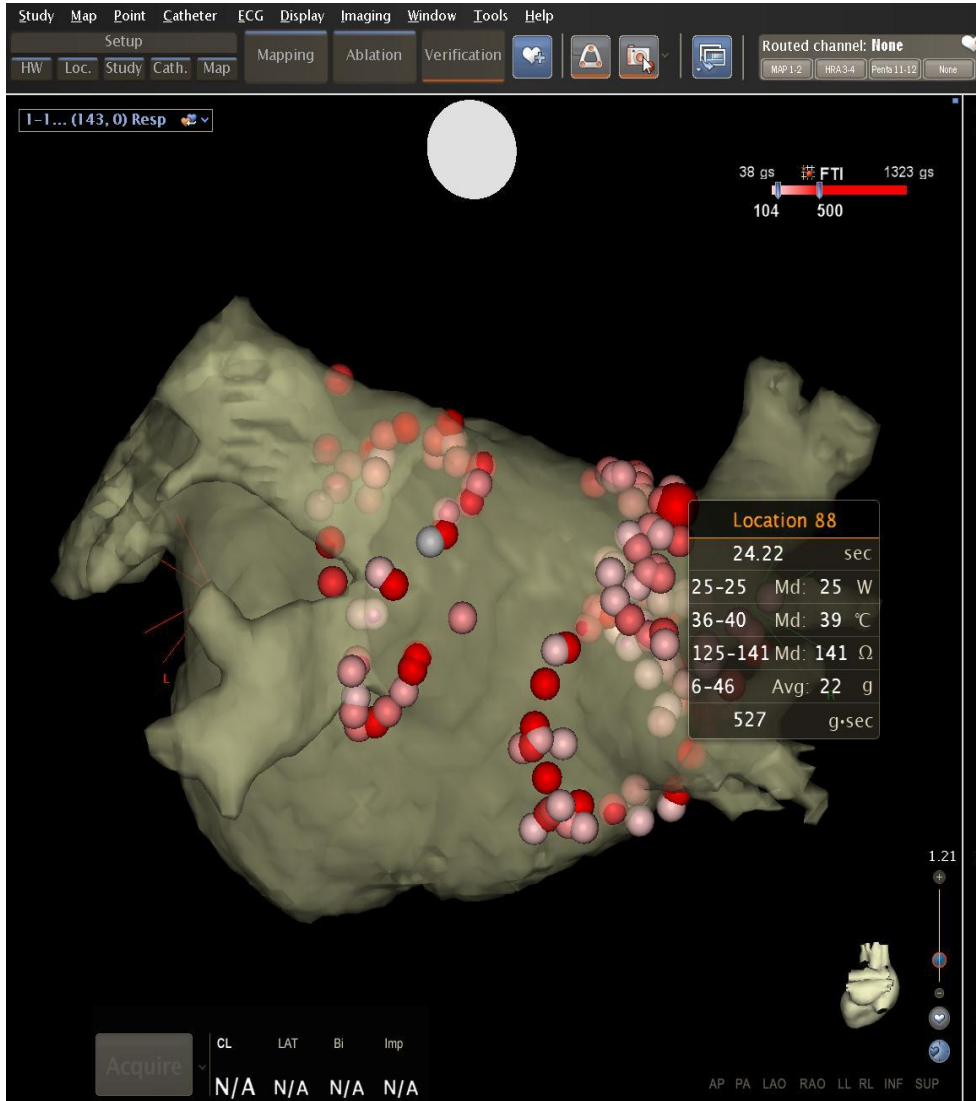


LSPV Anterior



VISITAG information

RSPV Posterior



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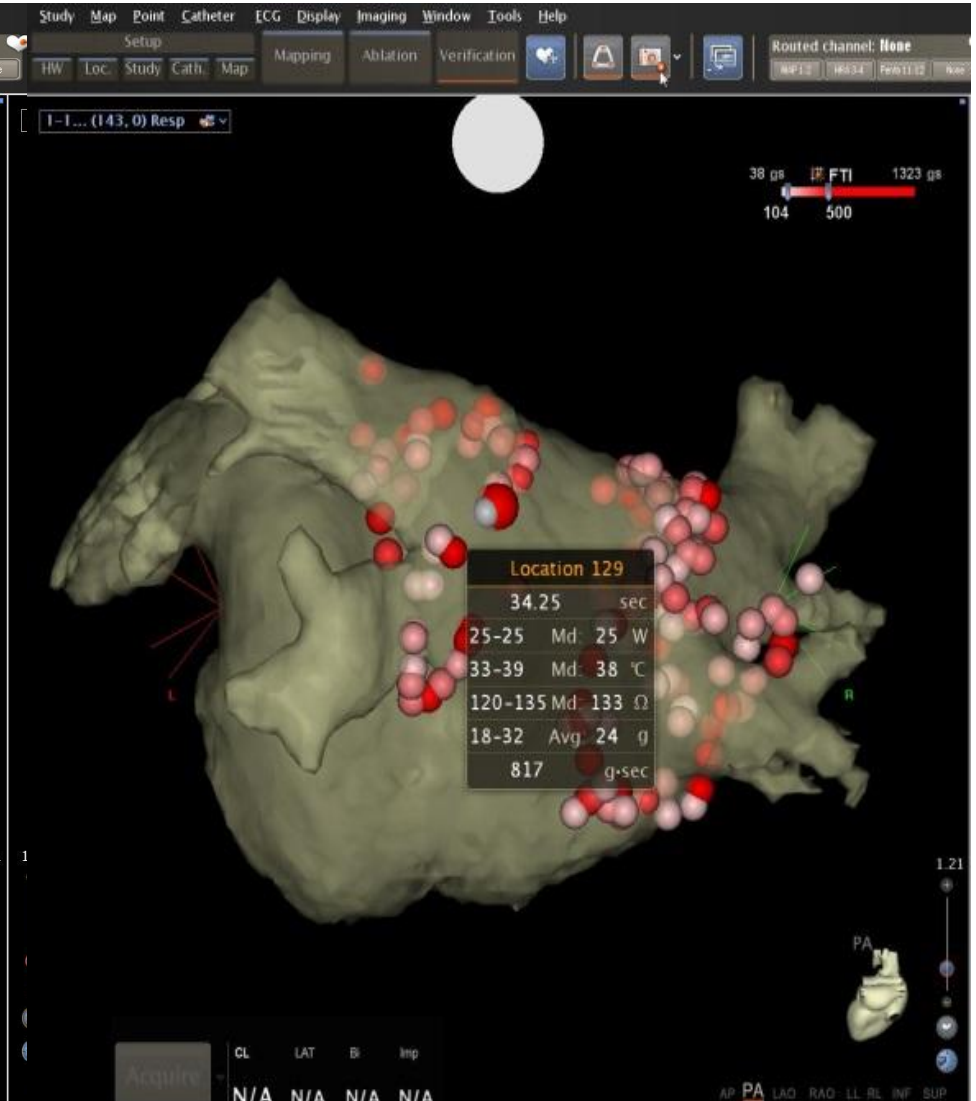
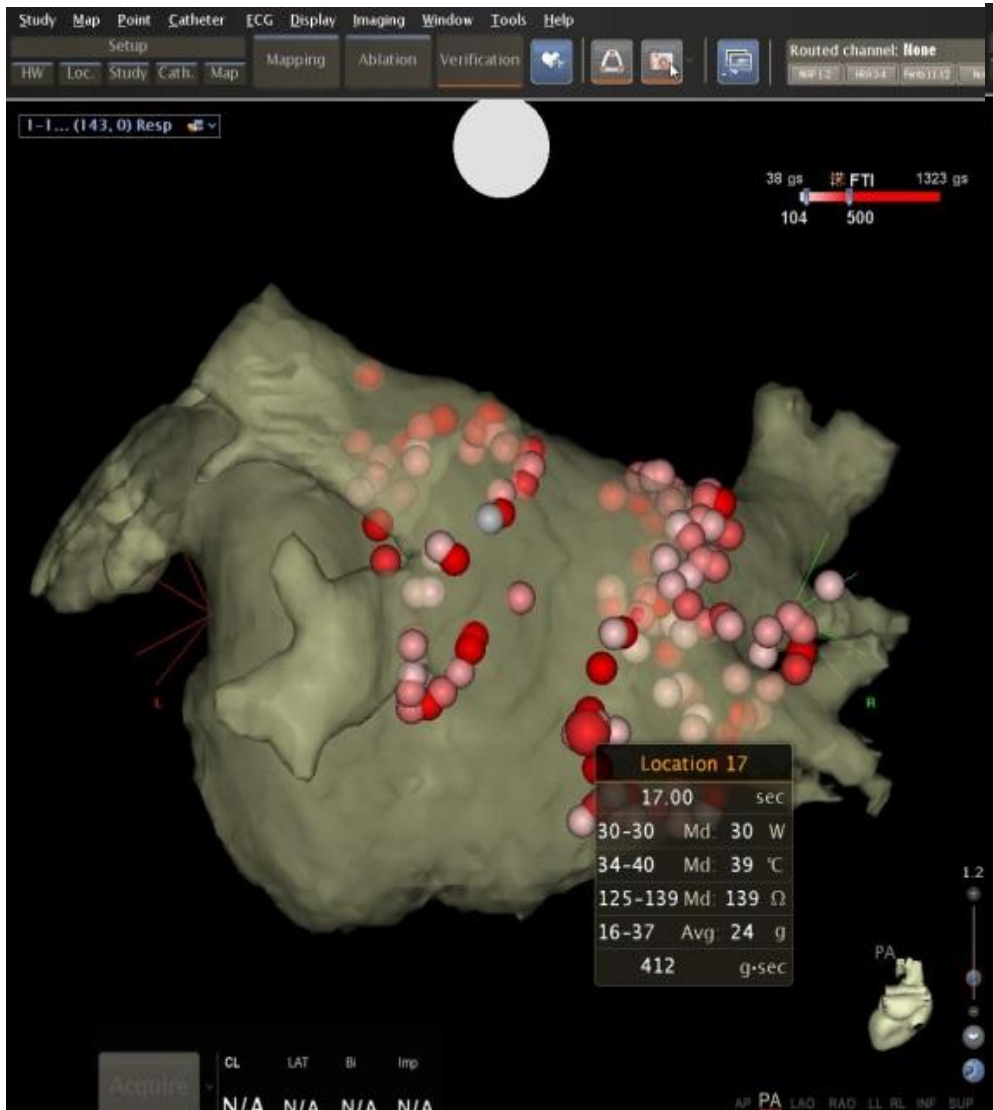
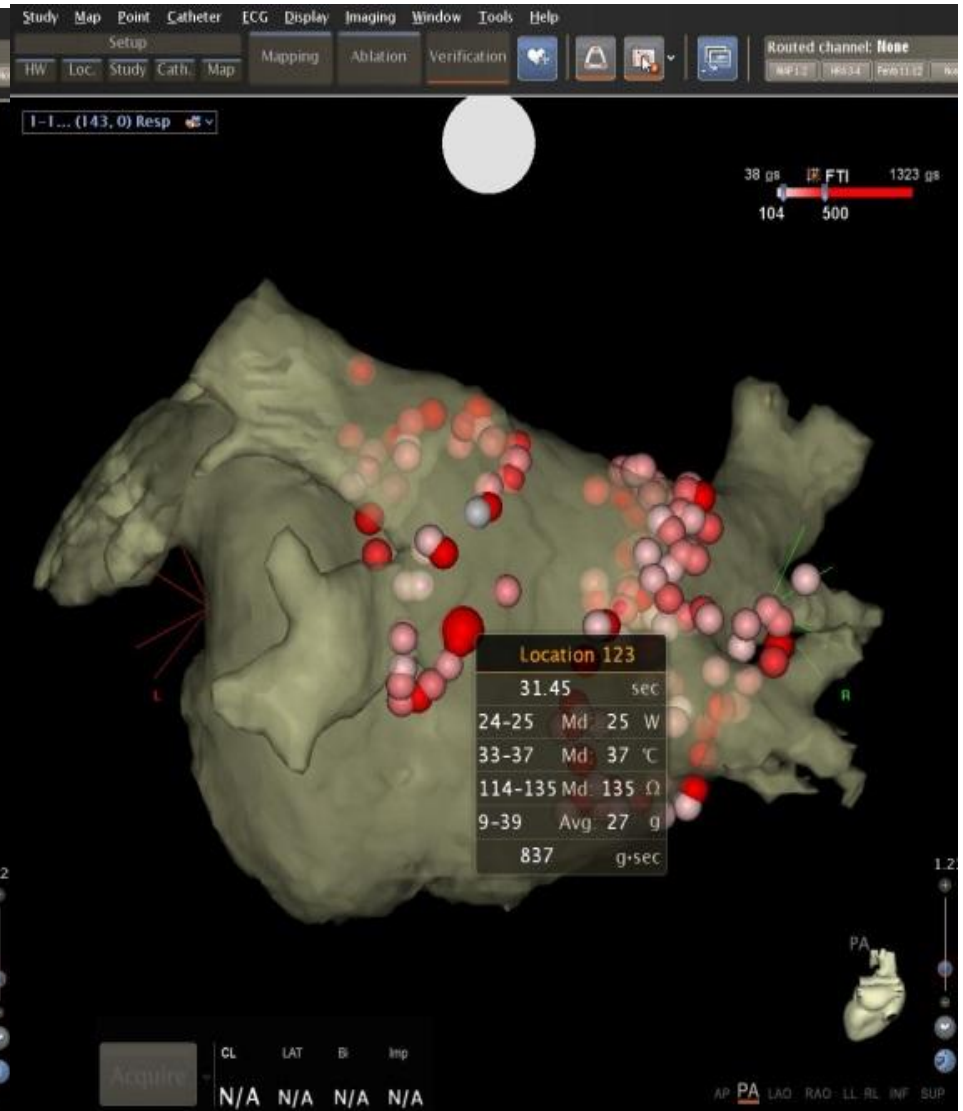


VISITAG information

RIPV Posterior

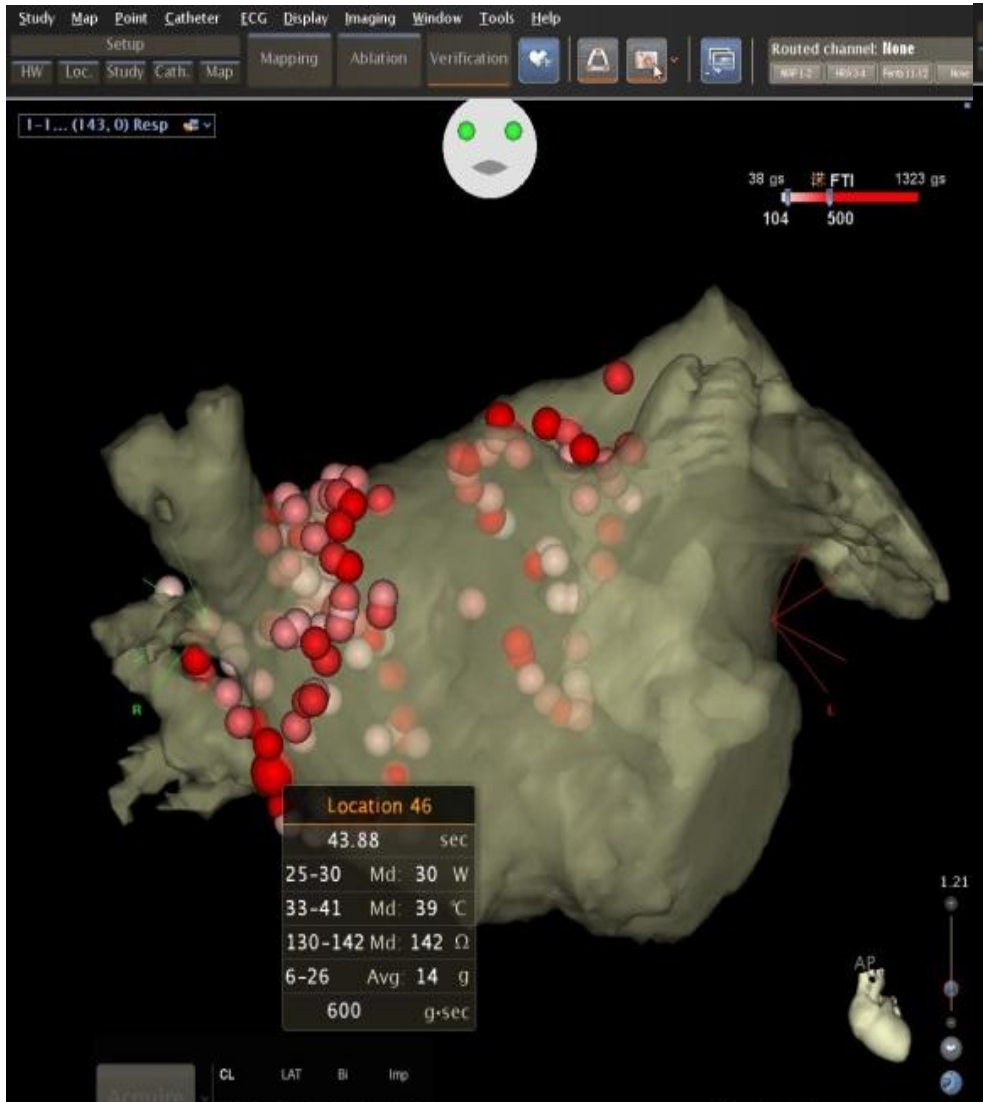


LIPV Posterior

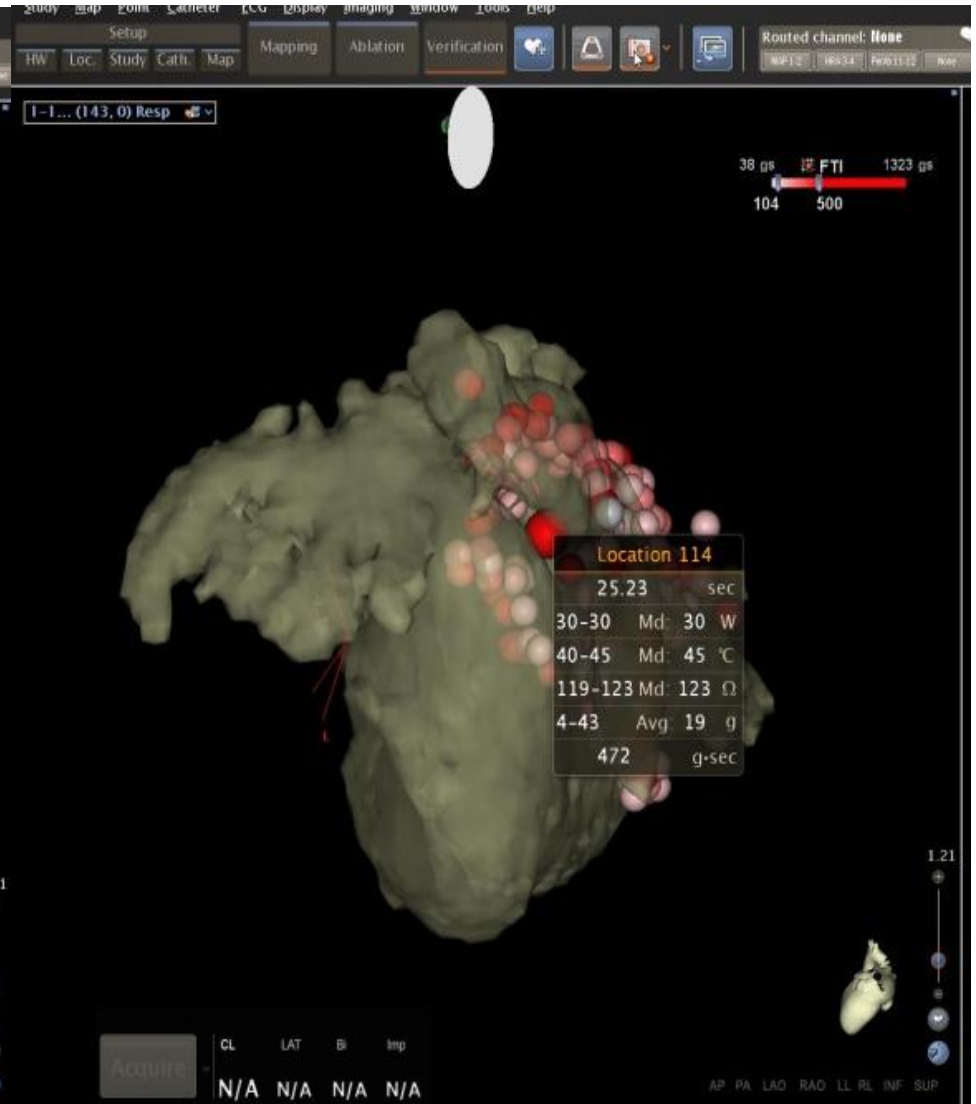


VISITAG information

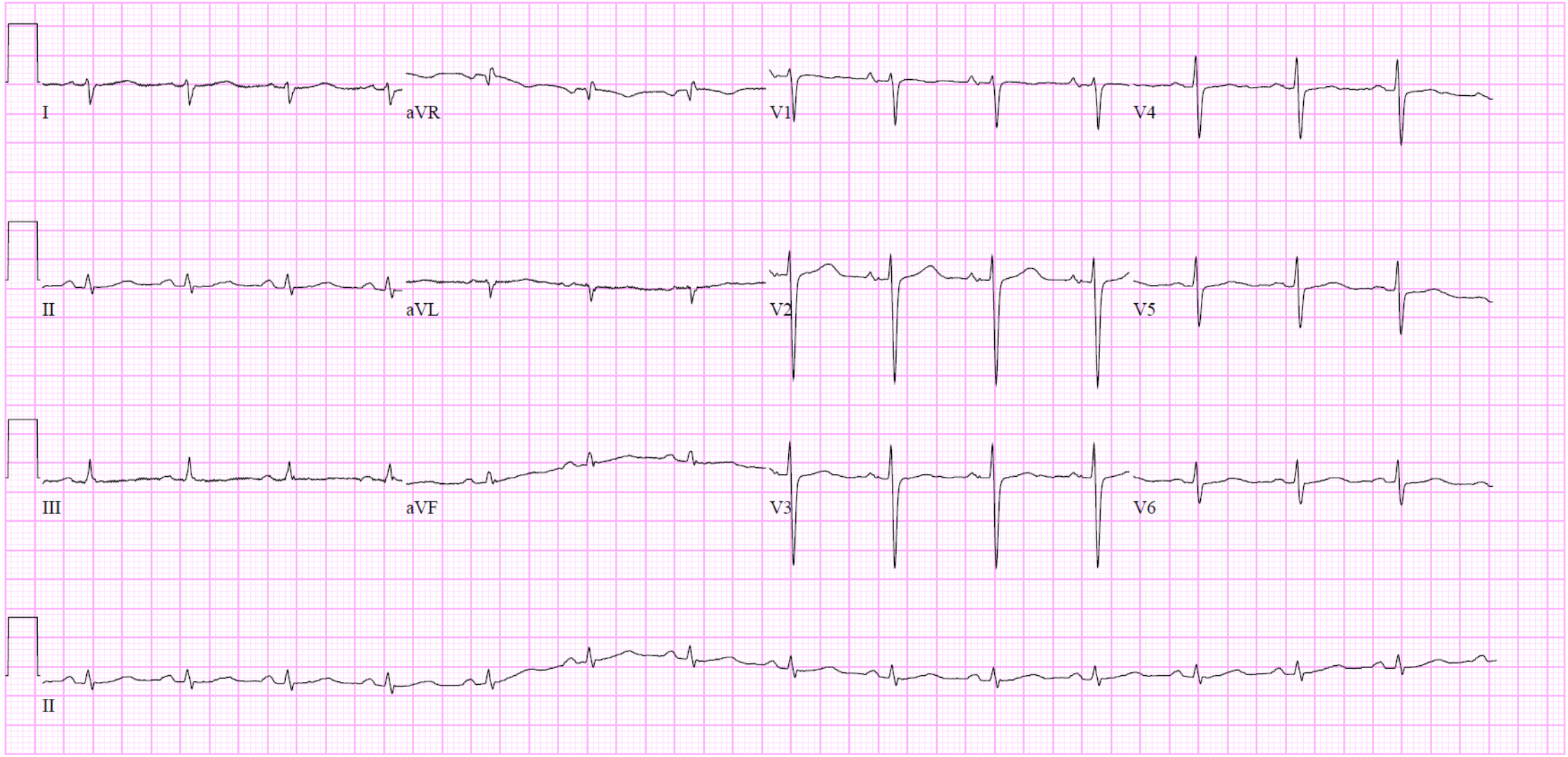
RSPV Anterior



LSPV Anterior



06/Apr/2016, after AF ablation



25mm/s 10mm/mV 40Hz 9.0.0 12SL 237 CID: 1 EID: EDT: ORDER:

ORIGINAL RESEARCH

Optimal Force–Time Integral for Pulmonary Vein Isolation According to Anatomical Wall Thickness Under the Ablation Line

Akio Chikata, MD; Takeshi Kato, MD, PhD; Satoru Sakagami, MD, PhD; Chieko Kato, MD, PhD; Takahiro Saeki, MD, PhD; Keiichi Kawai, MD; Shin-ichiro Takashima, MD, PhD; Hisayoshi Murai, MD, PhD; Soichiro Usui, MD, PhD; Hiroshi Furusho, MD, PhD; Shuichi Kaneko, MD, PhD; Masayuki Takamura, MD, PhD

***Background*—**Low contact force and force–time integral (FTI) during catheter ablation are associated with ineffective lesion formation, whereas excessively high contact force and FTI may increase the risk of complications. We sought to evaluate the optimal FTI for pulmonary vein (PV) isolation based on atrial wall thickness under the ablation line.

***Methods and Results*—**Contact force parameters and FTI during anatomical ipsilateral PV isolation for atrial fibrillation and atrial wall thickness were assessed retrospectively in 59 consecutive patients for their first PV isolation procedure. The PV antrum was divided into 8 segments, and the wall thickness of each segment under the ablation line was determined using multidetector computed tomography. The FTI for each ablation point was divided by the wall thickness of the PV antrum segment where each point was located to obtain FTI/wall thickness. In total, 5335 radiofrequency applications were delivered, and 85 gaps in PV isolation ablation lines and 15 dormant conductions induced by adenosine were detected. The gaps or dormant conductions were significantly associated with low contact force, radiofrequency duration, FTI, and FTI/wall thickness. Among them, FTI/wall thickness had the best prediction value for gaps or dormant conductions by receiver operating characteristic curve analysis. FTI/wall thickness of <76.4 gram-seconds per millimeter (gs/mm) predicted gaps or dormant conductions with sensitivity (88.0%) and specificity (83.6%), and FTI/wall thickness of <101.1 gs/mm was highly predictive (sensitivity 97.0%; specificity 69.6%).

***Conclusions*—**FTI/wall thickness is a strong predictor of gap and dormant conduction formation in PV isolation. An FTI/wall thickness ≈100 gs/mm could be a suitable target for effective ablation. **(*J Am Heart Assoc*. 2016;5:e003155 doi: 10.1161/JAHA.115.003155)**

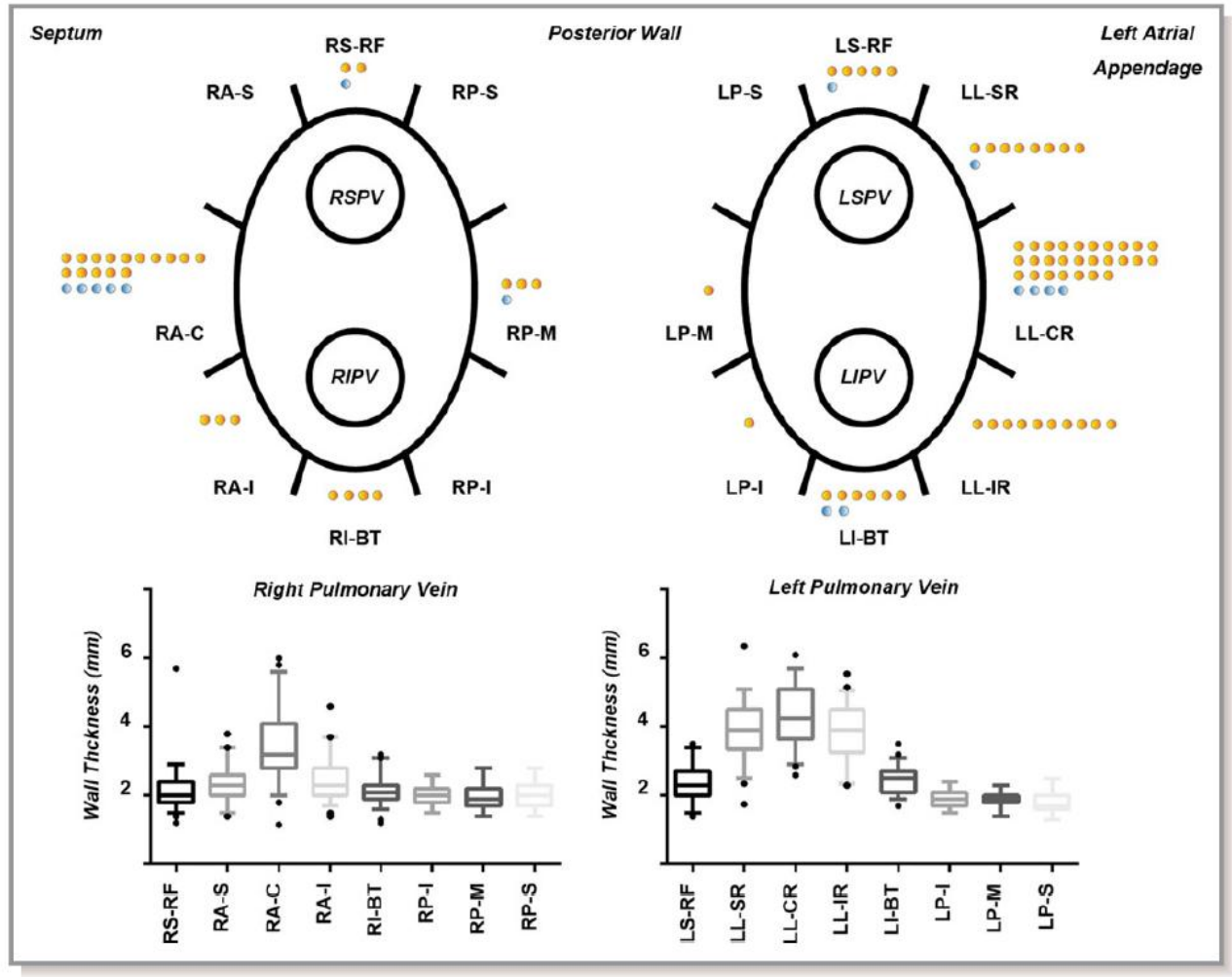


Figure 1. Myocardial thickness of each segment under the ablation line (lower panels) and distribution of acute gaps and dormant conductions (DCs) after pulmonary vein isolation (upper panels). Yellow circles represent acute gaps, blue circles represent DCs. LI-BT indicates left inferior bottom; LIPV, left inferior pulmonary vein; LL-CR, left lateral carina ridge; LL-IR, left lateral inferior ridge; LL-SR, left lateral superior ridge; LP-I, left posterior inferior; LP-M, left posterior middle; LP-S, left posterior superior; LSPV, left superior pulmonary vein; LS-RF, left superior roof; RA-C, right anterior carina; RA-I, right anterior inferior; RA-S, right anterior superior; RI-BT, right inferior bottom; RIPV, right inferior pulmonary vein; RP-I, right posterior inferior; RP-M, right posterior middle; RP-S, right posterior superior; RSPV, right superior pulmonary vein; RS-RF, right superior roof.

Table 2. CF Parameters for Each Segment Under the Ablation Line

PV	Segment	Wall Thickness (mm)	Average CF (g)	Max CF (g)	Min CF (g)	RF Duration (s)	FTI (gs)	FTI/Wall Thickness (gs/mm)
Left	Superior roof	2.4±0.5	16.8±7.3	34.9±19.5	7.7±5.2	23.0±11.5	375.6±236.2	163.7±116.0
	Lateral superior ridge	3.9±0.9	16.7±6.9	32.6±16.7	6.2±4.8	26.4±13.8	434.9±299.4	114.2±77.9
	Lateral carina ridge	4.3±0.9	15.7±6.2	33.1±15.5	6.9±5.0	27.6±13.4	427.1±257.9	102.6±68.5
	Lateral inferior ridge	3.9±0.8	16.5±7.4	32.3±13.3	7.9±7.1	26.1±12.8	409.1±247.6	108.2±68.3
	Inferior bottom	2.5±0.4	17.7±8.0	31.3±11.6	8.4±7.5	20.2±10.6	333.5±209.2	136.4±87.7
	Posterior inferior	1.9±0.3	16.5±7.7	26.9±10.9	7.7±7.1	15.4±6.4	234.7±100.0	124.0±57.0
	Posterior middle	1.9±0.3	16.3±7.4	28.0±12.0	7.5±6.5	17.4±7.1	275.4±174.8	146.1±96.1
	Posterior superior	1.8±0.3	17.4±8.0	32.5±17.4	8.4±6.4	19.8±9.2	322.1±169.3	186.9±102.5
Right	Superior roof	2.1±0.6	21.2±8.4	58.7±27.9	6.8±6.1	19.7±9.6	397.9±216.7	190.9±110.5
	Anterior superior	2.3±0.5	19.9±8.4	35.3±13.5	9.2±7.1	22.8±10.7	436.4±275.6	191.2±119.7
	Anterior carina	3.4±1.1	22.2±10.4	35.6±13.6	9.8±8.6	25.3±13.5	538.7±377.8	164.3±122.6
	Anterior inferior	2.4±0.6	23.8±10.2	39.8±14.2	10.1±9.1	23.1±11.7	533.4±330.8	229.2±148.9
	Inferior bottom	2.1±0.4	23.4±10.9	41.1±15.0	7.8±9.4	20.2±9.6	448.3±270.7	205.1±111.4
	Posterior inferior	2.0±0.3	18.9±9.1	37.4±15.1	4.9±6.8	20.1±10.1	346.9±18.0	175.2±93.2
	Posterior middle	2.0±0.4	20.0±8.9	42.0±18.7	6.7±6.8	19.9±8.9	376.5±203.3	193.1±109.5
	Posterior superior	2.1±0.5	20.7±7.4	56.1±23.1	6.2±6.1	19.9±10.3	386.3±207.2	192.3±108.5

CF indicates contact force; FTI, force–time integral; gs, gram-seconds; Max, maximum; Min, minimum; PV, pulmonary vein; RF, radiofrequency.

Table 3. Ablation Parameters at Each Point With a Gap or DC Compared With Those Without

	With Gap or DC (n=100)	Without Gap or DC (n=5235)	*P* Value
FTI, gs	199.0±12.3	407.9±3.7	<0.0001
Average CF, g	13.8±0.6	19.2±0.1	<0.0001
Max CF, g	30.4±1.5	37.6±0.3	0.0001
Minimum CF, g	5.3±0.5	7.6±0.1	0.0007
RF duration, s	15.2±0.9	22.46±0.2	<0.0001
FTI/wall thickness, gs/mm	50.6±2.4	164.8±1.5	<0.0001
RF power, W	28.7±0.2	28.0±0.1	0.08

CF indicates contact force; DC, dormant conduction; FTI, force–time integral; gs, gram-seconds; RF, radiofrequency.

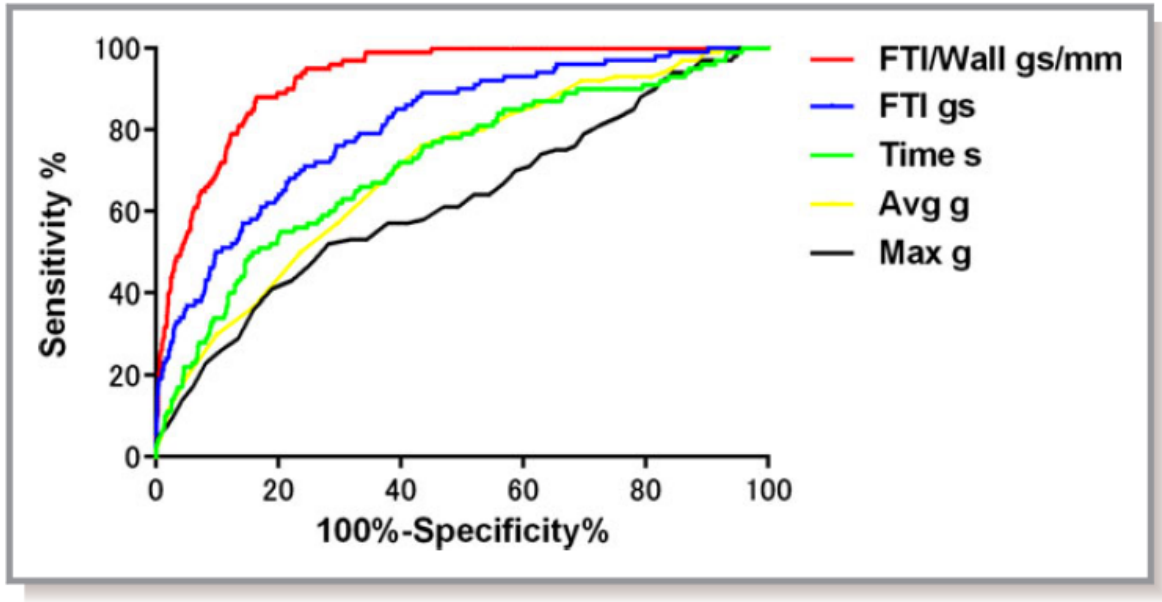


Figure 2. Receiver operating characteristic curve analysis for acute gap and dormant conduction (DC) predictability. FTI/wall thickness showed the best prediction value with an area under the curve (AUC) of 0.9242 (95% CI 0.9060–0.9425, *P*<0.001 vs AUCs of FTI and the other contact force [CF] parameters). FTI, average CF, maximum CF, and RF duration had AUCs of 0.8101, 0.7046, 0.6246, and 0.7161, respectively. The best threshold for FTI/wall thickness for predicting acute gaps or DCs was 76.4 gs/mm (sensitivity 88.0%; specificity 83.6%). An FTI/wall thickness of <101.1 gs/mm was highly predictive of acute gap or DC (sensitivity 97.0%; specificity 69.6%). Avg indicates average; FTI, force–time integral; gs, gram-seconds; Max, maximum.

In this study

- **MDCT analysis revealed that the wall thickness was different at each part of the ablation line and was thickest at the left lateral ridge (LLR);**
- **The gaps or DCs were significantly associated with low CF, RF duration, FTI, and FTI/wall thickness**
- **ROC curve analysis identified FTI/wall thickness as the best predictor for gaps and DCs**

In this study

- **The wall thickness of LLR,**
  - **Lateral superior ride 3.9 ± 0.9 mm**
  - **Lateral carinal ridge 4.3 ± 0.9 mm**
  - **Lateral inferior ridge 3.9 ± 0.8 mm**
- **Left posterior 2 mm**
- **Right anterior carina 3.4 ± 1.1**
- **Right other sites 2 mm**

- A lower average CF has been reported as a strong predictor of gap formation
- It has been reported that CF at the LLR tends to be low and that the majority of conduction gaps after single continuous circular lesions around ipsilateral PVs were located at the LLR and anterior wall of the right PV.
- In present study, the CF for LLR was low, and most of the gaps and DCs were located at the LLR or the right anterior carina, which was consistent with previous reports.
- They speculate that the lower CF and insufficient FTI against the thick atrial walls at the LLR and anterior right PV wall led to the formation of gaps and DCs.

- It has been reported that a minimum FTI of ≈400 gs for each lesions was necessary to avoid reconnection or to create transmural lesion in PVI.
- Conversely, the relationship between FTI and electrogram attenuation plateaued at ≈500 gs, and FTI and impedance drop also plateaued at ≈500 gs.
- Beyond this plateau point, continuation of ablation is unlikely to produce further gains but may increase the potential risk of complications such as perforation, steam pops, or damage to extracellular structures.

- **FTI/wall thickness ≈100 gs/mm could be a suitable target value to achieve effective ablation.**

Long-Term Results of Catheter Ablation in Paroxysmal Atrial Fibrillation

Lessons From a 5-Year Follow-Up

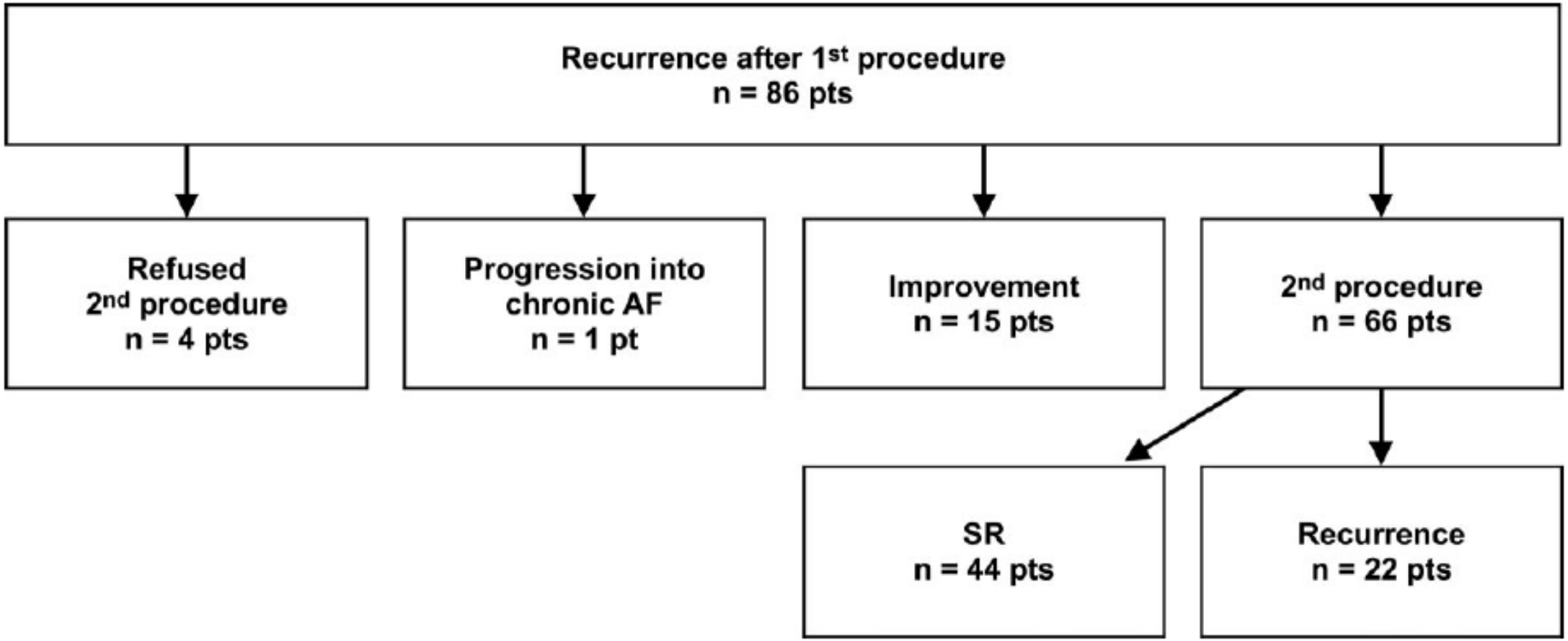
Feifan Ouyang, MD*; Roland Tilz, MD*; Julian Chun, MD; Boris Schmidt, MD; Erik Wissner, MD; Thomas Zerm, MD; Kars Neven, MD; Bulent Köktürk, MD; Melanie Konstantinidou, MD; Andreas Metzner, MD; Alexander Fuernkranz, MD; Karl-Heinz Kuck, MD

Background—Paroxysmal atrial fibrillation (AF) naturally progresses toward chronic AF at an estimated rate of 15% to 30% over a 1- to 3-year period. Pulmonary vein (PV) isolation is increasingly performed for the treatment of drug-refractory paroxysmal AF. The long-term data on clinical outcome after circumferential PV isolation are limited.

Methods and Results—From 2003 to late 2004, 161 patients (121 men; age, 59.8±9.7 years) with symptomatic paroxysmal AF and normal left ventricular function underwent circumferential PV isolation guided by 3-dimensional mapping and double Lasso technique. Right-sided and left-sided continuous circular lesions encircling the ipsilateral PVs were placed with irrigated radiofrequency energy. The procedure end point was the absence of all PV spikes for at least 30 minutes after PV isolation verified by 2 Lasso catheters placed within the ipsilateral PVs. Sinus rhythm was present in 75 patients (46.6%) after the initial procedure during a median follow-up period of 4.8 years (0.33 to 5.5 years). A second procedure was performed in 66 and a third procedure in 12 patients. Recovered PV isolation conduction was observed in 62 of 66 patients (94.0%) during the second and in 8 of 12 patients (66.7%) during the third procedure. After a median of 1 (1 to 3) procedure, stable sinus rhythm was achieved in 128 of 161 patients (79.5%), whereas clinical improvement occurred in an additional 21 of 161 patients (13.0%) during a median follow-up of 4.6 years (0.33 to 5.5 years). Four patients in stable sinus rhythm died during follow-up. Progression toward chronic AF was observed in 4 patients (2.4%); however, only 2 patients reported symptoms.

Conclusion—In patients with paroxysmal AF and normal left ventricular function, circumferential PV isolation results in stable sinus rhythm in the majority of patients, and low incidence of chronic AF was observed after ablation during up to 5 years of follow-up. **(*Circulation*. 2010;122:2368-2377.)**

Recurrent ATas after the initial ablation procedure



- In 66 patients, a repeat procedure was performed at a median of 120 days after the initial procedure.
- During the second procedure, mapping demonstrated a macro-AT with its critical isthmus between the mitral annulus and the left sided PVs in 9 patients, a macro-AT with its critical isthmus between both CCIs in 2 patients, and a macro-AT within the right atrial free wall in 1 patient.
- Recovered PV conduction during SR was found in 62 of 66 patients (94%); conduction gaps were located along the right PVs in 40 patients (61%) and the left-sided PVs in 51 patients (77%). All conduction gaps were successfully closed with a minimal number of irrigated radiofrequency current applications. After CPVI, frequent atrial extrasystoles were identified and ablated at the superior crista terminalis in 1 patient and within the superior vena cava in 2 patients.
- In 1 of 4 patients without recovered PV conduction, mapping and ablation was successfully performed, targeting a focal AT originating from the roof of the LA.

- **The estimated probability to maintain SR at 5 years of follow-up after a single procedure was 45.3% and increased to 78.1% after a median 1 (1 to 3) procedure.**

Table 2. Distribution of Conduction Gaps During the Second and Third Ablation Procedures

Patient	Age, y/Sex	Time From First to Second Procedure, d	Time From First to Third Procedure, d	Conduction Gaps at the R-CCLs		Conduction Gaps at the L-CCL	
				During Second Procedure	During Third Procedure	During Second Procedure	During Third Procedure
1*	63/F	151	352			Anterosuperior	
2	46/M	70	718		Posteroinferior	Anterosuperior	
3	78/F	6	289			Anterosuperior	Posterosuperior
4	62/F	5	738	Posterosuperior	Inferior		
5	41/F	119	208	Posterosuperior		Inferior	
6*	65/M	184	222			Anteroinferior	Anteroinferior
7	63/M	48	221	Posterosuperior Anteroinferior			
8*	67/M	91	317	Posterosuperior		Posteroinferior	
9	67/F	3	644		Anteroinferior	Anterosuperior	
10	41/F	5	497			Anterosuperior	Inferior
11	63/F	4	865				Posteroinferior
12	46/M	10	728		Posteroinferior		
Mean±SD		58.0±64.8	483.3±242.5				

R-CCL indicates CCLs around the ipsilateral septal pulmonary veins; L-CCL, CCLs around the ipsilateral lateral pulmonary veins.

Electrophysiologic Findings and Long-Term Outcomes in Patients Undergoing Third or More Catheter Ablation Procedures for Atrial Fibrillation

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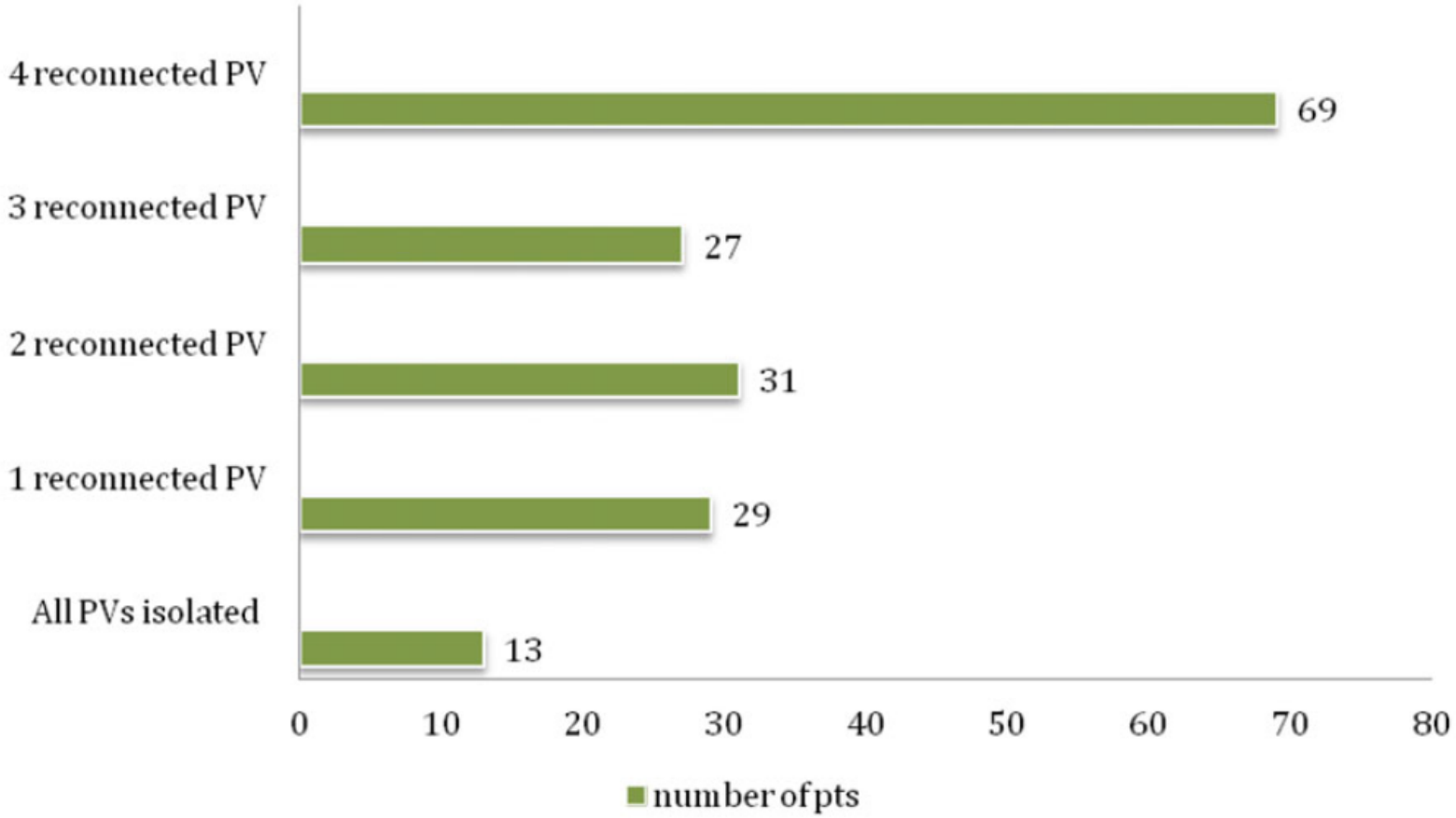
Electrophysiologic Findings. ***Introduction:*** **Pulmonary vein (PV) status, arrhythmia sources, and outcomes with ≥3 ablation procedures have not been characterized.**

Methods and Results: **All patients with ≥3 procedures were included and underwent antral reisolation of reconnected PVs and ablation of non-PV triggers. Of 2,886 patients who underwent PVI, 181 (6%) had more than 2 ablation procedures (3 procedures in 146 and ≥4 procedures in 35). In 12 patients, the clinical arrhythmia was other than AF. Of the remaining 169 patients, 69 (41%) had 4 reconnected PVs, 27 (16%) had 3, 31 (18%) had 2, and 29 (17%) had 1. Only 13 (8%) had all PVs still isolated. Provocative techniques in 127 patients initiated PV triggers in 92 patients, including AF or PV atrial tachycardia in 64 (50%), and reproducible PV APDs in 28 (22%). Thirty-six (20%) had a new non-PV trigger targeted. At a mean of 36 months (12–119 months) after last procedure, 63 patients (47%) had no AF off antiarrhythmic drugs (AAD); 28 (21%) had no AF with AAD; and 18 (13%) had rare AF with good symptom control; 26 patients (19%) had recurrent AF.**

Conclusions: **At time of third or greater AF ablation, PV reconnection is the rule (92%) and PV triggers initiating AF can be demonstrated. Following repeat PVI and targeting non-PV triggers, 81% of patients had clinical AF control. Our findings suggest that PV reisolation and attempts to identify and eliminate non-PV triggers are effective and support the role of multiple repeat procedures for AF recurrence.**
(J Cardiovasc Electrophysiol, Vol. pp. 1-7)

Status of PVs at time of repeat ablation in the 169 patients in whom the PVs were surveyed.



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CLINICAL RESEARCH

Recurrence of paroxysmal atrial fibrillation after pulmonary vein isolation: is repeat pulmonary vein isolation enough? A prospective, randomized trial

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Received 20 October 2014; accepted after revision 10 December 2014

Aims In patients with paroxysmal atrial fibrillation (pAF), pulmonary vein isolation (PVI) has become an accepted treatment option with single procedure success rates of 60–80%. A repeat ablation is performed in ~30% of patients because of arrhythmia recurrence. The strategy for this repeat procedure is not defined.

Methods and results Patients with pAF recurrence after PVI were prospectively randomized and underwent a second ablation procedure with either PVI of all reconnected veins or PVI with an additional left atrial anterior line. Follow-up in our arrhythmia clinic was every 3 months up to 12 months including 7 day Holter monitoring. A total of 77 patients (mean age 63 ± 9 years, 69% males) were included in the analysis. A repeat PVI was performed in 41 patients, PVI + anterior line in 36 patients. After a follow-up of 12 months, 26 of 41 (63%) patients after repeat PVI and 18 of 36 (50%) patients with PVI + anterior line were in stable sinus rhythm off antiarrhythmic medication ($P = 0.26$). In most patients (12 of 15 patients with PVI and 14 of 18 patients with PVI + anterior line) with an arrhythmia recurrence after the second procedure, the recurring arrhythmia was paroxysmal AF. In 2 of 15 patients of the PVI group and in 4 of 18 patients of the PVI + anterior line group atypical flutter was the reoccurring arrhythmia (P = NS).

Conclusion In this prospective randomized trial, patients with a recurrence of paroxysmal AF had no better outcome after repeat PVI + one left atrial line compared with patients with repeat PVI only.

Keywords Atrial fibrillation • Relapse; • Pulmonary vein isolation • Anterior line • PVI

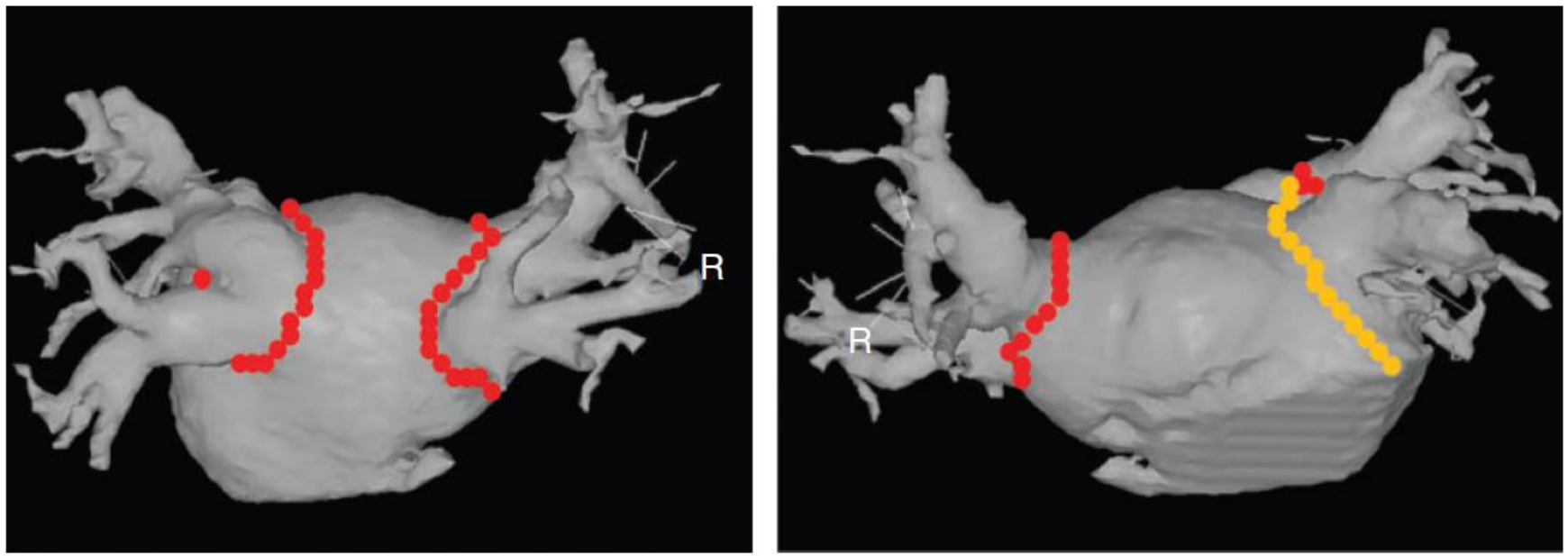
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Table 1 Baseline characteristics

	PVI ($n = 41$)	PVI + anterior line ($n = 36$)	*P* value
Age	64 ± 9	62 ± 8	0.33
Gender (male)	68%	69%	1.0
Duration of atrial fibrillation (months)	74.5 ± 76	97.3 ± 80	0.25
Time since initial PVI (months)	21.5 ± 27.6	17.3 ± 24.7	0.5
$CHADS^2$ VASc score	2.3 ± 1.7	2.1 ± 1.8	0.62
Art. hypertension	71%	61%	0.47
Hyperlipidemia	39%	61%	0.07
Coronary artery disease	14.6%	8.3%	0.5
Diabetes mellitus	12%	8.3%	0.7
Previous stroke	7.3%	16.7%	0.3
Size of left atrium	44 ± 6.2	43.7 ± 5	0.85

Table 2 Procedural data

	PVI	PVI + anterior line	*P* value
Reconnected PV per patient	3.7 ± 0.9	3.3 ± 0.9	0.02
Procedure time (min)	106.6 ± 42	117.9 ± 52	0.3
RF time (min)	33.5 ± 18	44.7 ± 19	0.01
Fluoroscopy time (min)	21.8 ± 14	16.9 ± 13.5	0.14
Fluoroscopy dose (cGym)	1818 ± 1219	1557 ± 1203	0.35
Tamponade	0	0	1.0
Procedural stroke	0	0	1.0
Blood transfusion	0	0	1.0
Groin pseudoaneurysm	1	0	1.0

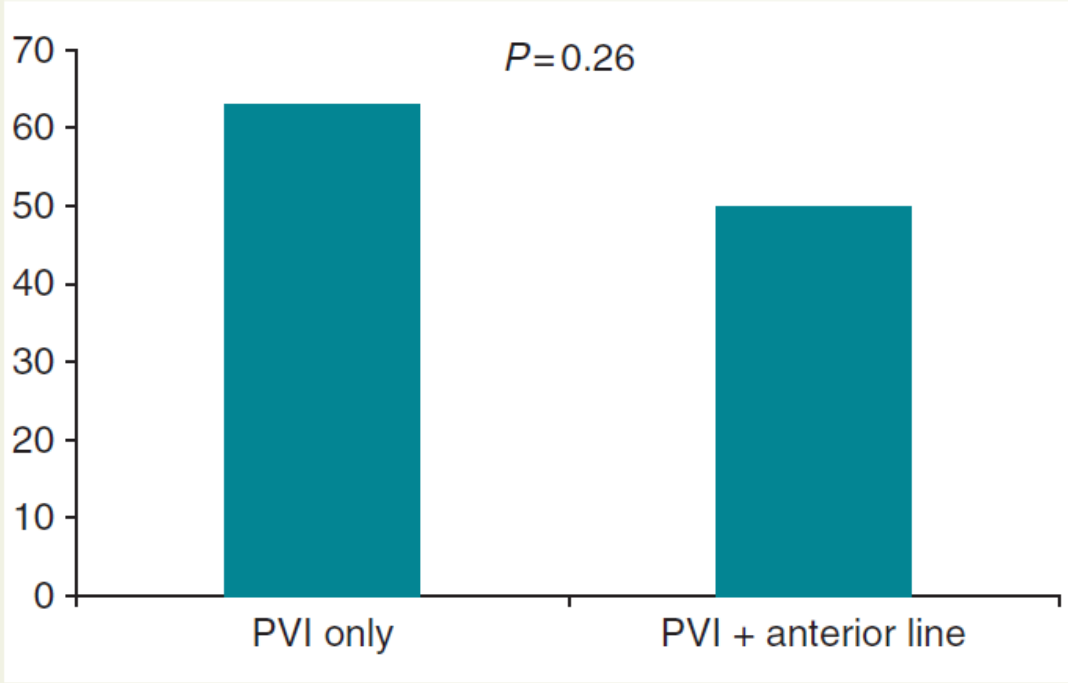

Figure 2 After a follow-up of 12 months 63% in the PVI only group and 50% in the PVI + anterior line group were in stable sinus rhythm off antiarrhythmic medication.

Table 3 Type of arrhythmia recurrence after repeat procedure

	PVI (*N* = 16)	PVI + anterior line (*N* = 18)	*P* value
Paroxysmal AF	75%	78%	0.4
Persistent AF	12.5%	0%	
Atypical flutter	12.5%	22%	

Europace (2013) **15**, 339–346
doi:10.1093/europace/eus321

Areas with complex fractionated atrial electrograms recorded after pulmonary vein isolation represent normal voltage and conduction velocity in sinus rhythm

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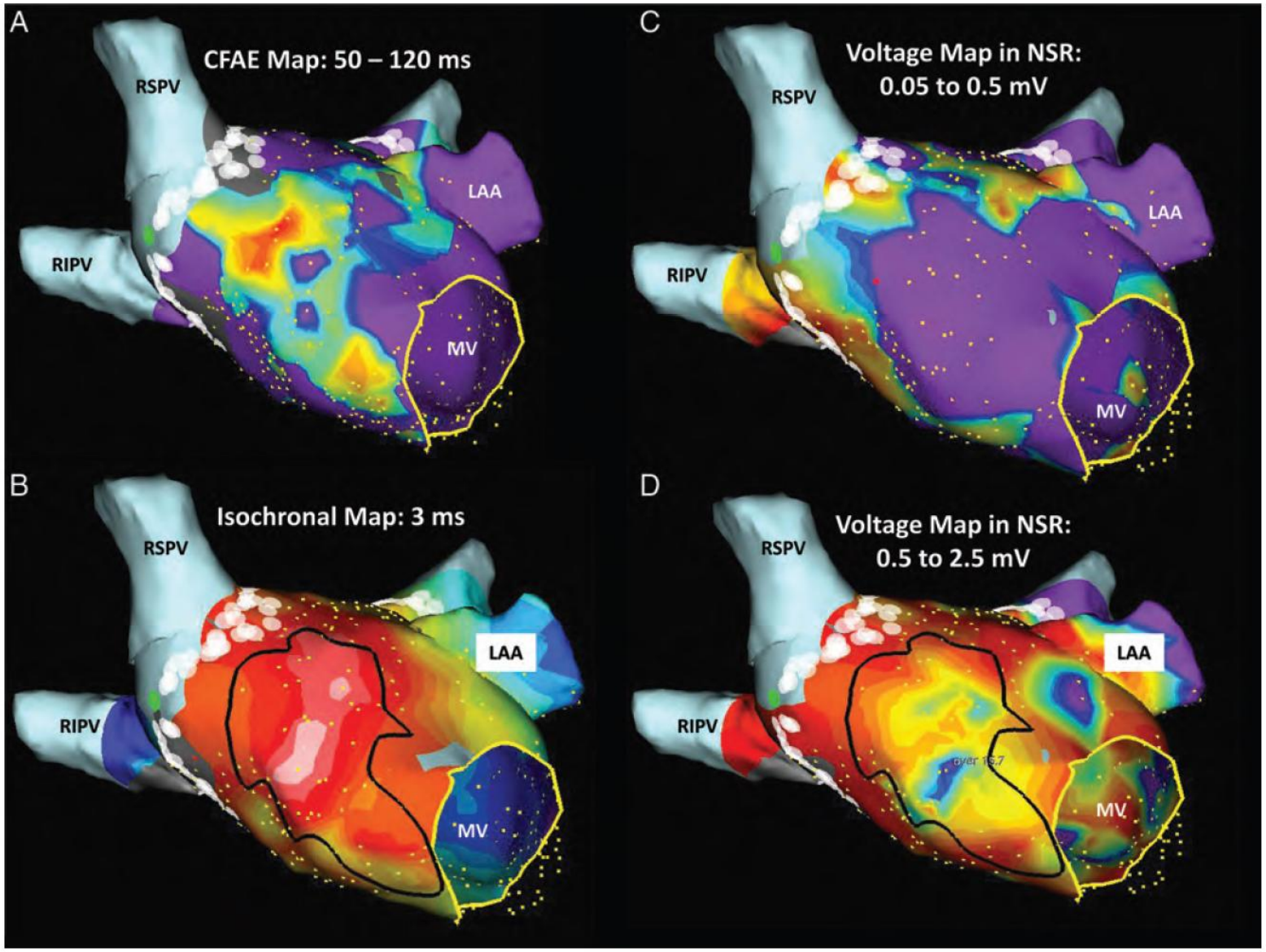
Aims Although complex fractionated atrial electrograms (CFAEs) are purported to represent critical sites for atrial fibrillation (AF) perpetuation, the mechanism and the significance of CFAE in the genesis of AF remain poorly understood. This study evaluated the relationship between CFAE and areas of abnormal atrial tissue defined by low-voltage electrograms (LVE) and signal average of the P-wave (SAPW).

Methods and results Complex fractionated atrial electrogram maps were obtained after pulmonary vein isolation in 15 patients with persistent AF. Patients were then cardioverted and voltage/activation maps were acquired in normal sinus rhythm (NSR). Total left atrium (LA), CFAE and LVE areas were measured as % of total LA area (mean $\pm$ SD). Conduction velocities of normal, LVE and CFAE areas were also measured during NSR. Patients underwent signal averaged ECG of the P-wave in NSR within 24 h of the procedure. Complex fractionated atrial electrograms areas accounted for 33 $\pm$ 24% of total LA. In NSR, only 12 $\pm$ 10% of LA area had LVE. There was no anatomic correlation between CFAE sites and LVE; the area of overlap between CFAE and LVE was only 1.6 $\pm$ 1.5%. Conduction velocity was faster in CFAE areas (2.3 $\pm$ 1.4 m/s) than in normal voltage areas (1.3 $\pm$ 0.3 m/s), and LVE areas (1.1 $\pm$ 0.7 m/s, $P = 0.06$). A positive correlation was only found between LVE areas and SAPW duration ($r = 0.7$, $P = 0.04$).

Conclusion Areas of CFAEs correspond to areas of normal atrial voltage and normal conduction velocity during NSR. Complex fractionated atrial electrogram probably represents the response of normal healthy atrial tissue to rapid pulmonary vein activation.

Minimal overlap between CFAE and low voltage electrogram areas, and normal conduction velocities in CFAE areas along the anteroseptal wall of the LA



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Inverse Relationship Between Fractionated Electrograms and Atrial Fibrosis in Persistent Atrial Fibrillation

Combined Magnetic Resonance Imaging and High-Density Mapping

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Objectives This study sought to evaluate the relationship between fibrosis imaged by delayed-enhancement (DE) magnetic resonance imaging (MRI) and atrial electrograms (Egms) in persistent atrial fibrillation (AF).

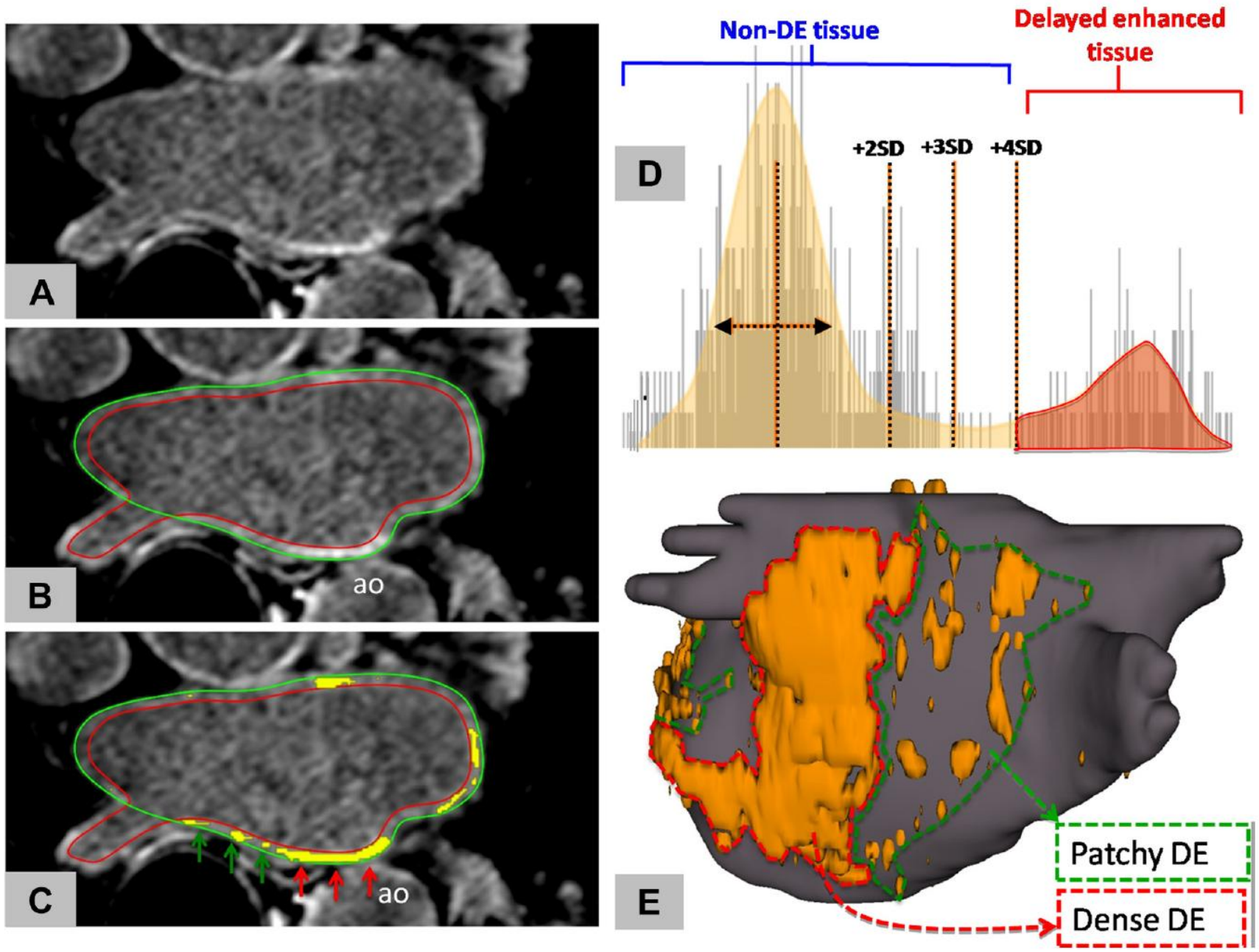
Background Atrial fractionated Egms are strongly related to slow anisotropic conduction. Their relationship to atrial fibrosis has not yet been investigated.

Methods Atrial high-resolution MRI of 18 patients with persistent AF (11 long-lasting persistent AF) was registered with mapping geometry (NavX electro-anatomical system (version 8.0, St. Jude Medical, St. Paul, Minnesota)). DE areas were categorized as dense or patchy, depending on their DE content. Left atrial Egms during AF were acquired using a high-density, 20-pole catheter (514 ± 77 sites/map). Fractionation, organization/regularity, local mean cycle length (CL), and voltage were analyzed with regard to DE.

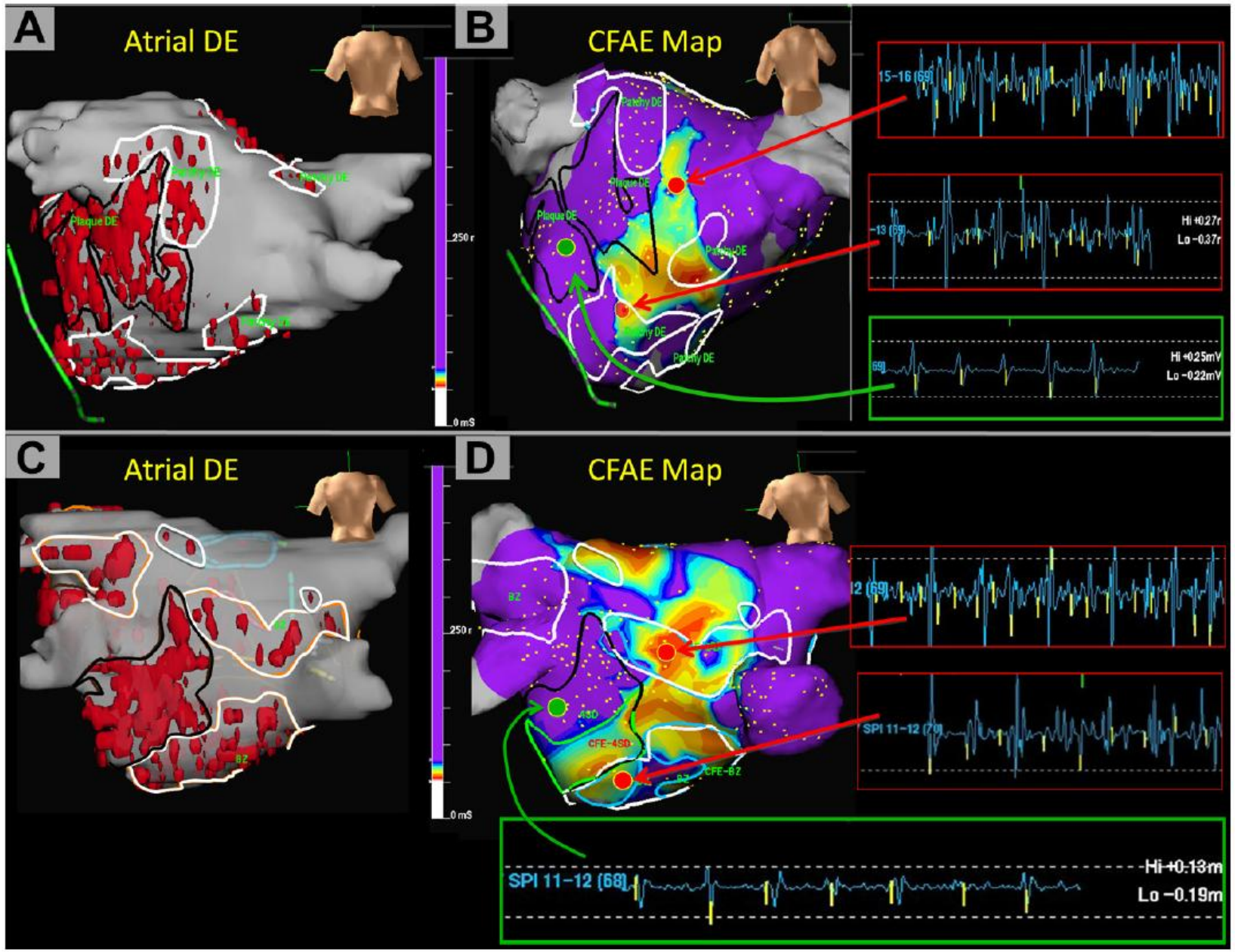
Results Patients with long-lasting persistent versus persistent AF had larger left atrial (LA) surface area (134 ± 38 cm^2 vs. 98 ± 9 cm^2, $p = 0.02$), a higher amount of atrial DE (70 ± 16 cm^2 vs. 49 ± 10 cm^2, $p = 0.01$), more complex fractionated atrial Egm (CFAE) extent (54 ± 16 cm^2 vs. 28 ± 15 cm^2, $p = 0.02$), and a shorter baseline AF CL (147 ± 10 ms vs. 182 ± 14 ms, $p = 0.01$). Continuous CFAE (CFEmean [NavX algorithm that quantifies Egm fractionation] <80 ms) occupied 38 ± 19% of total LA surface area. Dense DE was detected at the left posterior left atrium. In contrast, the right posterior left atrium contained predominantly patchy DE. Most CFAE (48 ± 14%) occurred at non-DE LA sites, followed by 41 ± 12% CFAE at patchy DE and 11 ± 6% at dense DE regions ($p = 0.005$ and $p = 0.008$, respectively); 19 ± 6% CFAE sites occurred at border zones of dense DE. Egms were less fractionated, with longer CL and lower voltage at dense DE versus non-DE regions: CFEmean: 97 ms versus 76 ms, $p < 0.0001$; local CL: 153 ms versus 143 ms, $p < 0.0001$; mean voltage: 0.63 mV versus 0.86 mV, $p < 0.0001$.

Conclusions Atrial fibrosis as defined by DE MRI is associated with slower and more organized electrical activity but with lower voltage than healthy atrial areas. Ninety percent of continuous CFAE sites occur at non-DE and patchy DE LA sites. These findings are important when choosing the ablation strategy in persistent AF. (J Am Coll Cardiol 2013;62:802–12) © 2013 by the American College of Cardiology Foundation

Detection, segmentation, and 3-D reconstruction of Atrial DE



Relationship of atrial DE to Continuous CFAE sites



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Is there still a role for additional linear ablation in addition to pulmonary vein isolation in patients with paroxysmal atrial fibrillation? An Updated Meta-analysis of randomized controlled trials☆

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ABSTRACT

Background: The benefits and risks of additional left atrium (LA) linear ablation in patients with paroxysmal atrial fibrillation (AF) remain unclear.

Methods: Randomized controlled trials were identified in the PubMed, Web of Science, Embase and Cochrane databases, and the relevant papers were examined. Pooled relative risks (RR) and 95% confidence interval (95% CI) were estimated using random effects models. The primary endpoint was the maintenance of sinus rhythm after a single ablation.

Results: Nine randomized controlled trials involving 1138 patients were included in this analysis. Additional LA linear ablation did not improve the maintenance of the sinus rhythm following a single procedure (RR, 1.03; 95% CI, 0.93–1.13; $P = 0.60$). A subgroup analysis demonstrated that all methods of additional linear ablation failed to improve the outcome. Additional linear ablation significantly increased the mean procedural time (166.53 ± 67.7 vs. 139.57 ± 62.44 min, $P < 0.001$), the mean fluoroscopy time (54.56 ± 38.7 vs. 44.32 ± 31.6 min, $P < 0.001$) and the mean radiofrequency (RF) energy application time (78.94 ± 28.39 vs. 59.74 ± 22.38 min, $P < 0.001$). No statistically significant differences in the rates of complications were noted (RR, 0.57; 95% CI, 0.27–1.19; $P = 0.13$).

Conclusions: Additional LA linear ablation did not exhibit any benefits in terms of sinus rhythm maintenance for paroxysmal AF patients following a single procedure. Additional linear ablation significantly increased the mean procedural, fluoroscopy and RF application times. This additional ablation was not associated with a statistically significant increase in complication rates. This finding must be confirmed by further large, high-quality clinical trials.

Study or Subgroup	PVI+linear ablation Events	Total	PVI Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Arbelo 2014	35	59	34	61	7.0%	1.06 [0.78, 1.45]
Fassini 2005	48	63	39	63	10.0%	1.23 [0.97, 1.56]
Gaita 2008	48	84	19	41	5.1%	1.23 [0.85, 1.80]
Hocini 2005	39	45	31	45	10.5%	1.26 [1.00, 1.58]
Kim 2013	108	153	81	102	16.4%	0.89 [0.77, 1.02]
Kim 2014	42	50	44	50	15.1%	0.95 [0.81, 1.12]
Mun 2012	83	104	46	52	16.8%	0.90 [0.79, 1.04]
Sawhney 2010	17	33	19	33	4.0%	0.89 [0.58, 1.39]
Sheikh 2006	45	50	41	50	15.0%	1.10 [0.94, 1.29]
Total (95% CI)		**641**		**497**	**100.0%**	**1.03 [0.93, 1.13]**
Total events	465		354			

Heterogeneity: $Tau^2 = 0.01$; $Chi^2 = 15.22$, df = 8 (P = 0.06); $I^2 = 47\%$

Test for overall effect: Z = 0.53 (P = 0.60)

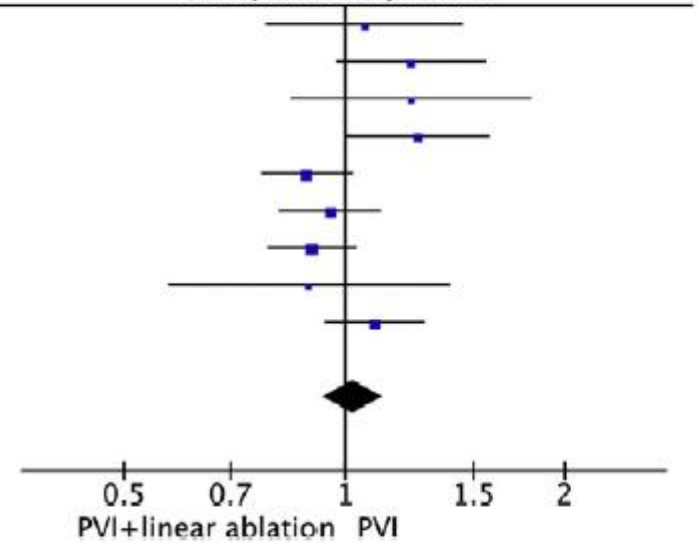
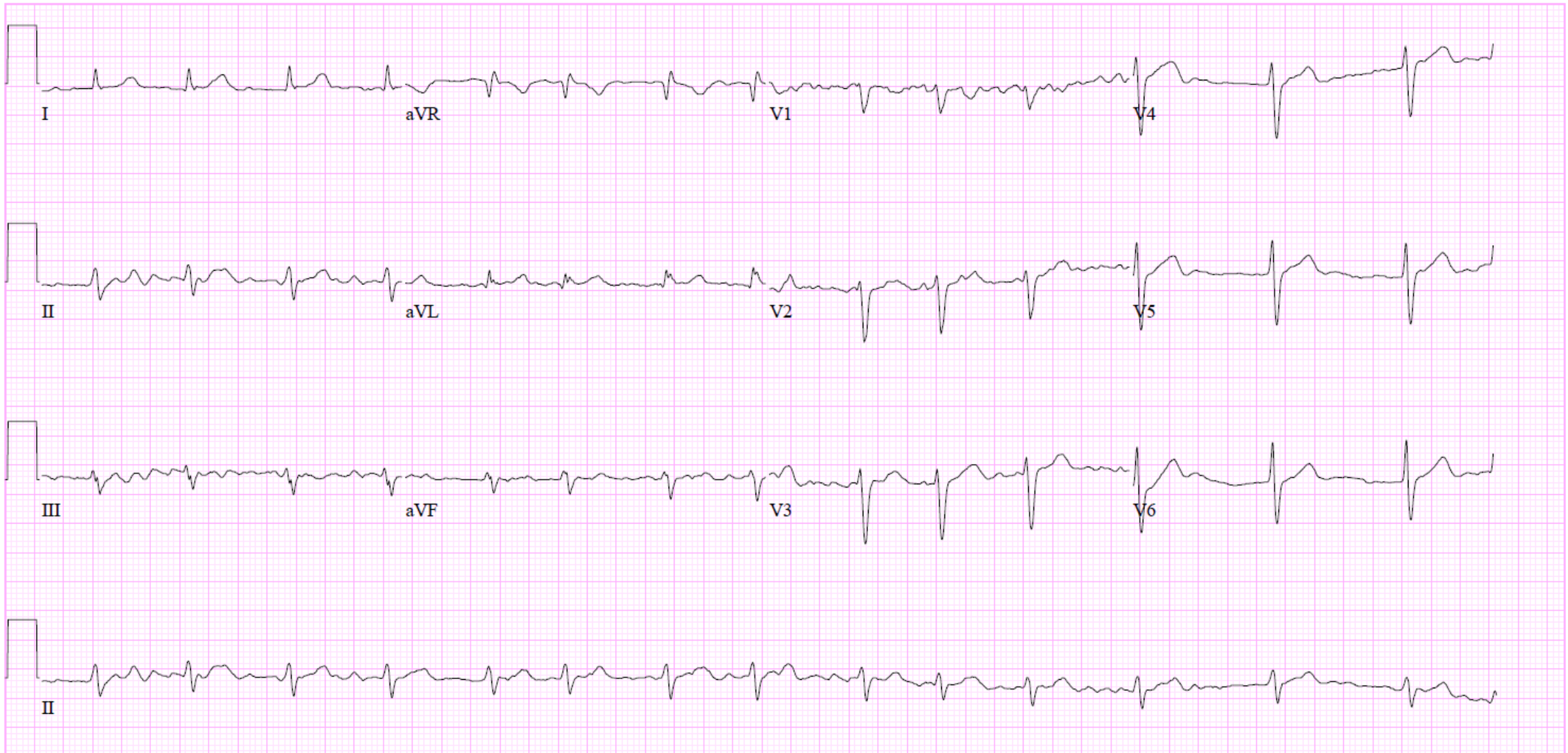


Fig. 2. Relative risks for sinus rhythm maintenance in the PVI group and the PVI plus linear ablation group. PVI, pulmonary vein isolation.

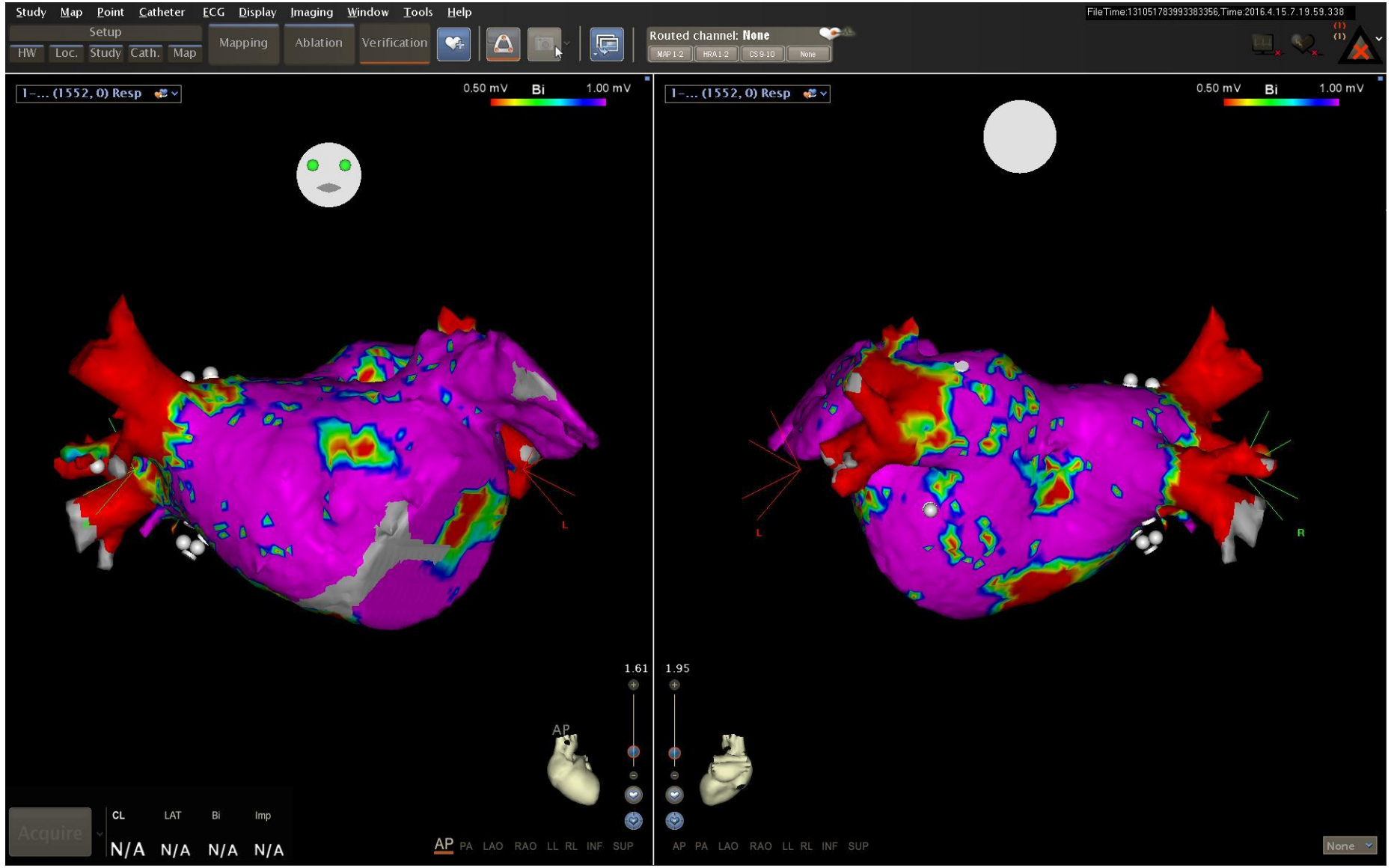
M/41, palpitation for 1wk

- **2013년 A-fib Dx. (Persistent AF for 10 yrs)**
- **2015.04.14. 본원에서 DC cardioversion 200J 2회 시행, sinus conversion되지 않았음**
- **2015.04.15. DC cardioversion 200J 1재시행, sinus conversion**
- **이후 외래 f/u 하던 중 afib recur**
- **2015.06.25. afib Ablation 시행**
- **이후 외래 f/u 하던 중**
- **2016.04.05 palpitation으로 외래 방문**

10/Feb/2015



2015.06.25 Initial Voltage



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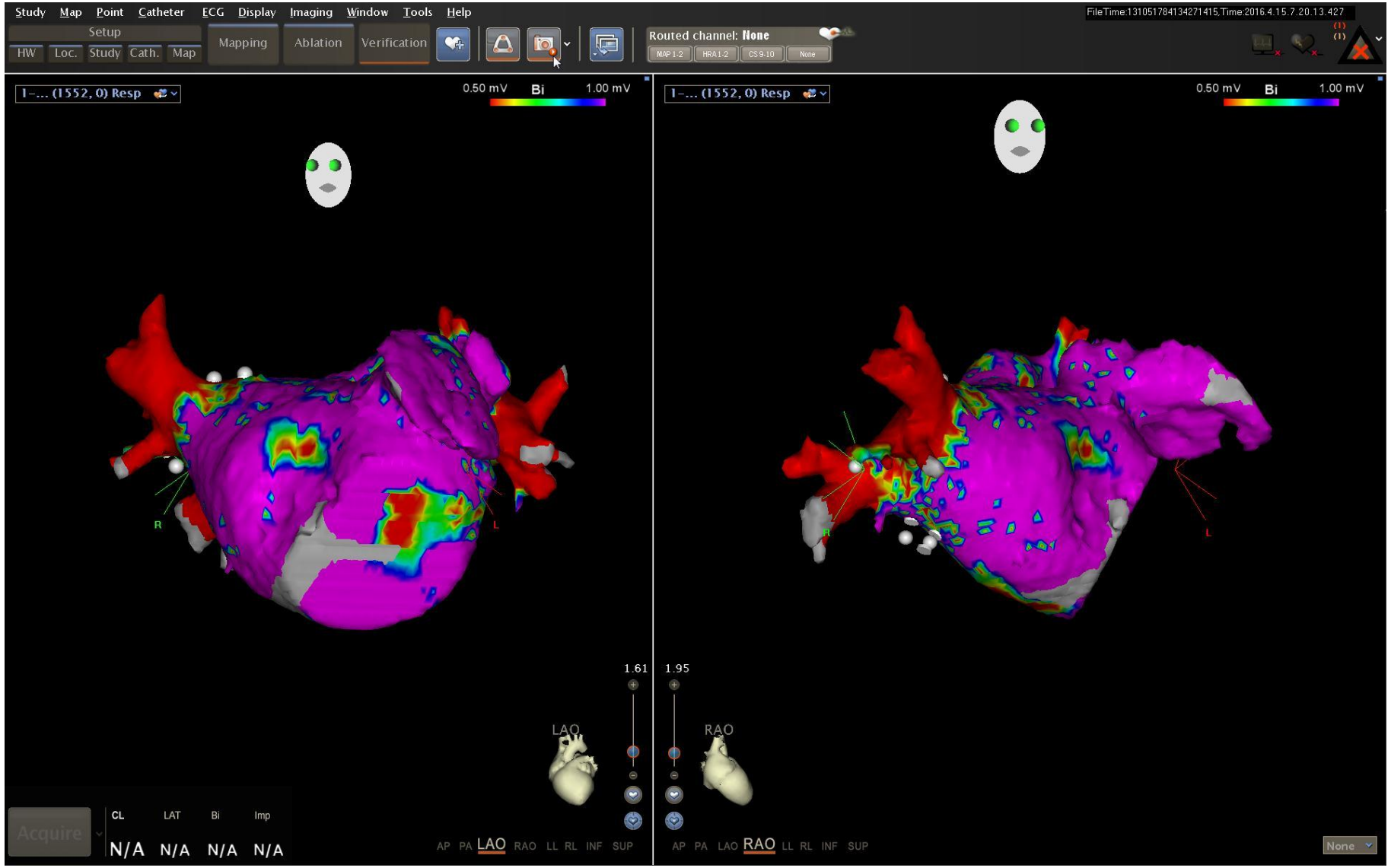
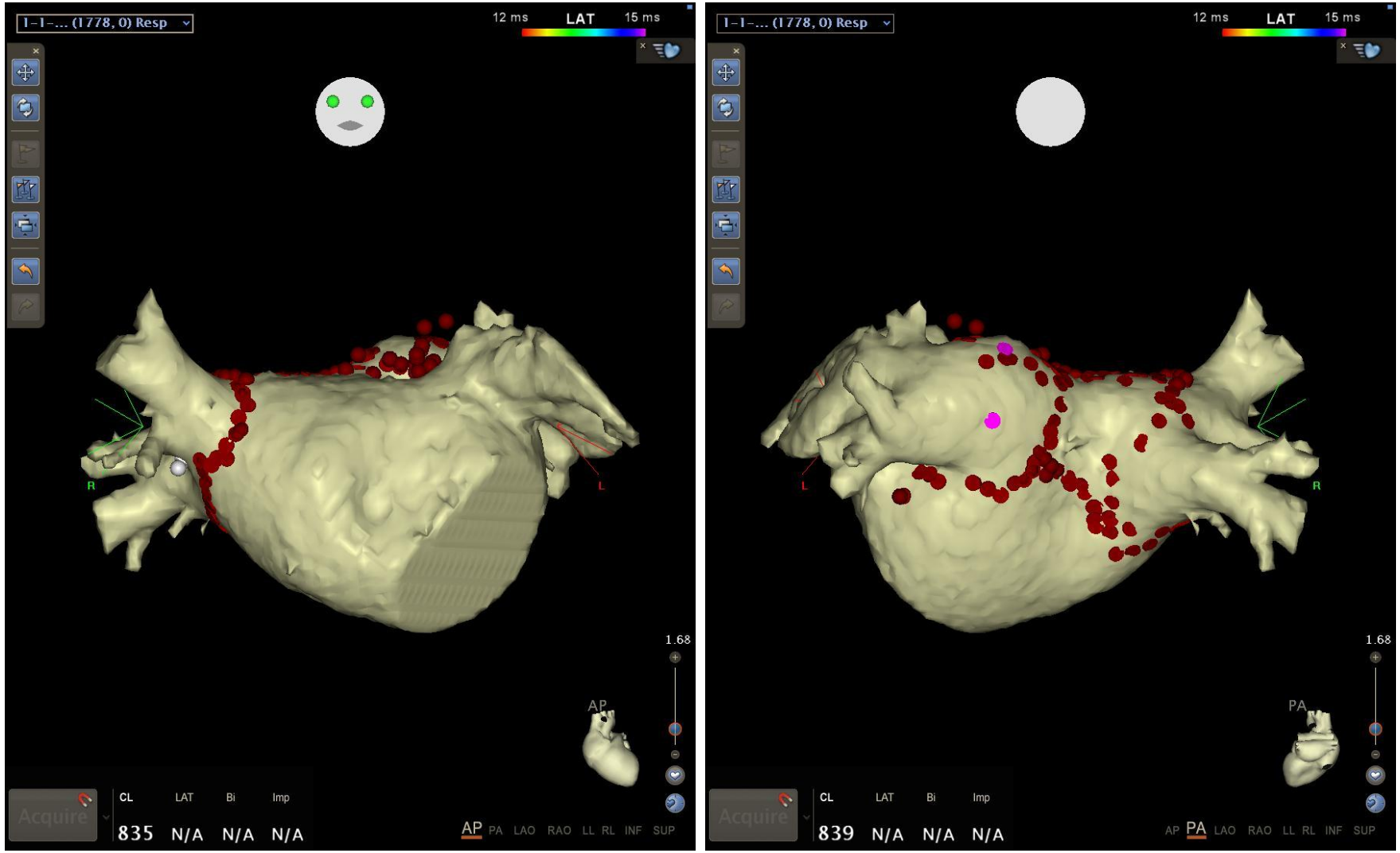


2015.06.25 LA Ablation



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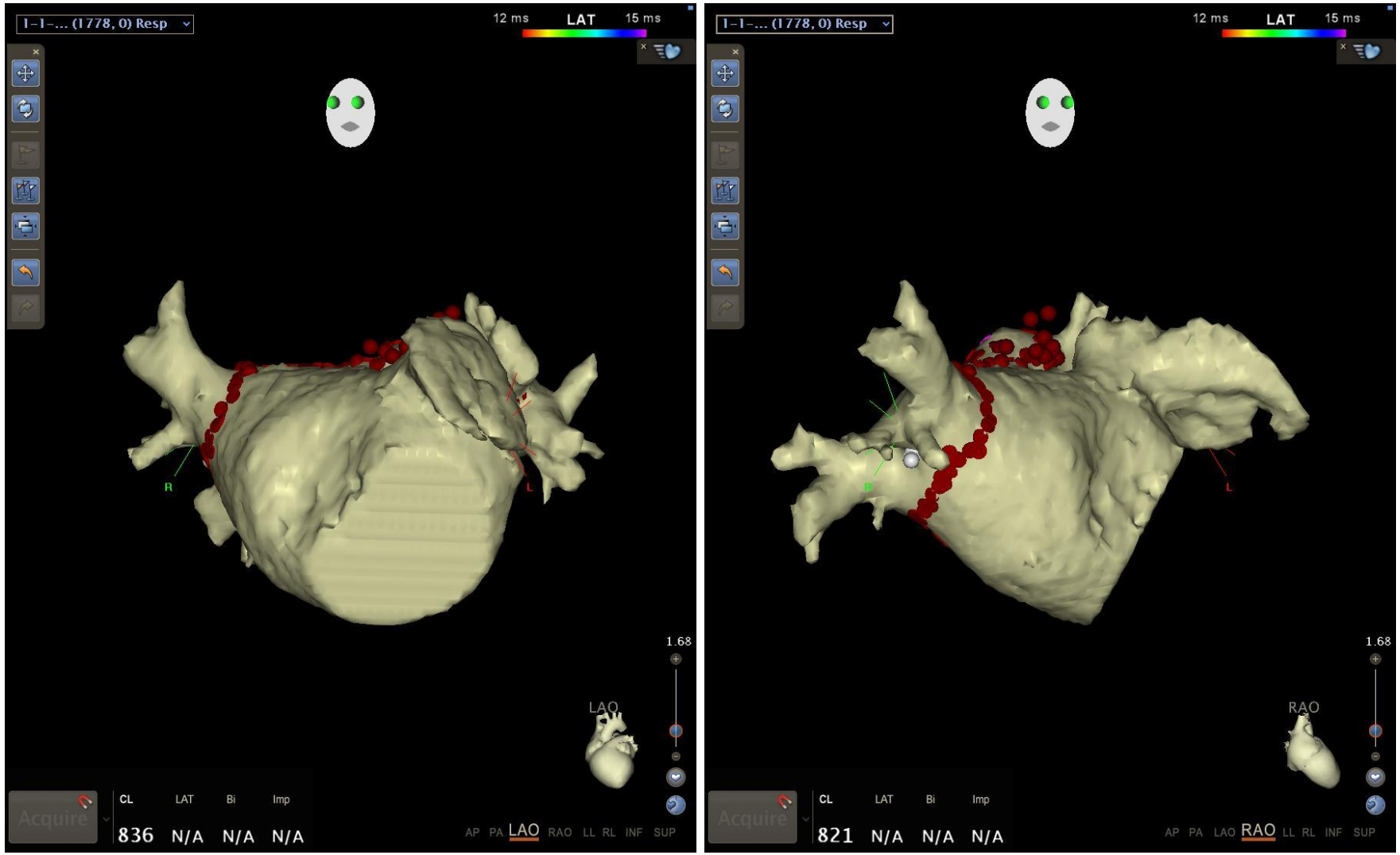
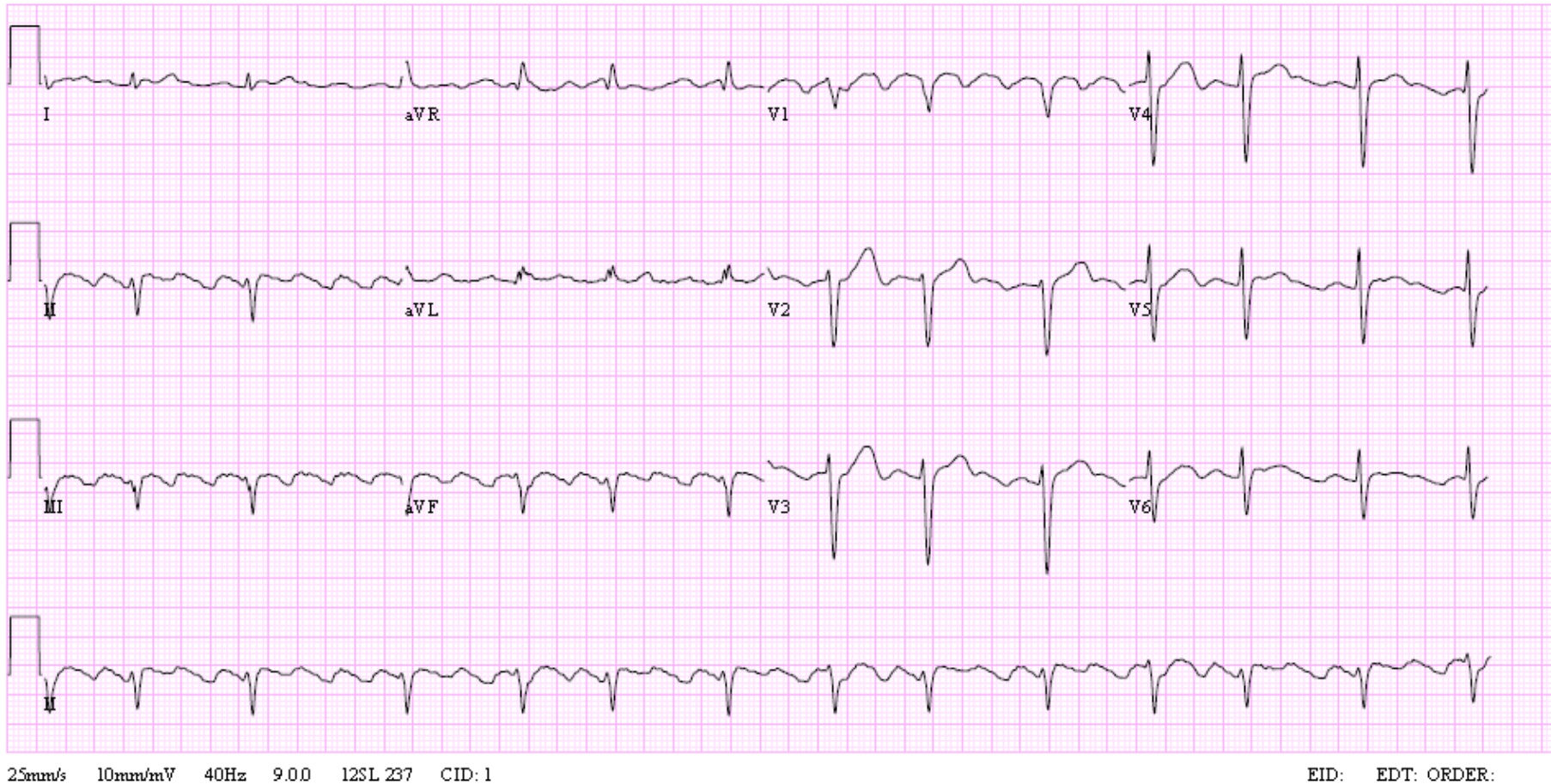
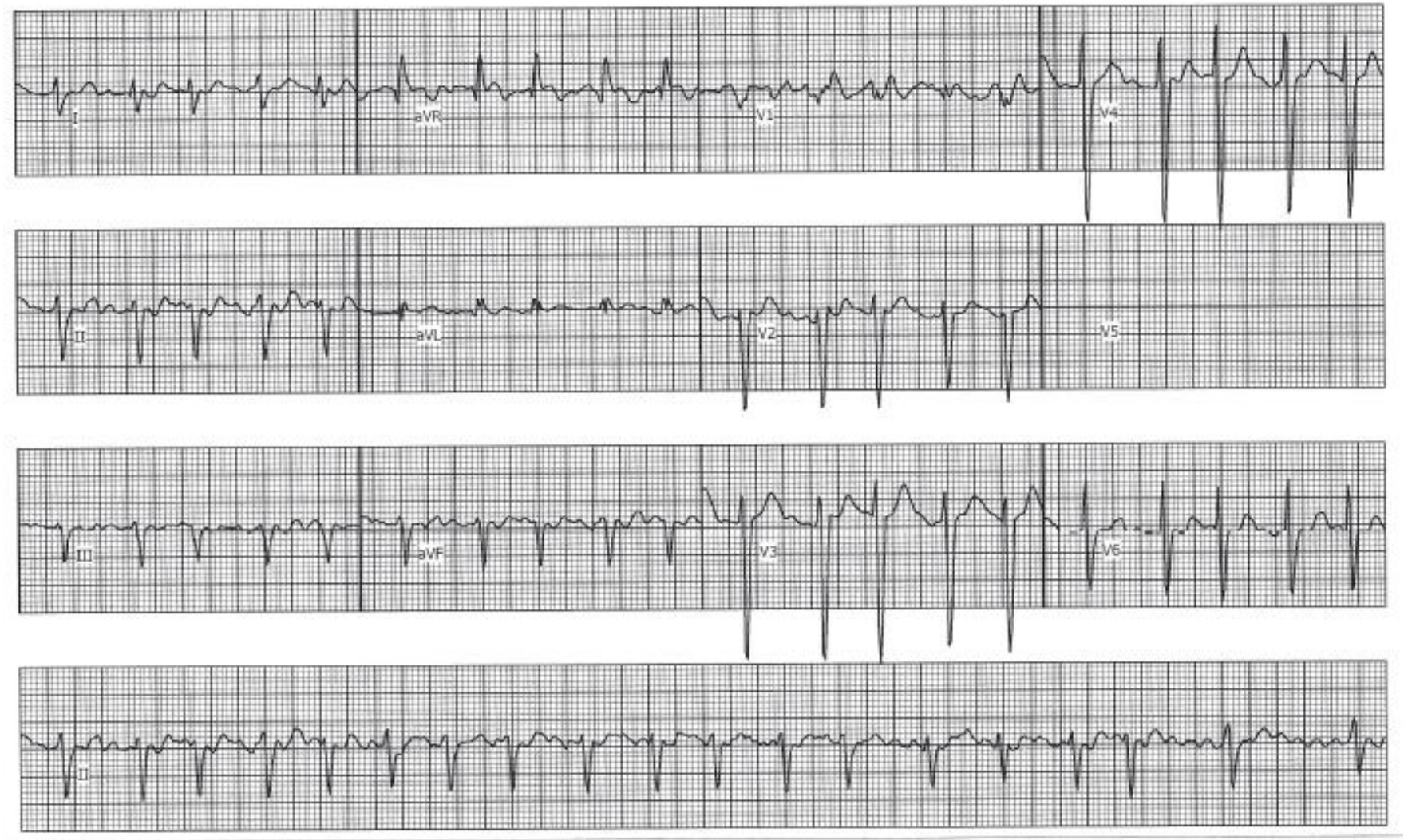


EKG (2016.04.05)



at cardiac cathroom (2016.04.14)



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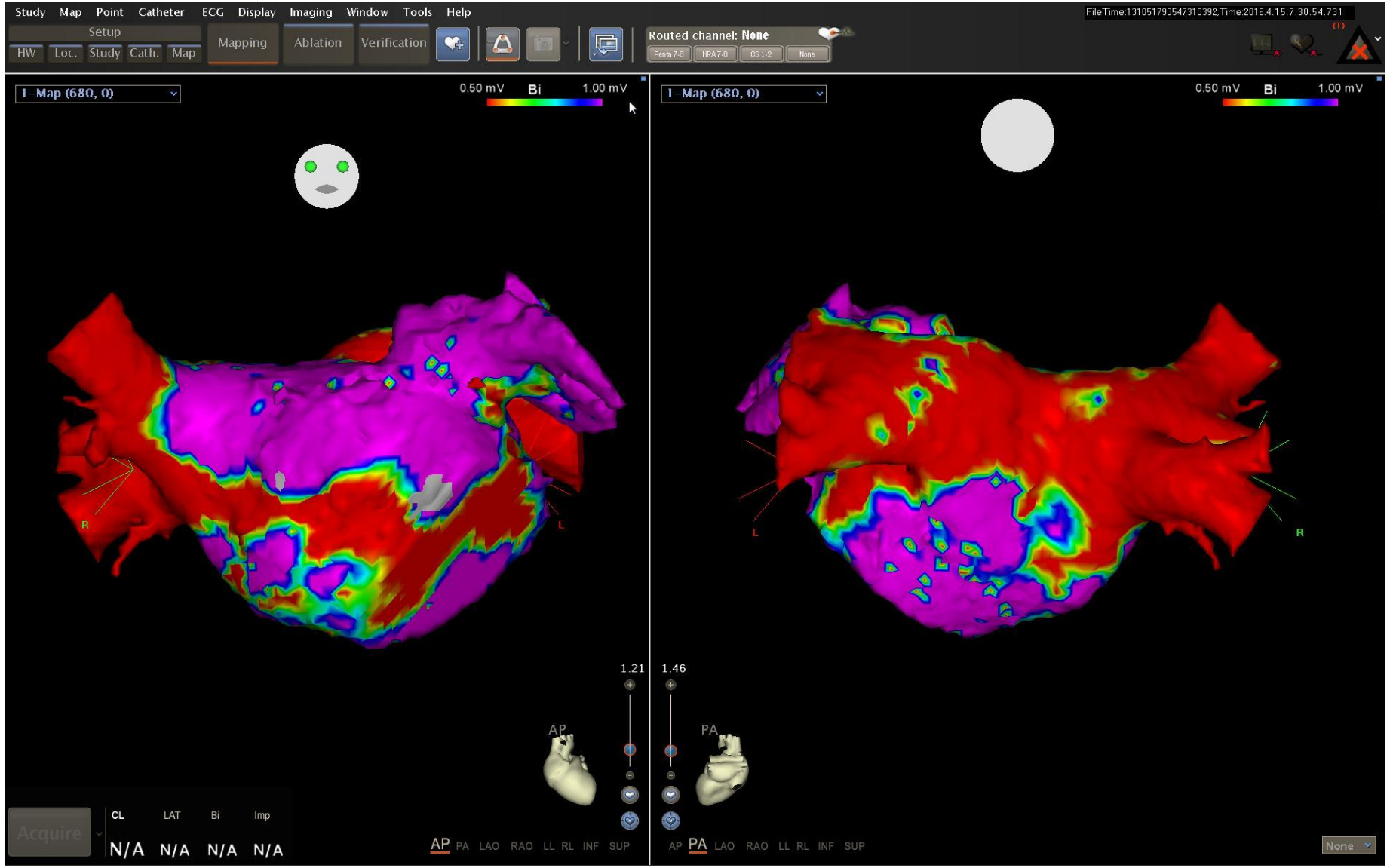

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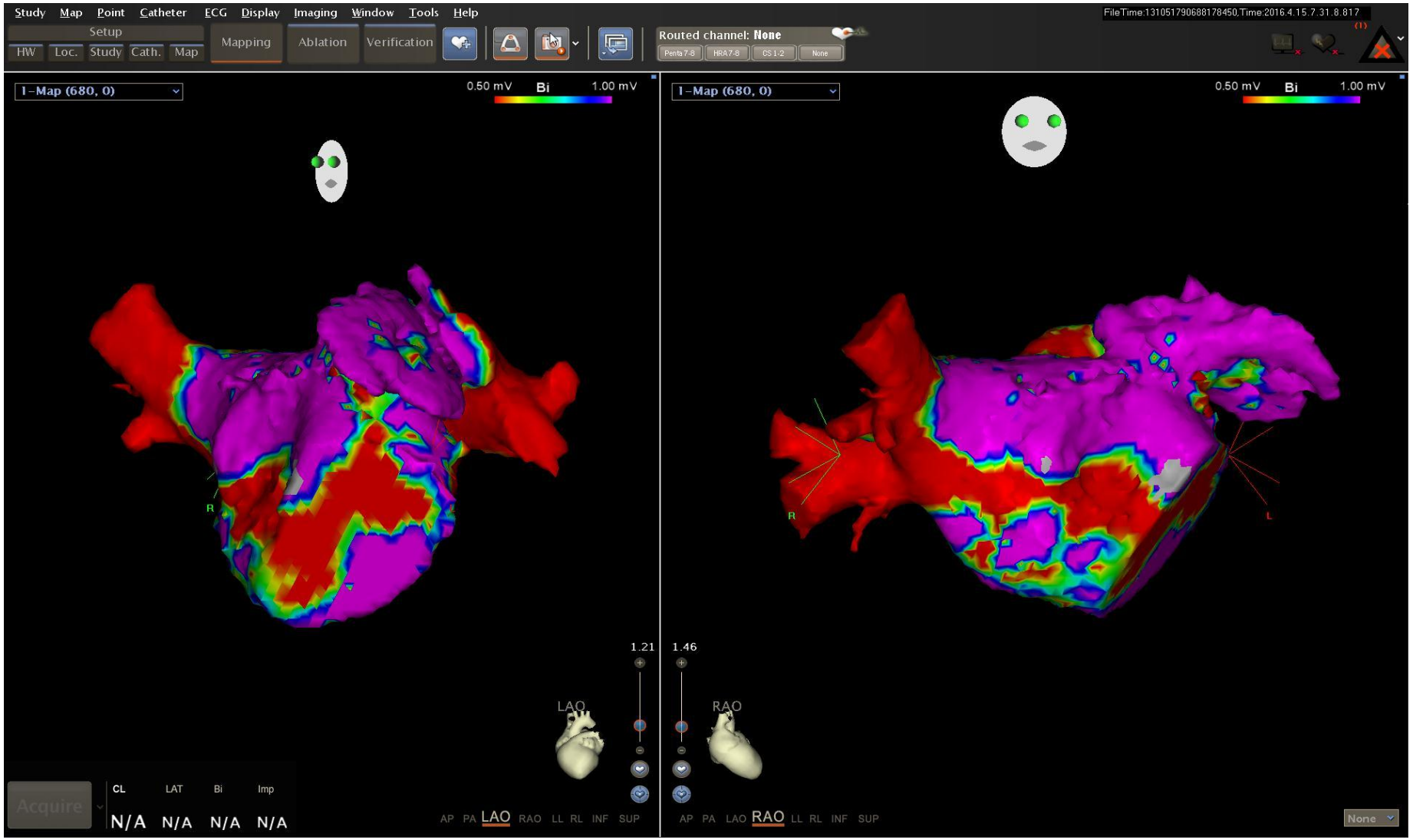

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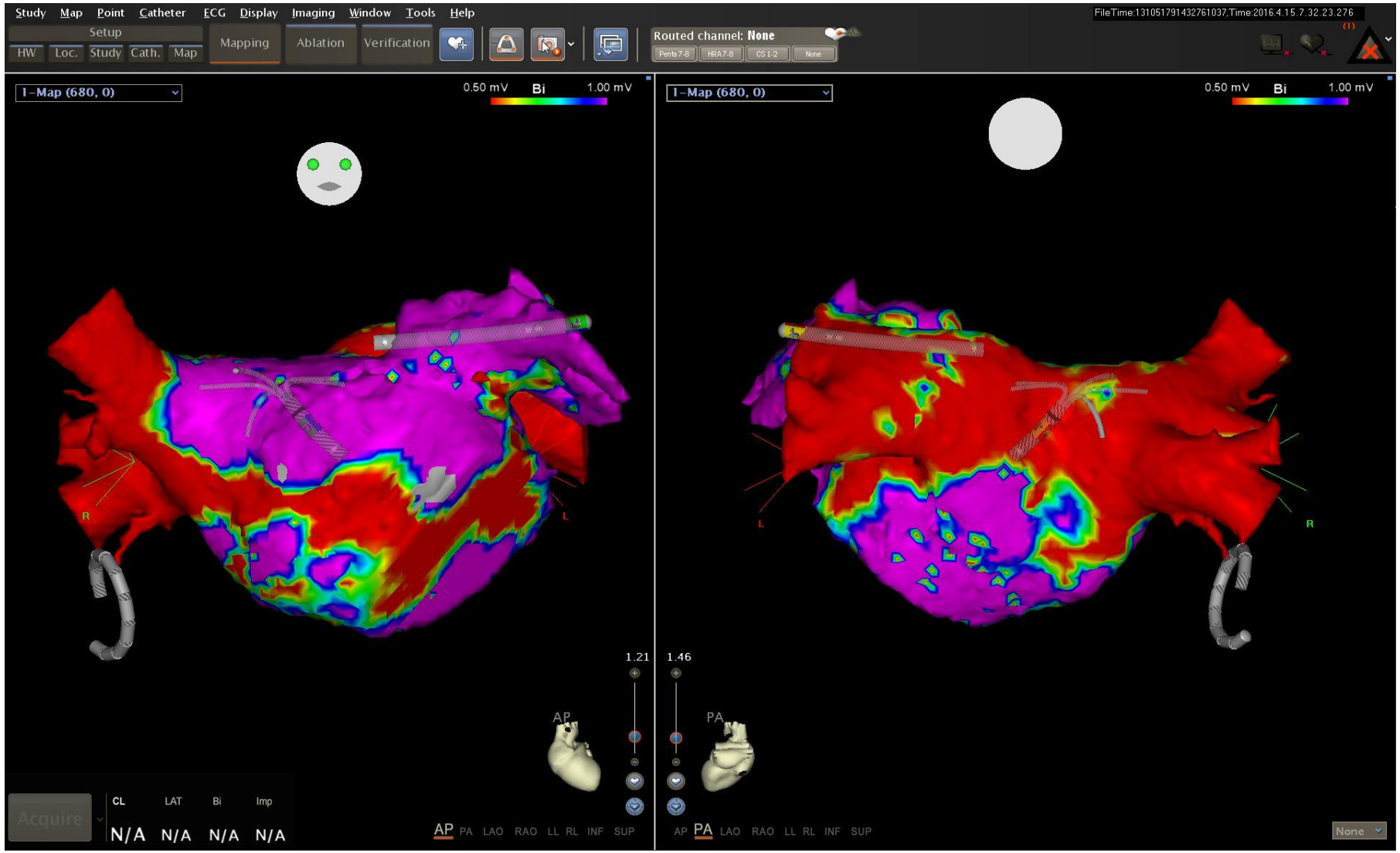

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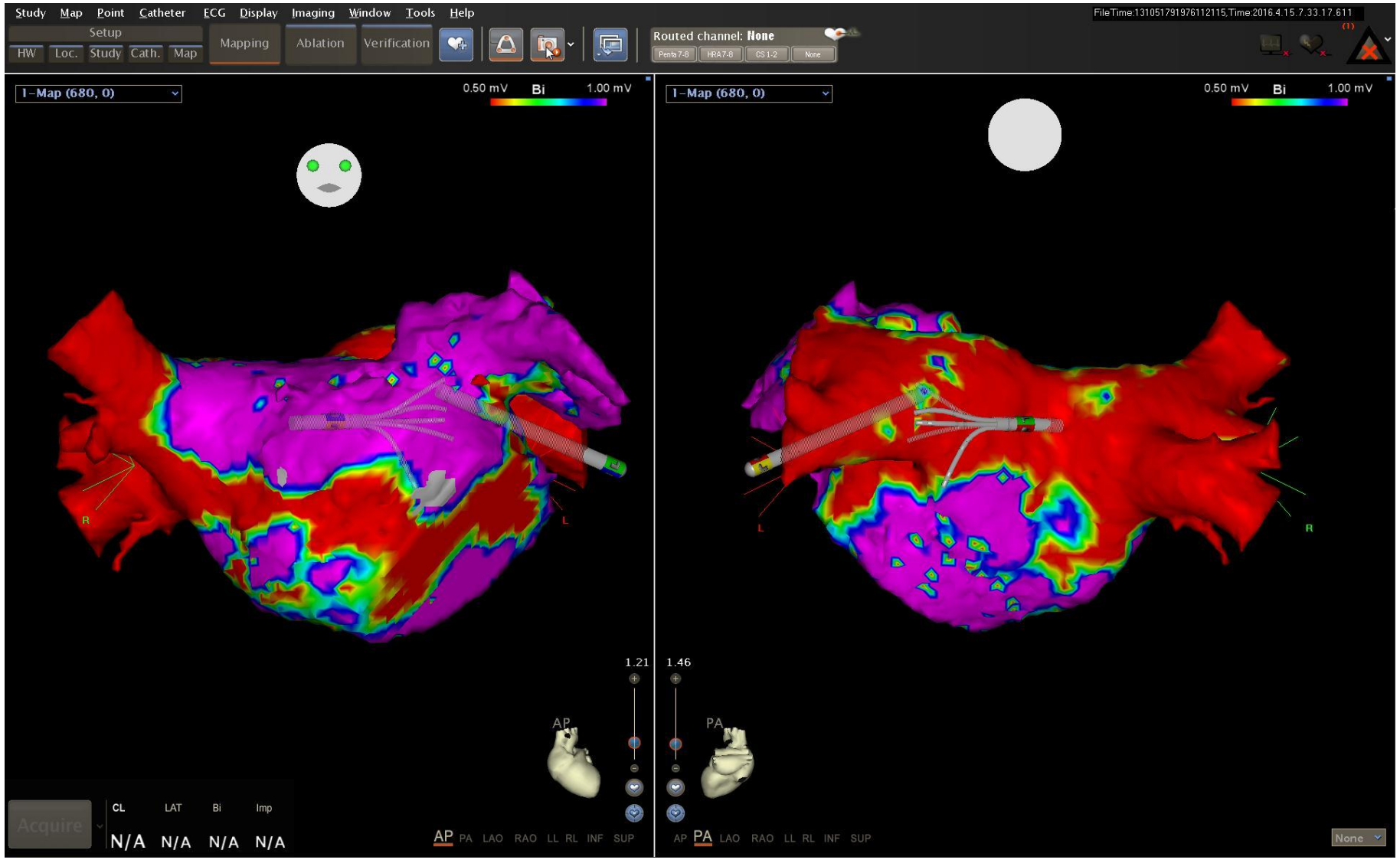

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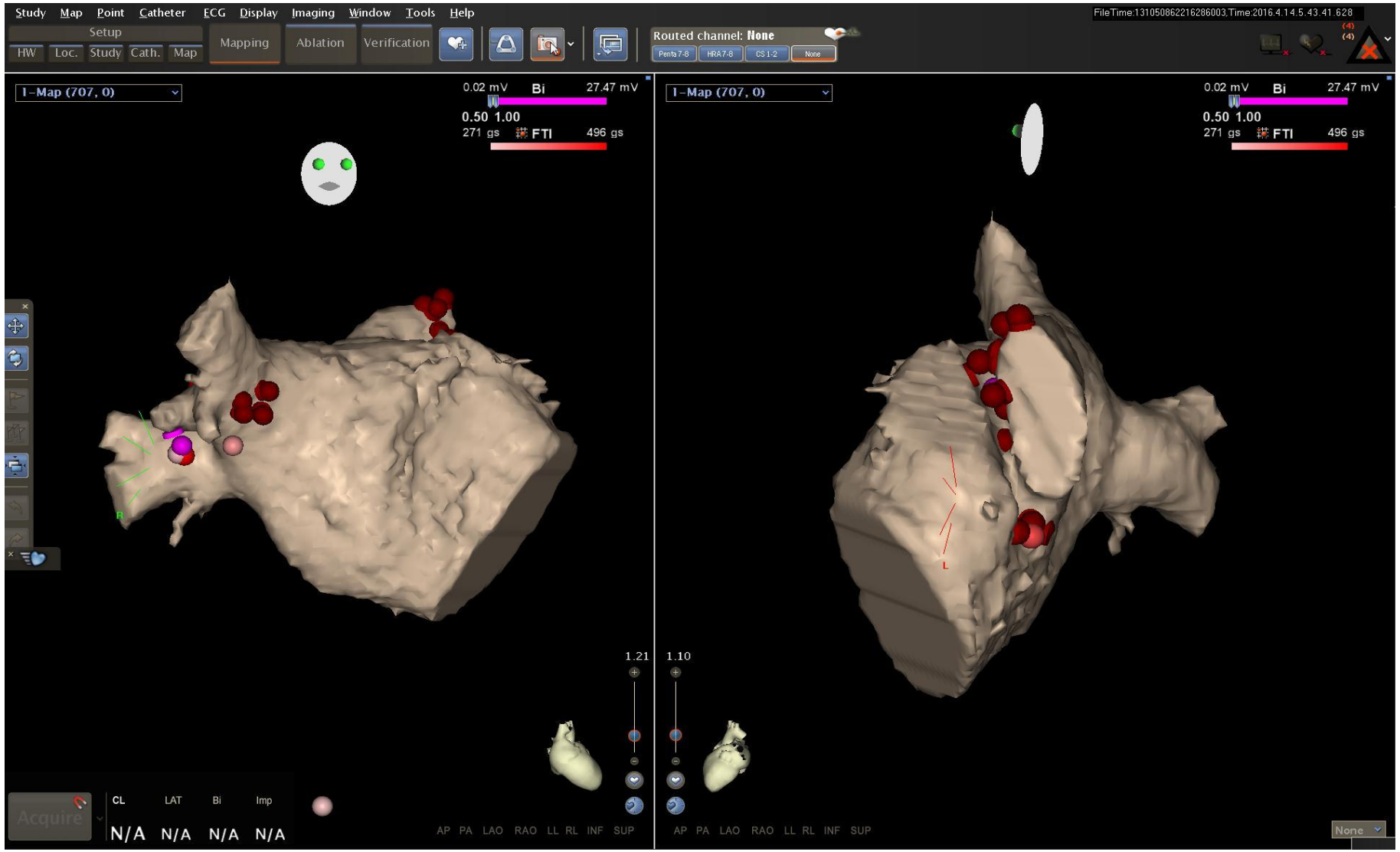
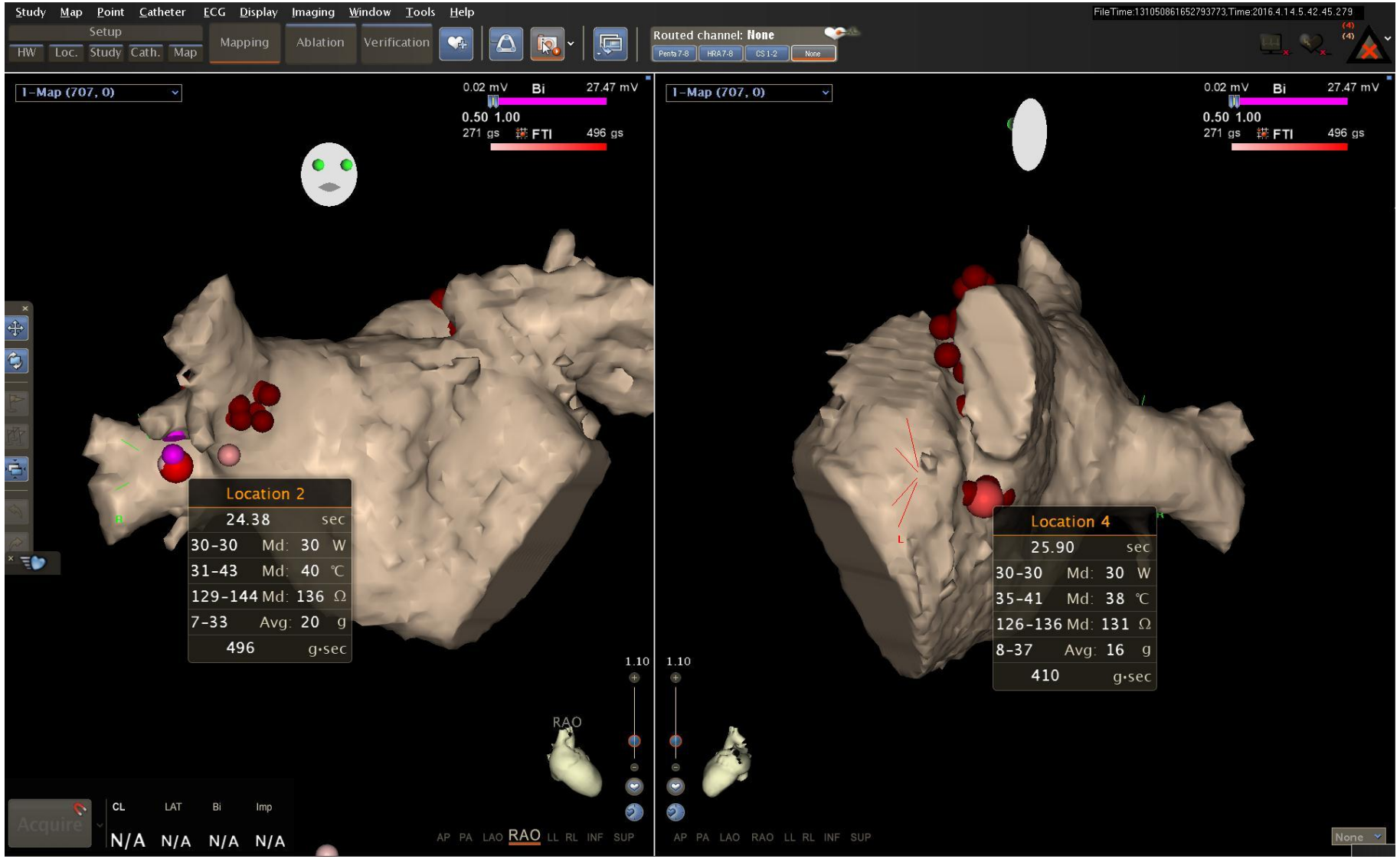
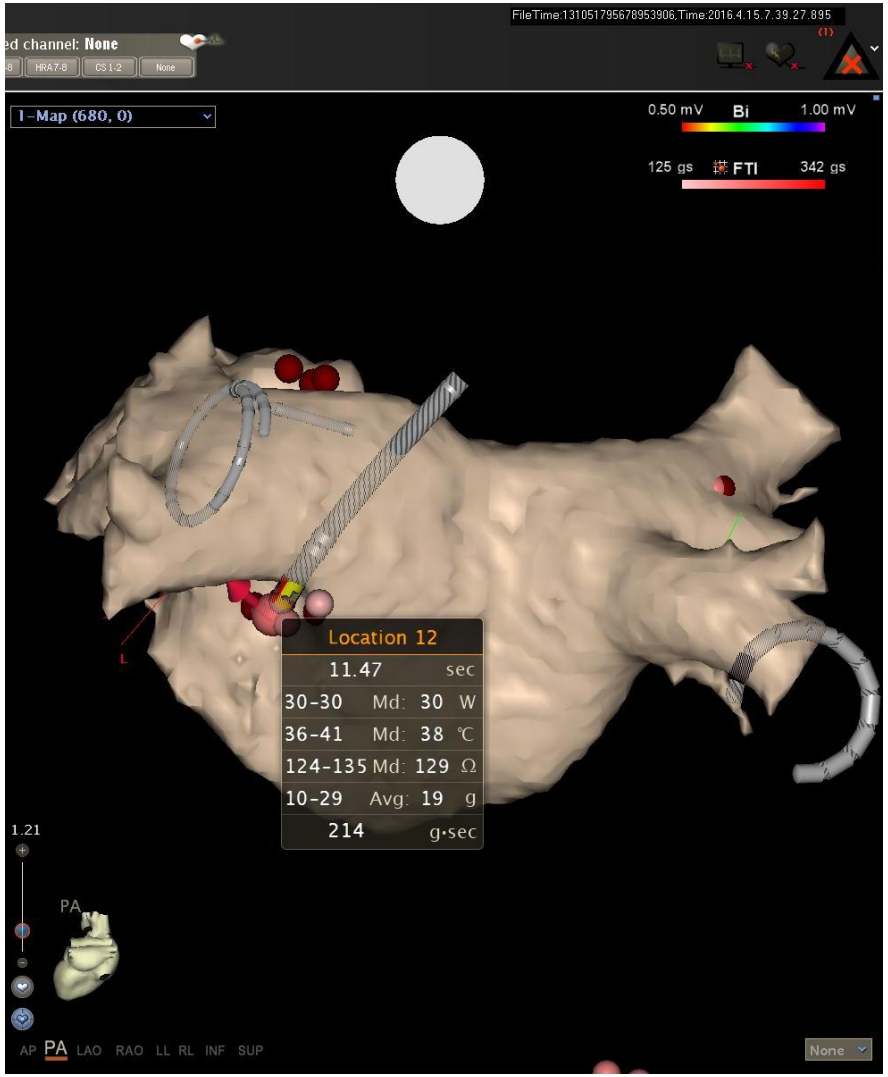
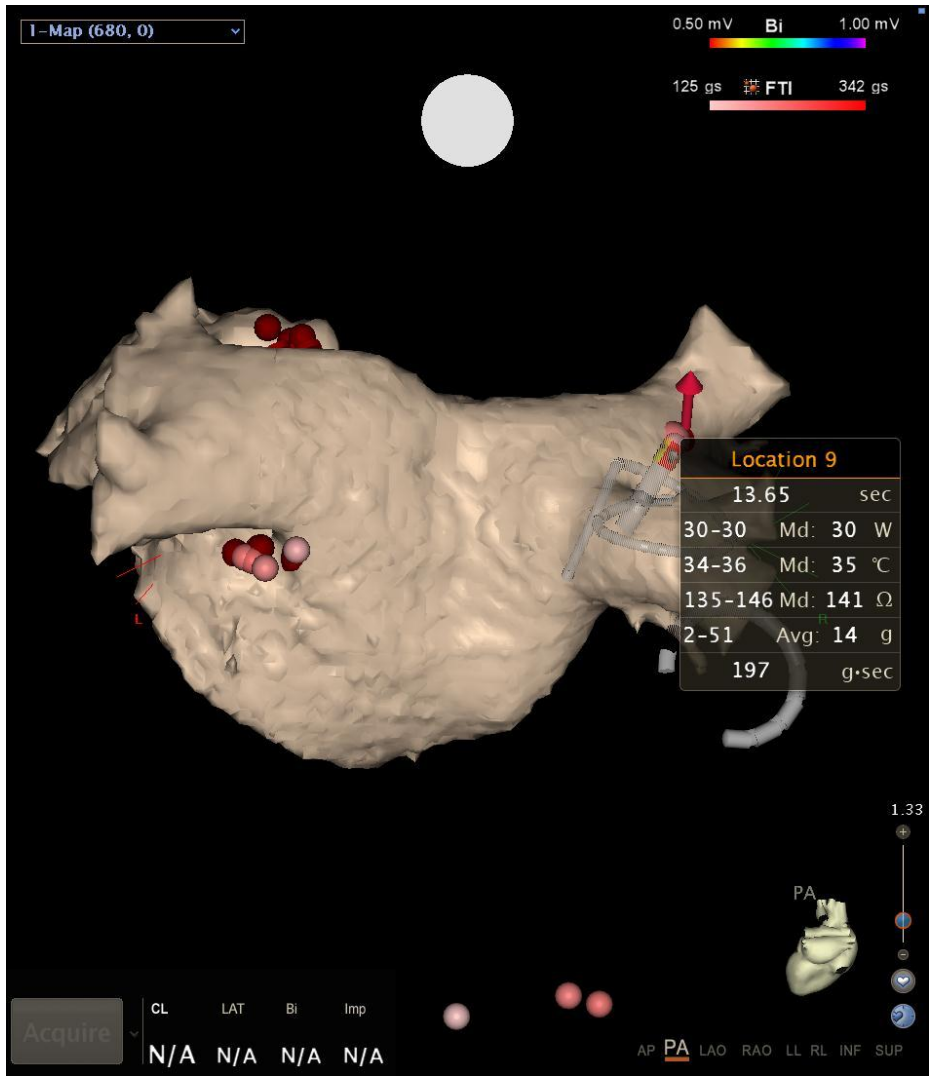


2016.04.14 LA Ablation_VISITAG Points

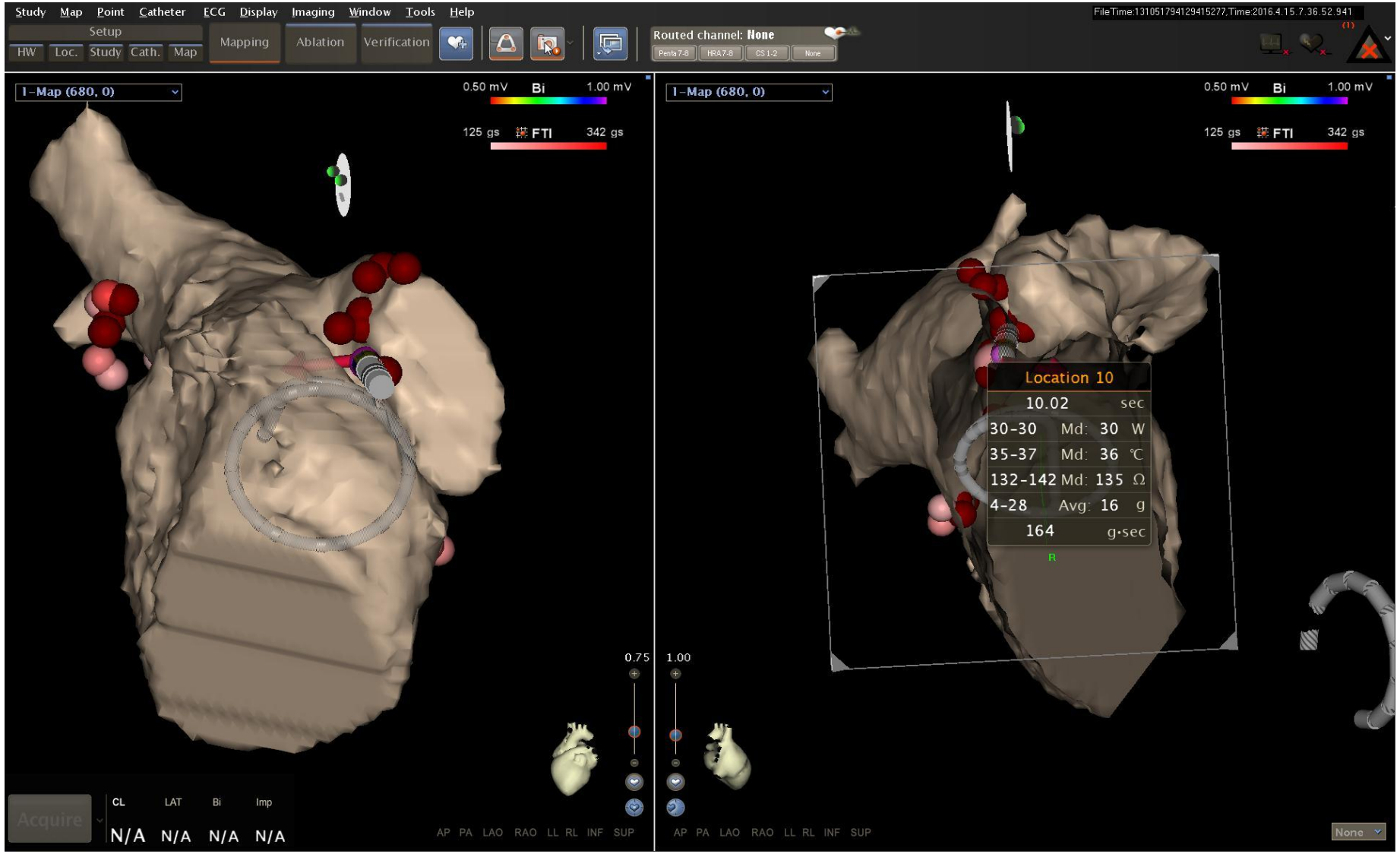


2016.04.14 LA Ablation_VISITAG Points

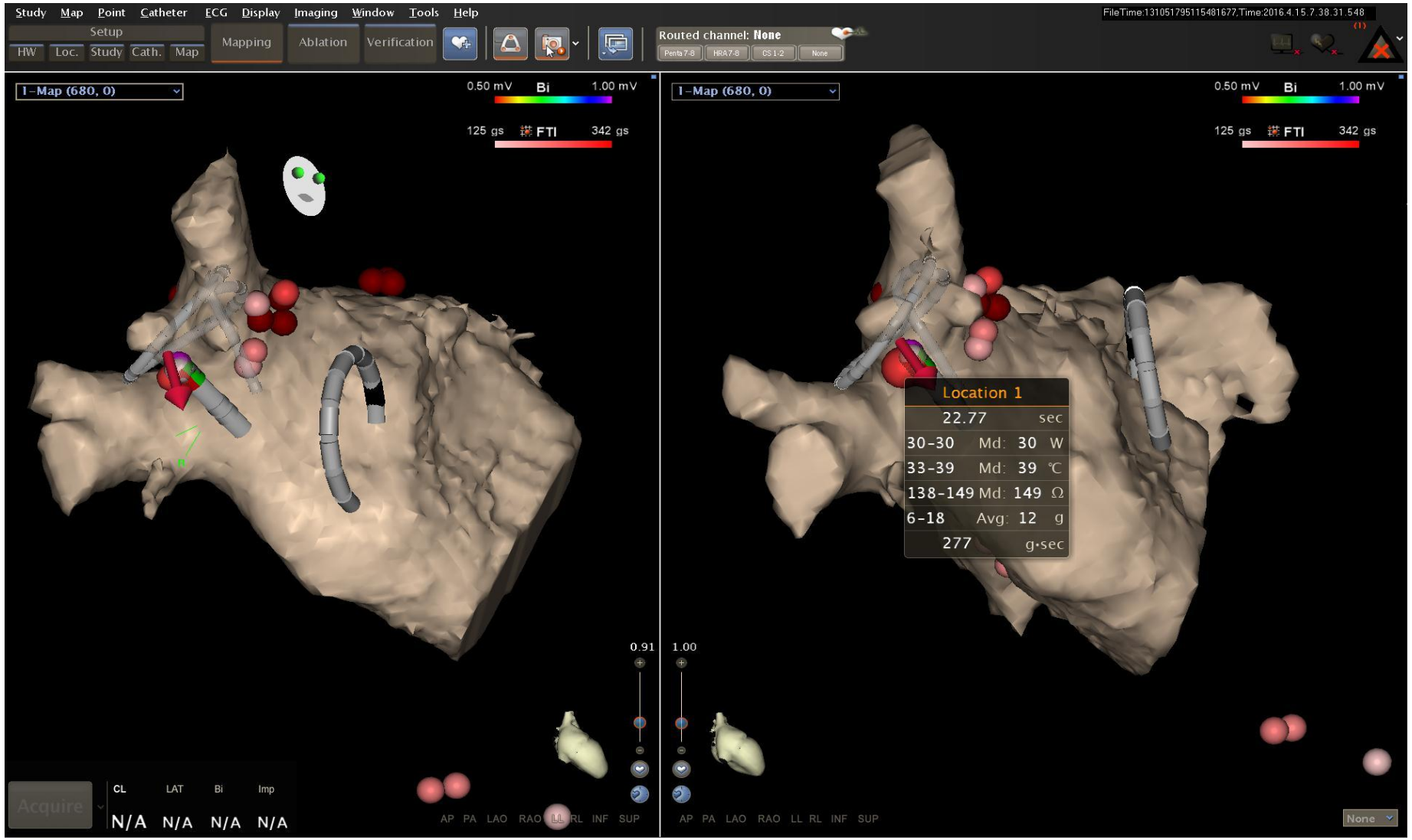




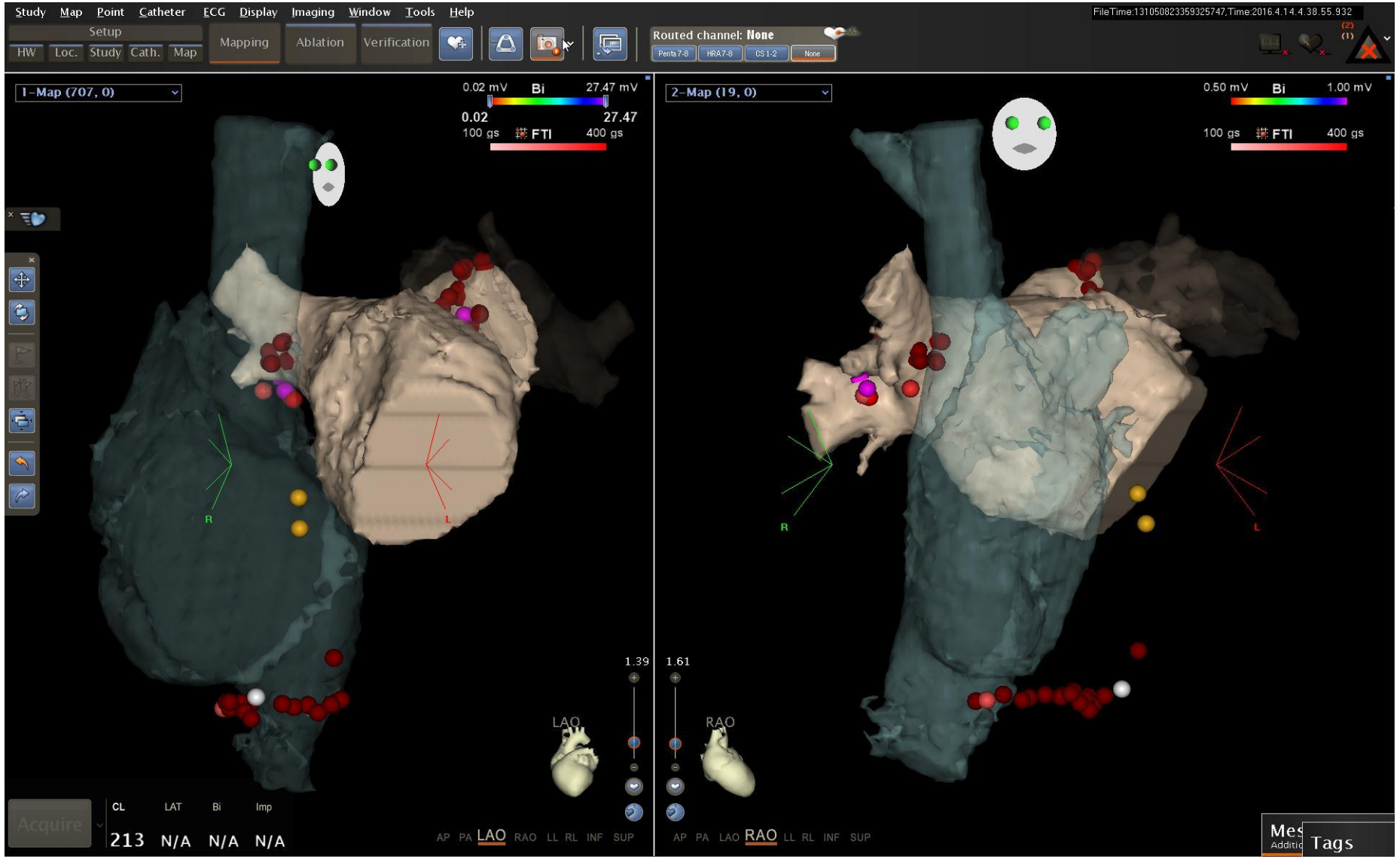
2016.04.14 PV potential elimination site and VISITAG Points near the termination site



2016.04.14 Residual PV potential elimination site and VISITAG Points near the termination site



2016.04.14 RA LA Ablation



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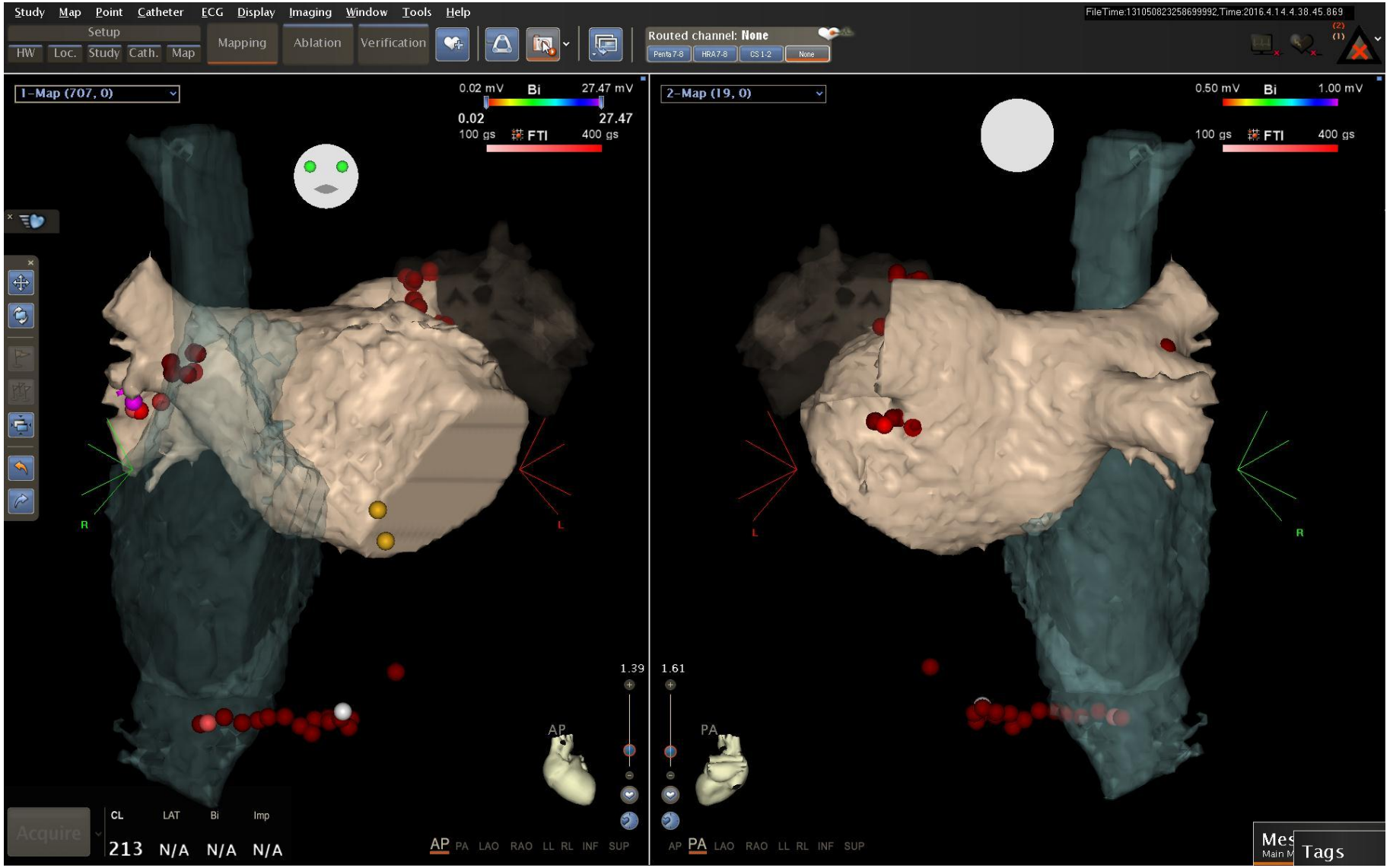

감사합니다.

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Volume 324 MARCH 21, 1991 Number 12

MORTALITY AND MORBIDITY IN PATIENTS RECEIVING ENCAINIDE, FLECAINIDE, OR PLACEBO

The Cardiac Arrhythmia Suppression Trial

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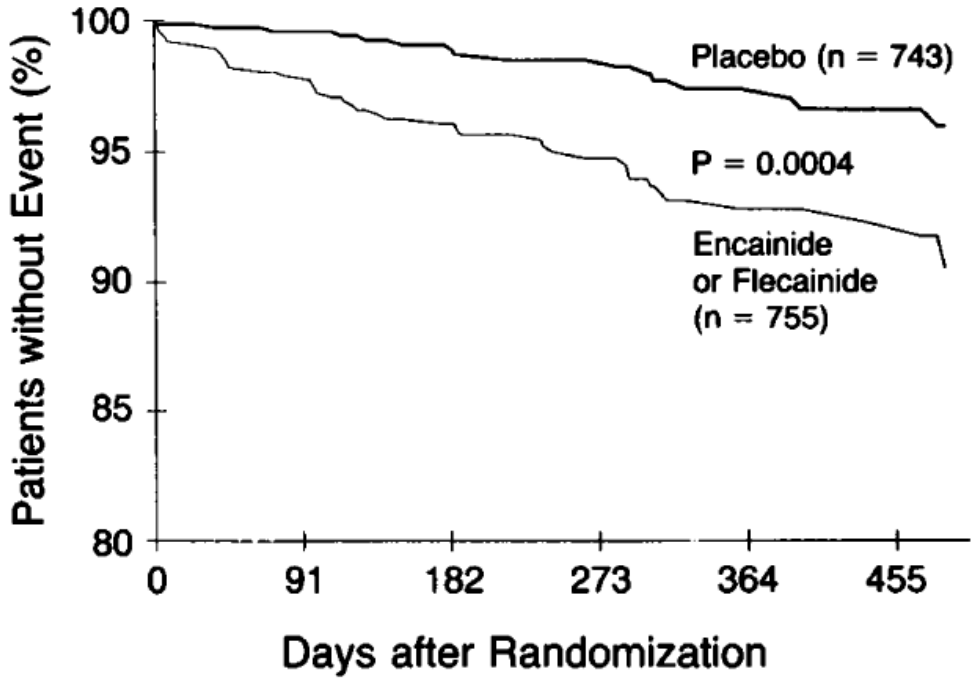
Abstract *Background and Methods.* In the Cardiac Arrhythmia Suppression Trial, designed to test the hypothesis that suppression of ventricular ectopy after a myocardial infarction reduces the incidence of sudden death, patients in whom ventricular ectopy could be suppressed with encainide, flecainide, or moricizine were randomly assigned to receive either active drug or placebo. The use of encainide and flecainide was discontinued because of excess mortality. We examined the mortality and morbidity after randomization to encainide or flecainide or their respective placebo.

Results. Of 1498 patients, 857 were assigned to receive encainide or its placebo (432 to active drug and 425 to placebo) and 641 were assigned to receive flecainide or its placebo (323 to active drug and 318 to placebo). After a mean follow-up of 10 months, 89 patients had died: 59 of arrhythmia (43 receiving drug vs. 16 receiving placebo; $P = 0.0004$), 22 of nonarrhythmic cardiac causes (17 receiving drug vs. 5 receiving placebo; $P = 0.01$), and 8 of noncardiac causes (3 receiving drug vs. 5 receiving placebo). Almost all cardiac deaths not due to arrhythmia were attributed to acute myocardial infarction with shock (11 patients receiving drug and 3 receiving placebo) or to chronic congestive heart failure (4 receiving drug and 2 receiving placebo). There were no differences between the patients receiving active drug and those receiving placebo in the incidence of nonlethal disqualifying ventricular tachycardia, proarrhythmia, syncope, need for a permanent pacemaker, congestive heart failure, recurrent myocardial infarction, angina, or need for coronary-artery bypass grafting or angioplasty.

Conclusions. There was an excess of deaths due to arrhythmia and deaths due to shock after acute recurrent myocardial infarction in patients treated with encainide or flecainide. Nonlethal events, however, were equally distributed between the active-drug and placebo groups. The mechanisms underlying the excess mortality during treatment with encainide or flecainide remain unknown. (N Engl J Med 1991; 324:781-8.)



Placebo	743	632	516	412	292	201
Active drug	755	631	507	392	286	198

Figure 1. Actuarial Probabilities of Freedom from Death or Cardiac Arrest Due to Arrhythmia in 1498 Patients Receiving Encainide or Flecainide or Corresponding Placebo.

The number of patients at risk of an event is shown along the bottom of the figure.