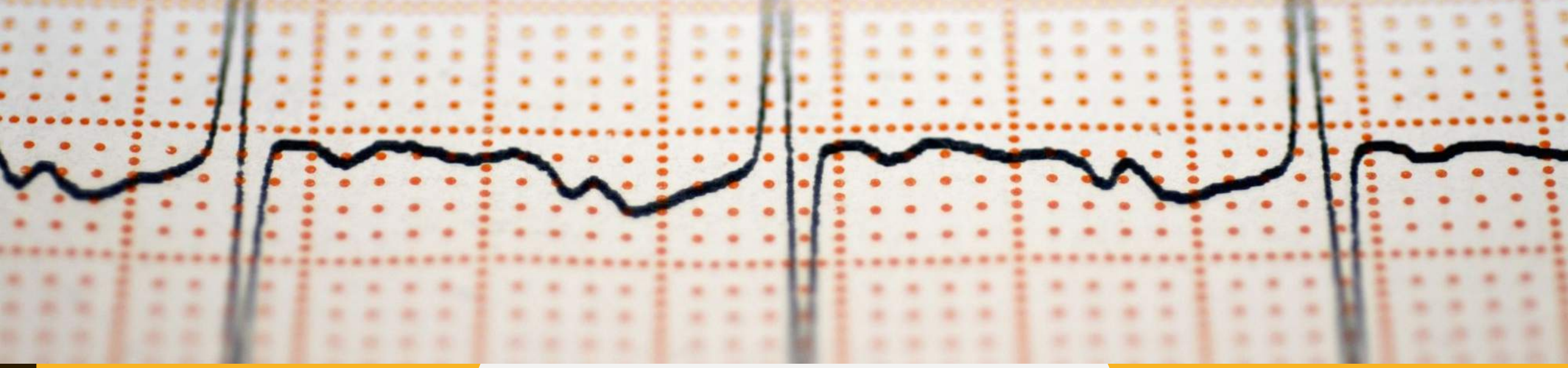


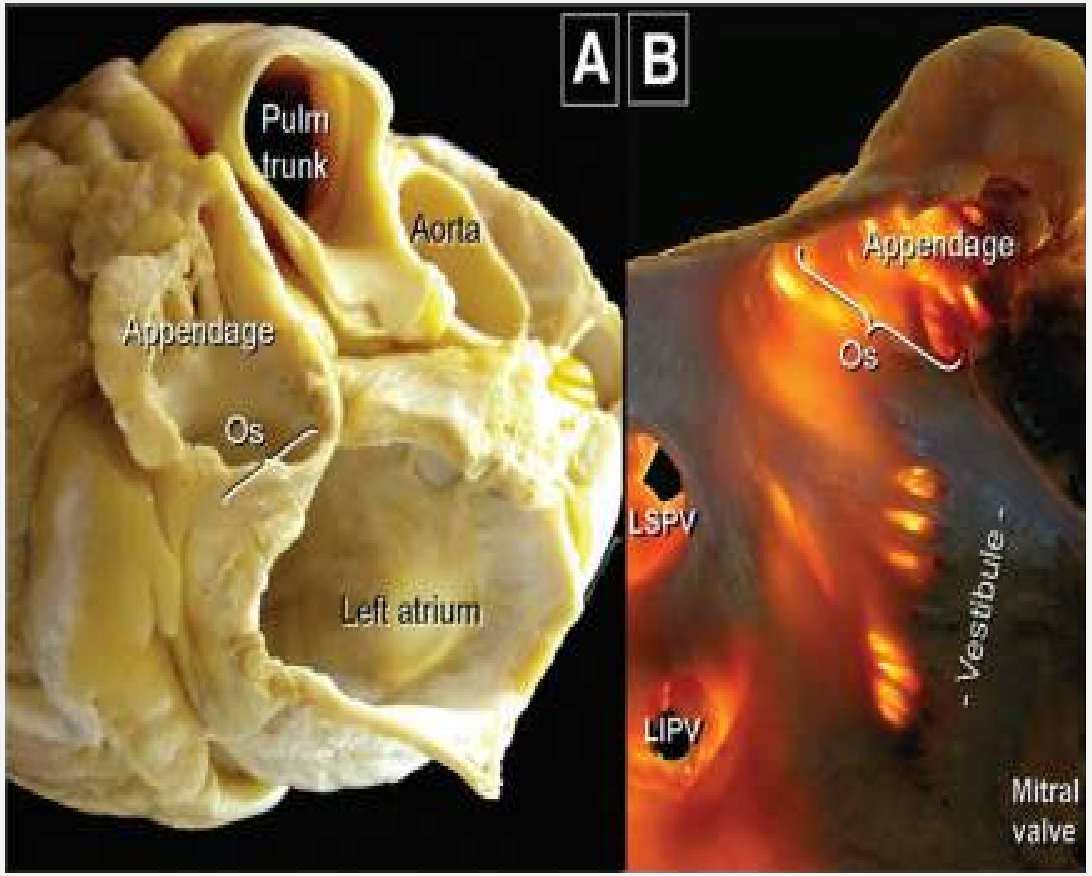
DIAGNOSI DI ARITMIA ATRIALE SINISTRA: MAPPAGGIO ED ABLAZIONE

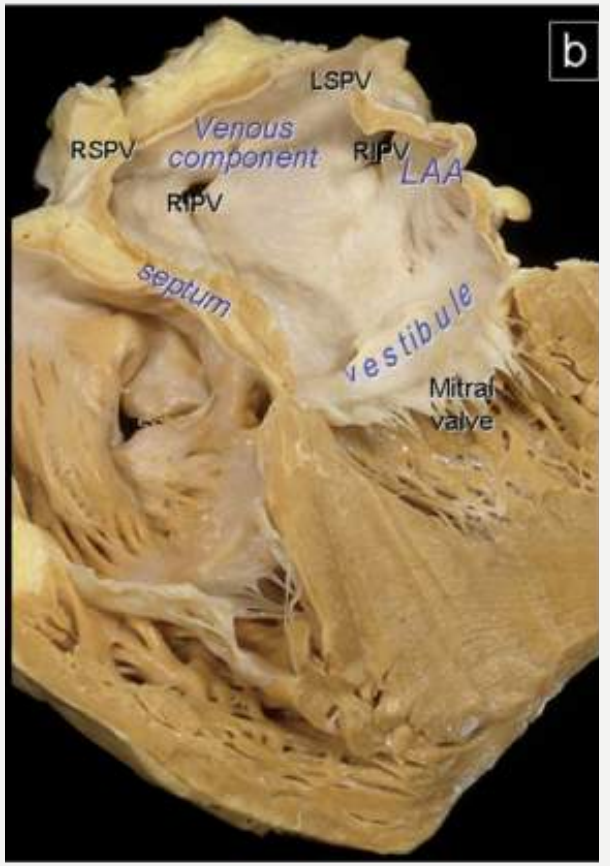
DOTT.SSA LUCCIOLA MARIA TERESA

ASL «CITTÀ DI TORINO» - OSPEDALE MARIA VITTORIA-MARTINI

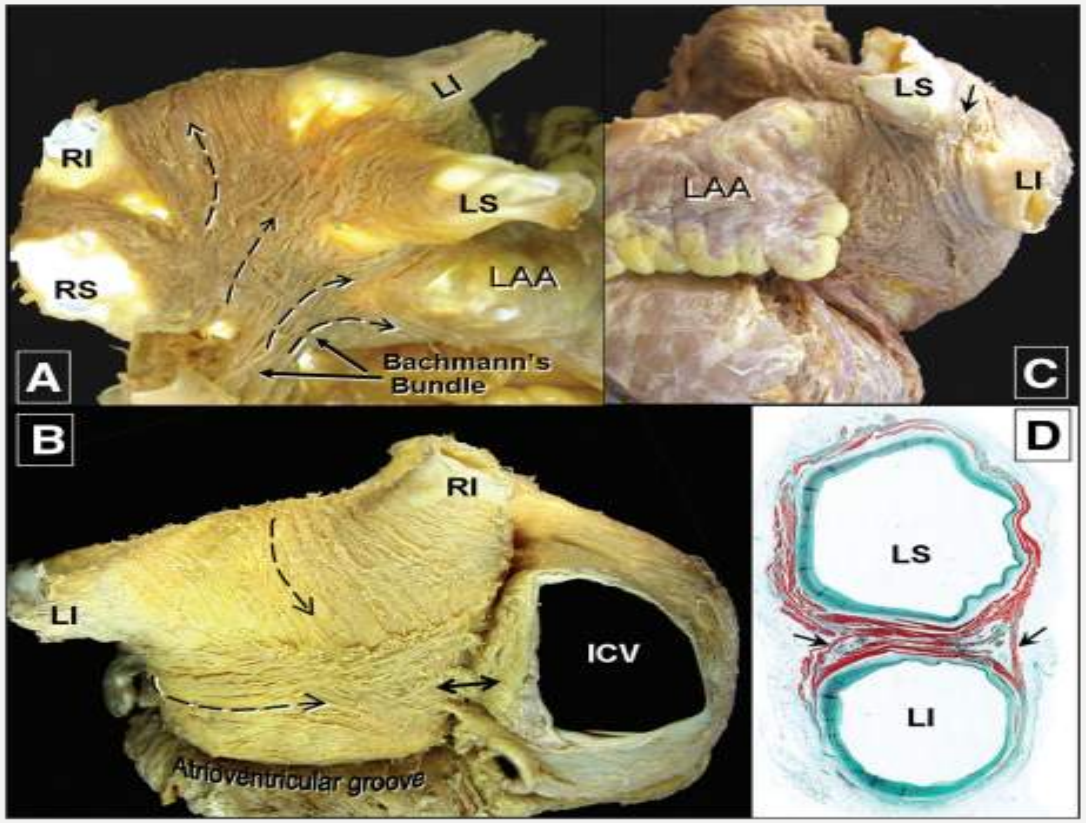
Conclusions

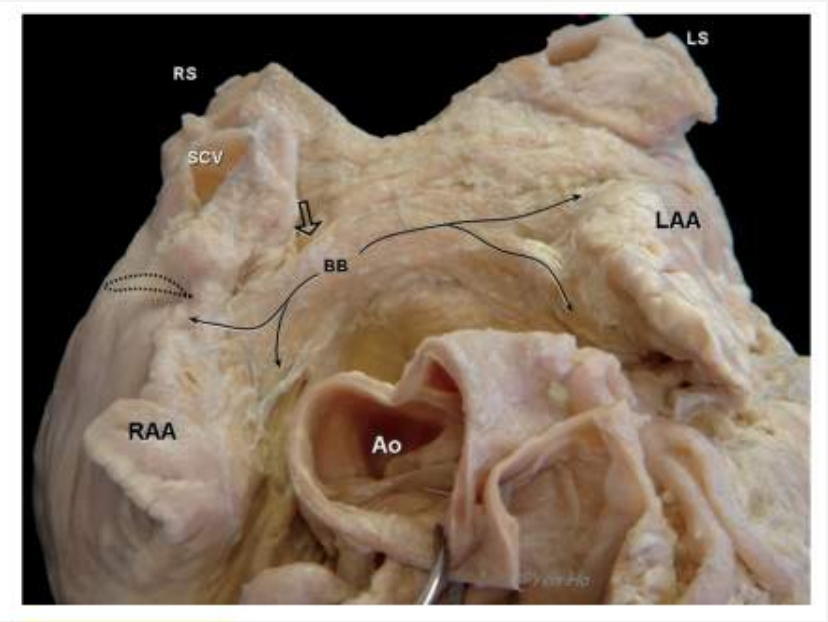
When carrying out electrophysiologic mapping and interventional procedures in and around the left atrium, knowledge of the anatomical structures in the vicinity of the target sites is important both for safety and efficacy. Characterized by smoother walls than the right atrium, the muscular walls of the left atrium nevertheless have variable thickness and composition that need to be taken into account during interventional procedures. The left atrium should not be viewed in isolation. Interatrial myocardial continuity exists not only at the septum and Bachmann's bundle. Bridges and strands at the muscular sleeves of the coronary sinus and pulmonary veins can make further interatrial connections. Spatial relationships of the left atrium to important extracardiac structures are highlighted in this anatomical review providing the foundation stone for building on knowledge for intervening in the living.



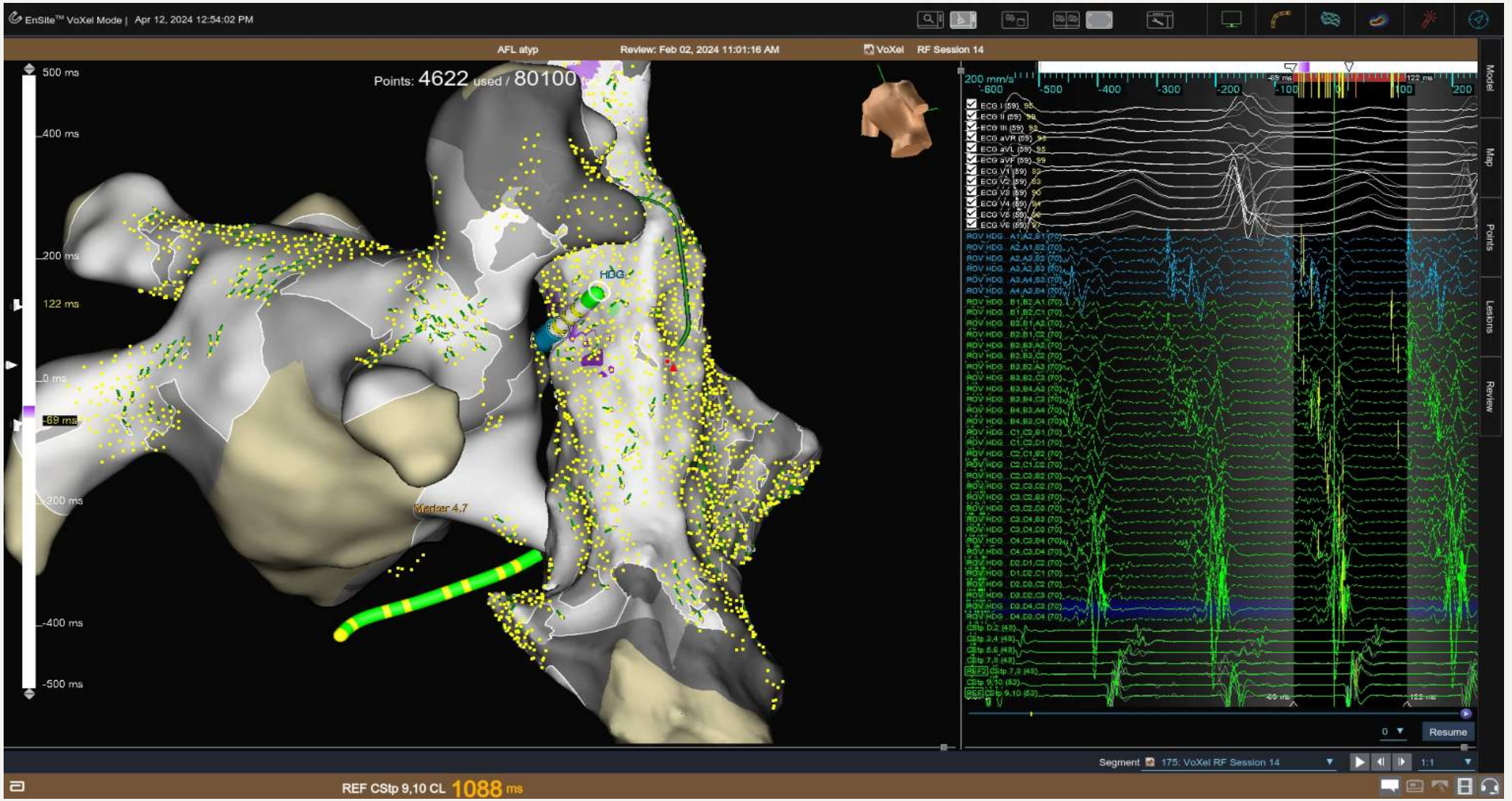


Il corpo atriale consta di una componente venosa (le vene polmonari), di un vestibolo attorno all'orifizio mitralico, di un'appendice e condivide il setto con l'atrio destro





La connessione muscolare interatriale più importante è il II fascio di Bachmann. Si estende dalla destra dell'orifizio SVC, attraversa il solco interatriale, scorre lungo la parete anteriore del LA fino alla LAA dove si divide in due rami che la circondano. La parte superiore prosegue lungo la cresta laterale sinistra e la parte inferiore verso vestibolo atriale per poi fondersi nella muscolatura atriale laterale e inferoposteriore.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122 ms
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HDG
Marker 4.7
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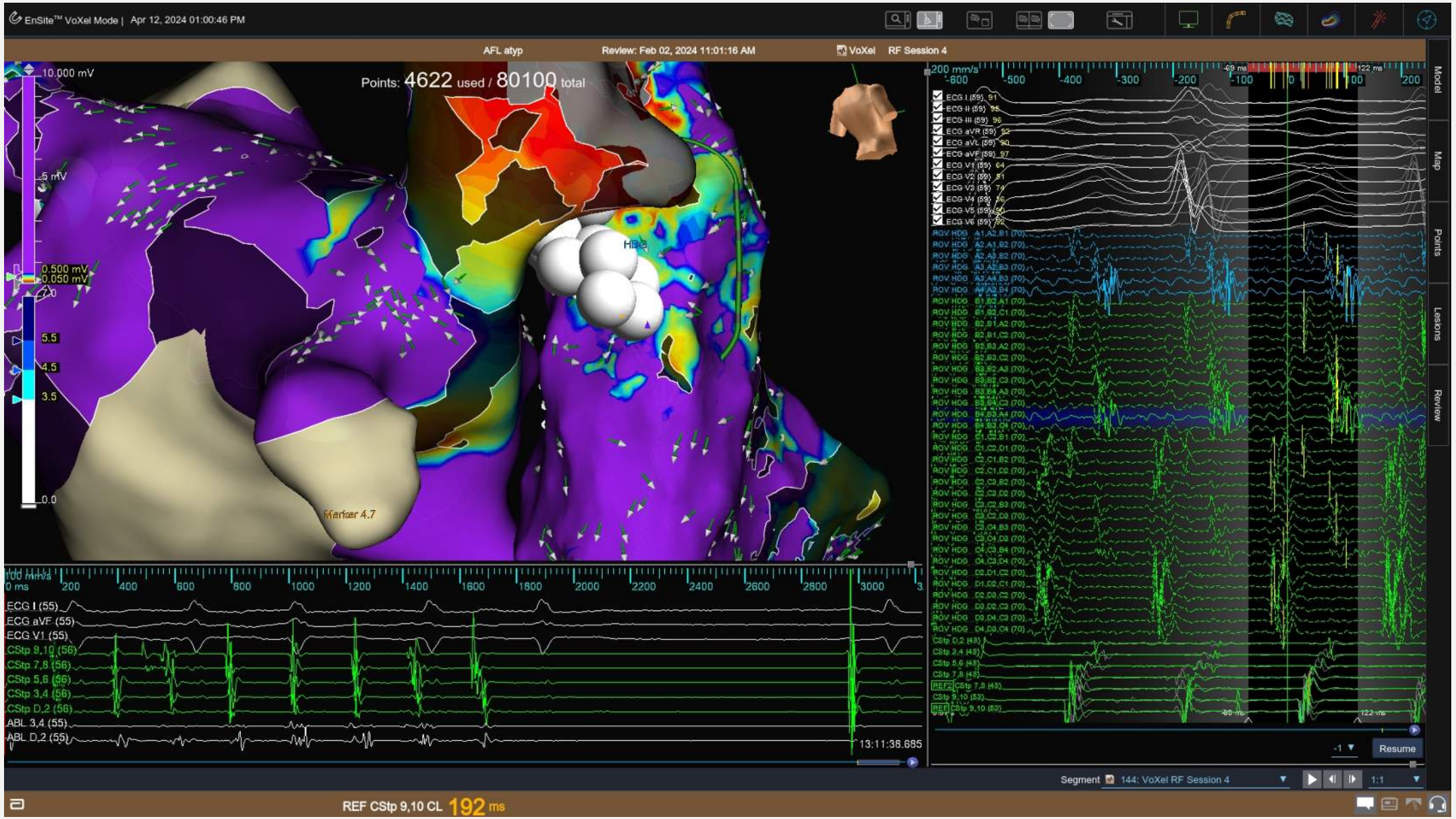
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4.5
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Marker 4.7
HDG
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ECG I (55)
ECG aVF (55)
ECG V1 (55)
CStp 9,10 (56)
CStp 7,8 (56)
CStp 5,6 (56)
CStp 3,4 (56)
CStp D,2 (56)
ABL 3,4 (55)
ABL D,2 (55)
13:11:38.685
Model
Map
Points
Lesions
Review
Resume
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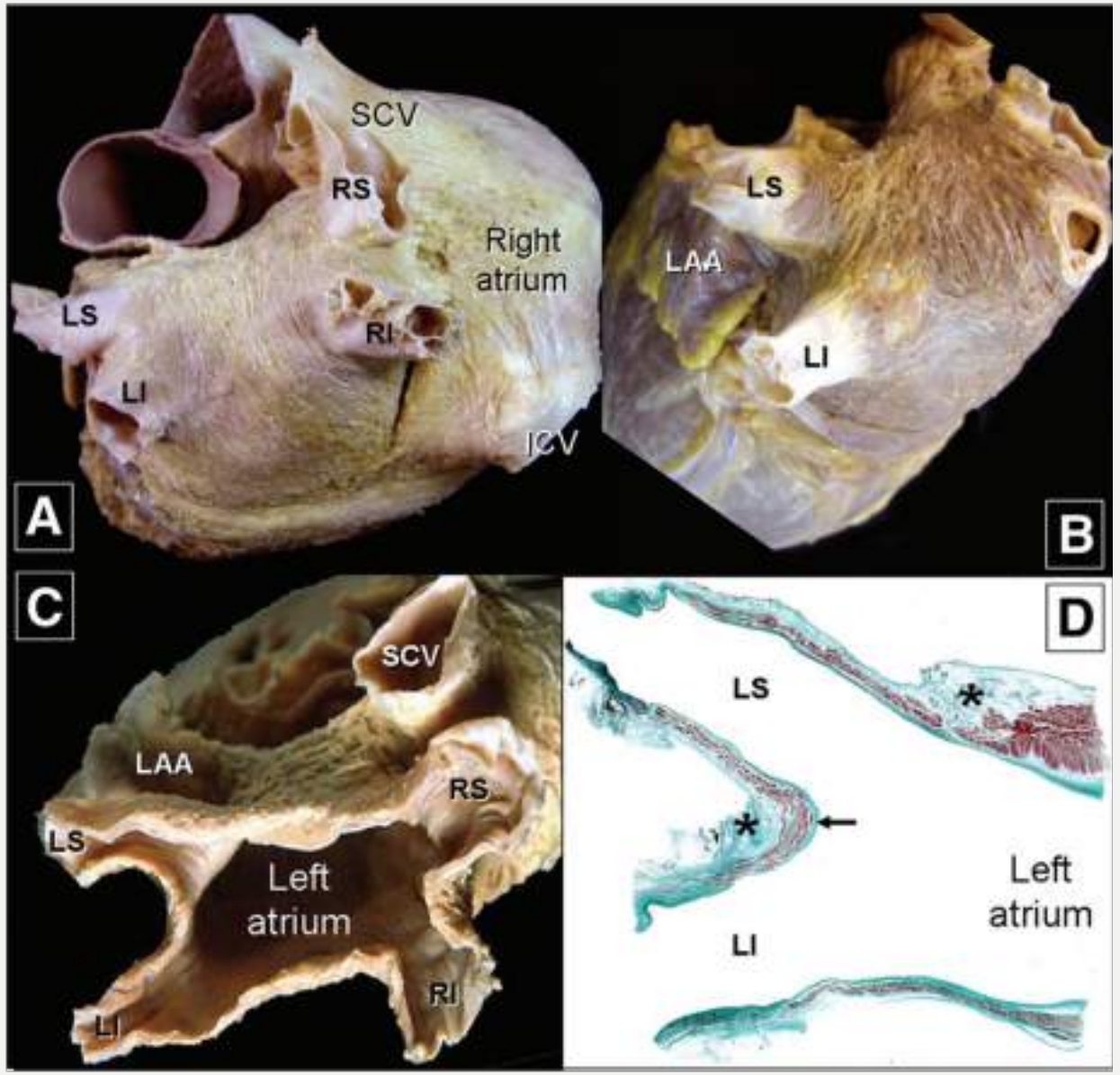
144: VoXel RF Session 4
REF CStp 9,10 CL 192 ms

VENE POLMONARI

1. Le vene polmonari entrano nella parete posteriore dell'atrio sinistro
2. Le vene sinistre sono localizzate più superiormente rispetto alle vene destre, sono situate posteriormente all'auricola, da cui sono separate dal «ridge»
3. La vena polmonare superiore destra passa dietro il giunzione tra l'atrio destro e la vena cava superiore, mentre la vena polmonare inferiore passa dietro l'area intercavale



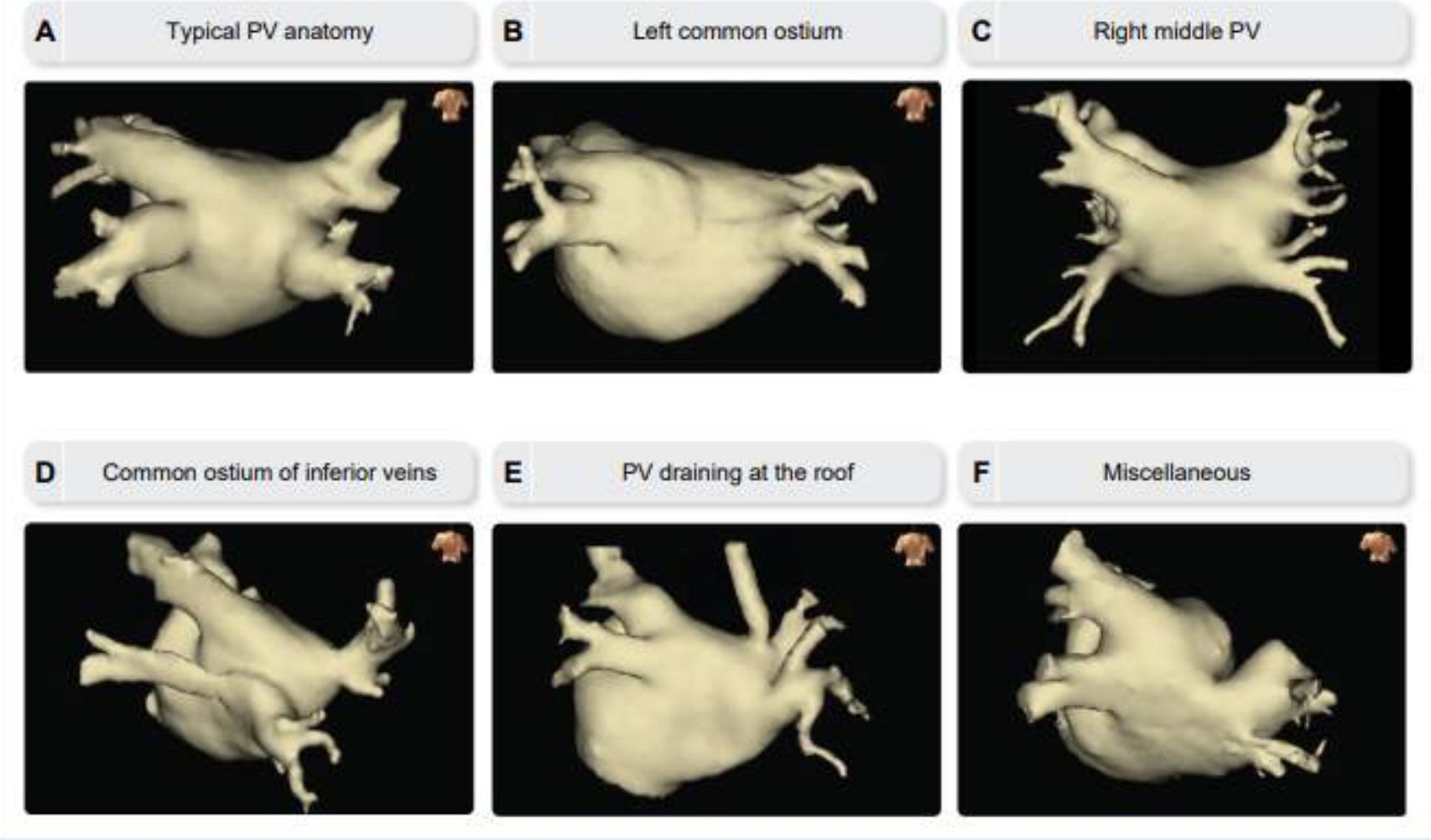


Figure 2 Typical PV anatomy and common variants. PV, pulmonary vein.

«È comune trovare due vene polmonari che entrano da ciascun polmone ma le variazioni si verificano non di rado».

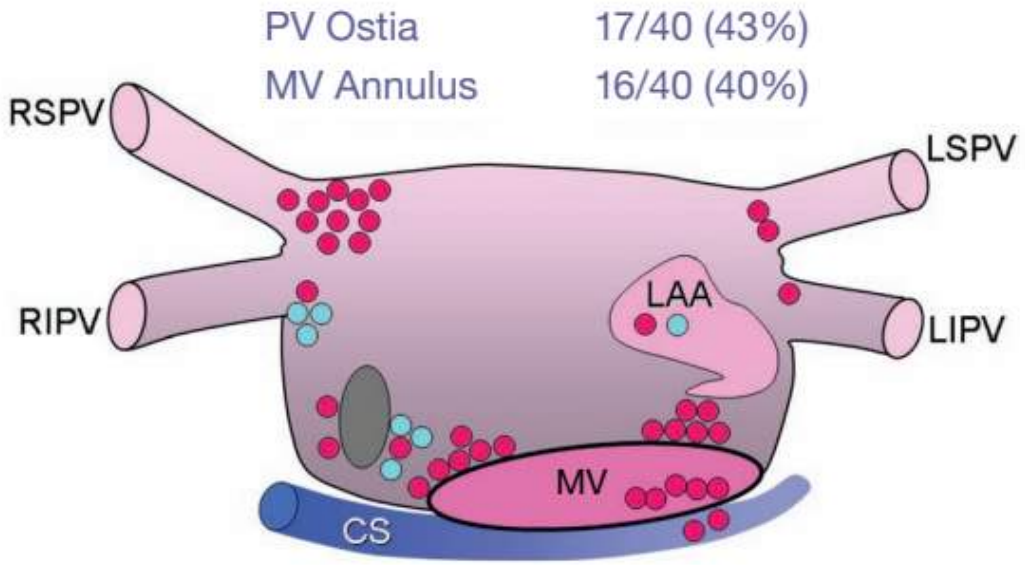


FIGURE 6.27

Preferential sites for origins of focal atrial tachycardia in the left atrium along the mitral valve (**MV**) annulus, the ostia of the pulmonary veins (**PV**), the fossa ovalis, and the appendage. **CS** = coronary sinus; **LAA** = left atrial appendage; **LIPV, LSPV, RIPV,** and **RSPV** = left inferior, left superior, right inferior, and right superior pulmonary vein, respectively.

SEDI DI TAF IN ATRIO SINISTRO

I foci ectopici delle vene svolgono un ruolo nella pategenesi della FA

Non è chiara la differenza tra questi foci e le ectopie responsabili delle TA

I foci delle TA sono più ostiali, con cicli più lunghi e sono generalmente singoli, a differenza delle ectopie responsabili delle FA che sono multipli con elevate frequenza di scarica e situati più all'interno delle vene.

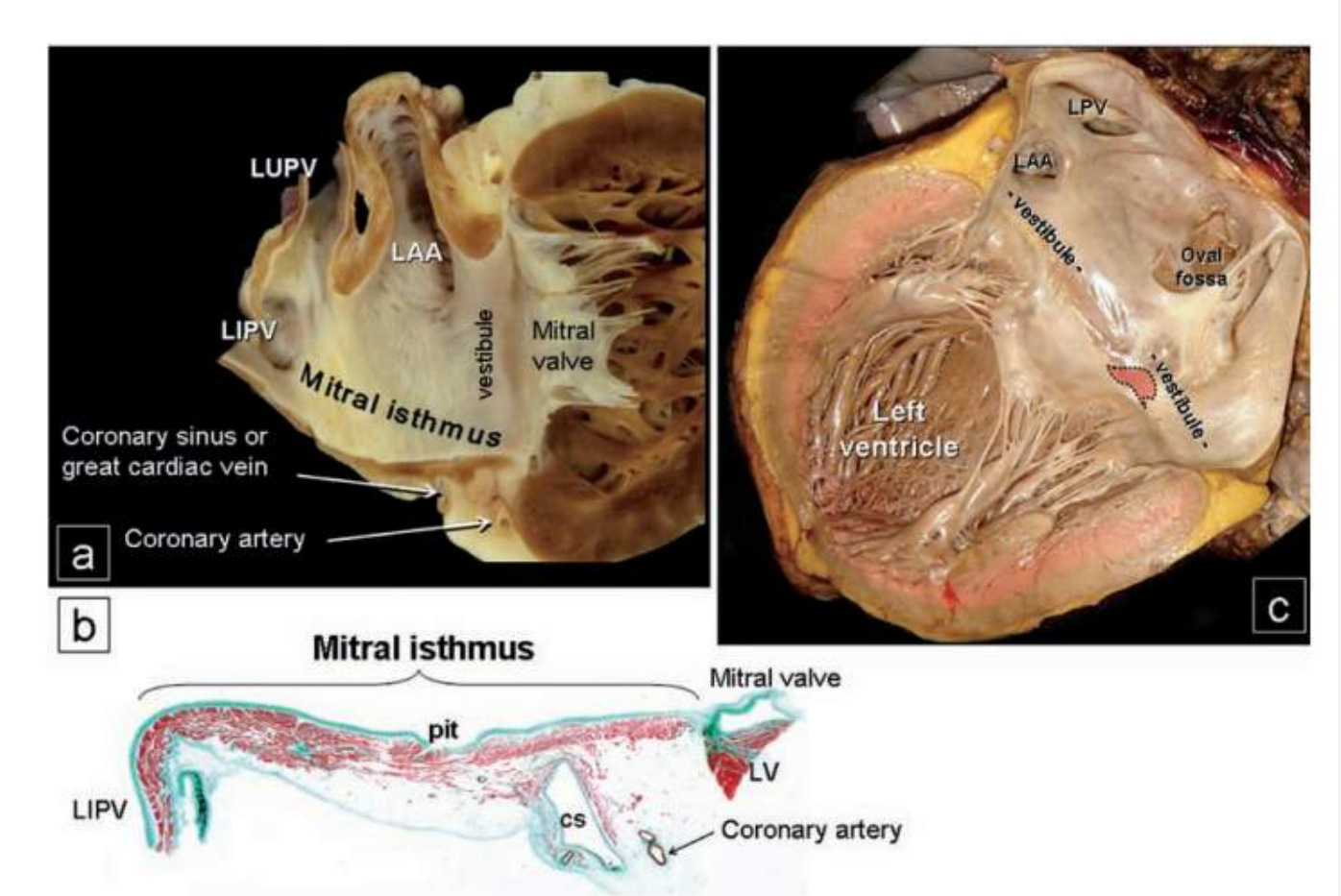
CLASSIFICAZIONE

POPOLAZIONE

- Assenza o presenza di cardiopatie organiche
- Età infantile o adulta

CIRCUITI

- Anomalo automatismo (infusione di isoproterenolo) - Beta bloccanti
- Attività triggerata (stimolazione programmata riproducibile) - adenosina e Verapamil
- Micro-rientro (stimolazione programmata, entrainment) - adenosina e verapamil



Diversi istmi anatomici possono essere individuati tra questi ostacoli nativi, che hanno il potenziale di sostenere il rientro.

Il vestibolo è costituito principalmente dall'istmo mitralico situato tra l'orifizio del LIPV e la valvola mitrale.
Non ci sono punti di riferimento endocardici per separare il vestibolo dalla componente venosa polmonare, anche se spesso sono presenti piccole fessure nella parete inferiore.

CASO CLINICO

B.C. Uomo di 69 anni

Anamnesi patologica remota

- Fap dal 2021 sottoposta a CVE e terapia B-bloccante e Nao
- Coro Tc di norma
- Recidive sintomatiche di Fap, avviati IC nel 2022
- 6/2023 Ablazione Tc con isolamento di vene

Anamnesi patologica prossima

- 1/2024 Cardiopalmo ritmico con evidenza ECG di verosimile flutter atriale istmo-dipendente; posta indicazione a ricovero per ablazione Tc

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4000
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4400
4600
ECG I (62)
ECG II (62)
ECG III (62)
ECG aVR (62)
ECG aVL (62)
ECG aVF (62)
ECG V1 (62)
ECG V2 (62)
ECG V3 (62)
ECG V4 (62)
ECG V5 (62)
ECG V6 (62)
CS1,9,10 (66)
CS1,7,8 (66)
CS1,5,6 (66)
CS1,3,4 (66)
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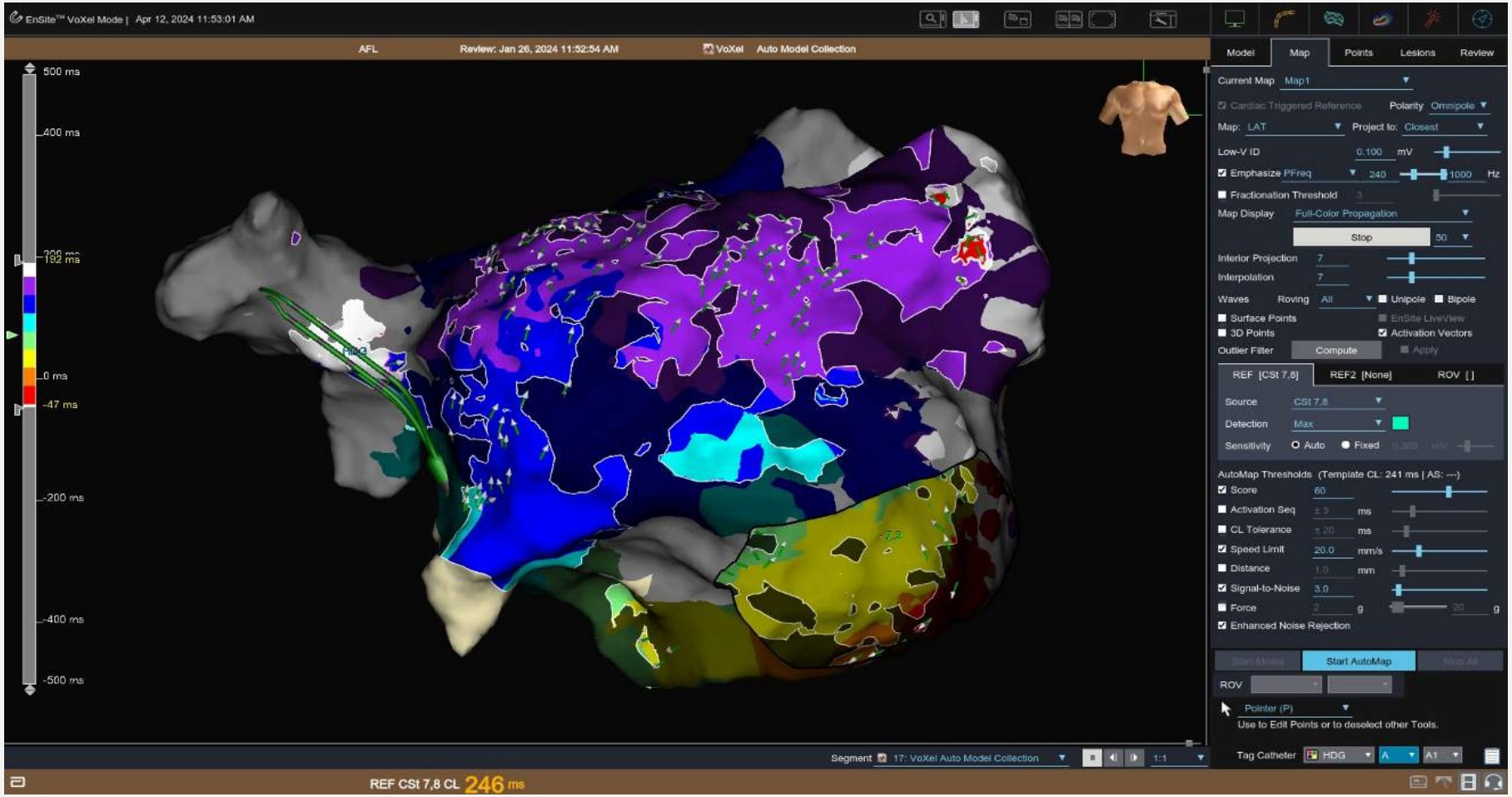
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Model
Map
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Lesions
Review
Current Map Map1
Cardiac Triggered Reference
Polarity Omnipole
Map: LAT
Project to: Closest
Low-V ID 0.100 mV
Emphasize PFreq 240 1000 Hz
Fractionation Threshold
Map Display Full-Color Propagation
Stop
Interior Projection 7
Interpolation 7
Waves Roving All Unipole Bipole
Surface Points
EnSite LiveView
3D Points
Activation Vectors
Outlier Filter Compute Apply
REF [CSt 7,8]
REF2 [None]
ROV [ ]
Source CSt 7,8
Detection Max
Sensitivity Auto Fixed
AutoMap Thresholds (Template CL: 241 ms | AS: ---)
Score 60
Activation Seq ± 5 ms
CL Tolerance ± 20 ms
Speed Limit 20.0 mm/s
Distance 1.0 mm
Signal-to-Noise 3.0
Force 2 g 20 g
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Start AutoMap
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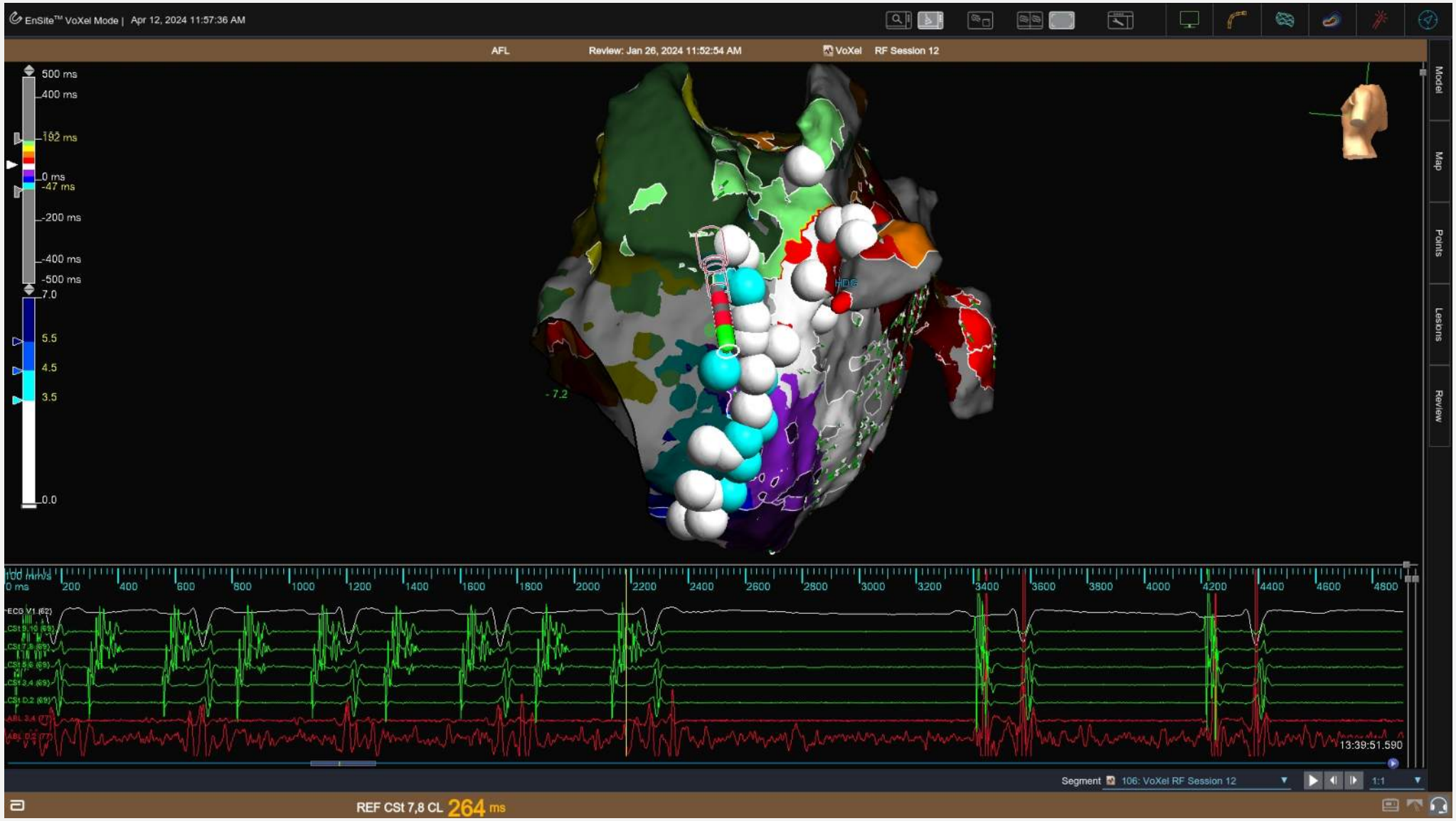
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VoXel
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-400 ms
-500 ms
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5.5
4.5
3.5
0.0
-7.2
Model
Map
Points
Lessons
Review
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Segment
106: VoXel RF Session 12
1:1
REF CSt 7,8 CL 264 ms

ISTMO POSTERIORE:

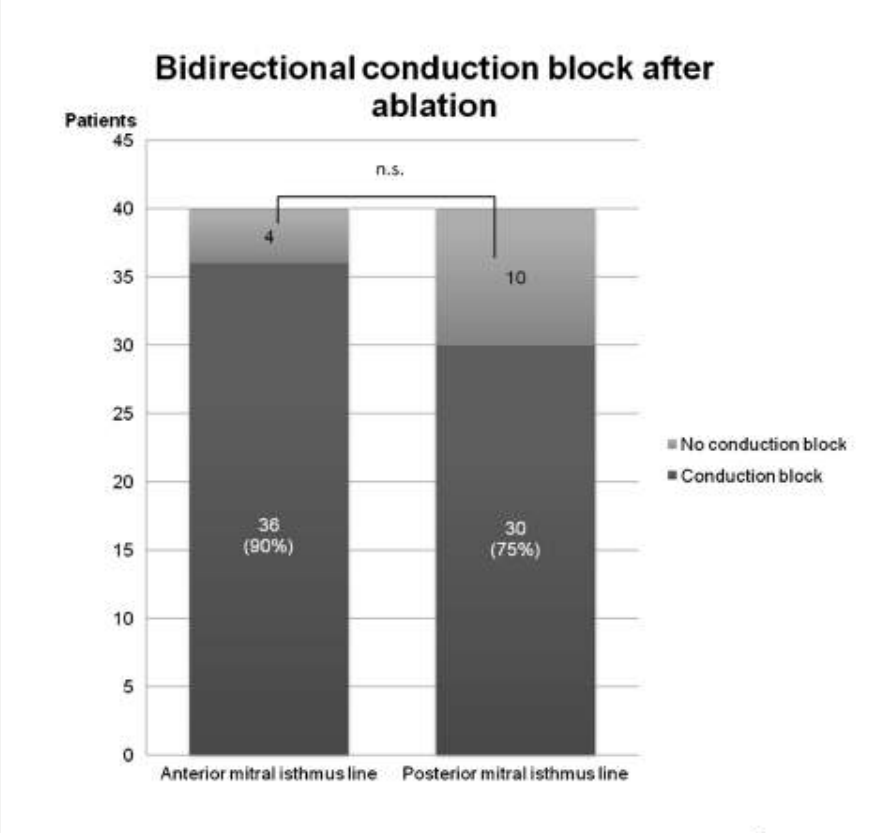
CONSIDERA ABLAZIONE DI MARSHALL

ISTMO ANTERIORE:

ATTENZIONE ALLE AT BIATRIALI

Comparison of the anterior and posterior mitral isthmus ablation lines in patients with perimitral annulus flutter or persistent atrial fibrillation

Published: 01 July 2015
Volume 44, pages 119–129, (2015) Cite this article



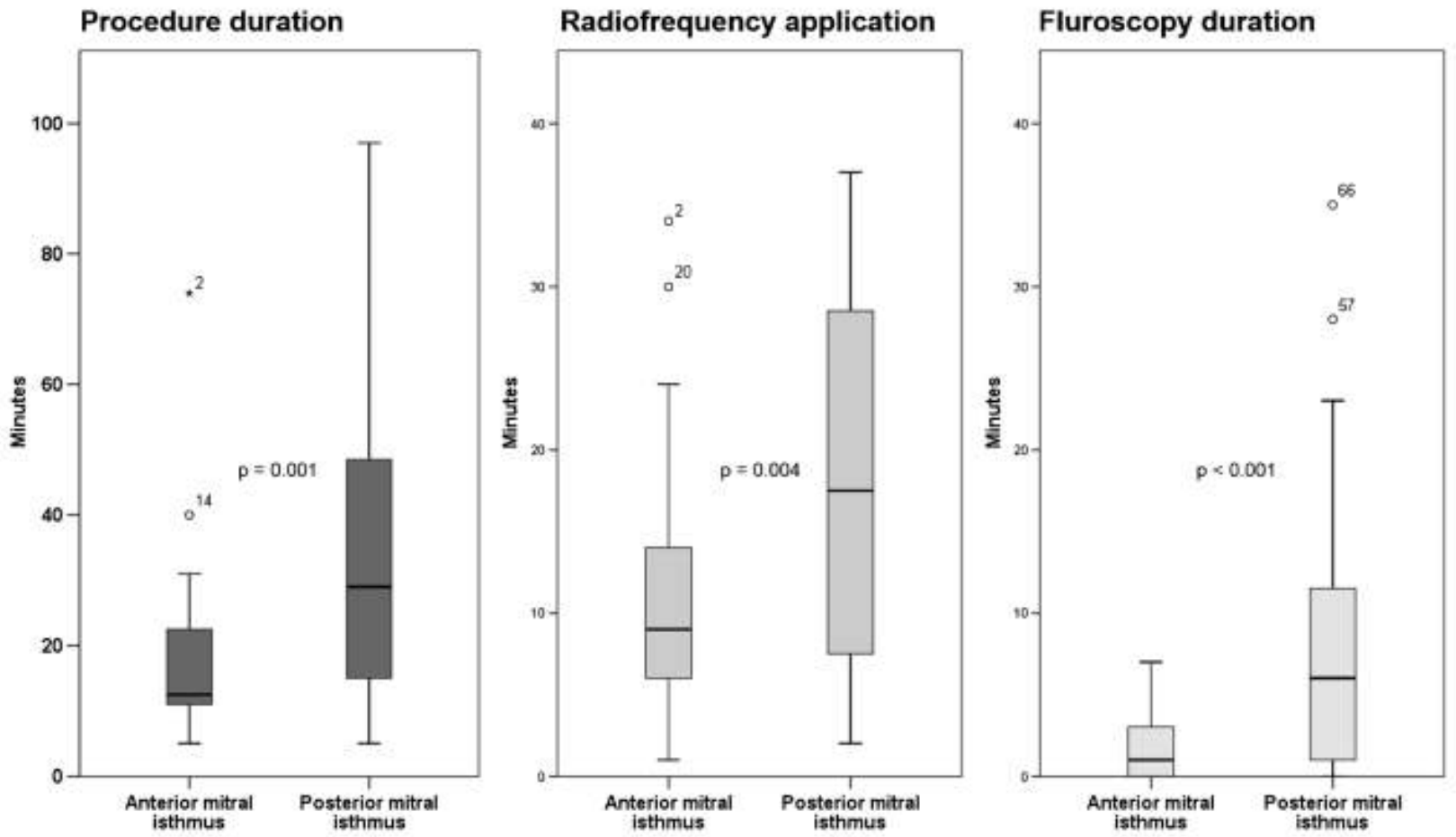
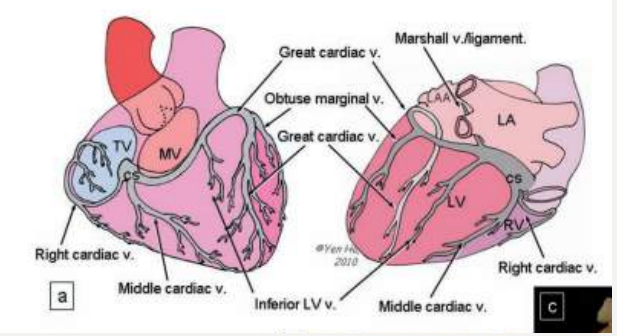
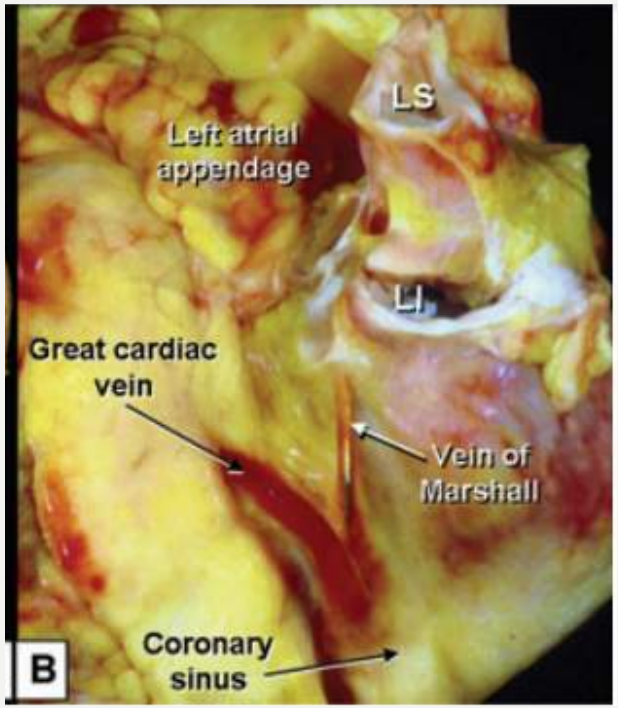


Fig. 5 Differences in procedural time effort, radiofrequency duration, and fluoroscopy duration between the anterior and posterior mitral isthmus line are displayed in a box plot graphic. The symbol "○" indicates mild outliers and the symbol "*" indicates extreme outliers





Il sistema venoso coronarico drena ~85% del flusso venoso attraverso il seno coronarico prossimale (CS) in atrio destro.

La vena cardiaca magna (GCV) ascende nel solco AV sinistro, dove passa vicino all'arteria circonflessa al di sotto di LAA.

Il VoM è un residuo embriologico del sistema cavale superiore sinistro derivante dall'involuzione della vena cardinale anteriore sinistra.

E' separata in due porzioni:

- la struttura extracardiaca, il legamento di Marshall, contenuta in una piega del pericardio, in quasi tutti i casi occlusa e associata a rami di nervi cardiaci estrinseci
- la parte intracardiaca generalmente pervia, situata anteriormente nel punto di congiunzione tra la vena cardiaca magna e il CS. Il VoM ha un manicotto miocardico epicardico (il fascio di Marshall) connesso con fibre nervose autonome strettamente associate e grasso.

MARSHALL BUNDLE ELIMINATION, PULMONARY VEIN ISOLATION, AND LINE COMPLETION FOR ANATOMICAL ABLATION OF PERSISTENT ATRIAL FIBRILLATION (MARSHALL-PLAN)

La vena di Marshall, un residuo embriologico della vena cava superiore sinistra e collocata all'interno dell'istmo mitralico, è implicata nella patogenesi della FA in quanto sede di innervazione simpatica e parasimpatica che può modulare le proprietà elettrofisiologiche del tessuto atriale contribuendo al mantenimento dell'aritmia. Per tali motivi, la vena di Marshall è stata considerata come possibile target di terapia per aumentare il successo della procedura ablativa anche nel caso di FA persistenti

La cosiddetta strategia Marshall-Plan per l'ablazione della fibrillazione atriale prevede tre fasi:

1. isolamento delle vene polmonari;
2. alcolizzazione (infusione di etanolo) della vena di Marshall;
3. ablazione lineare dell'atrio sinistro per bloccare gli istmi anatomici della mitrale, del tetto e del cavo-tricuspidale.

Lo studio randomizzato prospettico presentato a EHRA 2023 ha messo a confronto la strategia Marshall-Plan rispetto al solo isolamento delle vene polmonari, in termini di recidive degli episodi aritmici a 12 mesi, su un campione di 120 pazienti (età media: 67 anni; 18% donne) con fibrillazione atriale persistente sintomatica della durata superiore a un mese trattati presso l'Univesity Hospital di Bordeaux.

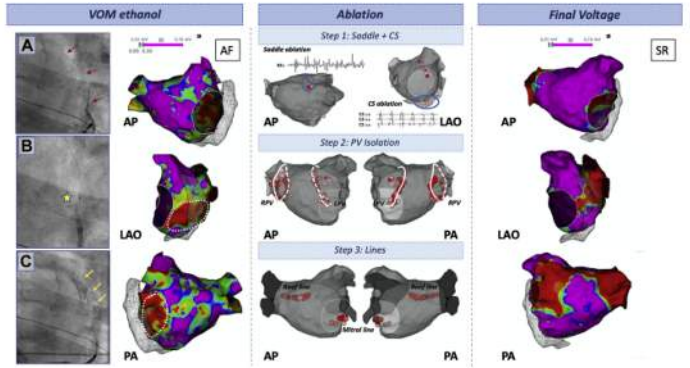


Figure 1 Marshall-PLAN (Marshall bundle elimination, Pulmonary vein isolation, and Line completion for ANatomical ablation of persistent atrial fibrillation) ablation strategy. **Left:** Successive steps for ethanol infusion into the vein of Marshall (VOM). **A:** Contrast injection into the VOM using a left internal mammary artery catheter. *Red arrows* indicate vein arborization. **B:** Insertion of the angioplasty balloon, which is then inflated in the proximal portion of the VOM (*yellow star* next to radiopaque marker on balloon). **C:** Contrast injection into the VOM shows staining of atrial tissue after administration of 10 mL ethanol administered (*yellow arrows*). A representative voltage map of the left atrium after ethanol infusion is also shown in anteroposterior (AP), left anterior oblique (LAO), and poster-ounterior (PA) views. Note the resulting low-voltage area around and below the left inferior pulmonary vein (*dashed white line*). This voltage map was performed in atrial fibrillation (AF) with standard voltage settings (range 0.05–0.5 mV). **Middle:** Representative example of anatomical left atrial maps demonstrating ablation tags for "saddle ablation" (with intracardiac signals), coronary sinus (CS) ablation (with intracardiac signals), pulmonary vein (PV) isolation, and linear lesions to achieve block of left anatomical isthmuses (mitral line, roof line). **Right:** Remapping of the left atrium at the end of the Marshall-PLAN ablation strategy. A voltage map of the left atrium at the end of the procedure is shown in sinus rhythm (SR).

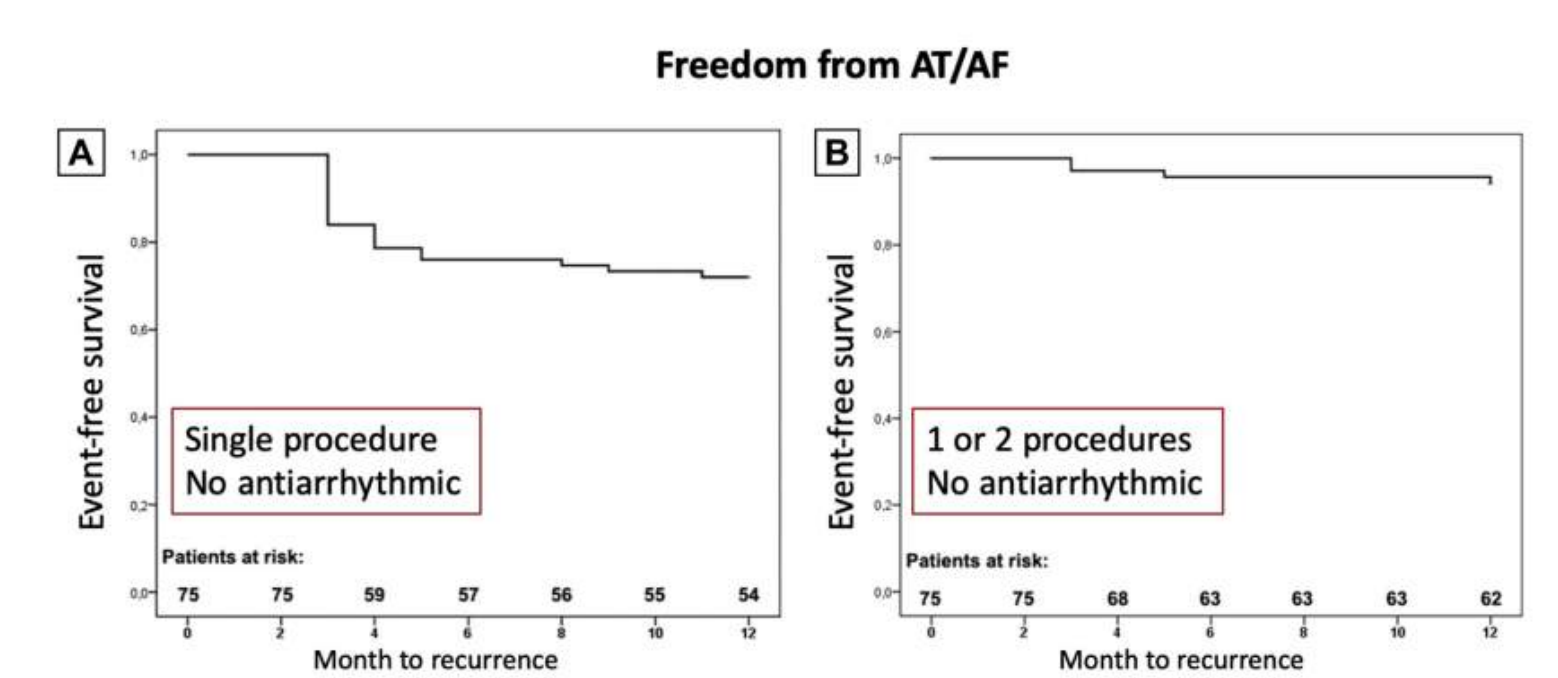
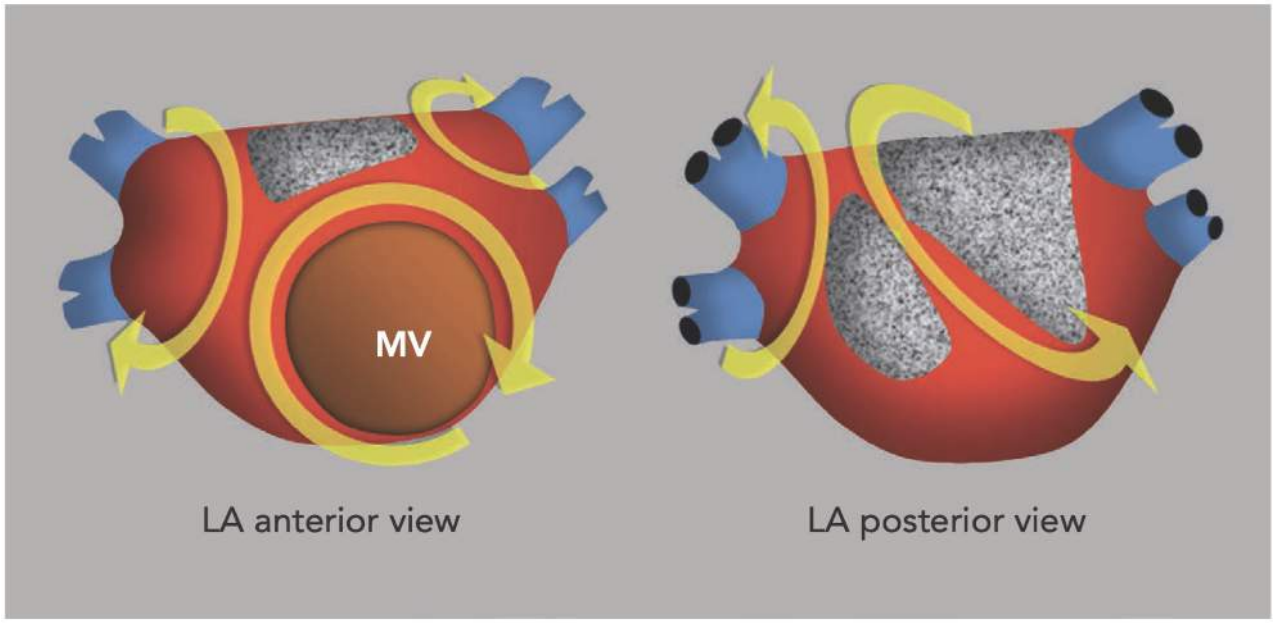


Figure 4 Freedom from atrial fibrillation (AF)/atrial tachycardia (AT). Kaplan-Meier event-free survival curves after a single ablation procedure, without antiarrhythmic drugs **(A)**, and after 1 or 2 procedures, without antiarrhythmic drugs **(B)**.

SEDI DI MRAT IN ATRIO SINISTRO



Stippled, grey areas represent low-voltage, unexcitable 'scars'. Yellow curved arrows indicate multiple possible re-entry pathways. The pulmonary veins are represented in blue. MV = mitral valve.

1. Flutter atriale peri-mitralico
2. Circuiti che coinvolgono le vene polmonari
3. Circuiti del setto sinistro
4. Post-MAZE

Arrhythmia & Electrophysiology Review 2017;**6**(2):55–62. DOI: 10.15420/aer.2017:5:2

CLASSIFICAZIONE

POPOLAZIONE

- Pregressi interventi CCH per cardiopatia congenita o acquisita, con una o più incisioni atriali chirurgiche
- Cardiopatia organica rilevante (dilatative o valvolare)
- Miopatia atriale isolata

CIRCUITI

- Macro-rientro atriale con singolo loop
- Macro-rientro atriale con doppio loop, con piccola porzione del circuito condivisa ad attivazione mesodiastolica
- Meccanismo focale

Circumferential pulmonary vein ablation with additional linear ablation results in an increased incidence of left atrial flutter compared with segmental pulmonary vein isolation as an initial approach to ablation of paroxysmal atrial fibrillation

Navinder Sawhney [1], Ramtin Anousheh, Wei Chen, Gregory K Feld

Affiliations + expand

PMID: 20339034 DOI: 10.1161/CIRCEP.109.924878

Abstract

Background: There has been growing concern that linear ablation is associated with an increased risk of iatrogenic arrhythmias in patients undergoing ablation for atrial fibrillation (AF). Therefore, we compared circumferential pulmonary vein ablation plus left atrial linear ablation (CPVA+LALA) with segmental pulmonary vein isolation (PVI)in patients with paroxysmal AF.

Methods and results: Sixty-six consecutive patients with paroxysmal AF were prospectively randomly assigned to receive PVI versus CPVA+LALA (consisting of encircling lesions around the pulmonary veins), a roof line, and a mitral isthmus line with documentation of bidirectional mitral isthmus block. All patients were seen at 1, 3, 6, and every 12 months after ablation, with 14-day continuous ECG monitoring every 6 months. At 16.4+/-6.3 months after 1 ablation procedure, 19 patients (58%) remained free of atrial arrhythmias after PVI versus 17 patients (51%) after CPVA+LALA (P=0.62). After PVI, 14 patients had recurrent paroxysmal AF, whereas after CPVA+LALA, 8 patients had recurrent AF, 6 had atypical left atrial flutter (LAFL), and 2 had both AF and LAFL (P=0.32 between PVI versus CPVA+LALA for AF but P=0.002 for LAFL). Twenty-eight patients (85%) remained arrhythmia-free after 1.3+/-0.5 PVI procedures versus 28 patients (85%) after 1.4+/-0.6 CPVA+LALA procedures (P=NS). Fluoroscopy time was longer after CPVA+LALA versus PVI (91 versus 73 minutes, P=0.04).

Conclusions: As an initial ablation approach in patients with paroxysmal AF, more LAFL occurred after CPVA+LALA and fluoroscopy times were longer compared with segmental PVI.

Flutter atriale atipico: forme iatrogene

Un aspetto che deriva dalla notevole diffusione della procedura di isolamento delle vene polmonari per il trattamento della fibrillazione atriale è l'insorgenza di flutter atriale sinistro, legata alla presenza di gap a livello dell'ostio o dell'antro delle vene polmonari.[2-8] l'incidenza di tali aritmie iatrogene è da considerare in crescita, data la recente tendenza, quasi univoca, di effettuare la deconnessione in regione più prossimale ("antrale") per ridurre l'incidenza di stenosi delle vene polmonari. Le aree di gap possono derivare sia da deconnessione incompleta sia da ripresa parziale di conduzione ostiale; il riconoscimento di tali aritmie è fondamentale, anche per una corretta definizione dell'outcome, in quanto la documentazione ECG e i sintomi possono erroneamente deporre per inefficacia dell'ablazione di fibrillazione atriale. Un dato fondamentale è che tali aritmie iatrogene complicano qualunque tipo di approccio all'isolamento delle vene polmonari, cardiochirurgico,[10] percutaneo mediante encircling o mediante isolamento guidato da catetere circonferenziale: l'incidenza, in

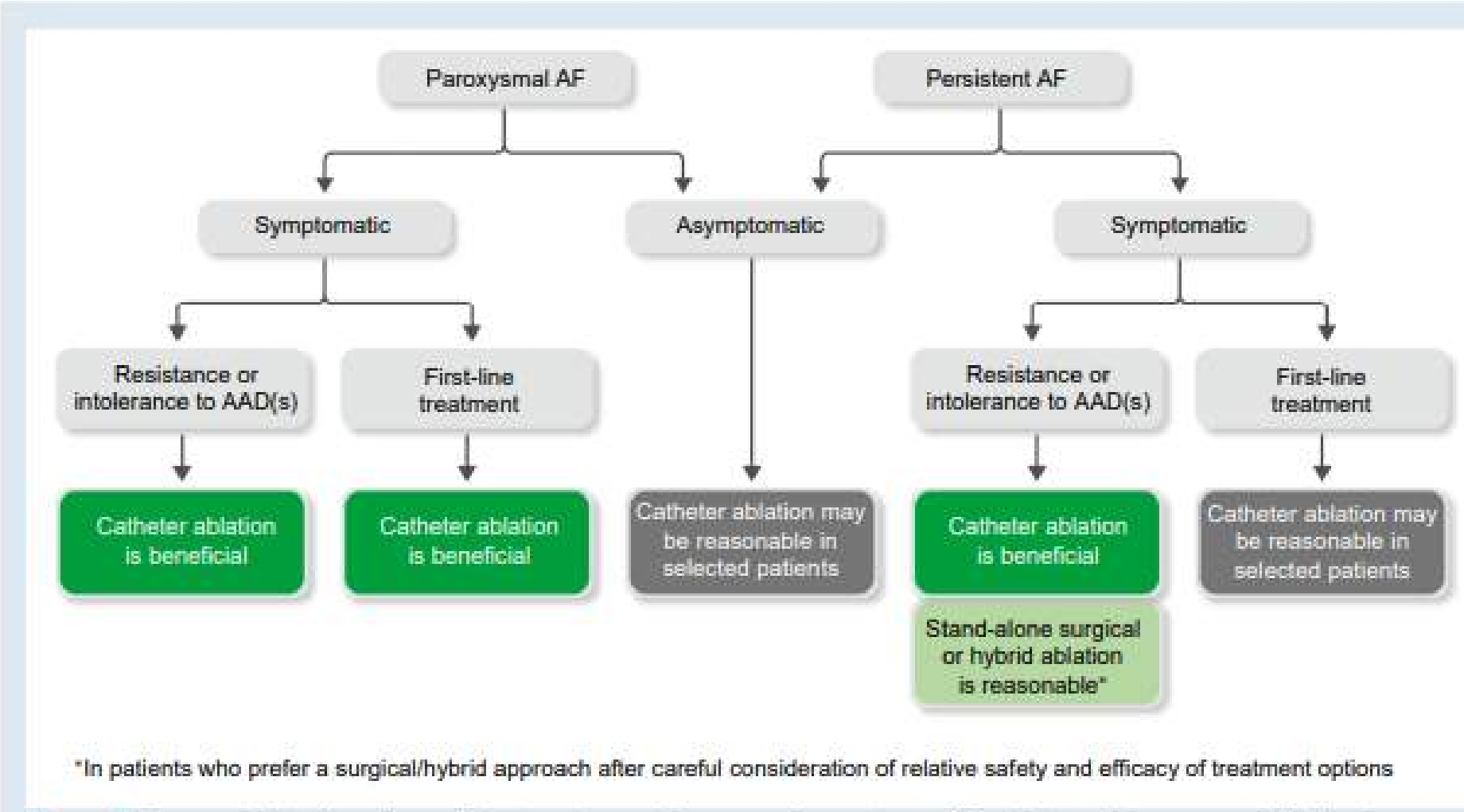
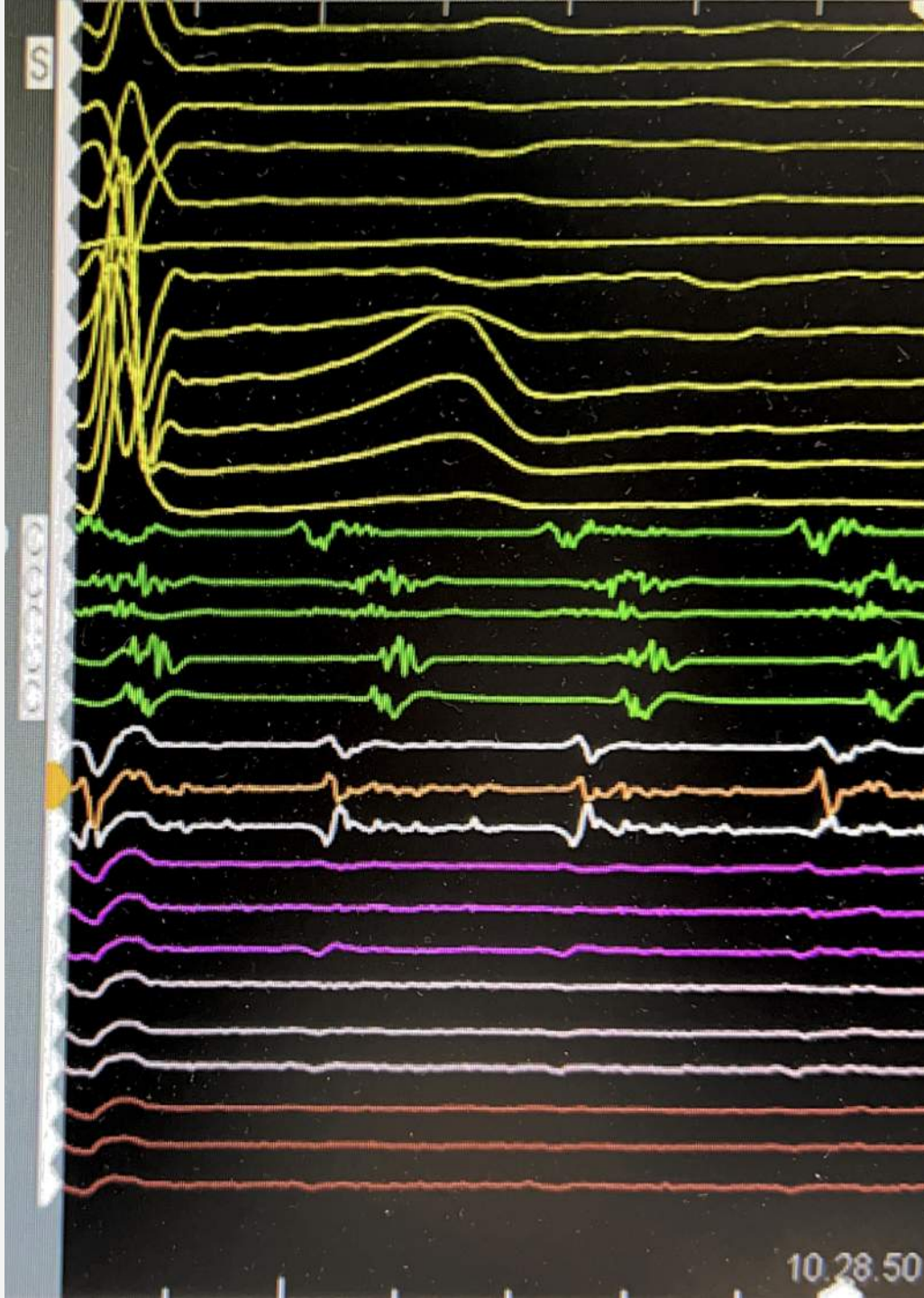


Figure 7 Suggested advice for catheter ablation in patients with paroxysmal or persistent AF in relation to the presence of AF-related symptoms. AAD, antiarrhythmic drug; AF, atrial fibrillation.

Ablation strategies	Category of advice	Type of evidence
Pulmonary vein isolation		
Electrical isolation of the PVs is required during all AF ablation procedures	Advice TO DO	META[236,238,241,243–245,247,248,253,294,304,566,622,788]
Achievement of electrical isolation requires, at a minimum, assessment and demonstration of entrance block into the PVs	Advice TO DO	META[236,238,241,243–245,247,248,253,294,304,566,622,788–792]
A waiting period (e.g. 20 min) following initial PVI may be reasonable to monitor for PV reconnection	Area of uncertainty	RAND[793–800]
Administration of adenosine 20 min following initial PVI, with reablation if PV reconnection occurs, may be reasonable to improve PVI durability	Area of uncertainty	RAND[794,796–798,801–807]
Pace capture–guided approach following PVI using RF energy may be reasonable to improve PVI durability	Area of uncertainty	RAND[808–810]
Adjunctive ablation targets beyond pulmonary vein isolation		
If linear ablation lesions are deployed, mapping and pacing maneuvers are required to document conduction block	Advice TO DO	OBS[811–818]
If a reproducible focal trigger that initiates AF is identified outside the PV ostia at the time of an AF ablation procedure, ablation of the focal trigger is beneficial	Advice TO DO	OBS[819–823]
Vein of Marshal ethanol infusion is reasonable to facilitate achieving block in the lateral mitral isthmus in patients with mitral annular flutter	May be appropriate TO DO	OBS[196,824–826]
Ablation of areas of abnormal myocardial tissue identified with voltage mapping during sinus rhythm may be reasonable during persistent AF ablation	Area of uncertainty	META[827–829]
Vein of Marshal ethanol infusion may be reasonable during persistent AF ablation	Area of uncertainty	RAND[830–834]
Mapping and ablation of non-PV triggers may be reasonable during persistent AF ablation	Area of uncertainty	OBS[819–823,835]
Isolation of the left atrial posterior wall may be reasonable during repeat ablation of persistent AF	Area of uncertainty	META[836–847]
Ablation of MRI-detected atrial delayed enhancement areas is not beneficial during persistent AF ablation[a]	Advice NOT TO DO	META[848,849]

STUDIO ELETTROFISIOLOGICO

- **Approccio convenzionale,** con il posizionamento di più cateteri multipolari nelle camere atriali, in modo da ottenere multiple registrazioni intracavitarie durante tachicardia, da sedi endocardiche anatomicamente definite su base fluoroscopica. Il mappaggio mirava alla ricerca di potenziali diastolici frammentati di bassa ampiezza e lunga durata, espressione di una zona di conduzione lenta. Le aree venivano testate con entrainment, con cui si localizzava l'istmo critico dell'aritmia
- **Approccio combinato,** che integra i dati del sistema di mappaggio elettroanatomico con quelli ottenuti tramite entrainment
- **Approccio elettroanatomico puro**



ENTRAINMENT

Una differenza tra intervallo post stimolazione ed il ciclo della tachicardia inferiore a **20 msec** classifica un sito come all'interno del circuito di rientro

LIMITAZIONI

- Elevato rischio di trasformazione della tachicardia in fibrillazione atriale o in altra morfologia
- Elevato rischio di interruzione della tachicardia
- Dati di mappaggio ambigui, soprattutto nel caso di rientri a doppio loop, in cui il ciclo sia lievemente differente

TECNOLOGIA

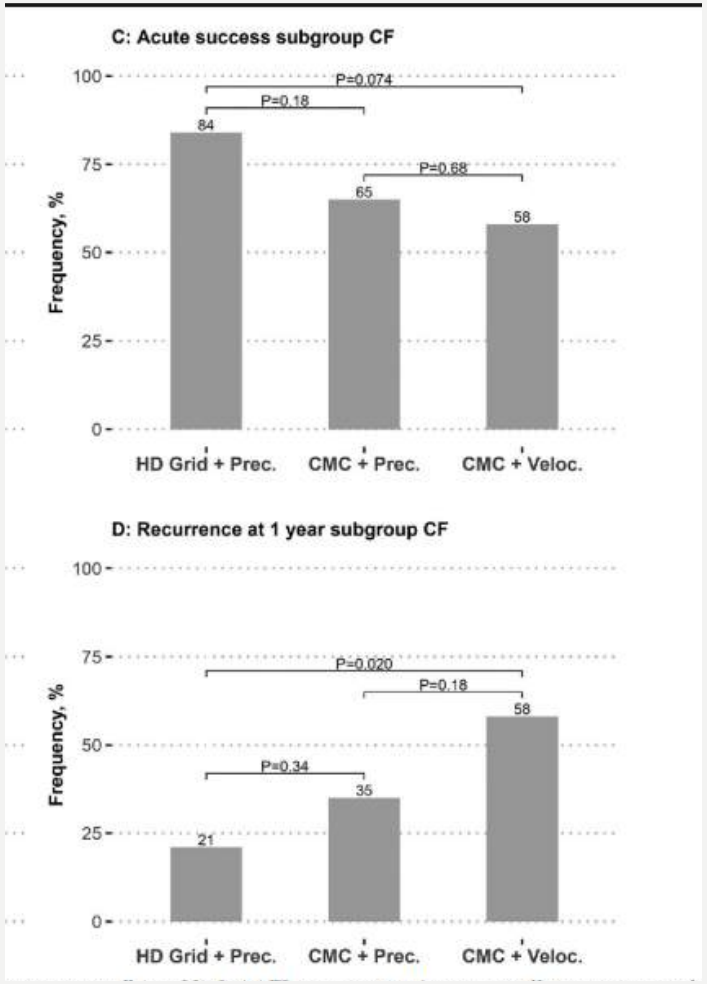
1) Contact Force

2) Automapping

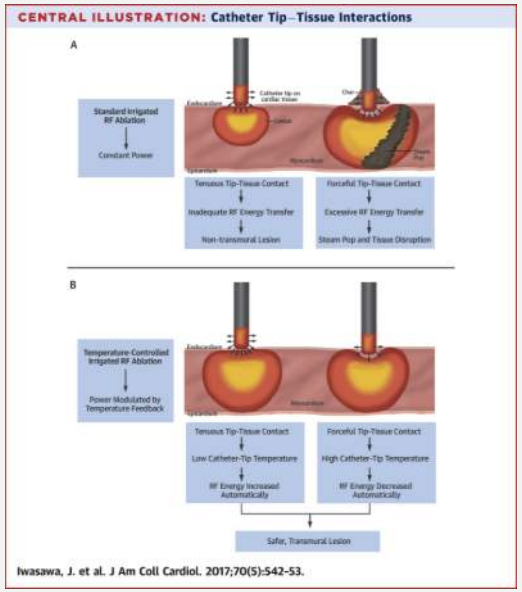
3) High-density mapping e algoritmi specifici

Ko Ko NL, Sriramoju A, Khetarpal BK, Srivathsan K. Atypical atrial flutter: review of mechanisms, advances in mapping and ablation outcomes. Curr Opin Cardiol. 2022 Jan 1;37(1):36–45. doi: 10.1097/HCO.0000000000000924. PMID: 34857715.

1. CONTACT FORCE



- Nei pazienti ablati con CF (n = 55), il **successo acuto è stato** del 69%, rispetto al 52% nei pazienti senza CF (n = 27)
- E' stata riscontrata una **tendenza non significativa in ricorrenze** ad un anno tra pazienti con e senza ablazione CF (38% vs. 59%, p = 0,07).



High-density versus low-density mapping in ablation of atypical atrial flutter J. C. Balt1 & M. N. Klaver1 & B. K. Mahmoodi1 & V. F. van Dijk1 & M. C. E. F. Wijffels1 & L. V. A. Boersma1Journal of Interventional Cardiac Electrophysiology (2021) 62:587–599

TECNOLOGIA

1) Contact Force

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2. AUTOMAPPING

La **sopravvivenza libera da AAFL** era significativamente più alta nei pazienti mappati con Precision che con Velocity (p = 0,011).

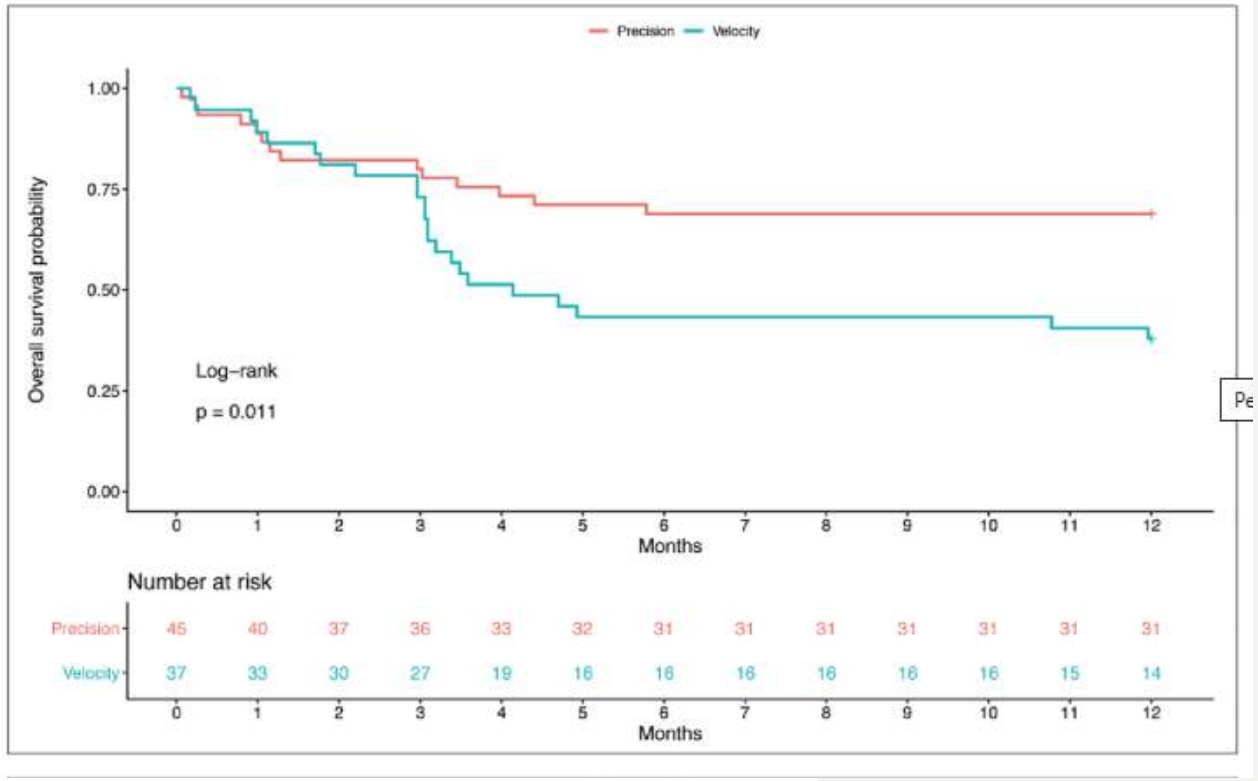


Table 3 Methodological differences between procedure types

	Number of datapoints	Electrode spacing (mm)	Electrode size (mm)	Number of electrodes	Possible number of vectors	Time to construct activation map (per flutter) (min)	Automated designation of points
CMC + Velocity	300–600	5	2	10	10	15–30	No
CMC + Precision	1000–15,000	5	2	10	10	5–15	Yes
HD Grid + Precision	1000–15,000	3	1	16	42	5–15	Yes

CMC decapolar circular mapping catheter, *HD* High-density

High-density versus low-density mapping in ablation of atypical atrial flutter J. C. Balt1 & M. N. Klaver1 & B. K. Mahmoodi1 & V. F. van Dijk1 & M. C. E. F. Wijffels1 & L. V. A. Boersma1Journal of Interventional Cardiac Electrophysiology (2021) 62:587–599

TECNOLOGIA

1) Contact Force

2) Automapping

3) High-density mapping e algoritmi specifici

- migliore identificazione delle aritmie complesse
- creare set di lesioni più focali
- evitare ablazioni inefficaci
- ablazione con miglior tasso di successo
- minor numero di flutter non mappabili
- miglior tasso di libertà di recidiva a un anno post-ablazione

Ko Ko NL, Sriramoju A, Khetarpal BK, Srivathsan K. Atypical atrial flutter: review of mechanisms, advances in mapping and ablation outcomes. Curr Opin Cardiol. 2022 Jan 1;37(1):36-45. doi: 10.1097/HCO.0000000000000924. PMID: 34857715.

3. MAPPAGGIO AD ALTA DENSITÀ

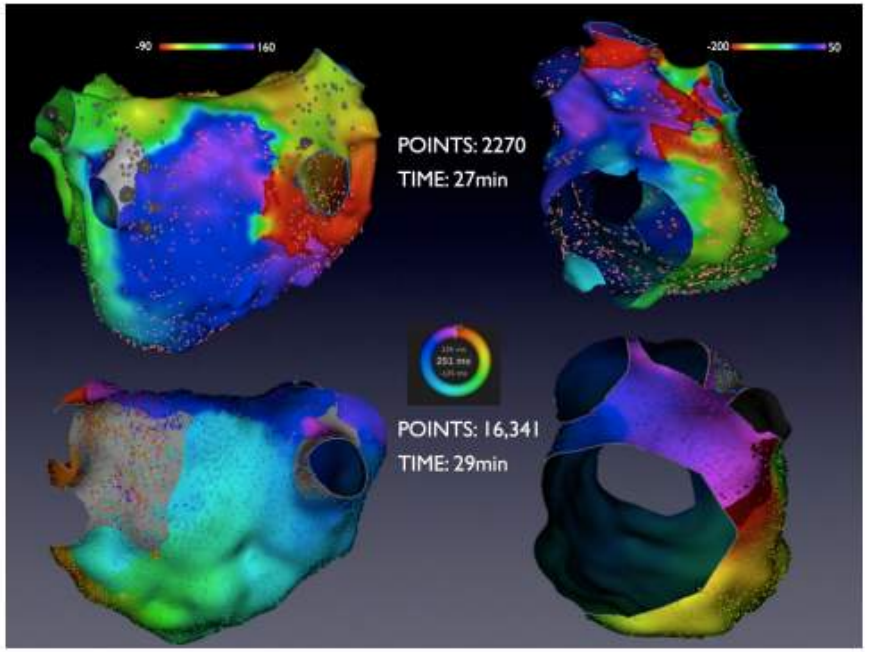


Figure 3 Activation map of scar-related atrial tachycardia. Activation map of scar-related reentrant atypical left atrial flutter. The patient underwent sequential mapping with CARTO 3 and Rhythmia during the same procedure. The upper panel shows an activation map created using CARTO 3 and a PentaRay catheter. The entire tachycardia cycle length was mapped with acquisition of 2270 points. The left upper panel is suggestive of a reentrant circuit around the right inferior pulmonary vein, demonstrating a site of "early meet late." However, entrainment from this site showed manifest P-wave fusion with a post-pacing interval that was 60 ms longer than the tachycardia cycle length, inconsistent with a reentrant circuit at this site. The mapping window (100% tachycardia cycle length) was then shifted from P-wave onset to mid P wave and led to a shift in the activation map with multiple sites of "early meet late" in and around the ridge between the left pulmonary vein and the appendage (right upper panel). The lower panel shows an activation map created using Rhythmia. The entire tachycardia cycle length was mapped to the left atrium with acquisition of 16,341 points. The activation map was consistent with a clockwise mitral annular flutter. Entrainment from the mitral annulus demonstrated concealed P-wave fusion and a post-pacing interval that was 2 ms longer than the tachycardia cycle length. Ablation at the mitral annulus terminated the tachycardia (patient 17).

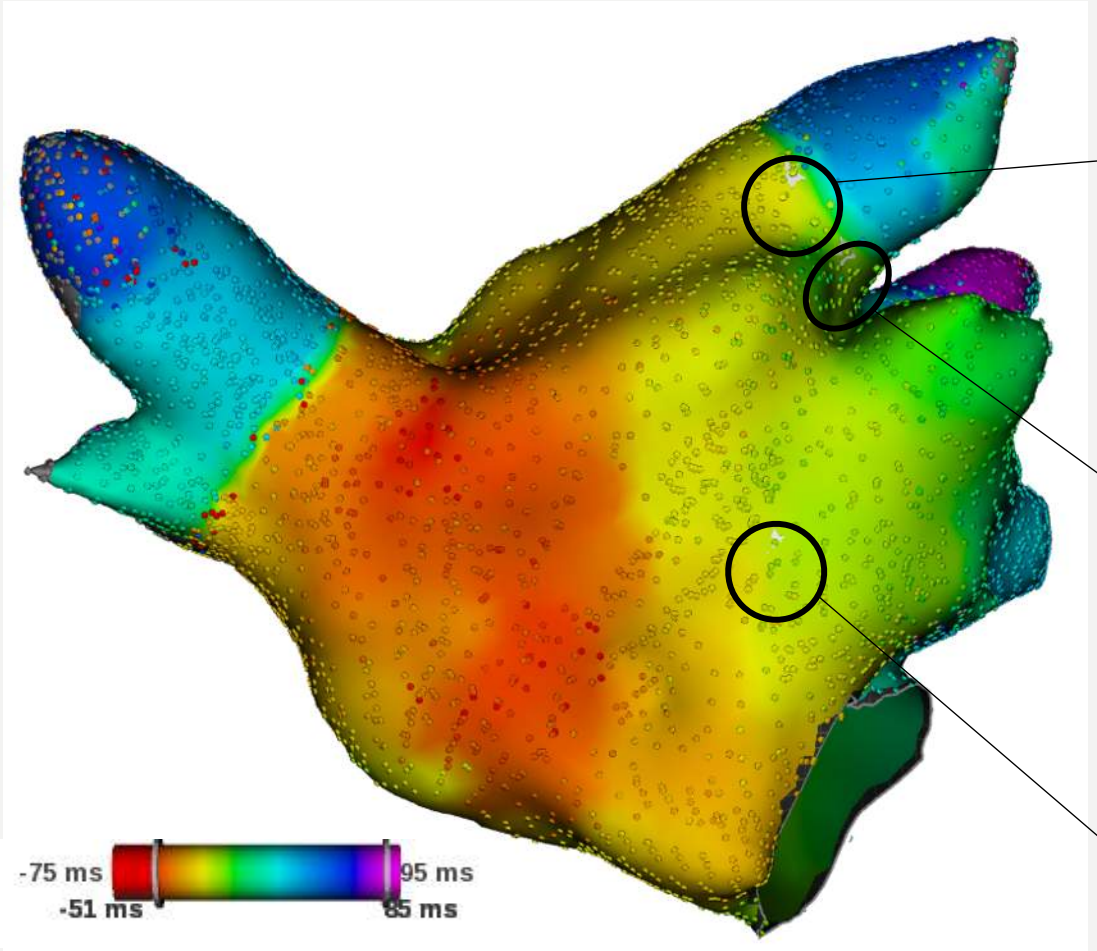
TOOLS

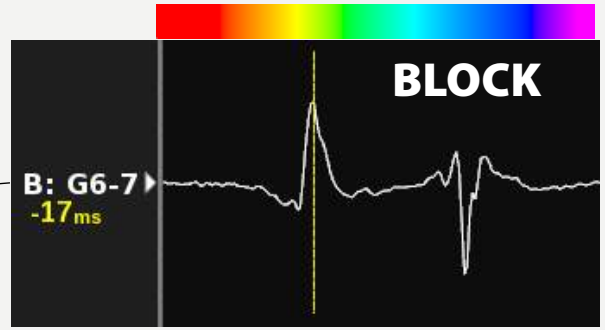
Catheter	Advisor HD Grid	Reflexion HD	Lasso	Pentaray	Octaray	Optrell	Intellamap Orion
Company	Abbott	Abbott	Biosense Webster	Biosense Webster	Biosense Webster	Biosense Webster	Boston Scientific
Catheter figure							
Number of electrodes	16	20	10–20	22	48	48	64
Electrode spacing	3 mm	2–7–2 mm	4.5 mm (15 mm) 6.0 mm (20 mm) 8.0 mm (25 mm) 2–6–2 mm (variable 15–25 mm)	4–4–4 mm 2–6–2 mm	3–3–3–3–3 mm 2–2–2–2–2 mm 2–5–2–5–2 mm	2.4 mm	2.5 mm
Size of electrodes	1 mm	1 mm (except tip which is 2 mm)	1 mm	0.76 mm	0.46 mm	0.46 mm 0.9 mm^2	0.4 mm^2

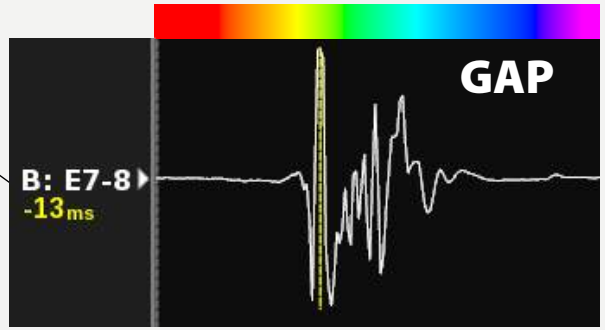
ALGORITMI SPECIFICI

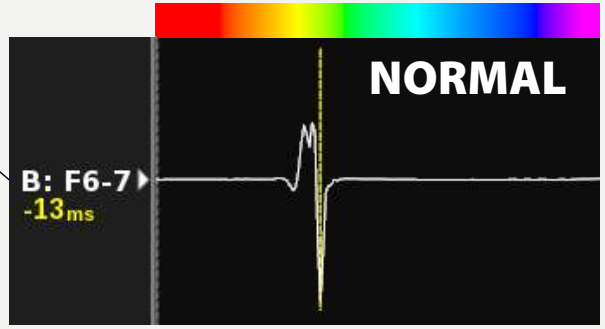
- LUMIPOINT (Boston scientific ®)
- COHERENT MAP (Biosense webster ®)
- OMNIPOLAR TECNOLOGY (Abbot ®)

LUMIPOINT: ALGORITMO CHE PERMETTE DI SUPERARE I LIMITI DEI SISTEMA DIMAPPAGGIO CHE SI ANNOTANO SULLA COMPONENTE PRINCIPALE, PERDENDO L'INFORMAZIONE SULLA TIPOLOGIA DEL SEGNALE. ILLUMINA SULLA MAPPA I POTENZIALI D'INTERESSE: POTENZIALI DOPPI, POTENZIALI SINGOLI IN UN MOMENTO PARTICOLARE DELLA FINESTRA D'INTERESSE O I POTENZIAL FRAMMENTATI



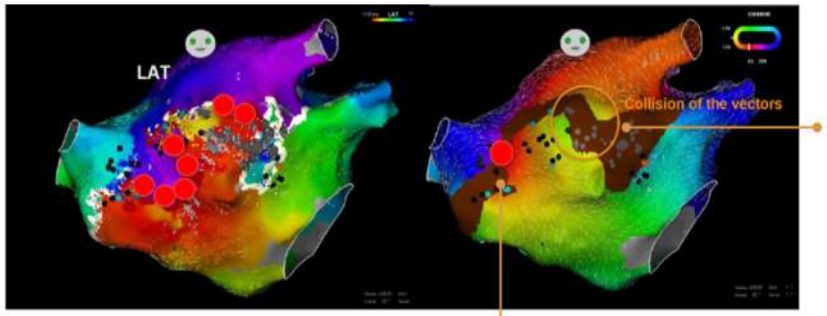






COHERENT MAPPING

COHERENT MAPPING PROVIDES YOU WITH **VECTORS VISUALIZATION INTEGRATING DIRECTION OF ACTIVATION & CONDUCTION VELOCITY.**



SLOW OR NO (SNO) CONDUCTION ZONE
display conduction barriers and slow conduction areas as copper colored zones.

SMALL, BOLD VELOCITY VECTORS
highlight slow conduction at critical isthmus.

- Coherent è un algoritmo che semplifica la diagnosi delle aritmie complesse integrando dati diversi: dati di attivazione (LAT), zone di scar, doppi potenziali taggati e vincoli anatomici
- Identifica la propagazione di un'aritmia per mezzo di vettori di velocità.

Circulation: Arrhythmia and Electrophysiology
Volume 11, Issue 8, August 2018
https://doi.org/10.1161/CIRCEP.118.006536

American Heart Association.

ORIGINAL ARTICLE

Activation Mapping With Integration of Vector and Velocity Information Improves the Ability to Identify the Mechanism and Location of Complex Scar-Related Atrial Tachycardias

Elad Anter, MD, Mattias Duytschaever, MD, PhD, Changyu Shen, PhD, Teresa Strisciuglio, MD, Eran Leshem, MD, MHA, Fernando M. Contreras-Valdes, MD, Jonathan W. Waks, MD, Peter J. Zimetbaum, MD, Kapil Kumar, MD, Peter S. Spector, MD, Adam Lee, MD, Edward P. Gerstenfeld, MD, Elad Nakar, MSc, Meir Bar-Tal, MSc, and Alfred E. Buxton, MD

+46%
HIGHER RESOLUTION IN LAT AND VOLTAGE MAPPING*

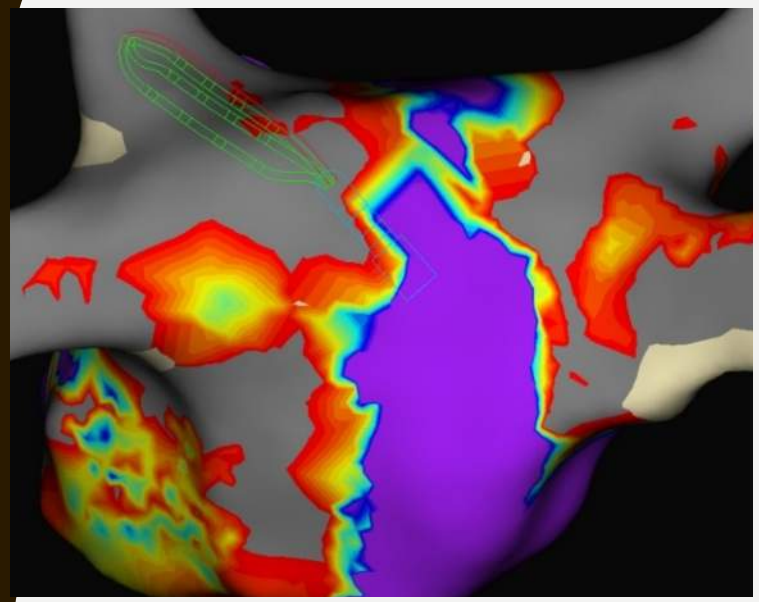
98.3%
IDENTIFICATION OF THE CRITICAL ISTHMUS
in atrial tachycardias†

>80%
REDUCED RF TIME
vs LAT algorithm‡

* When compared to CARTO® 3 System 4.3.5
† When compared to Standard LAT Mapping
‡ Based on a multicenter Phase I trial (n=35)

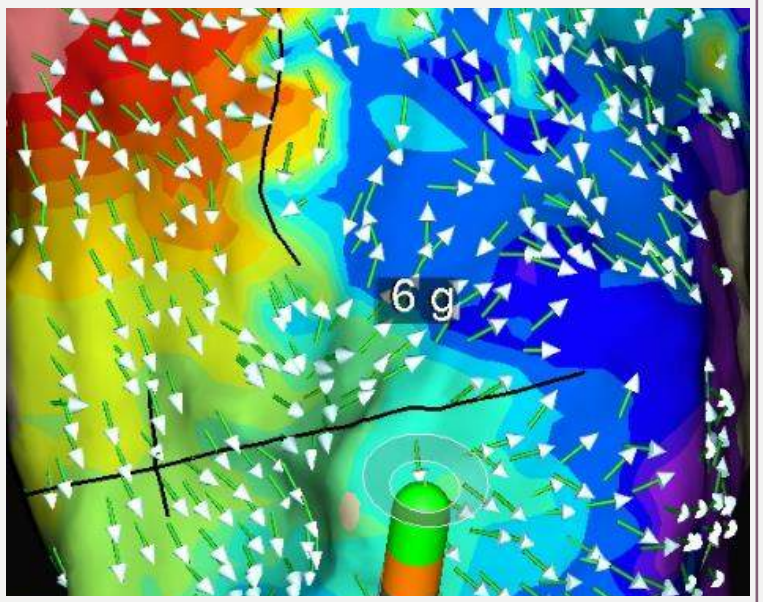
OMNIPOLAR TECHNOLOGY: ALGORITMO CHE PERMETTE DI RICOSTRUIRE VIRTUALMENTE IL BIPOLO ELETTRICO ORIENTANDOLO LUNGO IL FRONTE DI PROPAGAZIONE DELL'IMPULSO, PERMETTENDO L'ACQUISIZIONE DELLA DIREZIONE, DELLA VELOCITÀ E DEL MASSIMO VOLTAGGIO DEL FRONTE DI PROPAGAZIONE

OMNIPOLAR VOLTAGE



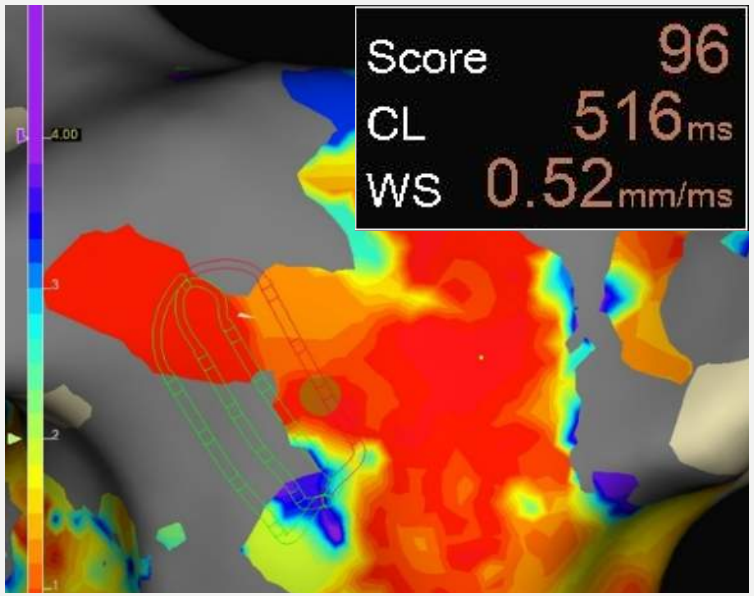
Maximum voltage measured from 360°

ACTIVATION DIRECTION



Arrows indicate wavefront activation direction

WAVE SPEED

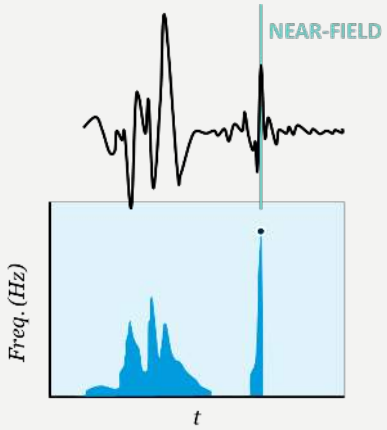


Color map and numeric values of how fast the wavefront is moving

EMPHASIS MAP: COMBINA LE INFORMAZIONI DI MAPPE DIVERSE, ENFATIZZANDO L'ATTIVAZIONE, IL VOLTAGGIOE LA FREQUENZA

ANNOTATION

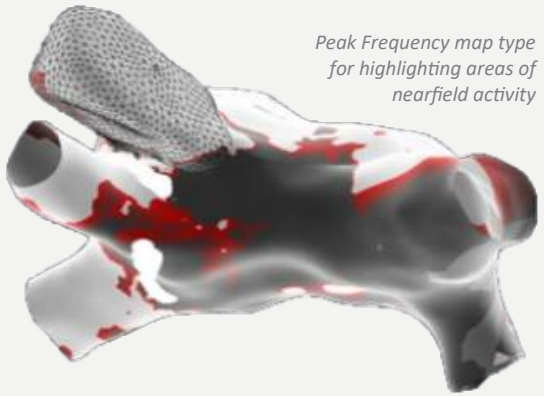
NEARFIELD EGM AQUISITION



SIMPLE, OBJECTIVE, AND AUTOMATED assessment of near-field signals

INTERPRETATION

PEAK FREQUENCY MAPS

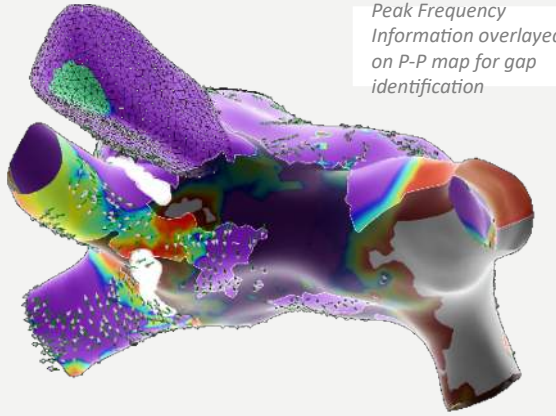


Peak Frequency map type for highlighting areas of nearfield activity

GAIN UNIQUE INSIGHTS ON SUBSTRATE AND TISSUE CONTACT with new peak frequency data points

INTERPRETATION

EMPHASIS MAPS



Peak Frequency Information overlayed on P-P map for gap identification

STREAMLINE MAP INTERPRETATION by emphasizing key information in related data sets

Table 4 Selected studies published on AAFL catheter ablation using high-density mapping

Author	Year	Study type	No. of patients/ no. of AAFL	Entrainment allowed	Procedural success rate	Long-term success rate	Follow-up (mo)	Notes
Derval et al. [22]	2020	Retrospective Cohort of ATs	132/214 (168 AAFL)	Yes	90% (macro-reentry) 98% (localized reentry)	54%	13 ± 9	Reentry is the predominant AT mechanism in patients with prior AF ablation
Siebermair et al. [7]	2020	Retrospective	55/78	No	96.3%	64.1–75%	24	Anatomical structures were more often involved in AAFL mechanisms in preablated patients
Giehm-Reese et al. [20]	2019	Retrospective	53/not reported	Yes	85%	51%	20 ± 12	
Winkle et al. [26]	2017	Retrospective	23/31	No	90.3%	61%	12	
Coffey et al. [19]	2013	Retrospective	91/171	Yes	94%	77% (freedom of AT or flutter only)	16 ± 12	Septal flutters were associated with higher rates of recurrences
Chae et al. [21]	2007	Retrospective Cohort of ATs recurrence post AF ablation	78/155 (120 AAFL)	Yes	86%	77%	13 ± 10	Most AT recurrences following AF ablation were related to gaps in prior ablation lines

Atypical atrial futter catheter ablation in the era of high-density mapping Alexandre Raymond-Paquin1,2 · Ajay Pillai1 · Rahul Myadam1 · Pranav Mankad1 · Scott Lovejoy3 · Jayanthi N. Koner Kenneth A. Ellenbogen Journal of Interventional Cardiac Electrophysiology https://doi.org/10.1007/s10840-023-01475-2, Received: 4 November 2022 / Accepted: 10 January 2023

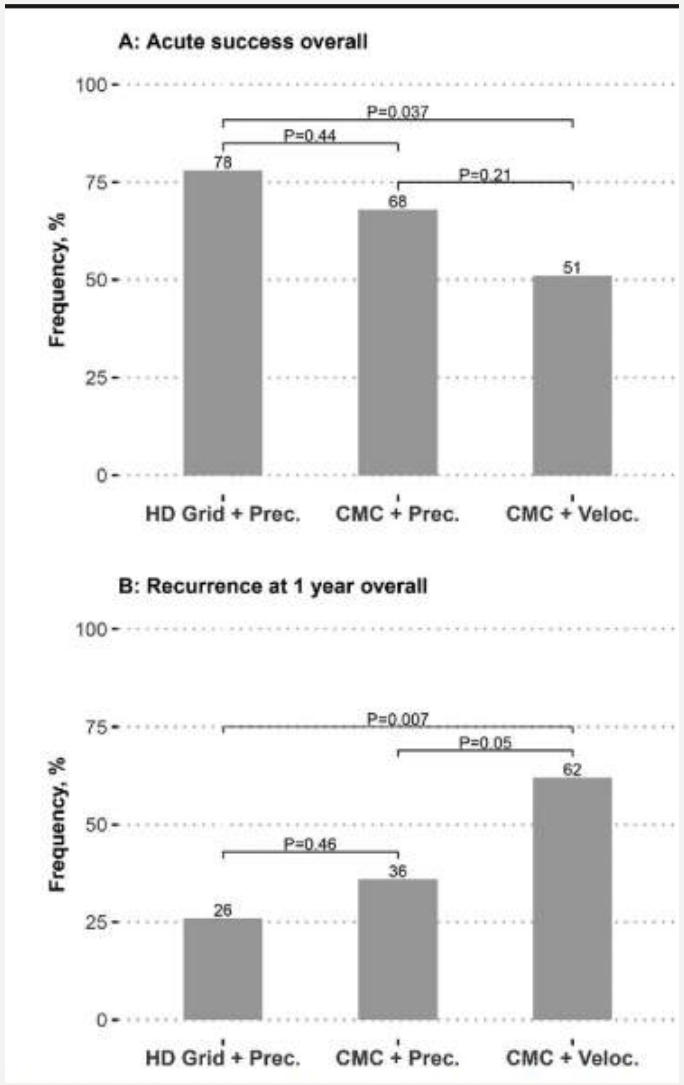
MAPPAGGIO AD ALTA DENSITÀ VS BASSA DENSITÀ

Table 2 Procedural findings

	Group 1 HD grid + Precision $n = 23$	Group 2 Circular MC + Precision $n = 22$	Group 3 Circular MC + Velocity $n = 37$	p value
Number of flutters during procedure	1.5 ± 0.8	1.9 ± 1.5	1.9 ± 1.4	0.77
Mean CL (ms)	288 ± 76	291 ± 92	324 ± 88	0.13
Total number of flutters	40	36	66	
Roof dependent	6 (15)	3 (8)	9 (14)	0.53
Peri-mitral	10 (25)	5 (14)	8 (12)	0.15
Septal	6 (15)	6 (17)	6 (9)	0.52
Macro-re-entry posterior LA	5 (13)	6 (17)	5 (8)	0.37
Macro-re-entry anterior LA	5 (13)	3 (8)	3 (5)	0.33
Localized re-entry LA	0	1 (3)	1 (2)	0.79
Right atrium	5 (13)	2 (6)	10 (15)	0.35
Unmappable	3 (8)	10 (27)	24 (36)	0.004
Procedure time (min)	143 ± 42	132 ± 41	143 ± 36	0.32
Ablation time (min)	25 ± 12	28 ± 16	25 ± 16	0.66
Rx time (min)	26 ± 12	25 ± 12	24 ± 10	0.84
DAP (mGy cm^2)	41 ± 21	37 ± 27	40 ± 32	0.34

The percentage of unmappable flutter was significantly different between groups. Post testing between groups regarding unmappable flutter: $p < 0.05$ between groups 1 and 2, $p < 0.01$ between groups 1 and 3, respectively. NS between groups 2 and 3

CL cycle length, *LA* left atrium, *DAP* dose area product



High-density versus low-density mapping in ablation of atypical atrial flutter J. C. Balt1 & M. N. Klaver1 & B. K. Mahmoodi1 & V. F. van Dijk1 & M. C. E. F. Wijffels1 & L. V. A. Boersma1Journal of Interventional Cardiac Electrophysiology (2021) 62:587–599

IMPATTO CLINICO DEL MAPPAGGIO AD ALTA DENSITÀ

Per quel che concerne la localizzazione: 10 (11%) si trovavano nell'atrio destro e 78 (89%) nell'atrio sinistro, di cui 22 (28%) dipendenti dal tetto e 37 (47%) dipendenti dalla mitrale (p= NS).

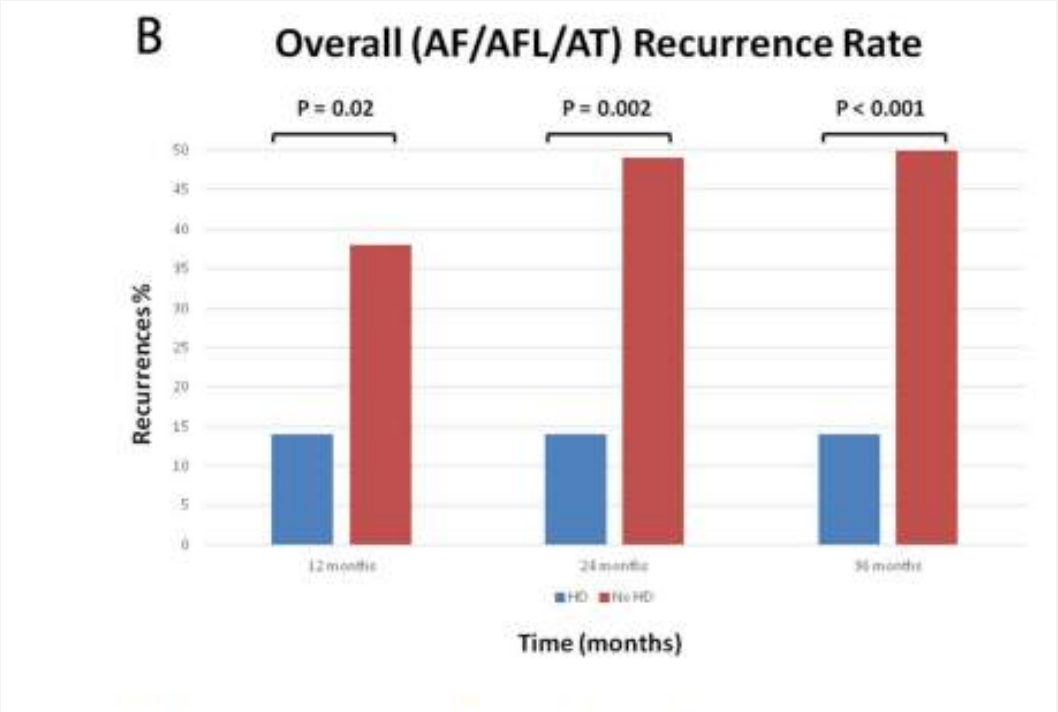
Ripristino del ritmo durante l'ablazione è stato osservato più frequentemente nel gruppo HD (79% vs 56%, p = 0,037), senza differenze nel tempo di mappatura, tempo procedurale e dose radiologica (p = NS).

	NO HD ($n=38$)	HD ($n=35$)	p value
Clinical characteristics			
Age, years	65 ± 7.97	67 ± 9.64	0.19
Male, n (%)	17 (51.52%)	24 (70.59%)	0.11
BMI, kg/m^2	26 ± 3.75	27 ± 5.07	0.31
Hypertension, n (%)	32 (82.05%)	24 (68.57%)	0.17
Previous cardiac surgery, n (%)	5 (12.82%)	4 (11.43%)	0.85
Diabetes, n (%)	9 (23.08%)	1 (2.86%)	0.01
Heart failure, n (%)	2 (5.13%)	3 (8.57%)	0.56
Vascular disease, n (%)	4 (10.26%)	7 (20.00%)	0.24
Previous stroke/TIA, n (%)	4 (10.26%)	2 (5.71%)	0.48
CHA2DS2 VASc, mean ± SD	2.44 ± 1.39	2.29 ± 1.56	0.66
Previous AF ablation, n (%)	8 (38.10%)	13 (39.9%)	0.92
Antiarrhythmic drugs			
Echocardiographic parameters			
LA diameter, mm	44 ± 6.55	44 ± 8.64	0.92
LA Area, cm^2	25 ± 5.7	29 ± 15.57	0.22
Ejection fraction, (%)	58 ± 6.25	58 ± 6.37	0.92
Procedure characteristics			
Mapping Systems Carto, n (%)	33 (87.18%)	17 (48.57%)	0.01
Mapping Systems Ensite, n (%)	5 (12.82%)	3 (8.57%)	056
Mapping Systems Rhythmia, n(%)	0	15 (42.86%)	NA
Arrhythmias location, n (%)			
Right flutter	6 (15.79%)	4 (11.43%)	0.59
Left flutter			
- Roof dependent	10 (26.32%)	12 (34.29%)	0.46
- Mitral dependent	12 (31.58%)	15 (42.86%)	0.32
- Others	3 (7.89%)	10 (28.57%)	0.02
Pacing maneuvers (PPI), n (%)	20 (53%)	3 (8%)	0.05
Ablation approaches, n (%)			
PVI	27 (71.05%)	20 (57.14%)	0.28
Roof line	11 (28.95%)	12 (34.28%)	0.38
Mitral lines	13 (34.21%)	14 (40.00%)	0.44
Posterior box	4 (10.52%)	3 (8.57%)	0.53
Procedural data			
Procedure time, min	231 ± 65.30	220 ± 68.52	0.55
Total DAP (Gy * cm^2)	14 ± 20.19	11 ± 10.54	0.58
Ablation SR restoration, n (%)	22 (56.41%)	27 (79.41%)	0.04
Electrical cardioversion, n (%)	12 (31.58%)	6 (17.65%)	0.17

Clinical impact of high-density mapping on the acute and long term outcome of atypical atrial futter ablations Andrea Di Cori1, Lorenzo Mazzocchetti1, Matteo Parollo1, Mario Giannotti, Antonio Canu1 · Valentina Barletta1, Salvatore della Volpe1, Rafaele De Lucia1, Stefano Viani1, Luca Segreti1, Ezio Soldati1, Giulio Zucchelli, Maria Grazia Bongiorni1 Received: 2 September 2021 / Accepted: 5 January 2022

IMPATTO CLINICO DEL MAPPAGGIO AD ALTA DENSITÀ

Tasso complessivo di recidiva di AFL/AT/AF a 1, 2 e 3 anni era inferiore nel gruppo HD (14% vs 37% p=0,02, 14% vs 48% p=0,002 e 14% vs 50% p<0,001, rispettivamente) con un trend dipendente dal tempo solo nel gruppo LD (37% vs 48% vs 50% rispettivamente a 1, 2 e 3 anni, p=0,059).



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TECNOLOGIA

1) Contact Force

2) Automapping

3) High-density mapping e algoritmi specifici

4) Energie di erogazione

FIGURE 1. FARAWAVE catheter. 12 French over-the-wire catheter that has five splines with four electrodes each. Figure showing basket and flower pose. Previously published. Ekanem E, Reddy VY, Schmidt B, *et al.*; MANIFESTPF Cooperative. Multinational survey on the methods, efficacy, and safety on the postapproval clinical use of pulsed field ablation (MANIFESTPF). *Europace* 2022 Sep 1;24(8):1256–1266. Permission obtained provided by Oxford University Press and Copyright Clearance Center. License Number 5602600774022.

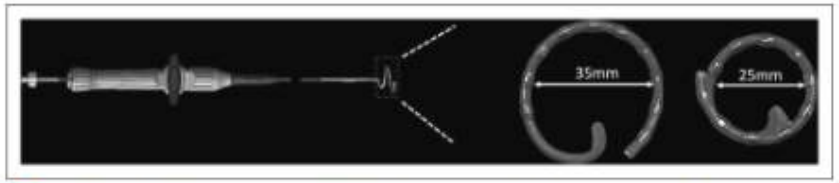


FIGURE 3. VARIPULSE catheter. An 8.5 French, 10 irrigated electrode catheter than can change from 25 to 35 mm diameter. Previously published. Yavin H, Brem E, Zilberman I, *et al.* Circular multielectrode pulsed field ablation catheter lasso pulsed field ablation. Lesion characteristics, durability, and effect on neighboring structures. *Circulation: Arrhythmia and Electrophysiology* 2021;14: e009229. Permission obtained. License number 5602601318610 provided by Wolters Kluwer Health, Inc. and Copyright Clearance Center.

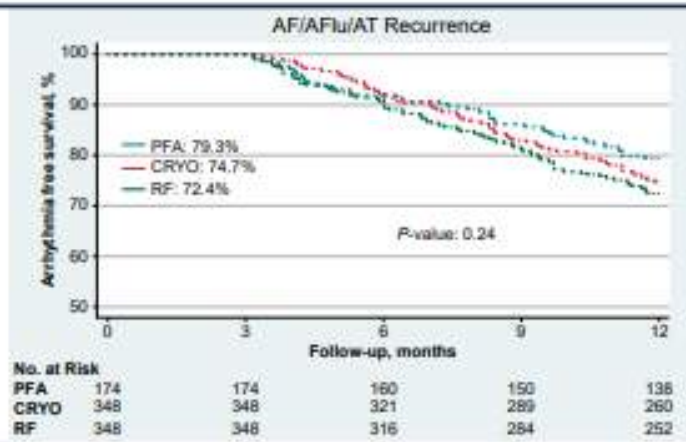
FIGURE 4. SHERE-9 catheter. The catheter has a 9 mm compressible lattice spherical tip with nine nodes, deflectable and 8 French profile. Previously published. https://news.medtronic.com/2022-12-05-Medtronic-completes-enrollment-in-pivotal-trial-evaluating-first-of-its-kind-pulsed-field-ablation-catheter-for-patients-with-atrial-fibrillation. Authorized by Medtronic.

FIGURE 2. PULSESELECT catheter. It is a circular, over the wire, 9 French, 25 mm diameter with nine electrodes. Previously published. https://news.medtronic.com/2023-03-06-Medtronic-PulseSelect-PFA-System-demonstrates-impressive-results-in-landmark-PULSED-AF-global-IDE-trial. Authorized by Medtronic.

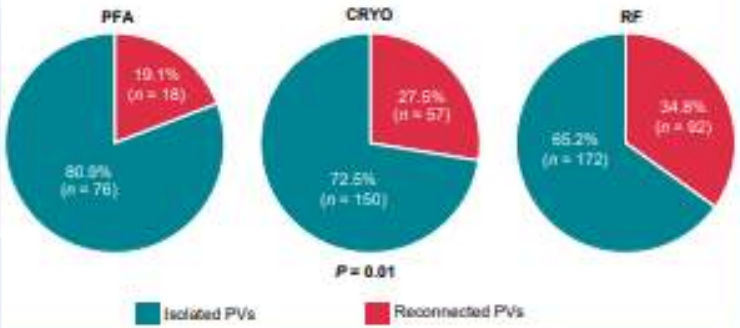
1572 Paroxysmal AF patients undergoing pulmonary vein isolation (4 institutions)

1:2:2 Propensity score-matching comparison

	174 Patients	348 Patients	348 Patients	
Procedural Time, min	52 ± 15	65 ± 22	85 ± 25	<0.001
Fluoroscopy Time, min	15 ± 3	18 ± 8	13 ± 7	<0.001
Major Complications	1.1% (*n* = 2)	1.1% (*n* = 4)	0.9% (*n* = 3)	0.92
Minor Complications	2.3% (*n* = 4)	7.5% (*n* = 26)	4.6% (*n* = 16)	0.034



PV Reconnection (145 redo procedures)



Durability of pulmonary vein isolation for atrial fibrillation: a meta-analysis and systematic review

Teodor Serban [1,2], Diego Mannhart [1,2], Qurrat-ul-ain Abid [3], Andres Höchli[4], Sorin Lazar [5], Philipp Krisai [1,2], Arianna Sofia Bettelini[1,2], Sven Knecht [1,2], Michael Kühne [1,2], Christian Sticherling [1,2], Jeanne du Fay de Lavallaz [1,2†], and Patrick Badertscher [1,2*†]

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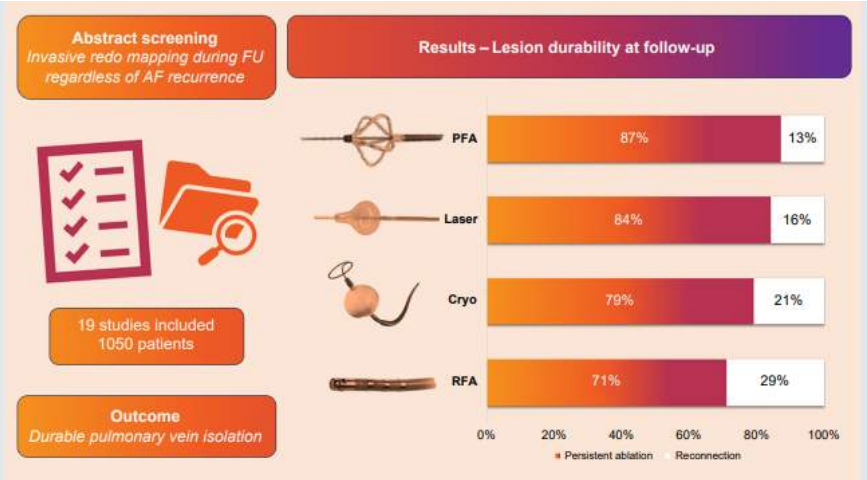


CASO CLINICO

C.M. Donna di 76 anni

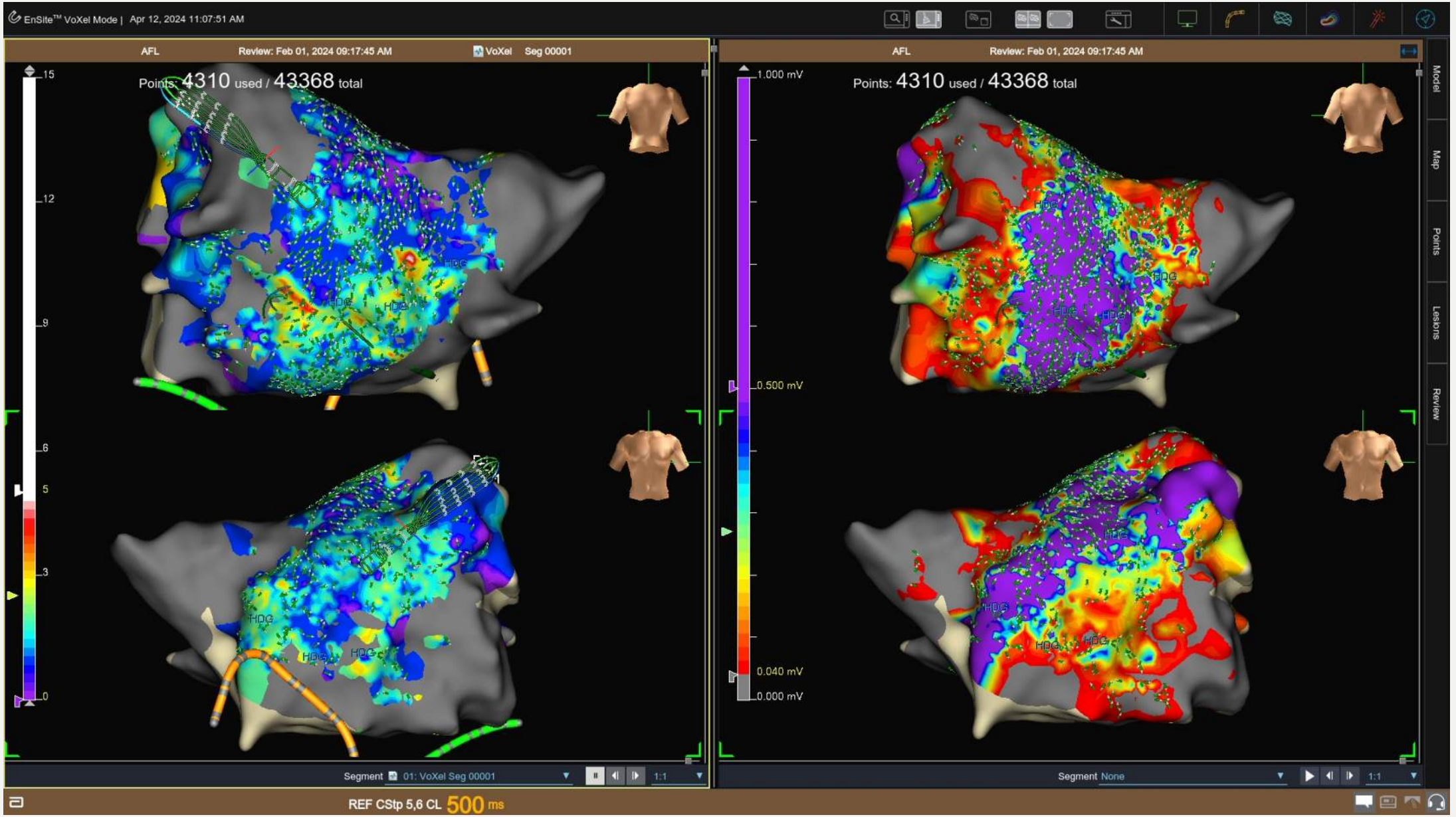
Anamnesi patologica remota

- Cardiopatia valvolare: sostituzione valvolare aortica con bioprotesi Perimount 21 per stenosi aortica severa sintomatica nel 2011, normale anatomia coronarica. FE conservata.
- Aritmie atriali ricorrenti dal 2011: ablazione TC mediante RF con isolamento delle VVPP nel 2016. Ricorrenza di aritmie (verosimile flutter tipico comune) a rapida

Anamnesi patologica prossima

- Da ottobre 2023 ripetuti accessi in DEA per cardiopalmo con riscontro di FLA ad media penetranza e di FA. Posta indicazione a re-do di ablazione TC.

EnSite™ VoXel Mode | Apr 12, 2024 12:04:01 PM
AFL
Review: Feb 01, 2024 09:17:45 AM
VoXel Auto Model Collection
25 mm/s
0 ms
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
ECG I (55)
ECG II (55)
ECG III (55)
ECG aVR (55)
ECG aVL (55)
ECG aVF (55)
ECG V1 (55)
ECG V2 (55)
ECG V3 (55)
ECG V4 (55)
ECG V5 (55)
ECG V6 (55)
Model
Map
Points
Lesions
Review
12:17:43.504
Segment 135: VoXel Auto Model Collection
2:1
REF ECG I CL 743 ms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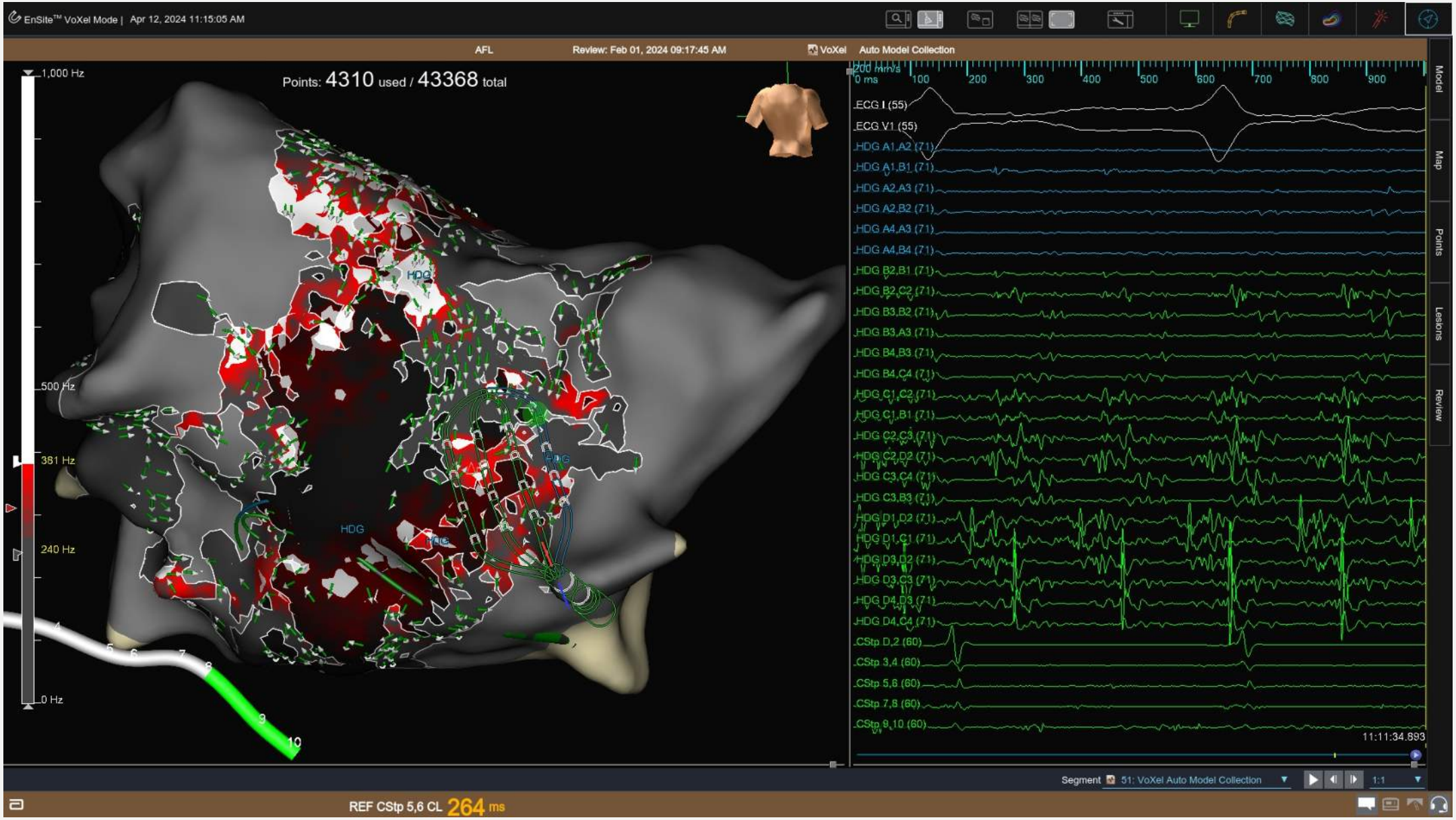
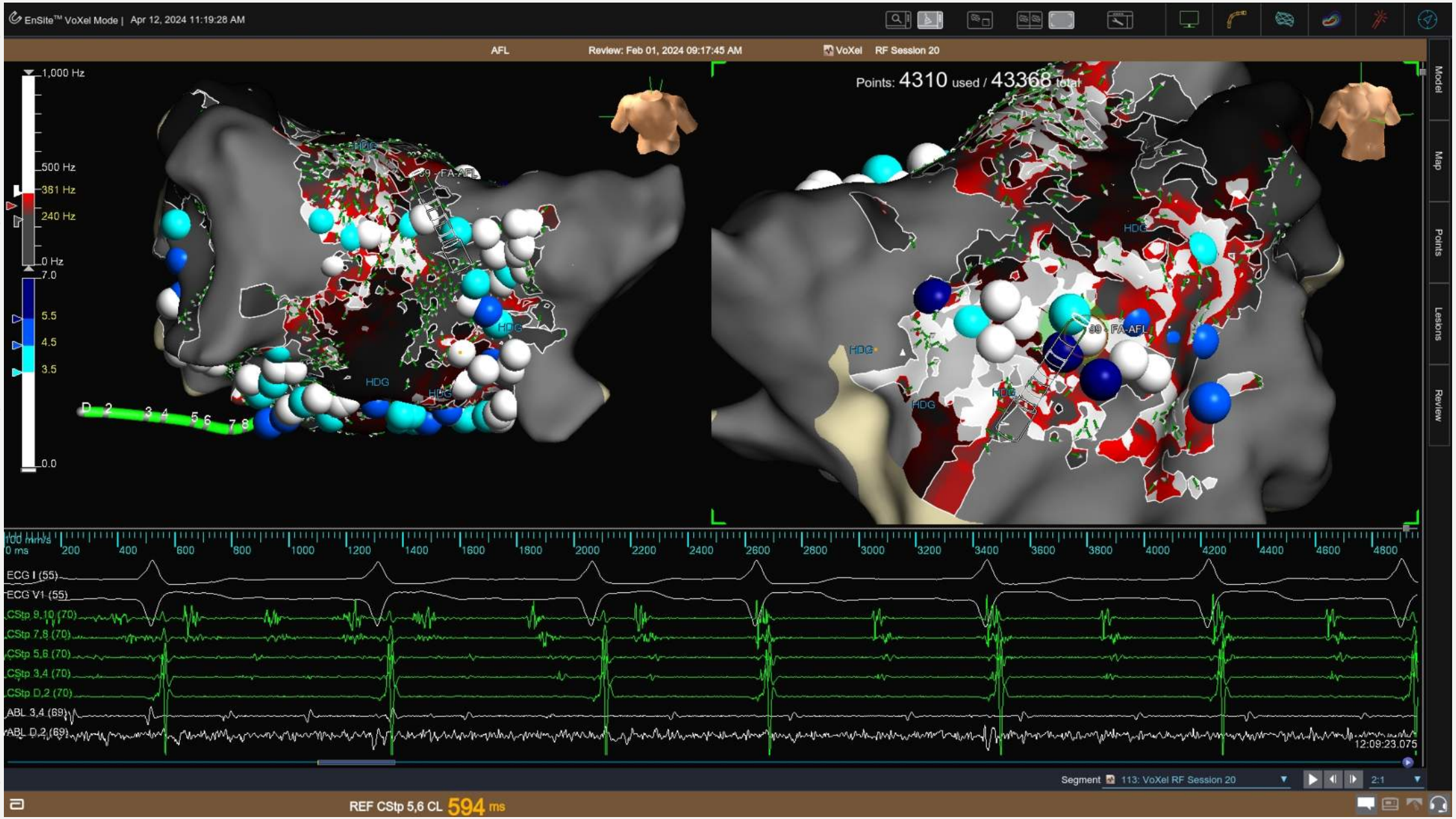
AFL
Review: Feb 01, 2024 09:17:45 AM
VoXel Seg 00001
Points: 4310 used / 43368 total
15
12
9
6
5
3
0
HDG
AFL
Review: Feb 01, 2024 09:17:45 AM
Points: 4310 used / 43368 total
1.000 mV
0.500 mV
0.040 mV
0.000 mV
Model
Map
Points
Lesions
Review
Segment 01: VoXel Seg 00001
1:1
Segment None
1:1
REF CStp 5,6 CL 500 ms


EnSite™ VoXel Mode | Apr 12, 2024 11:15:05 AM
AFL
Review: Feb 01, 2024 09:17:45 AM
VoXel
Auto Model Collection
Points: 4310 used / 43368 total
1,000 Hz
500 Hz
381 Hz
240 Hz
0 Hz
HDG
200 mm/s
0 ms
100
200
300
400
500
600
700
800
900
ECG I (55)
ECG V1 (55)
HDG A1,A2 (71)
HDG A1,B1 (71)
HDG A2,A3 (71)
HDG A2,B2 (71)
HDG A4,A3 (71)
HDG A4,B4 (71)
HDG B2,B1 (71)
HDG B2,C2 (71)
HDG B3,B2 (71)
HDG B3,A3 (71)
HDG B4,B3 (71)
HDG B4,C4 (71)
HDG C1,C2 (71)
HDG C1,B1 (71)
HDG C2,C3 (71)
HDG C2,D2 (71)
HDG C3,C4 (71)
HDG C3,B3 (71)
HDG D1,D2 (71)
HDG D1,C1 (71)
HDG D3,D2 (71)
HDG D3,C3 (71)
HDG D4,D3 (71)
HDG D4,C4 (71)
CStp D,2 (60)
CStp 3,4 (60)
CStp 5,6 (60)
CStp 7,8 (60)
CStp 9,10 (60)
11:11:34.893
Model
Map
Points
Lesions
Review
Segment
51: VoXel Auto Model Collection
1:1
REF CStp 5,6 CL 264 ms


EnSite™ VoXel Mode | Apr 12, 2024 11:19:28 AM
AFL
Review: Feb 01, 2024 09:17:45 AM
VoXel RF Session 20
1,000 Hz
500 Hz
381 Hz
240 Hz
0 Hz
7.0
5.5
4.5
3.5
0.0
Points: 4310 used / 43368 total
HDG
39 - FA-AFL
Model
Map
Points
Lesions
Review
ECG I (55)
ECG V1 (55)
CStp 9,10 (70)
CStp 7,8 (70)
CStp 5,6 (70)
CStp 3,4 (70)
CStp D,2 (70)
ABL 3,4 (69)
ABL D,2 (69)
12:09:23.075
Segment 113: VoXel RF Session 20
2:1
REF CStp 5,6 CL 594 ms

EnSite™ VoXel Mode | Apr 12, 2024 12:03:34 PM
AFL
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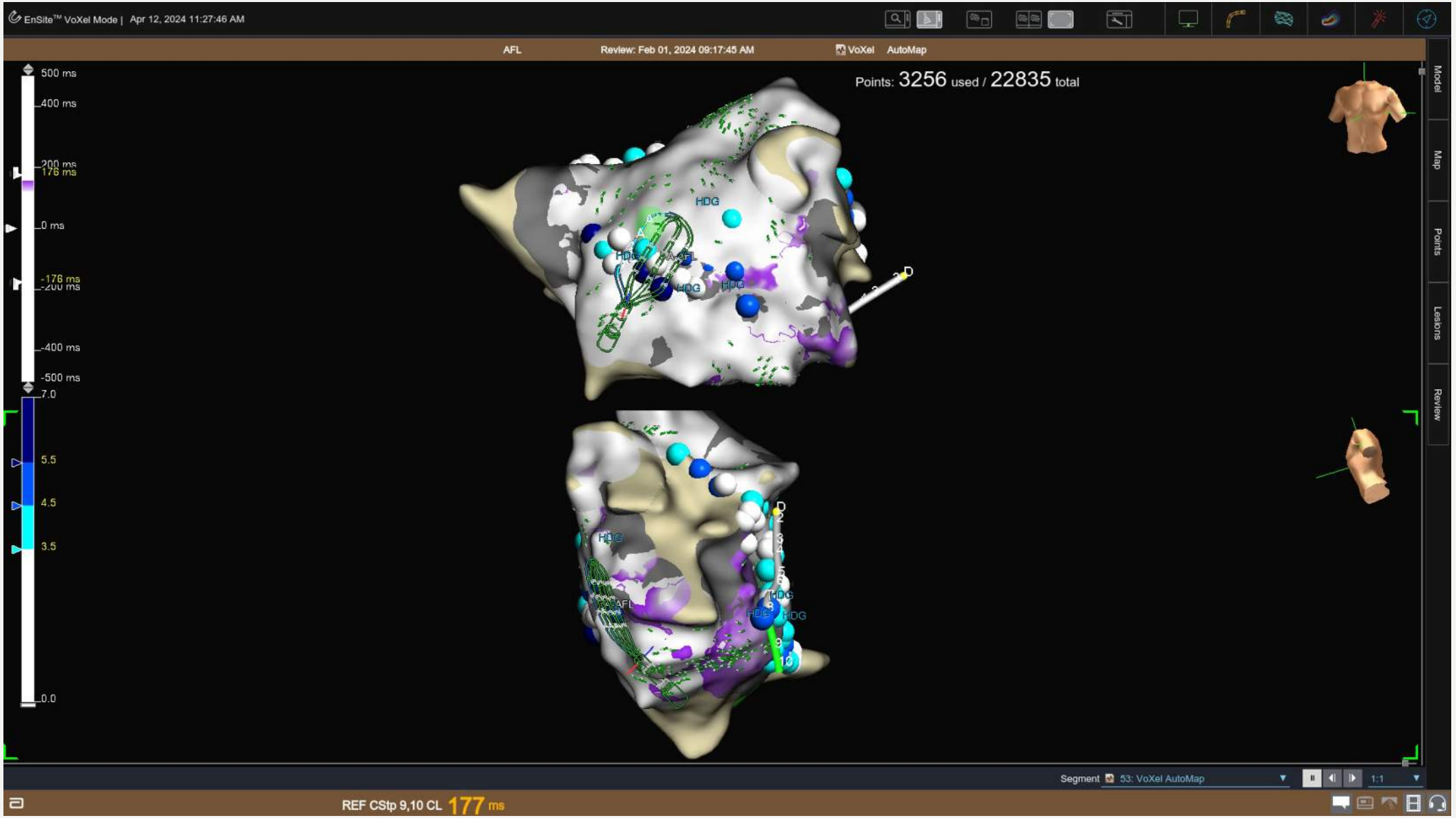
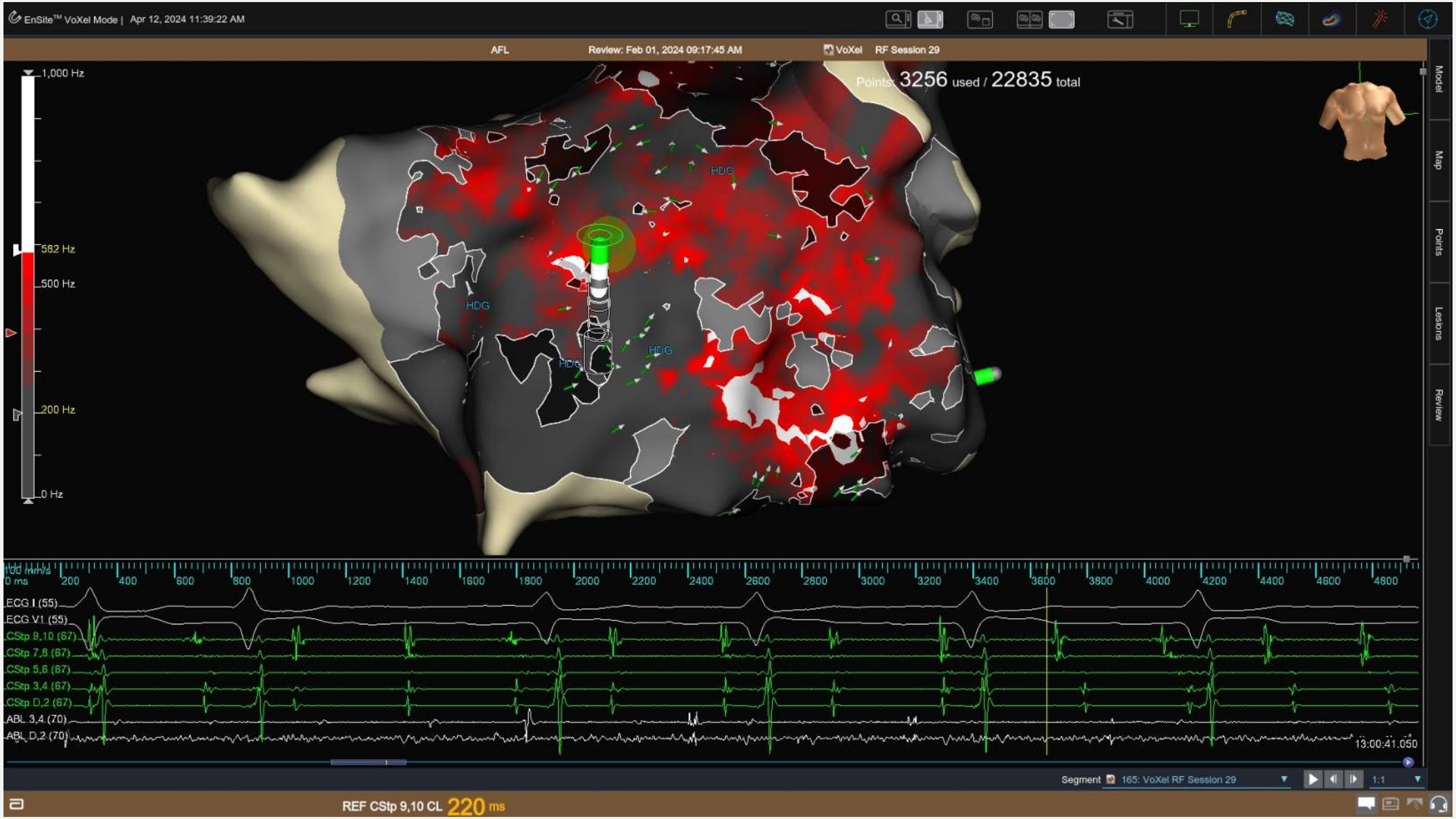
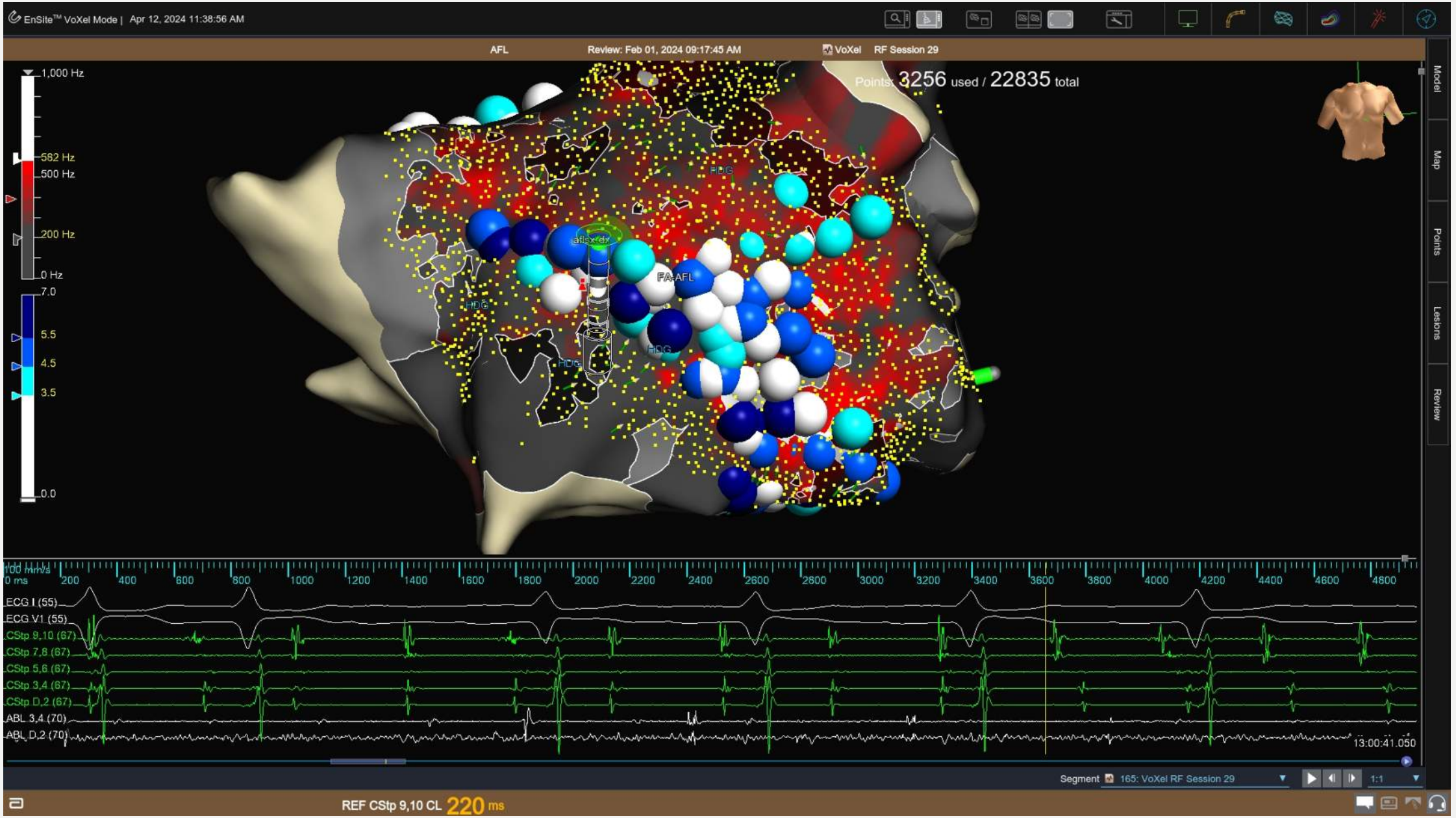
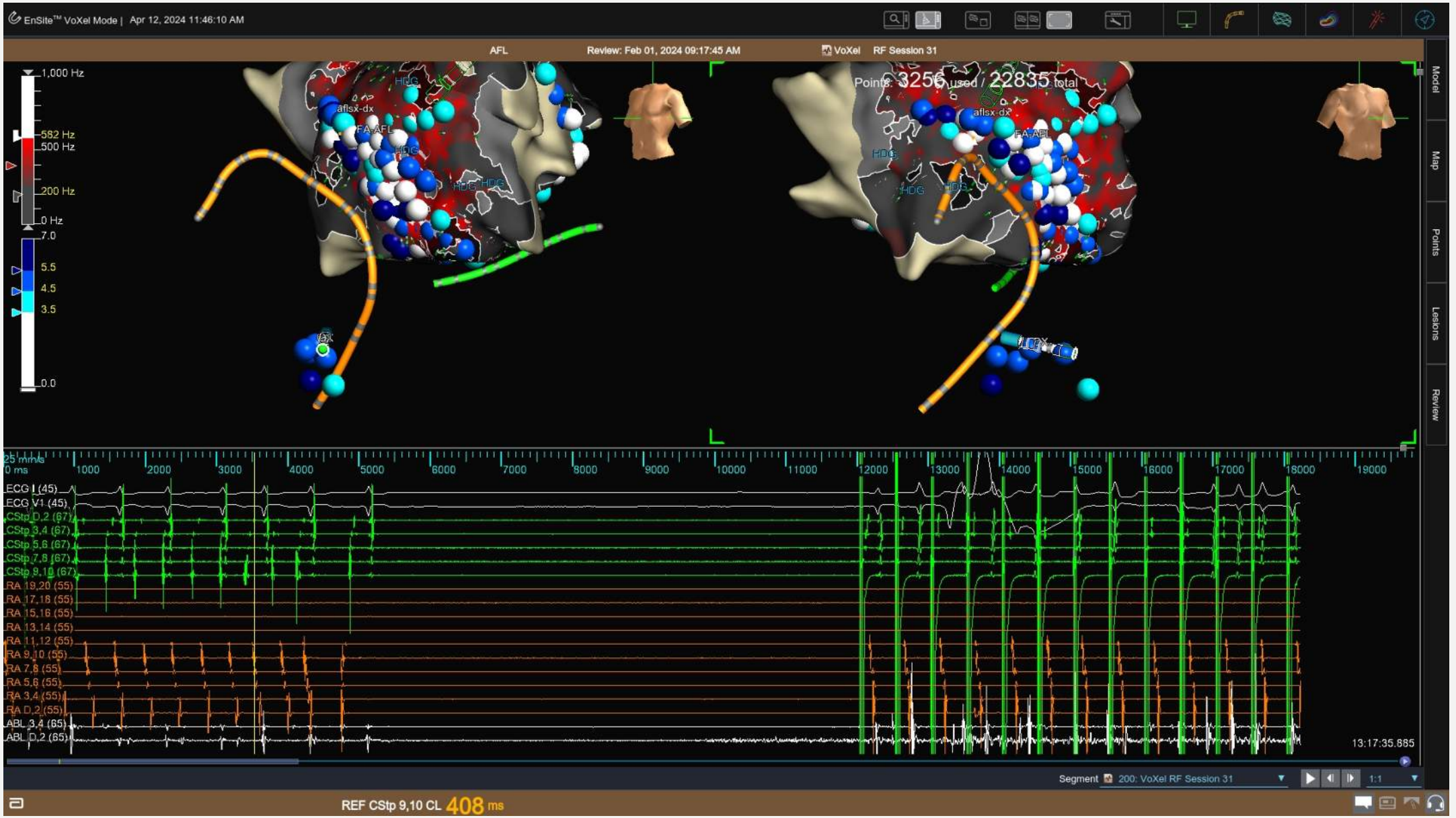
VoXel Auto Model Collection
0 ms
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
4200
4400
4600
4800
ECG I (55)
ECG II (55)
ECG III (55)
ECG aVR (55)
ECG aVL (55)
ECG aVF (55)
ECG V1 (55)
ECG V2 (55)
ECG V3 (55)
ECG V4 (55)
ECG V5 (55)
ECG V6 (55)
ABL D,2 (78)
ABL 3,4 (78)
CStp D,2 (67)
CStp 3,4 (67)
CStp 5,6 (67)
CStp 7,8 (67)
CStp 9,10 (67)
12:17:30.745
Segment 135: VoXel Auto Model Collection
1:1
Model
Map
Points
Lesions
Review
REF ECG I CL 664 ms

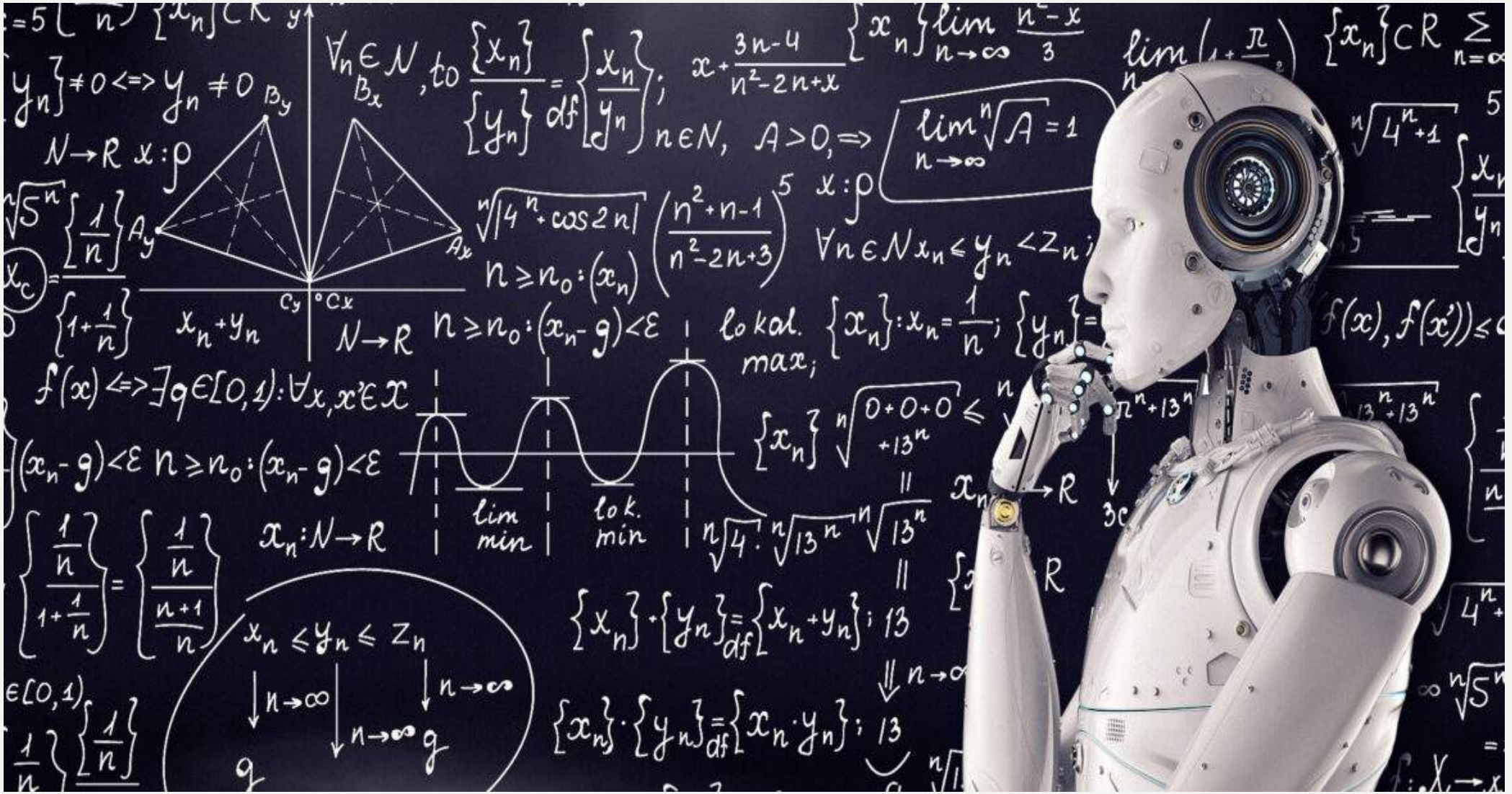

EnSite™ VoXel Mode | Apr 12, 2024 11:27:46 AM
AFL
Review: Feb 01, 2024 09:17:45 AM
VoXel AutoMap
Points: 3256 used / 22835 total
500 ms
400 ms
200 ms
176 ms
0 ms
-176 ms
-200 ms
-400 ms
-500 ms
7.0
5.5
4.5
3.5
0.0
HDG
AFL
Model
Map
Points
Lesions
Review
Segment 53: VoXel AutoMap
1:1
REF CStp 9,10 CL 177 ms


EnSite™ VoXel Mode | Apr 12, 2024 11:39:22 AM
AFL
Review: Feb 01, 2024 09:17:45 AM
VoXel RF Session 29
1,000 Hz
582 Hz
500 Hz
200 Hz
0 Hz
Points: 3256 used / 22835 total
HDG
HDG
HDG
HDG
Model
Map
Points
Lesions
Review
100 mm/s
0 ms
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
4200
4400
4600
4800
ECG I (55)
ECG V1 (55)
CStp 9,10 (67)
CStp 7,8 (67)
CStp 5,6 (67)
CStp 3,4 (67)
CStp D,2 (67)
ABL 3,4 (70)
ABL D,2 (70)
13:00:41.050
Segment 165: VoXel RF Session 29
1:1
REF CStp 9,10 CL 220 ms


EnSite™ VoXel Mode | Apr 12, 2024 11:38:56 AM
AFL
Review: Feb 01, 2024 09:17:45 AM
VoXel
RF Session 29
Points: 3256 used / 22835 total
1,000 Hz
582 Hz
500 Hz
200 Hz
0 Hz
7.0
5.5
4.5
3.5
0.0
FA-AFL
HDG
ECG I (55)
ECG V1 (55)
CStp 9,10 (67)
CStp 7,8 (67)
CStp 5,6 (67)
CStp 3,4 (67)
CStp D,2 (67)
ABL 3,4 (70)
ABL D,2 (70)
13:00:41.050
Segment 165: VoXel RF Session 29
REF CStp 9,10 CL 220 ms
Model
Map
Points
Lesions
Review


EnSite™ VoXel Mode | Apr 12, 2024 11:46:10 AM
AFL
Review: Feb 01, 2024 09:17:45 AM
VoXel RF Session 31
1,000 Hz
582 Hz
500 Hz
200 Hz
0 Hz
7.0
5.5
4.5
3.5
0.0
Points: 3256 used / 22835 total
aflsx-dx
FA-AFL
HDG
Model
Map
Points
Lesions
Review
25 mm/s
0 ms
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
ECG I (45)
ECG V1 (45)
CStp D,2 (67)
CStp 3,4 (67)
CStp 5,6 (67)
CStp 7,8 (67)
CStp 9,10 (67)
RA 19,20 (55)
RA 17,18 (55)
RA 15,16 (55)
RA 13,14 (55)
RA 11,12 (55)
RA 9,10 (55)
RA 7,8 (55)
RA 5,6 (55)
RA 3,4 (55)
RA D,2 (55)
ABL 3,4 (65)
ABL D,2 (65)
13:17:35.885
Segment 200: VoXel RF Session 31
1:1
REF CStp 9,10 CL 408 ms

LEARN
FROM THE
PAST
THINK
ABOUT THE
FUTURE
BUT
LIVE
NOW



GRAZIE PER L'ATTENZIONE