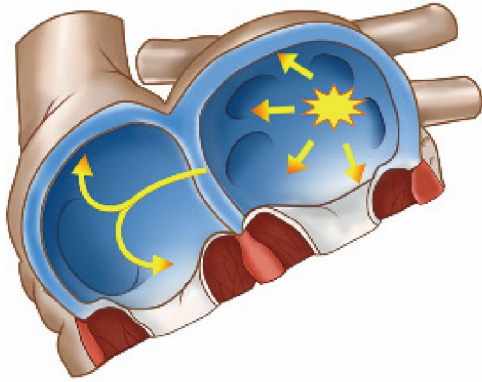


Impatto dell'intelligenza artificiale per la caratterizzazione del substrato della FA persistente

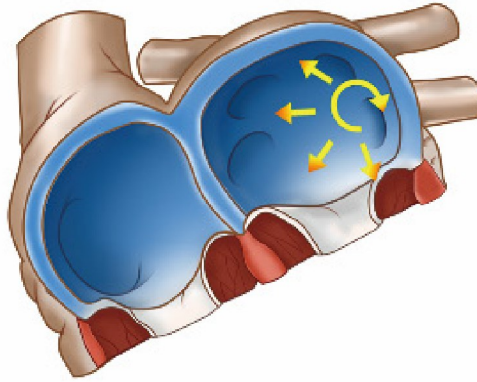
Dott.ssa Graziana Viola
UOC Cardiologia Ospedale SS Trinità
ASL 8 Cagliari



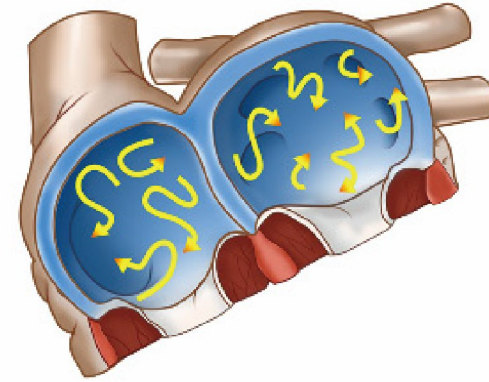
Classical AF mechanisms



Ectopic focus

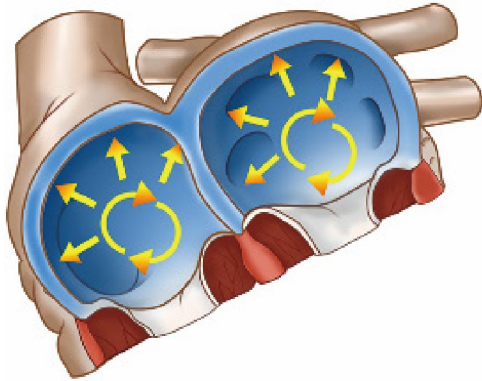


Single circuit re-entry

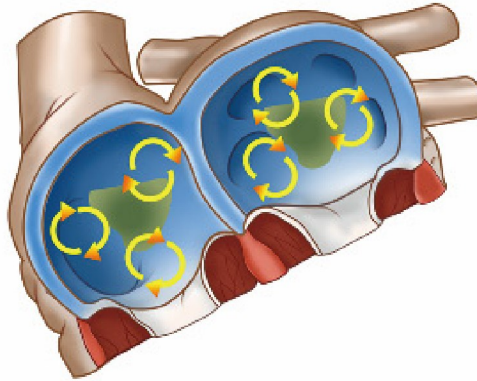


Multiple wandering wavelet

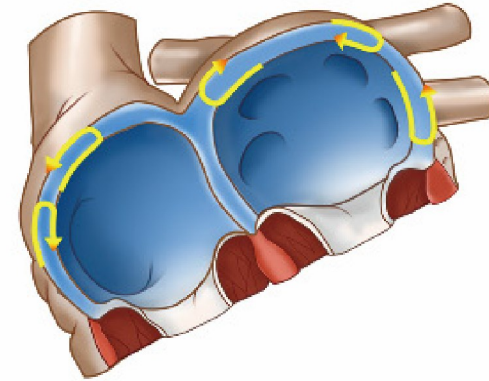
Novel mechanisms concepts



Stable rotors



Unstable rotors

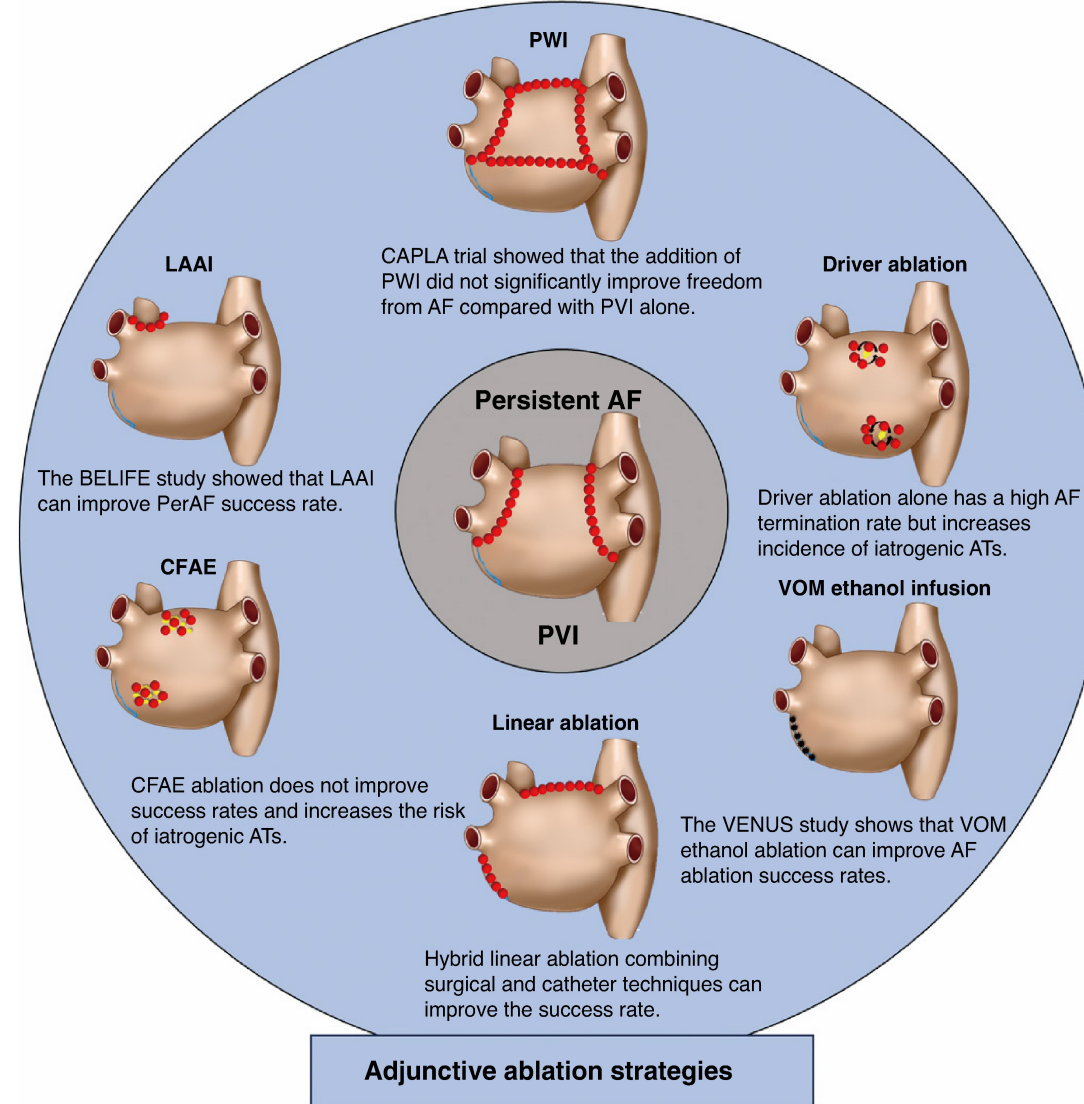


Epi-endo dissociation

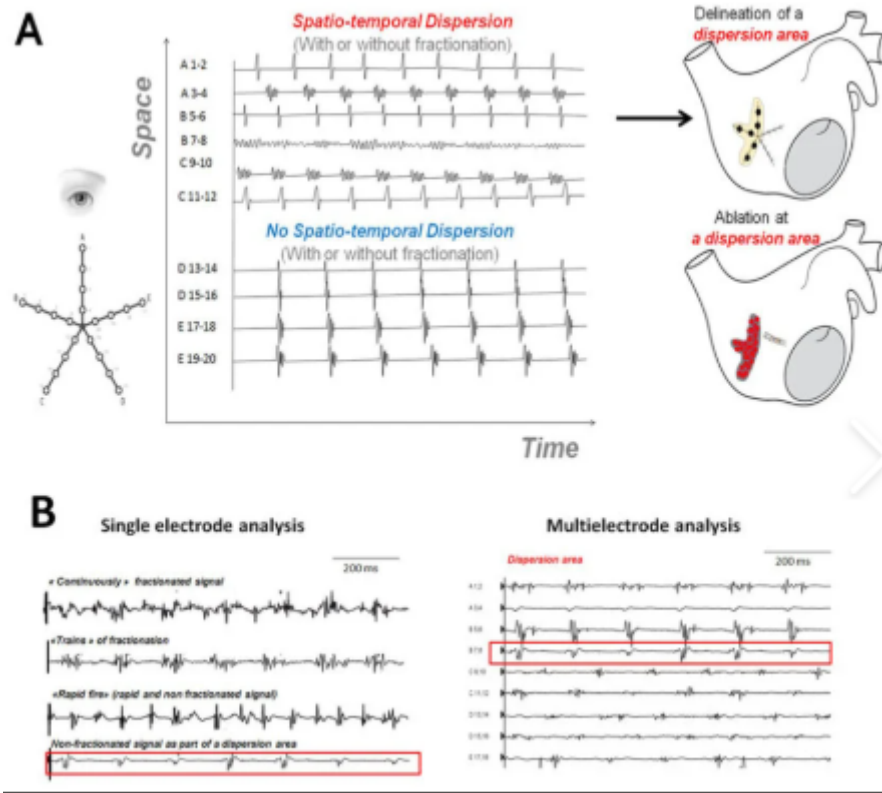
Adjunctive ablation strategies for persistent AF beyond PVI can be categorized into three main types:

- **Anatomical ablation: primarily linear ablation, including roof lines, mitral isthmus lines, and inferior lines;**
- **Electrogram-guided ablation: targeting fragmented potentials, focal potentials, low-voltage substrate modification, and drivers;**
- **Electro-anatomical guided ablation: incorporating linear ablation alongside electrogram-guided ablation, such as stepwise approach.**

Tecniche ablative attualmente utilizzate



DISPERSIONE SPAZIO TEMPORALE



Defined as clusters of adjacent bipolar electrograms exhibiting activation spanning the entire AF cycle length, this electrophysiological signature is thought to represent critical sites of microreentry, thus ensuring AF maintenance

Artificial intelligence for individualized treatment of persistent atrial fibrillation: a randomized controlled trial

- 374 patients randomized :188 were assigned to a tailored cardiac ablation procedure and 186 were assigned to a standard-of-care PVI procedure
- The primary efficacy endpoint was freedom from documented AF with or without antiarrhythmic drugs at 12 months after a single ablation procedure.
- Secondary endpoints included freedom from any atrial arrhythmic events, and the secondary composite safety endpoint consisted of death, cerebrovascular events, or treatment-related serious adverse events.

Artificial intelligence for individualized treatment of persistent atrial fibrillation: a randomized controlled trial

[Isabel Deisenhofer](#) , [Jean-Paul Albenque](#), [Sonia Busch](#), [Edouard Gitenay](#), [Stavros E. Mountantonakis](#), [Antoine Roux](#), [Jerome Horvilleur](#), [Babe Bakouboula](#), [Saumil Oza](#), [Selim Abbey](#), [Guillaume Theodore](#), [Antoine Lepillier](#), [Yves Guyomar](#), [Francis Bessiere](#), [Jaap Jan Smit](#), [Theophile Mohr Durdez](#), [Paola Milpied](#), [Anthony Appetiti](#), [Daniel Guerrero](#), [Tom De Potter](#), [Christian De Chillou](#), [Seth Goldbarg](#), [Atul Verma](#), [John D. Hummel](#) & [TAILORED-AF Investigators](#)

[Nature Medicine](#) (2025) | [Cite this article](#)

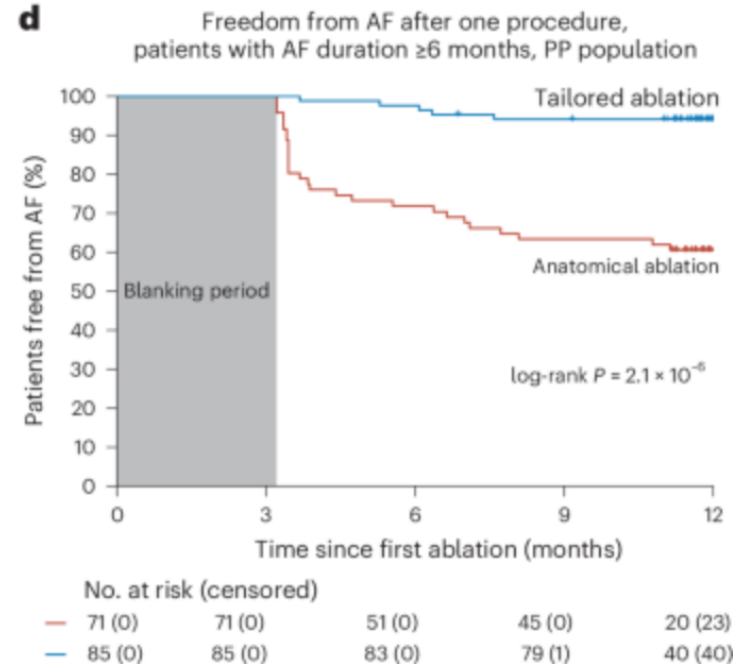
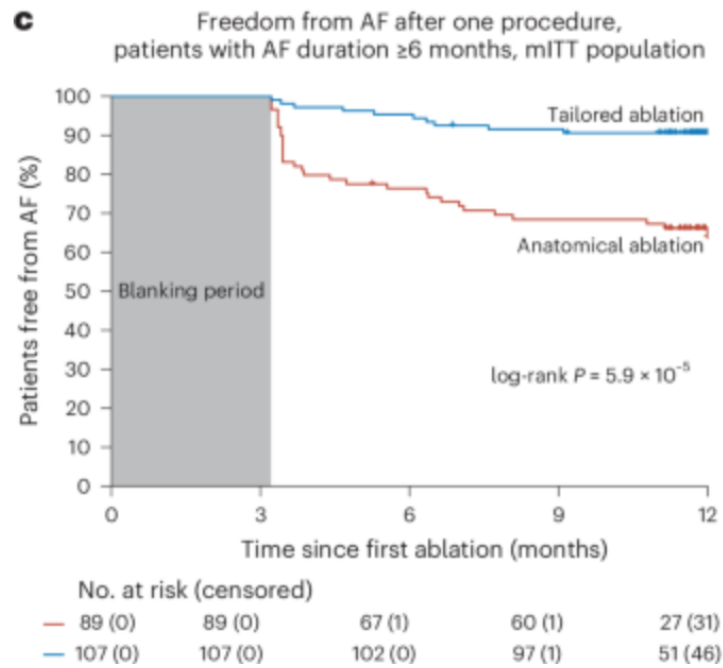
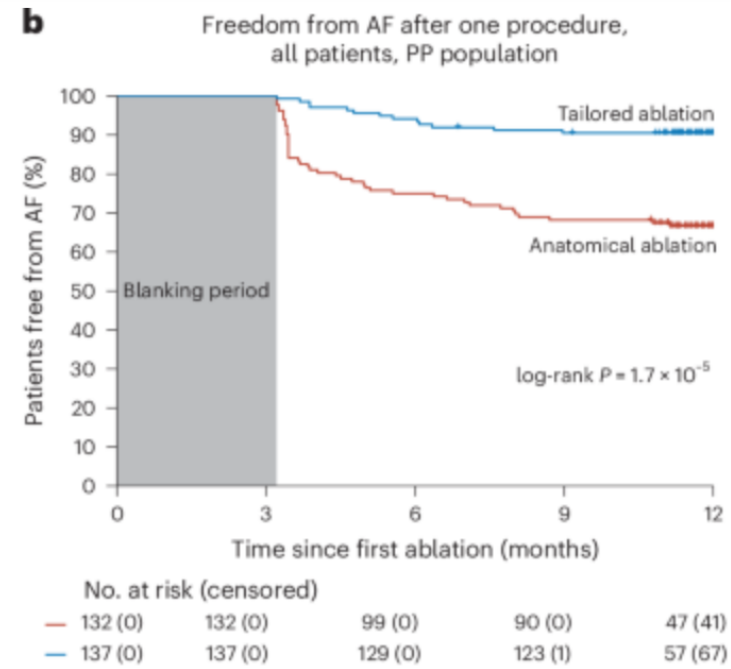
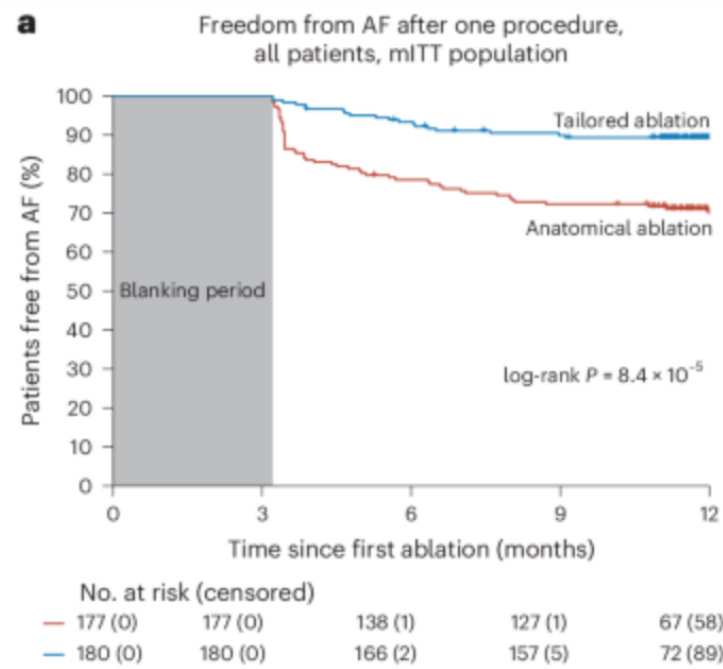
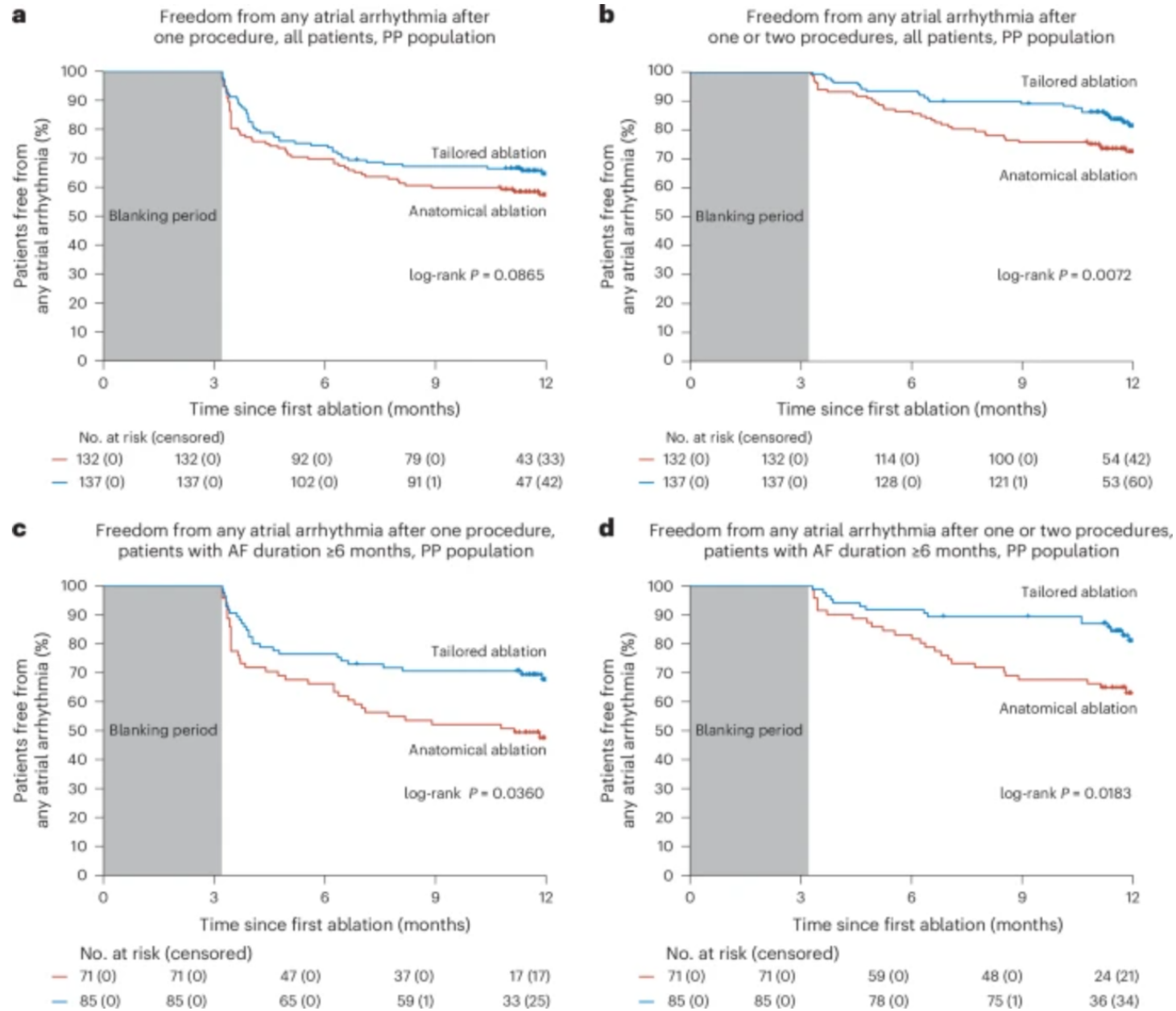
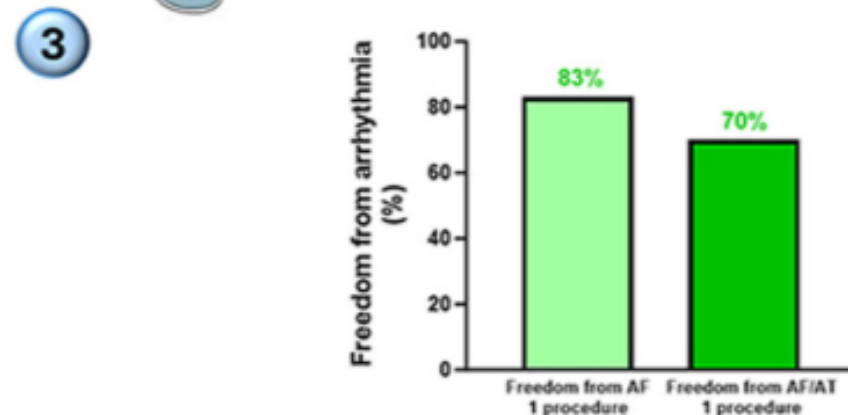
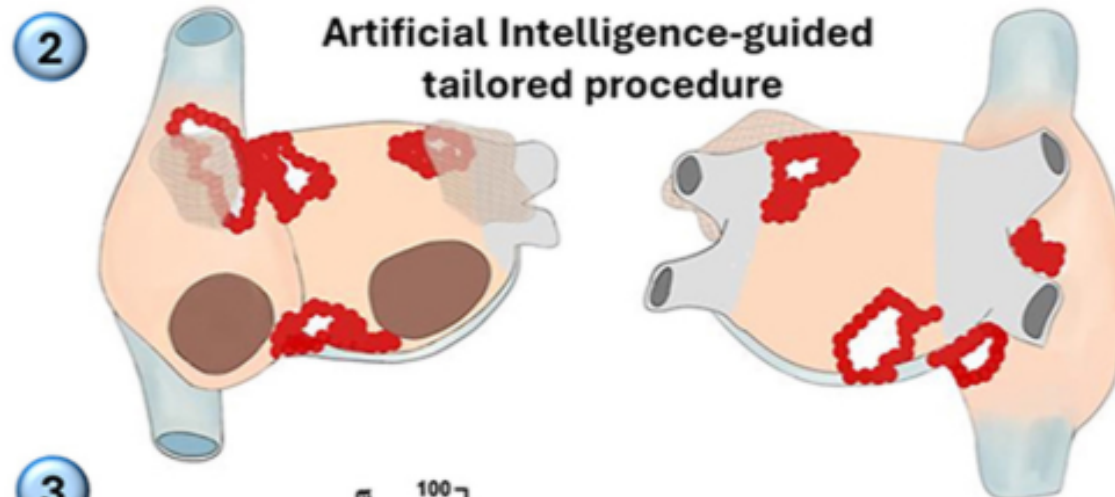
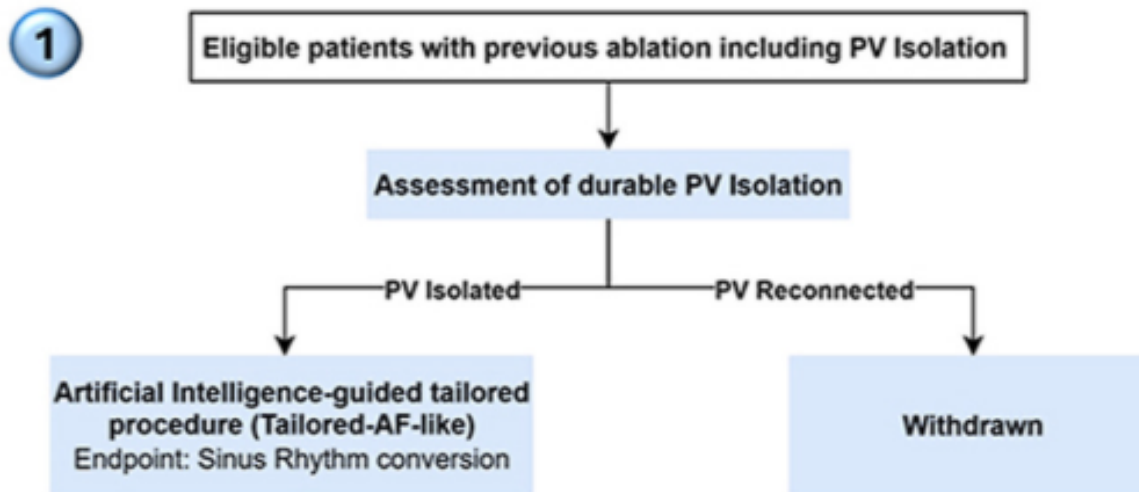


Fig. 3: Kaplan–Meier analysis of secondary effectiveness endpoints.





Hummel J, Zei P, Metzl M ...
**Reablation of atrial fibrillation targeting
electrogram dispersion in patients with isolated
veins: The RESTART trial**
Heart Rhythm, 2026; 23, 1083-1090

Exclusion criteria

1. Previous ablation procedure-related complication (e.g. fistula, perforation, etc.)
2. Previous ablation for long-standing persistent AF with a duration of greater than 24 months
3. Long-standing persistent AF recurrence (>1-year) prior to redo procedure
4. Previous AF ablation using VX1 software or Volta AF-Xplorer
5. Severe obesity (BMI > 50)
6. Very dilated Left Atrium (LA) (e.g. LA diameter > 55 mm and/or LA surface > 40 cm² determined by 2D echocardiography)
7. Patients with AF secondary to an obvious reversible cause
8. Inadequate anticoagulation as defined in the inclusion criteria
9. LA thrombus on Transesophageal Echocardiography (TEE)* or CT Scan prior to procedure
10. Contraindications to anticoagulation (heparin, warfarin or NOAC)
11. Patients who are or may potentially be pregnant
12. Any cardiac surgery except catheter ablation within the past 2 months (60 days) (includes PCI)
13. Myocardial infarction within the past 2 months (60 days)
14. Previous AV valve surgery
15. Patient diagnosed with hypertrophic cardiomyopathy
16. History of blood clotting or bleeding abnormalities
17. Documented arterial thromboembolic event (including TIA) within the past 12 months (365 days)
18. Rheumatic Heart Disease
19. Cardiac Sarcoidosis
20. Chronic severe Heart Failure (NYHA functional class IV and/or LVEF < 25%)
21. Awaiting cardiac transplantation or other cardiac surgery within the next 12 months (365 days)
22. Unstable angina within the past month
23. Acute illness or active systemic infection or sepsis
24. AF secondary to electrolyte imbalance, thyroid disease, or reversible or non-cardiac cause

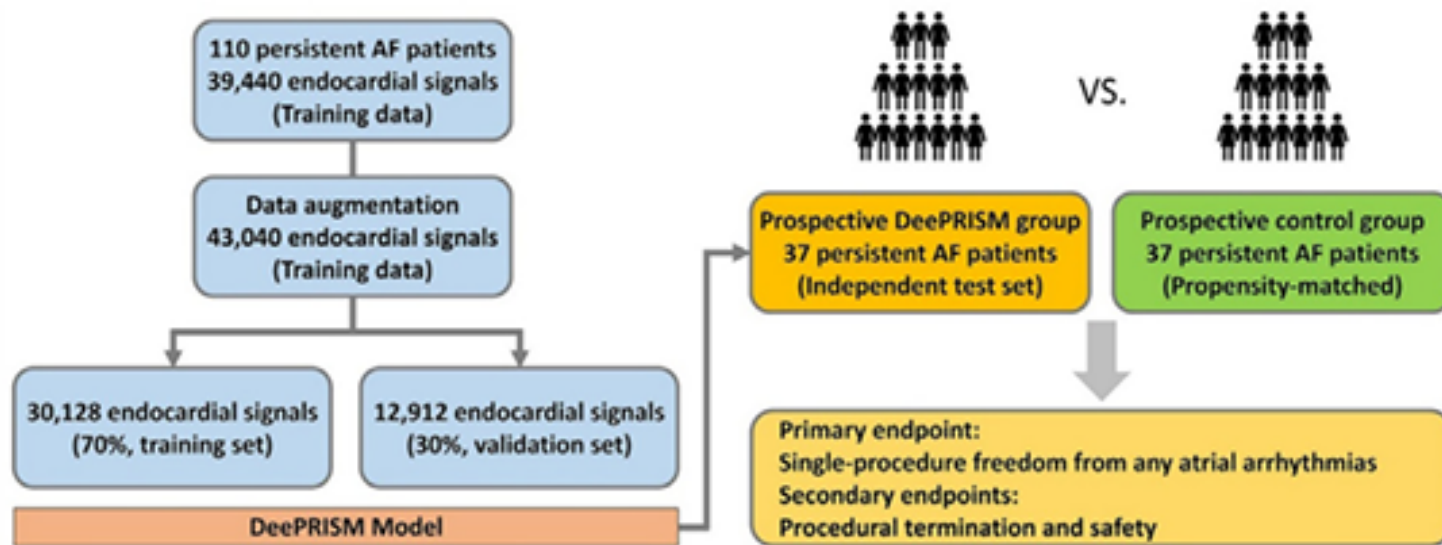
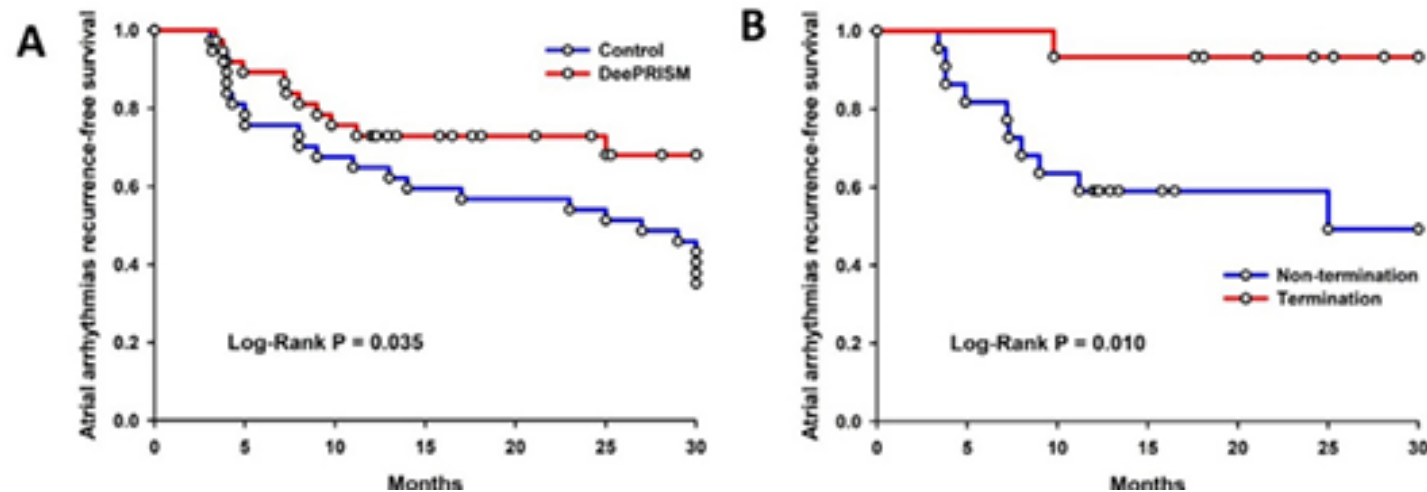


Figure 1. The flowchart of the study population.

Dee PRISM

- Morphological Repetitiveness by Periodicity and Similarity
- L'algoritmo predice siti di terminazione della FA
- 40% Terminazione acuta
- 70% liberi da aritmia

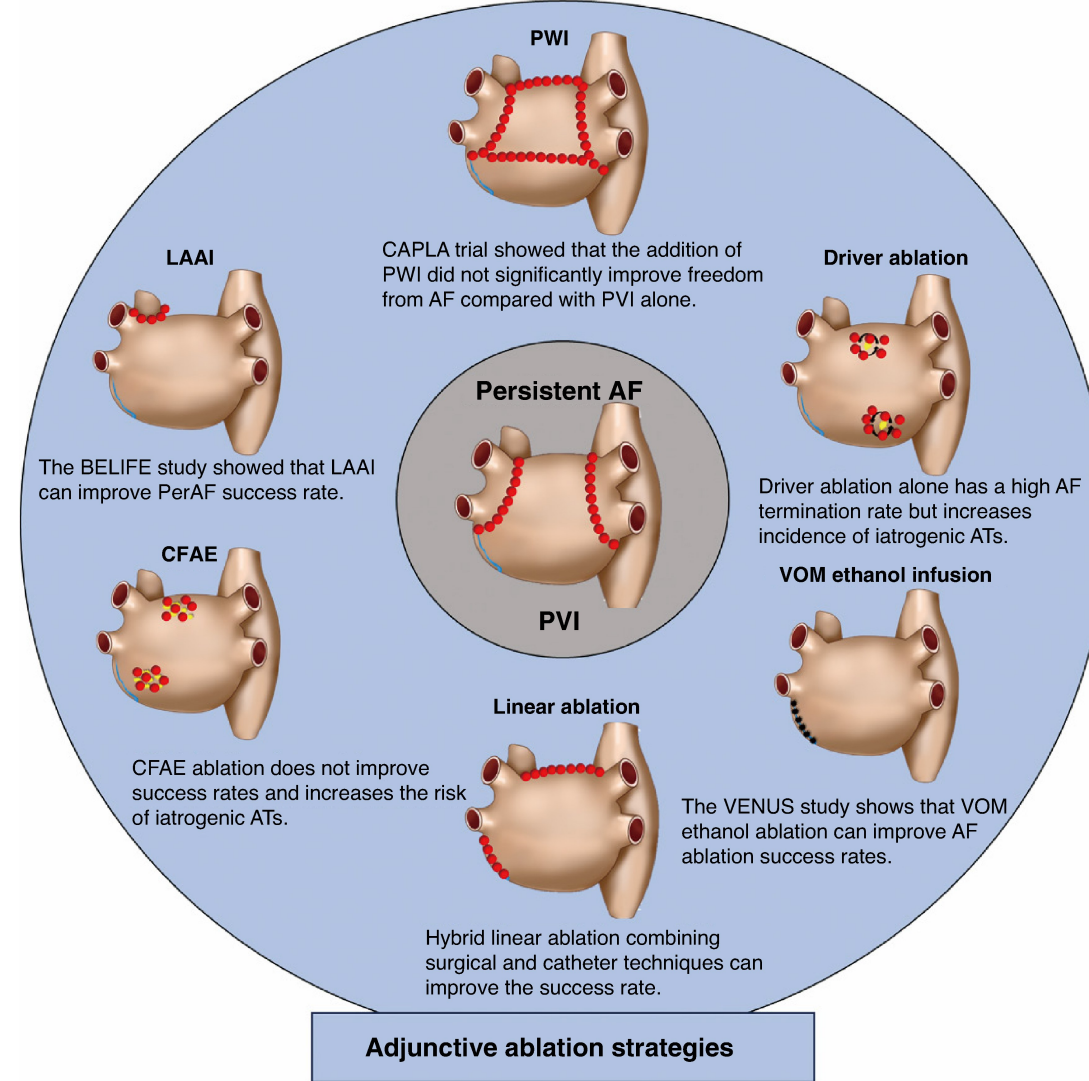


Liu C, Chiang C, Lin Y ...

DH-499637-005 ARTIFICIAL INTELLIGENCE-DRIVEN PRECISION ABLATION IN PERSISTENT AF: ENHANCING ENDOCARDIAL SIGNAL PREDICTION FOR ABLATION SUCCESS

Heart Rhythm, 22, S12-S13

RF ABLATION ONLY!!!



DIGITAL TWIN

Digital twins create patient-specific virtual heart models based on anatomical and physiological data, offering a promising approach for personalized ablation simulations

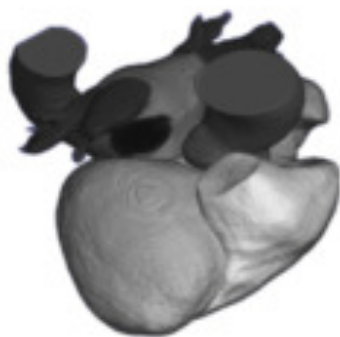
An effective digital twin for AF must integrate three critical components:

- detailed biophysical models that simulate the underlying electrophysiological and structural mechanisms of the heart,
- real-time patient-specific data to update and refine the model dynamically,
- the ability to make clinically relevant predictions to support decision-making in AF management

3D reconstruction



Patient MRI/CT imaging

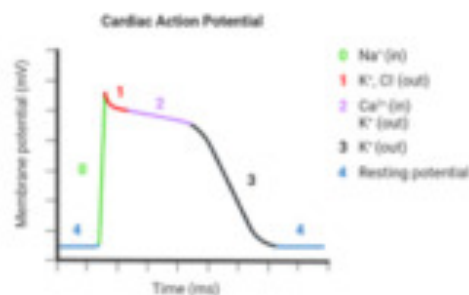


Automatic segmentation and 3D reconstruction

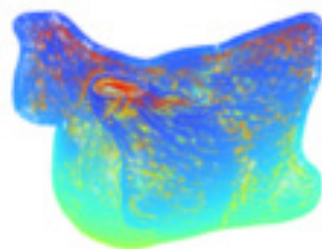
Patient-specific AF biophysics model



Tissue/organ level properties



Electrophysiological properties



Fibrosis distribution/Fibre orientation

Explore ablation plan

AF induction pacing protocol

Identify ablation targets

Perform virtual ablations

Identify emergent ablation targets

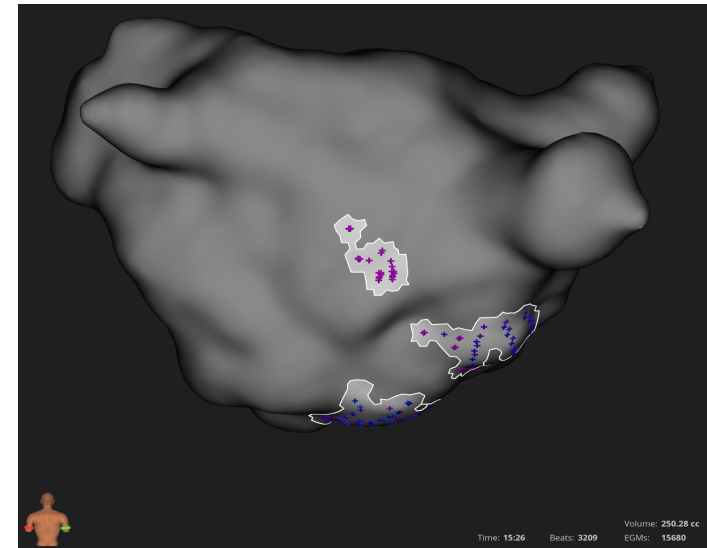
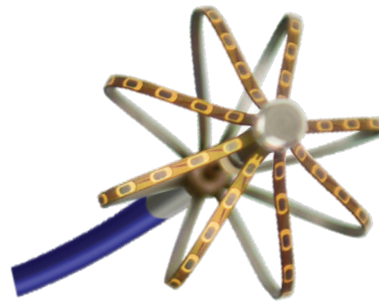
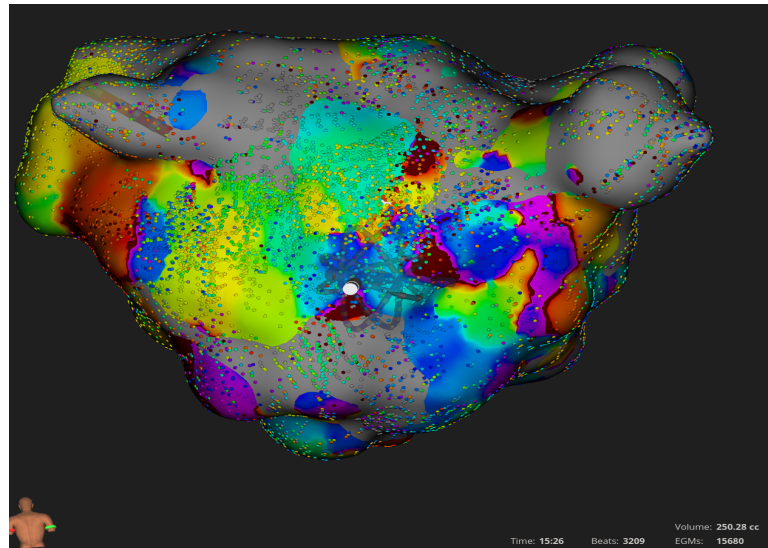
Yes

No



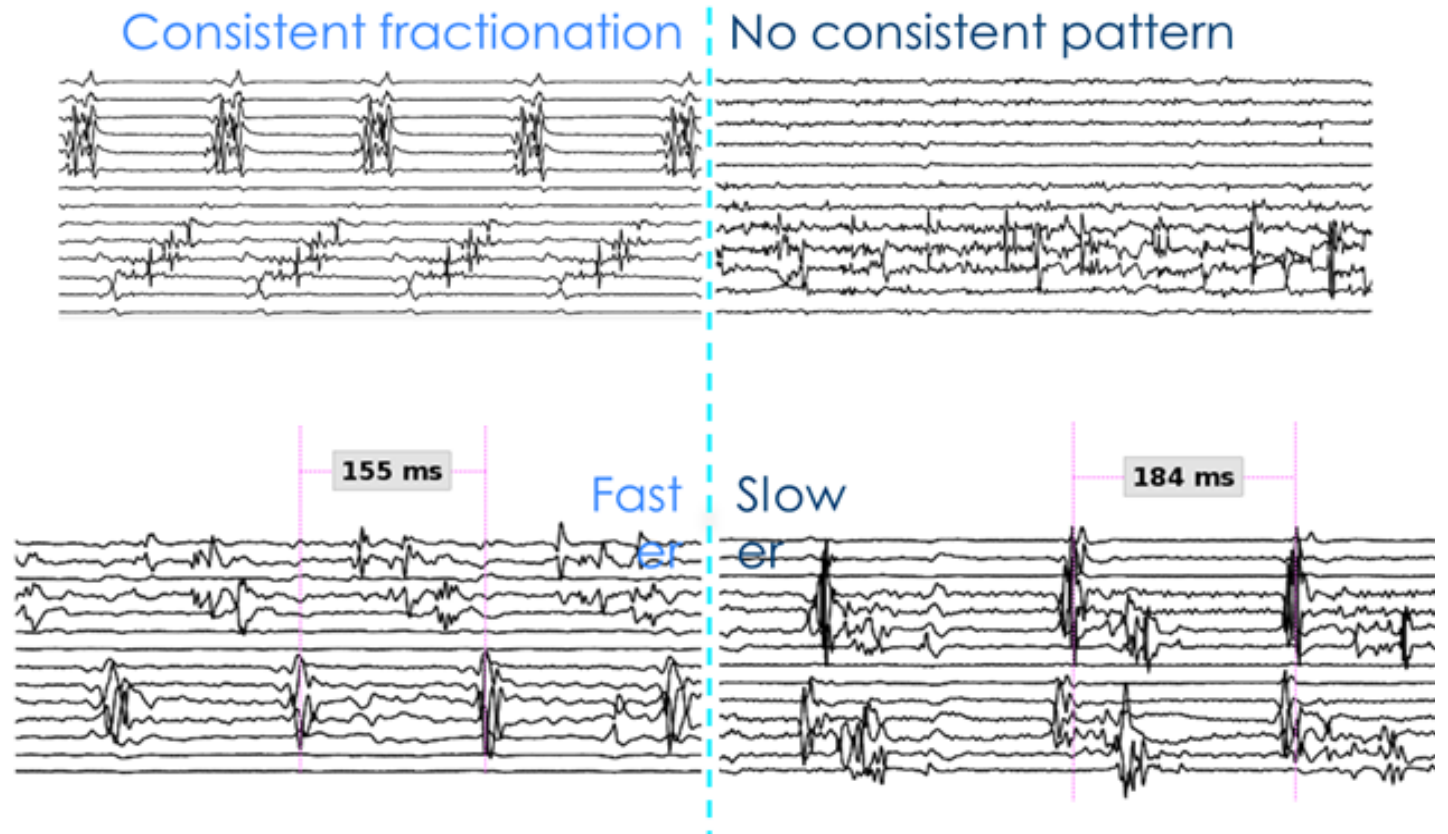
OCKHAM

AI FOR PERS AFIB



OCKHAM

METRICS



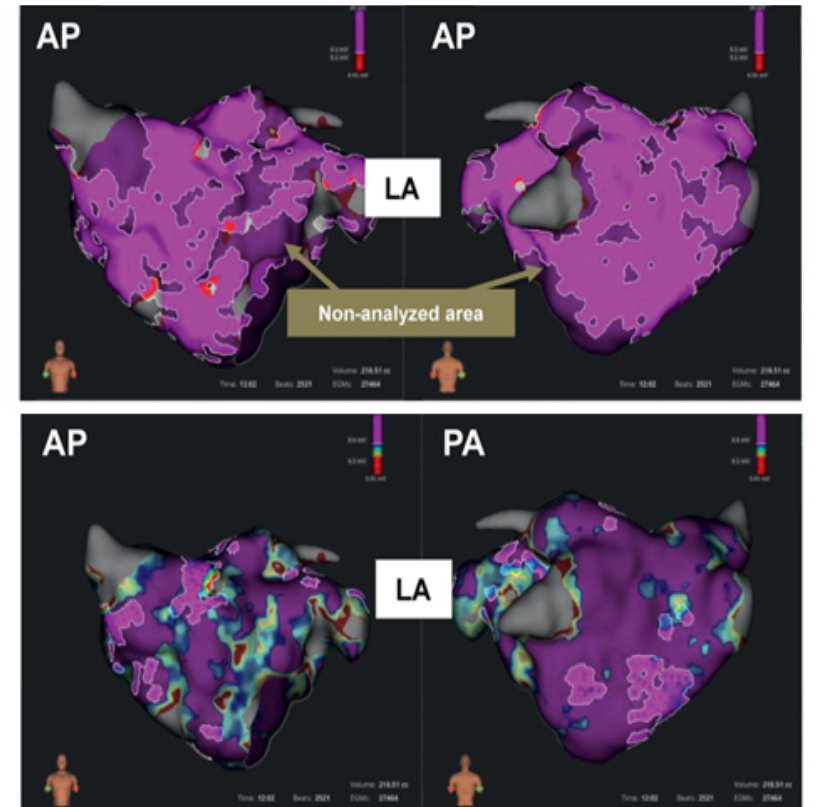
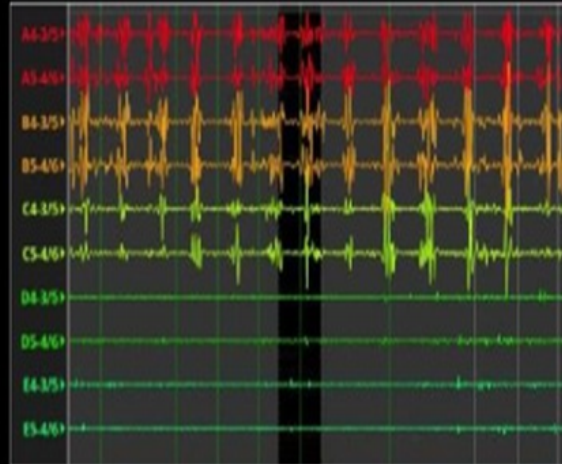
OCKHAM

TRIPOLAR EGMs

Bipolar

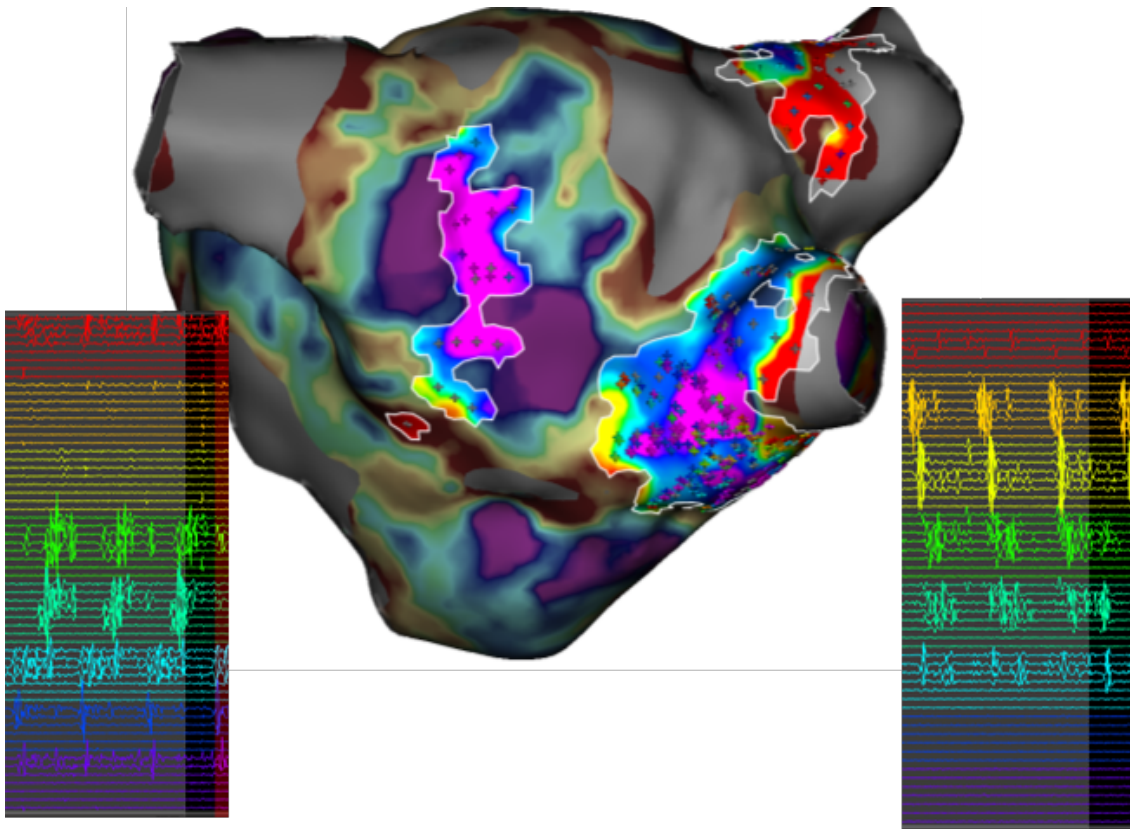


Tripolar



OCKHAM

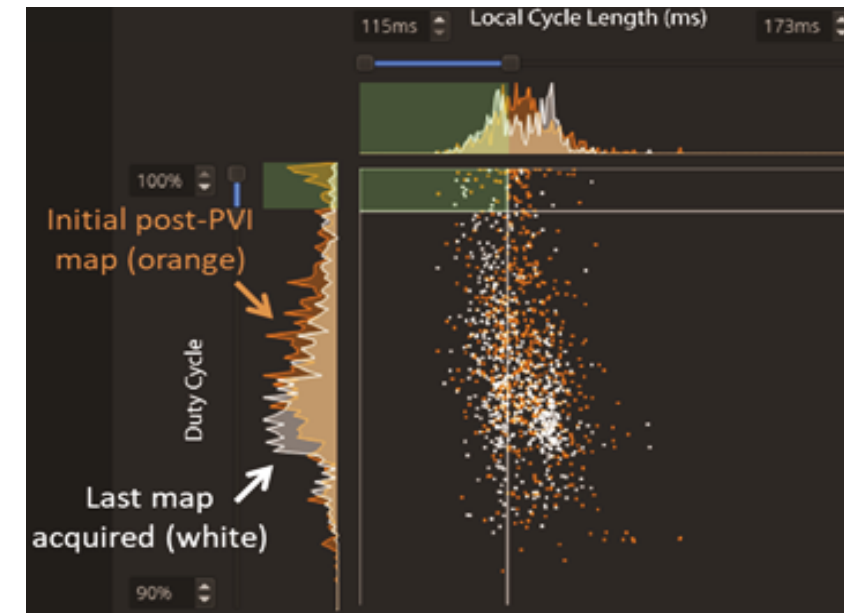
FIRST STUDY



Novel mapping tool to identify drivers in persistent atrial fibrillation: first clinical experience

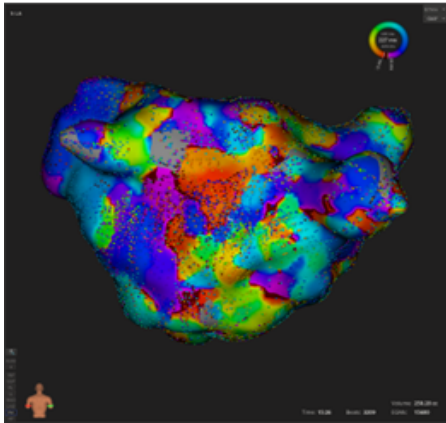
D G Latcu, S Milanese, A Kingston, S Canepa, C Lerebours, S Gutrod, B Enache, N Benhenda, N Saoudi

EP Europace, Volume 25, Issue Supplement 1, June 2023, euad122.167,



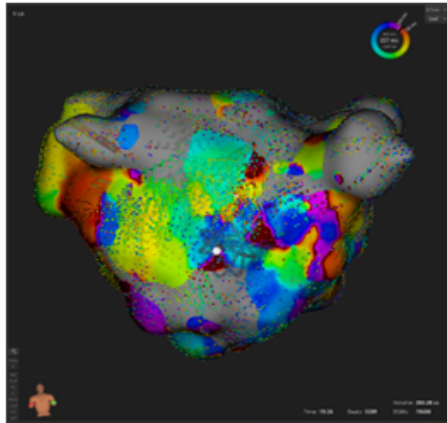
OCKHAM WORKFLOW

Activation



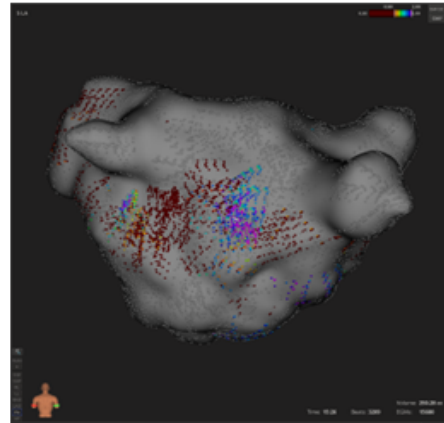
Illustrates entire
chamber activation

Post PVI Activation



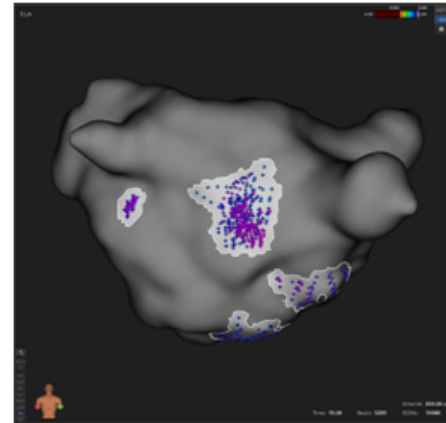
Illustrates Post PVI
chamber activation

Consistency (0.6)



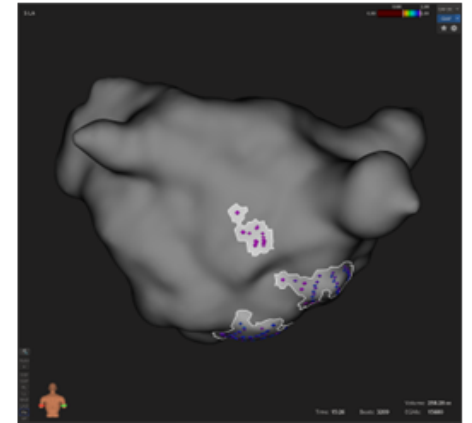
Shows only
consistent morphology

Duty Cycle (≥ 0.8)



Further filters to beats
that are activating
>80% of the local cycle
length

Local Cycle Length (Fastest 10ms range)



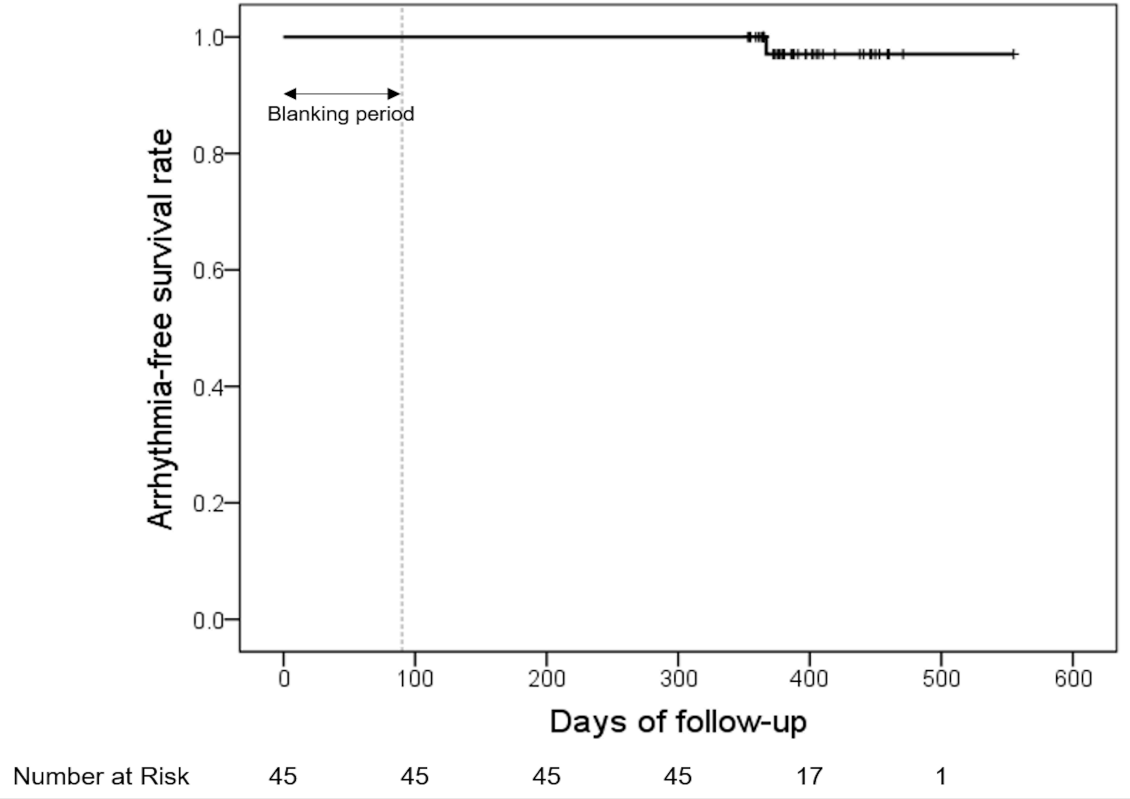
Assesses activation
rapidity and filters to
narrow range of local
CL

OCKHAM

ANOTHER STUDY

Electrophysiological Characteristics of Atrial Fibrillation Trigger Sites During Ongoing Atrial Fibrillation Using Ultra-High-Resolution Mapping

[Kohki Nakamura](#)✉, [Takehito Sasaki](#), [Taiki Masuyama](#), [Kentaro Minami](#), [Shingo Yoshimura](#), [Suguru Nishiuchi](#), [Akiko Kodama](#), [Kojiro Hattori](#), [Kenichi Kaseno](#), [Nobusada Funabashi](#), [Shigeto Naito](#)



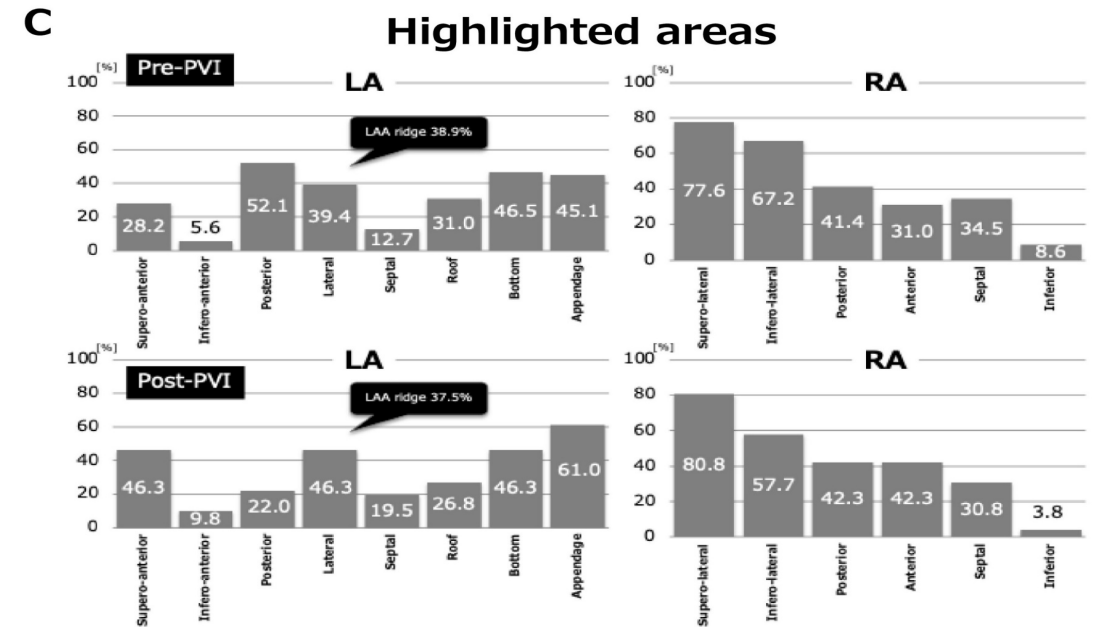
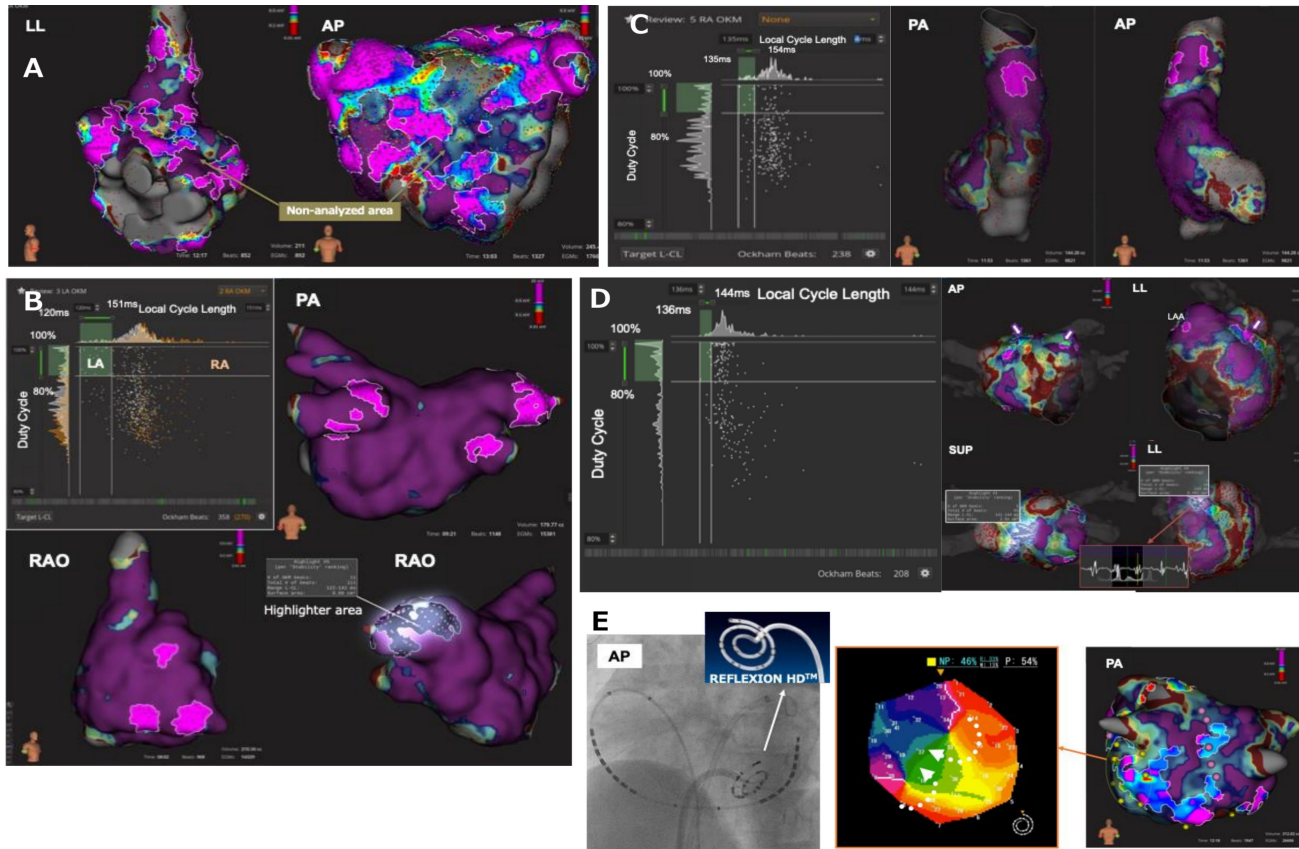
Variable	PVs	LA	SVC	RA	p
L-CL (ms)					
Minimum	126 (119–135)	131 (124–136)	155 (143–172)**†‡§	139 (130–148)**†	<0.0001

OCKHAM

MOST RECENT STUDY

Characterization and anatomical distribution of AF driver sources identified by the novel Ockham AF mapping module

Tetsuma Kawaji^{a,b,*}, Yosuke Murase^c, Soichiro Yamashita^d, Saki Yamano^a, Ryuta Ishida^a, Misaki Naka^a, Bingyuan Bao^a, Tomoya Kimura^a, Shun Hojo^a, Shintaro Matsuda^a, Masashi Kato^a, Takafumi Yokomatsu^a, Shinji Miki^a

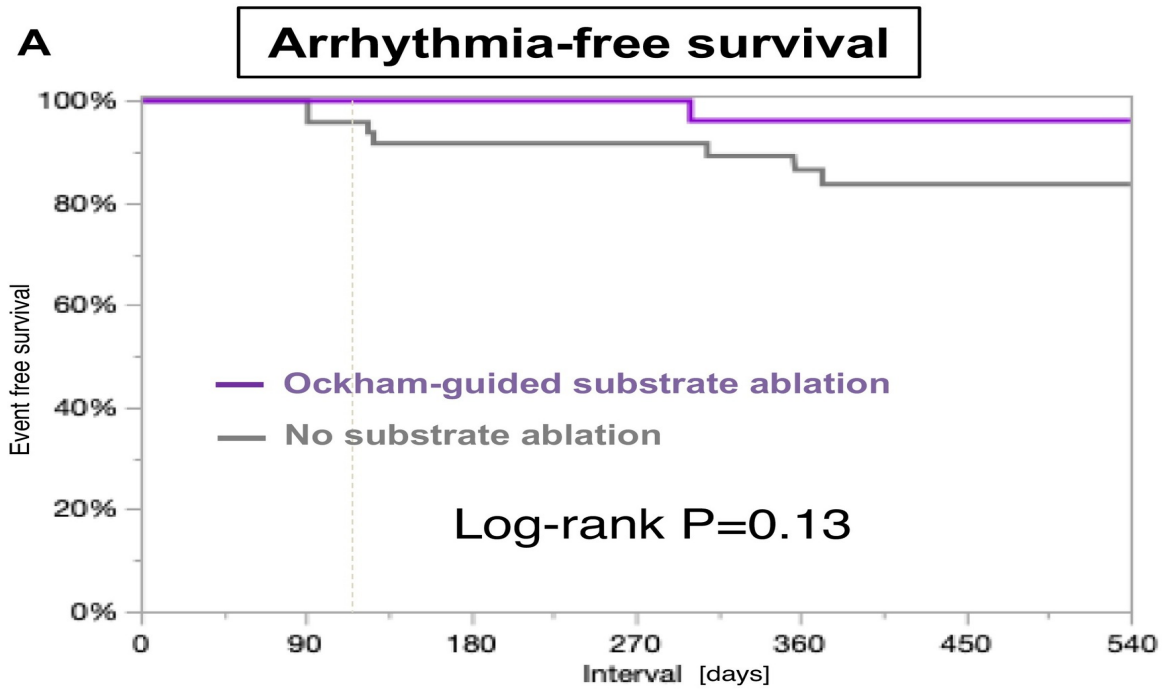


OCKHAM

MOST RECENT STUDY

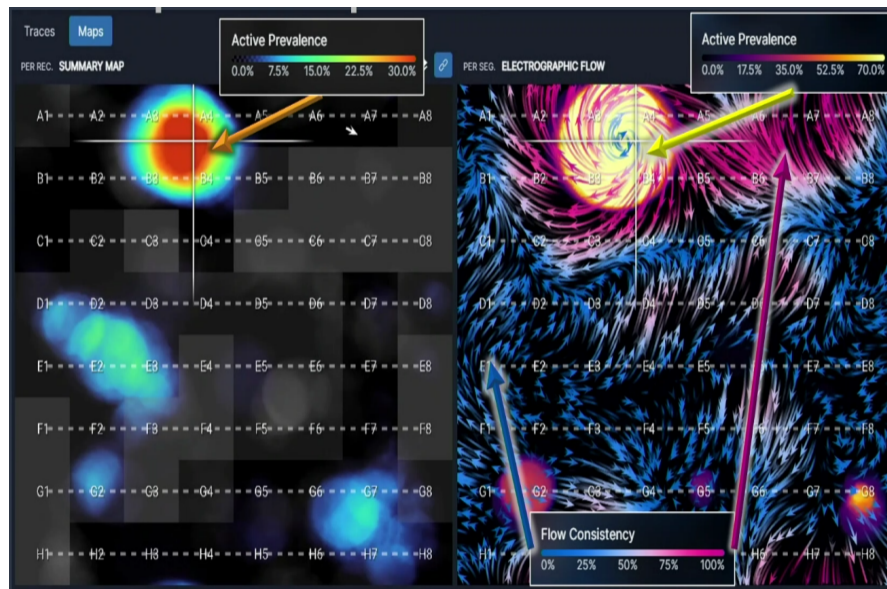
Characterization and anatomical distribution of AF driver sources identified by the novel Ockham AF mapping module

Tetsuma Kawaji^{a,b,*}, Yosuke Murase^c, Soichiro Yamashita^d, Saki Yamano^a, Ryuta Ishida^a, Misaki Naka^a, Bingyuan Bao^a, Tomoya Kimura^a, Shun Hojo^a, Shintaro Matsuda^a, Masashi Kato^a, Takafumi Yokomatsu^a, Shinji Miki^a



Interval 0 day 90 days 180 days 360 days 540 days

Ockham-guided substrate



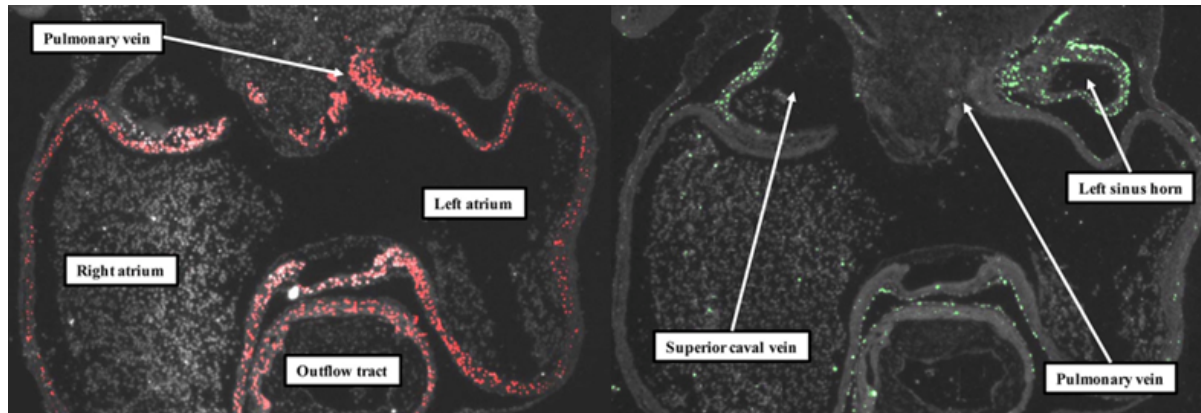
CORTEX

What is Cortex?

Differentiated mapping technology repeatedly identifies AF sources

Clinical Background

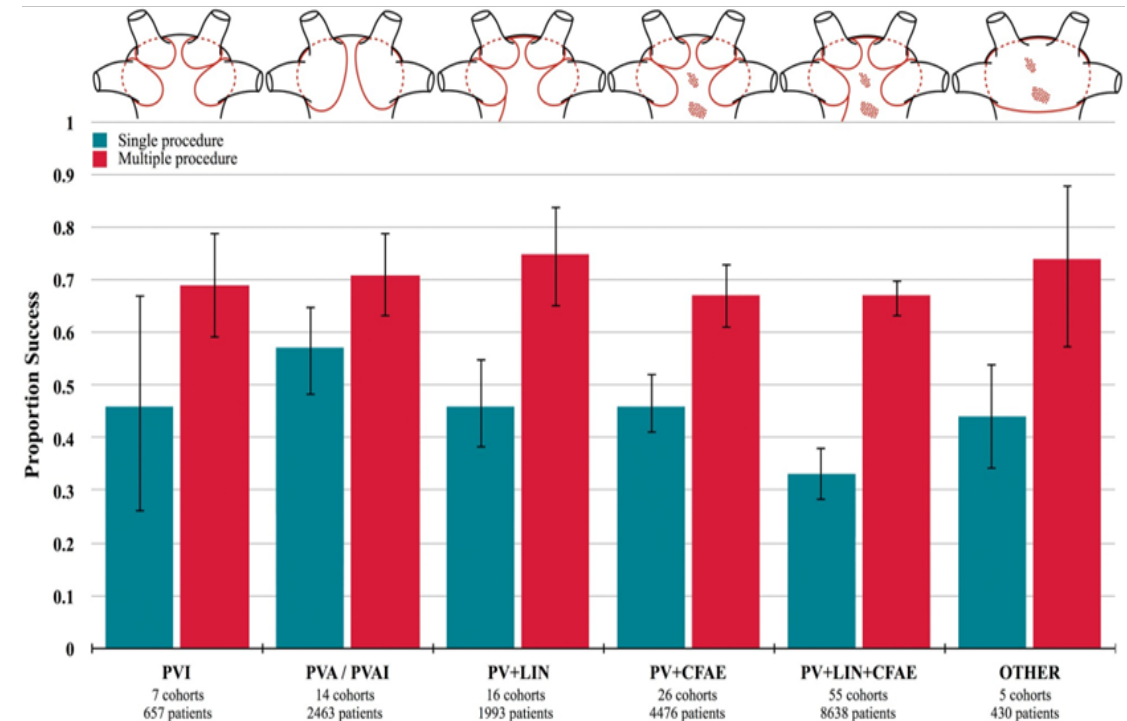
- **Pulmonary vein isolation (PVI)** remains the cornerstone of AF ablation, however complex AF also driven by non-PVI sources
- **Identification** of non-PV ablation targets in persistent and redo AF patients remains subjective and clinical outcomes vary by operator and center
- **Pulsed-field ablation** has revolutionized AF ablation with safety, durability and efficiency – but leads to concerns of ‘over-ablating’ healthy tissue to improve outcomes
- **Persistent AF** success rate hasn’t improved much



Outcomes of persistent and long-standing persistent atrial fibrillation ablation: a systematic review and meta-analysis

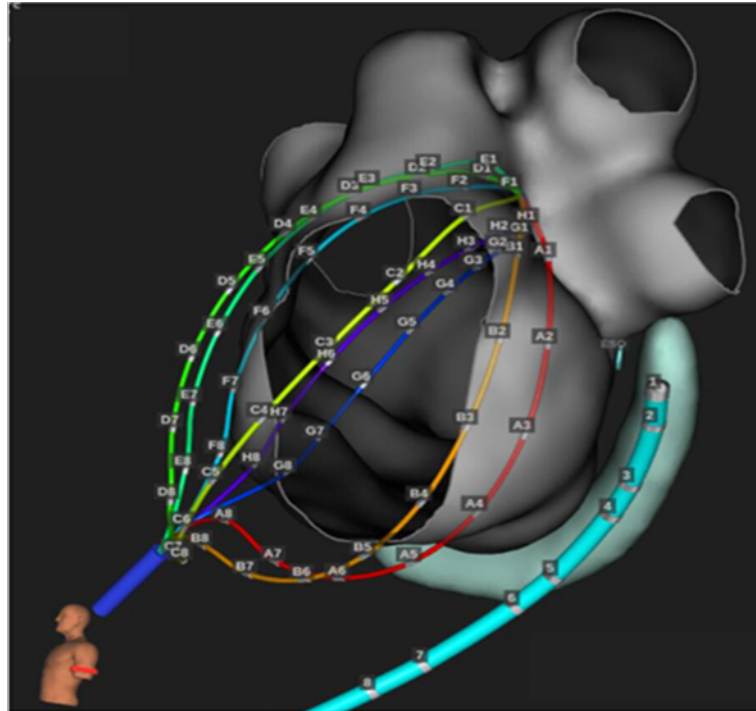
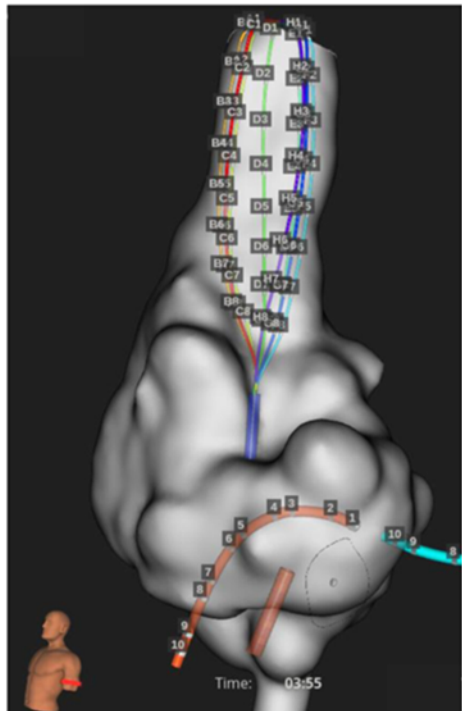
Jock A Clarnette, Anthony G Brooks, Rajiv Mahajan, Adrian D Elliott, Darragh J Twomey, Rajeev K Pathak, Sharath Kumar, Dian A Munawar, Glenn D Young,

Changing Empiric Lesion Sets Does Not Improve Outcomes

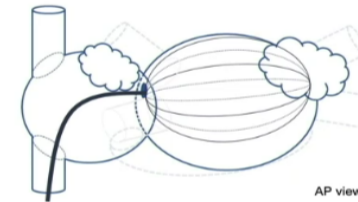


WORKFLOW

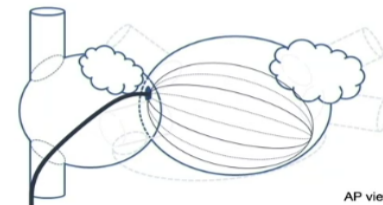
One-minute, full chamber mapping identifies AF sources and assesses flow stability in the atrium



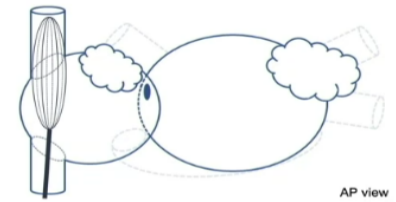
- 1) Posterosuperior LA: basket dome points toward trigonum of LSPV, LIPV, and LAA with basket expanded to fill LA**



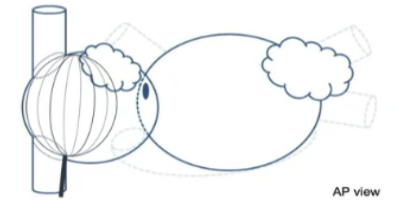
- 2) Anterolateral LA: basket dome points to LAA/MVA with basket expanded to fill LA as much as possible



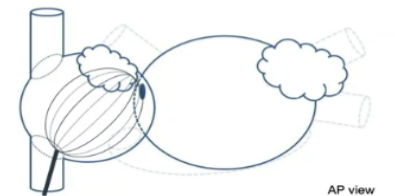
- 3) SVC/RA junction: basket positioned half in SVC and half in RA with tubular configuration



- 4) **Central RA:** basket dome points to SVC with straight catheter orientation and basket expanded to fill RA as much as possible

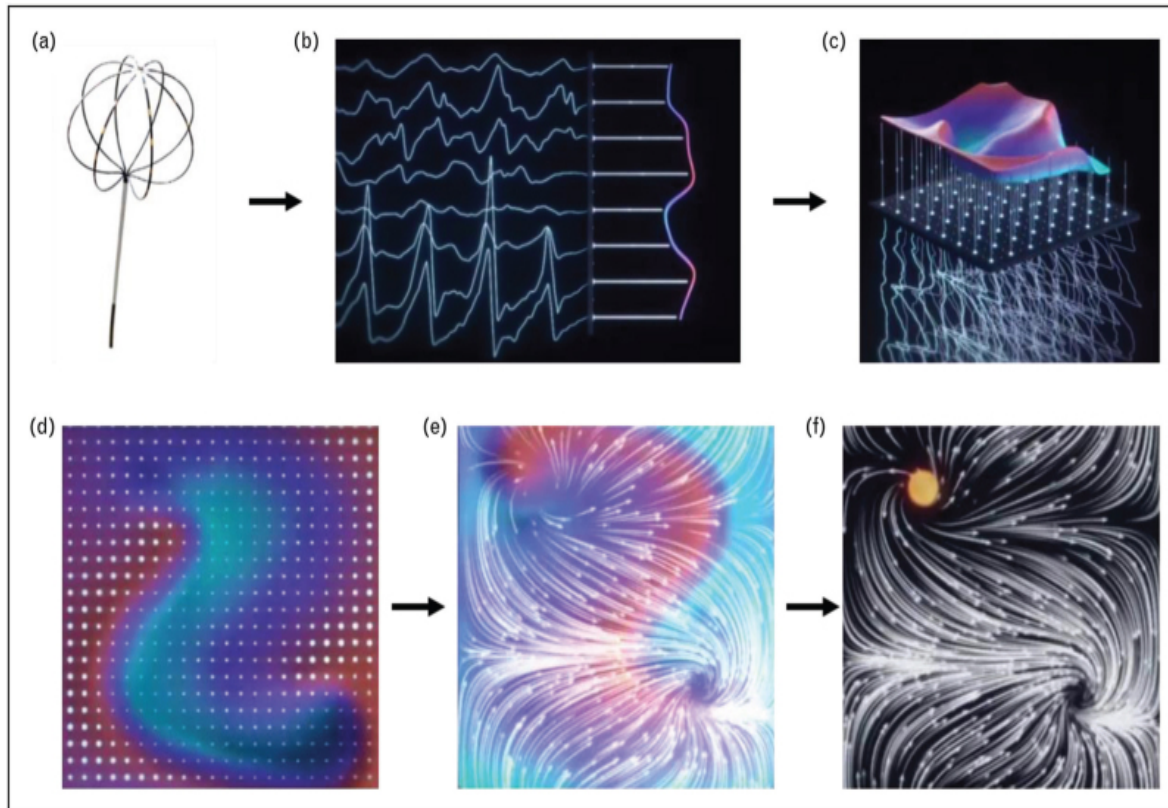


- 5) Anteroseptal RA: basket dome points to RAA/TVA with catheter deflected anterior and lateral from SVC

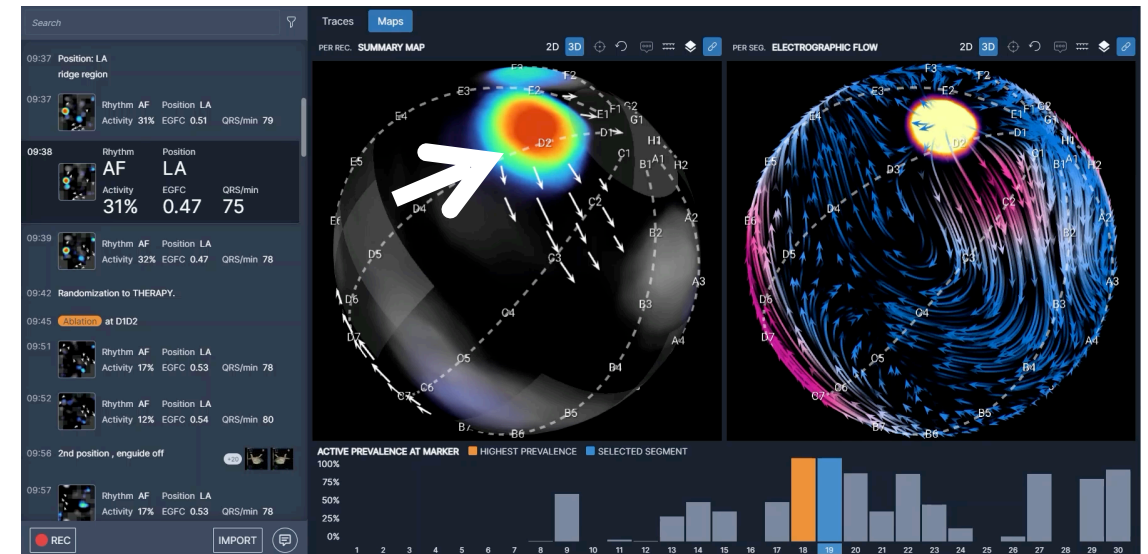


What is Cortex?

WORKFLOW



Cortex EGF (Electrographic Flow) Mapping

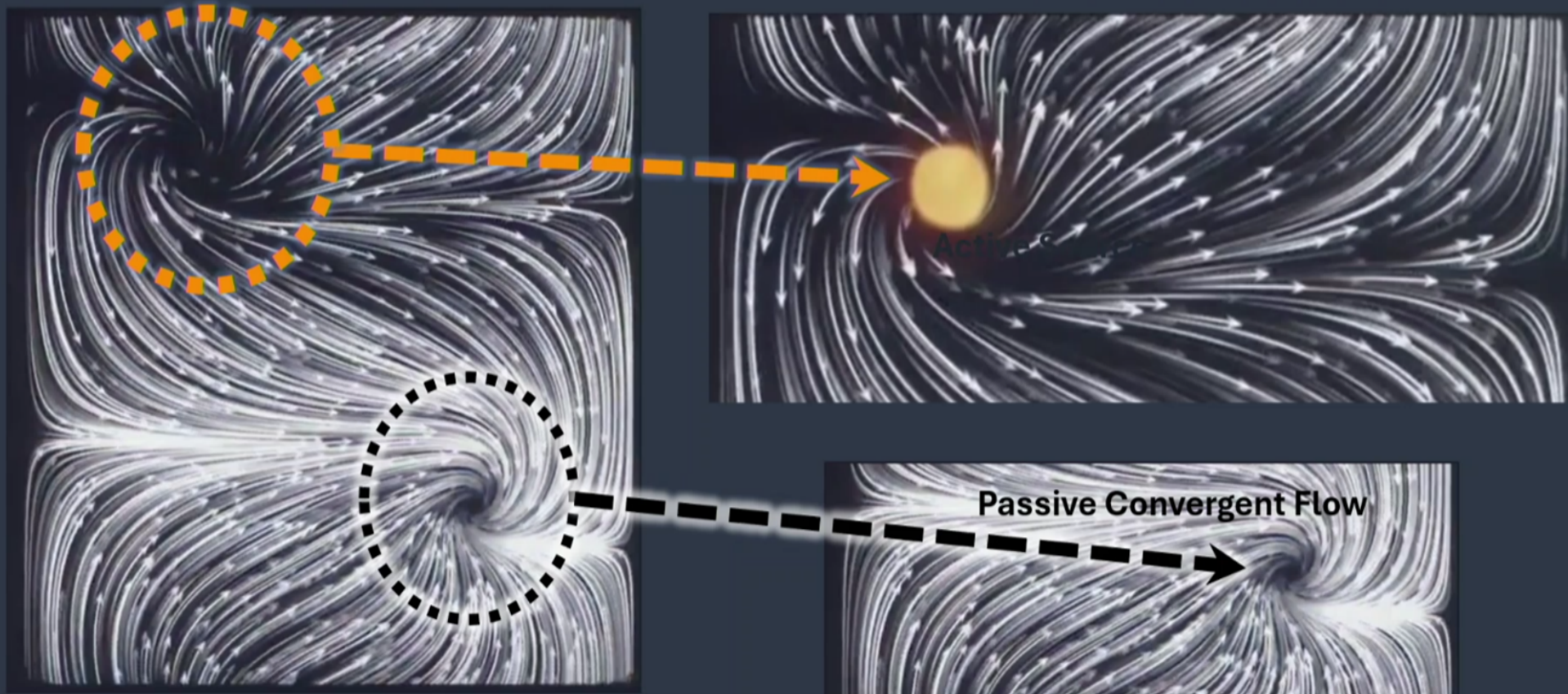


One-minute, full chamber mapping identifies AF sources and assesses flow stability in the atrium

ACTIVE AND PASSIVE SOURCE

Electrographic Flow Target

Active Sources present themselves as origins of divergent excitation waves and can be detected by tracking the excitation wave propagation in the myocardium around them.



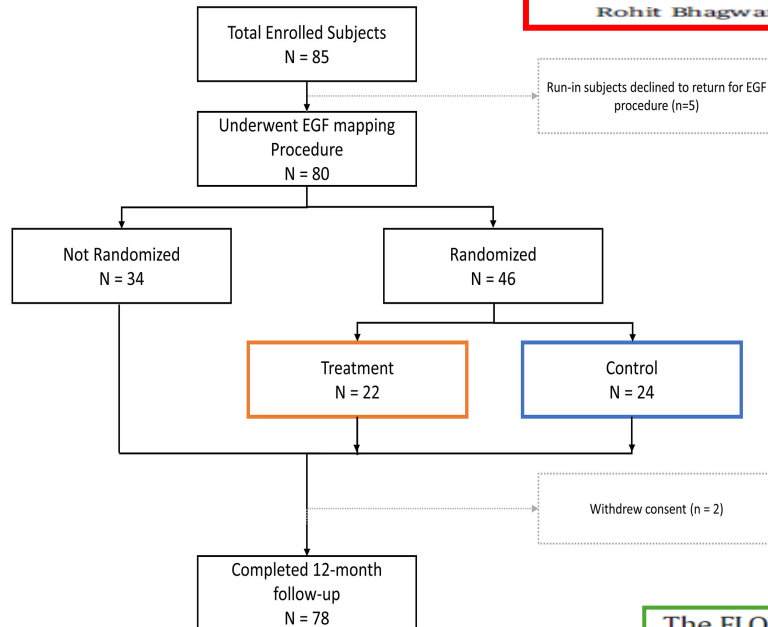
CORTEX

FIRST RANDOMIZED STUDY

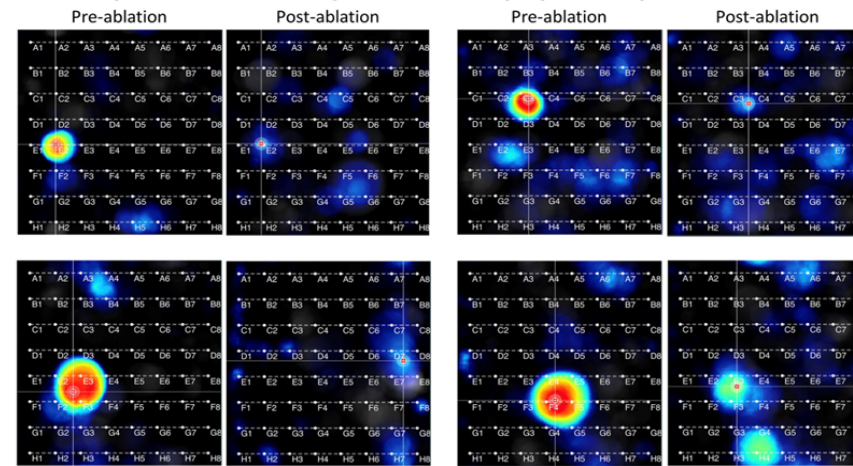
A Randomized Trial of Electrographic Flow-Guided Redo Ablation for Nonparoxysmal Atrial Fibrillation (FLOW-AF)



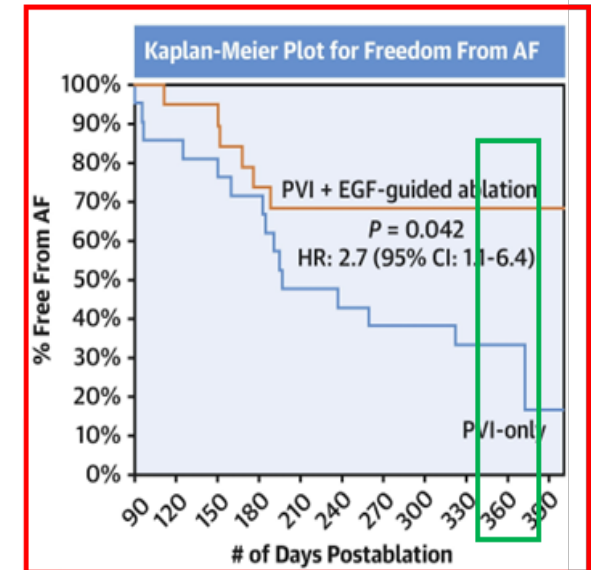
Vivek Y. Reddy, MD,^{a,b} Anke Langbein, MD,^c Jan Petru, MD,^a Tamas Szili-Torok, MD, PhD,^d Moritoshi Funasako, MD, PhD,^a Leon Dinshaw, MD,^e Sip Wijchers, MD,^d Andreas Rillig, MD,^e Stefan G. Spitzer, MD,^c Rohit Bhagwandien, MD,^d Andreas Metzner, MD,^e Melissa H. Kong, MD,^f Petr Neuzil, MD, PhD^a



Representative Sample of EGF maps pre- vs. post-ablation

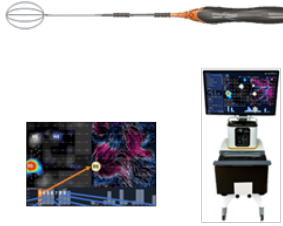
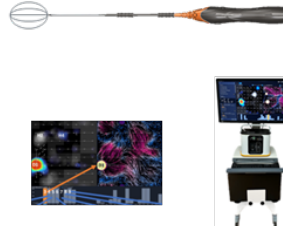


The FLOW-AF trial was a prospective, multicenter, randomized clinical trial in which patients with PerAF or LS-PerAF undergoing redo ablation procedures underwent EGF mapping after confirmation of intact PVI. In this challenging population of nonparoxysmal AF patients: 1) EGF mapping identified sources in 60% of the cohort; and 2) PVI+ EGF-guided source ablation improved AF-free survival beyond PVI-alone at 1 year by 51% on an absolute basis.



CORTEX

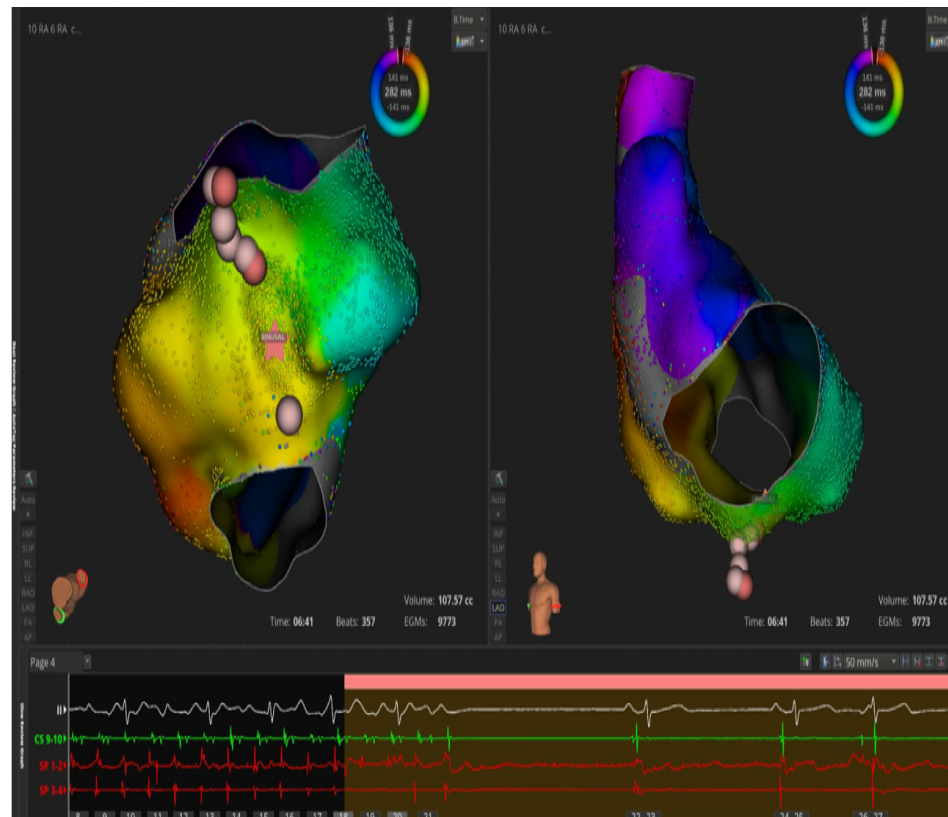
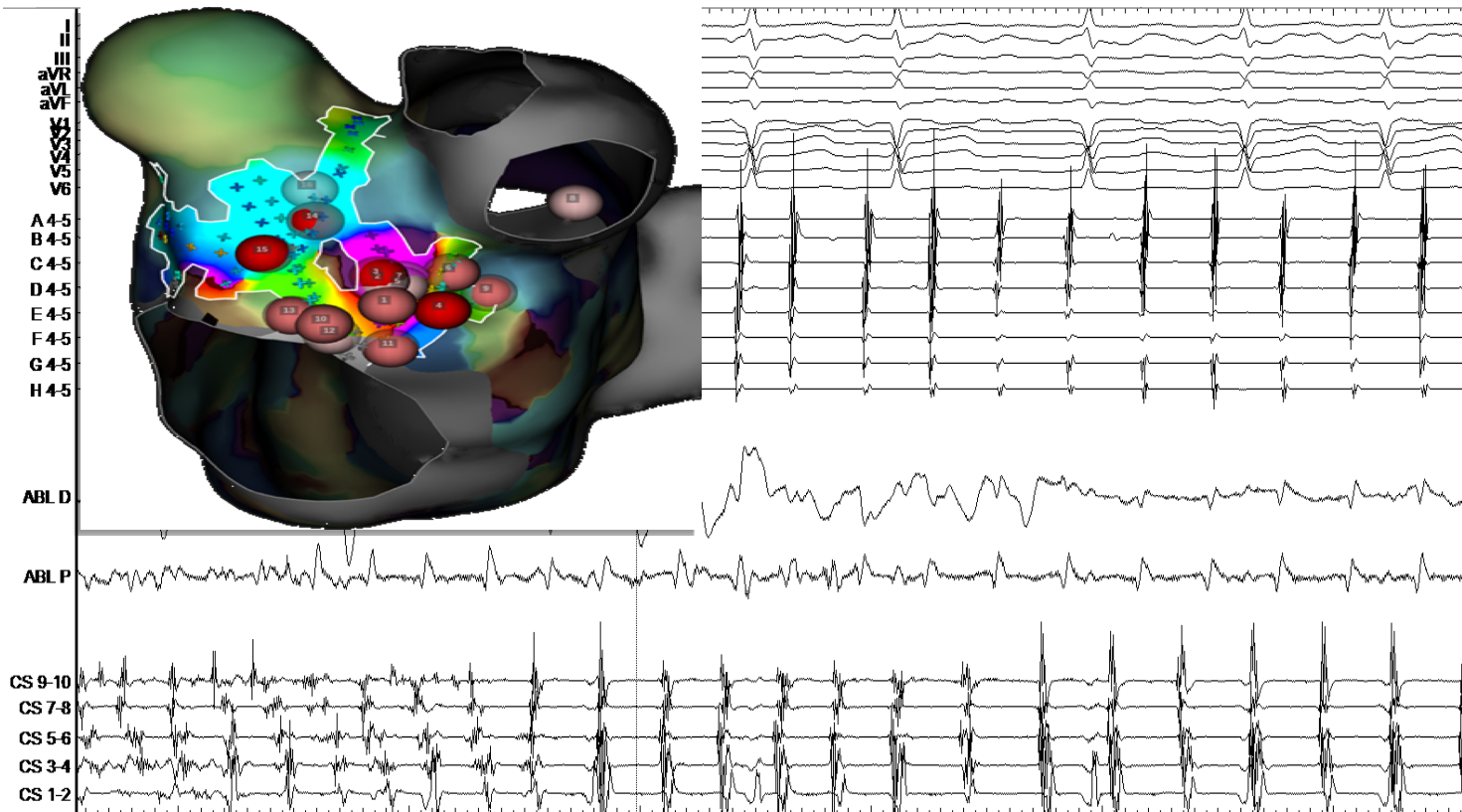
STUDY ON GOING WITH PFA SYSTEMs

	RESOLVE-AF ('24-'25)	OPTIMiZe ('25-'26)
EGF MAPPING	OptiMap Catheter Gen 1.0 OptiMap System SW 1.2 	OptiMap Catheter Gen 1.0 & 2.0 OptiMap System SW 1.3 
PVI+ & SOURCE ABLATION	Commercially-approved Devices and Systems	  FARAWAVE Nav (for mapping and ablation) FARAPOINT
EA MAPPING SYSTEM	Commercially-approved Devices and Systems	  OPAL HDxw/ FARAVIEW Mapping SW

Grazie per l'attenzione !!

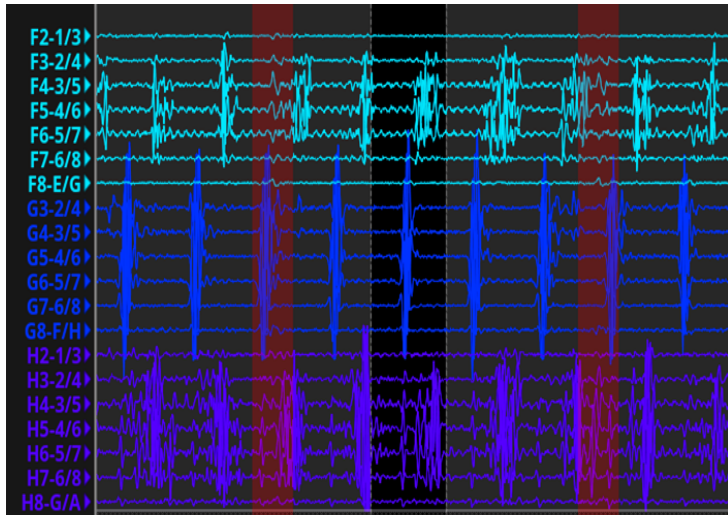


WORKFLOW: EXAMPLE

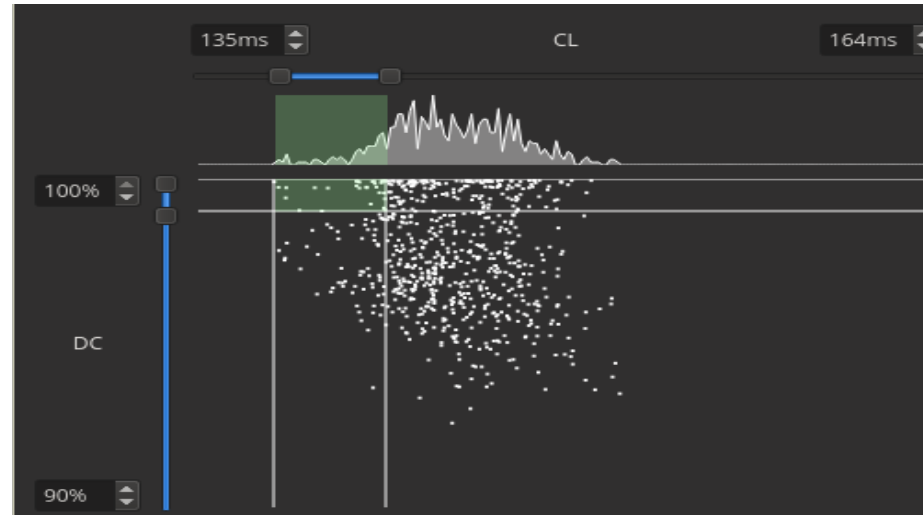


OCKHAM

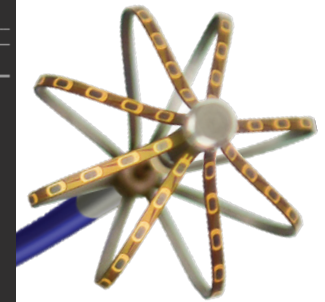
METRICS



The electrogram morphology repetitiveness across consecutive beats and catheter electrodes



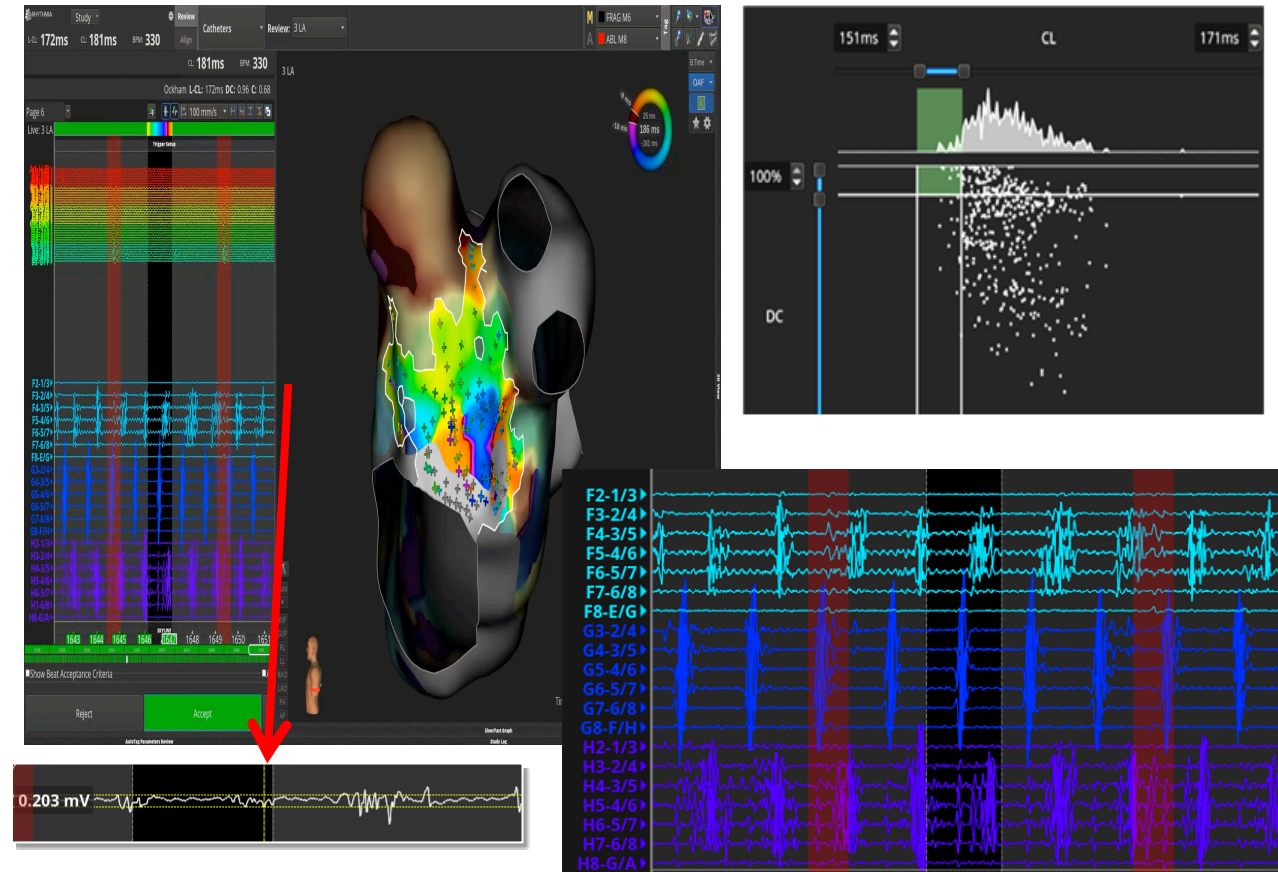
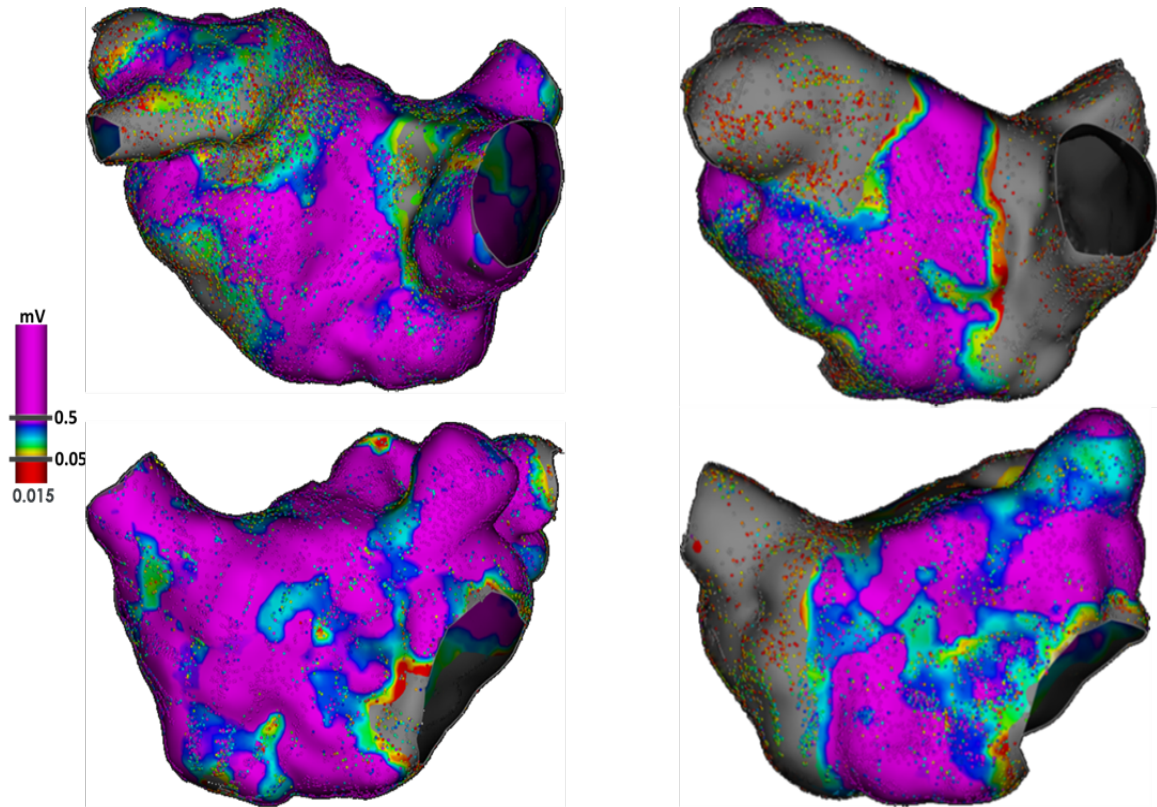
Measurement based on the activation across all 64 electrodes from the Orion for three consecutive beats



The % of local cycle length covered by EGMs across all splines on the ORION to identify continuous excitation compatible with reentry

OCKHAM

WORKFLOW: EXAMPLE



OCKHAM

ANOTHER STUDY

Electrophysiological Characteristics of Atrial Fibrillation Trigger Sites During Ongoing Atrial Fibrillation Using Ultra-High-Resolution Mapping

Kohki Nakamura, Takehito Sasaki, Taiki Masuyama, Kentaro Minami, Shingo Yoshimura, Suguru Nishiuchi, Akiko Kodama, Kojiro Hattori, Kenichi Kaseno, Nobusada Funabashi, Shigeto Naito

