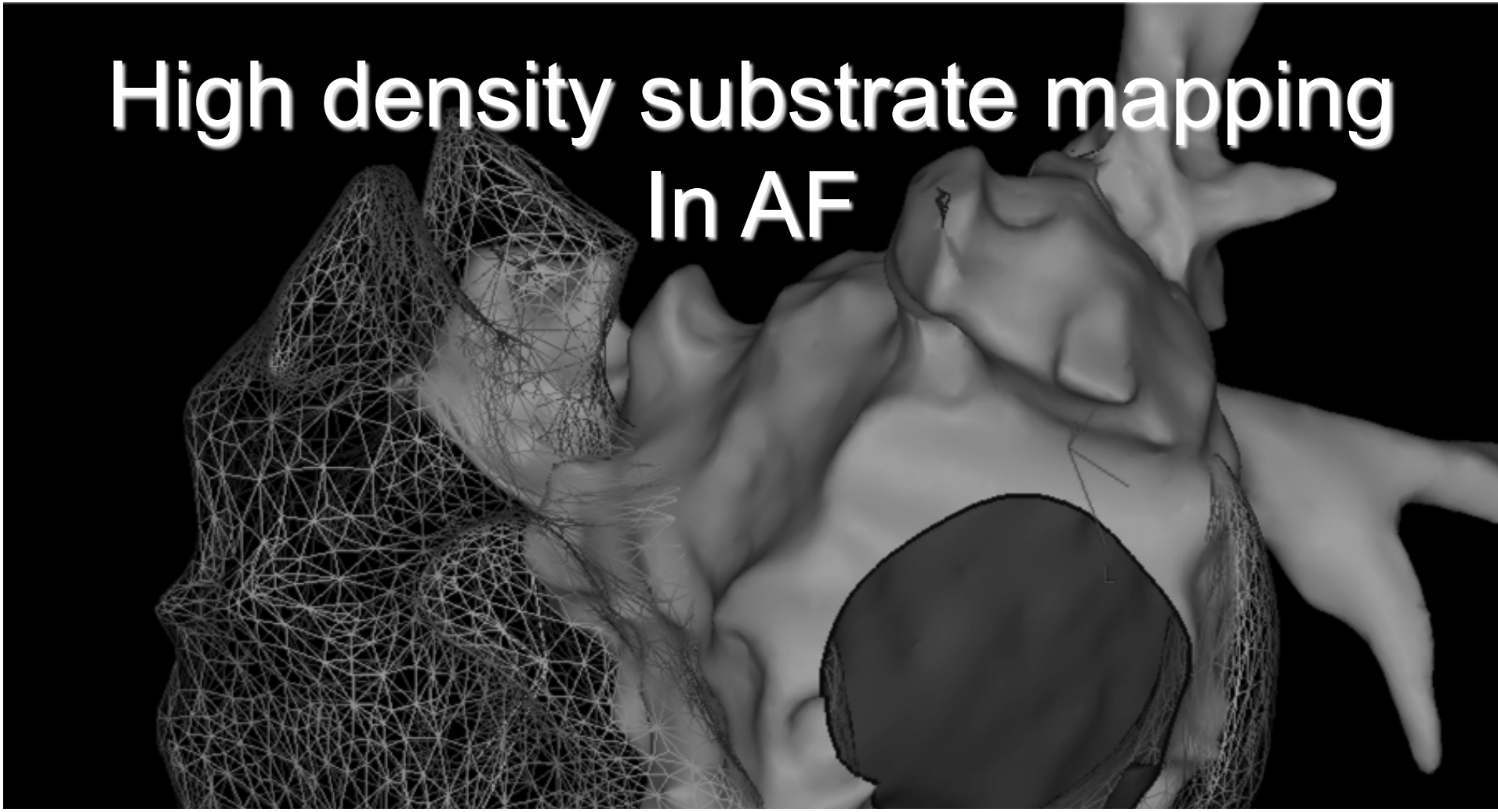
High density substrate mapping In AF



A Pisapia J Seitz C Bars M Bremondy
*A Ferracci * J Khalifa ***

- * St Joseph Hospital Marseille
- ** Ann Arbor University

High density mapping in AF

BACKGROUND :

Results of several randomized clinical trials have shown no benefits to adding either complex fractionated atrial electrogram or linear ablation to PVI compared to doing only PVI in patients with persistent AF . (STAR AF II – BOCA – CHASE-AF)

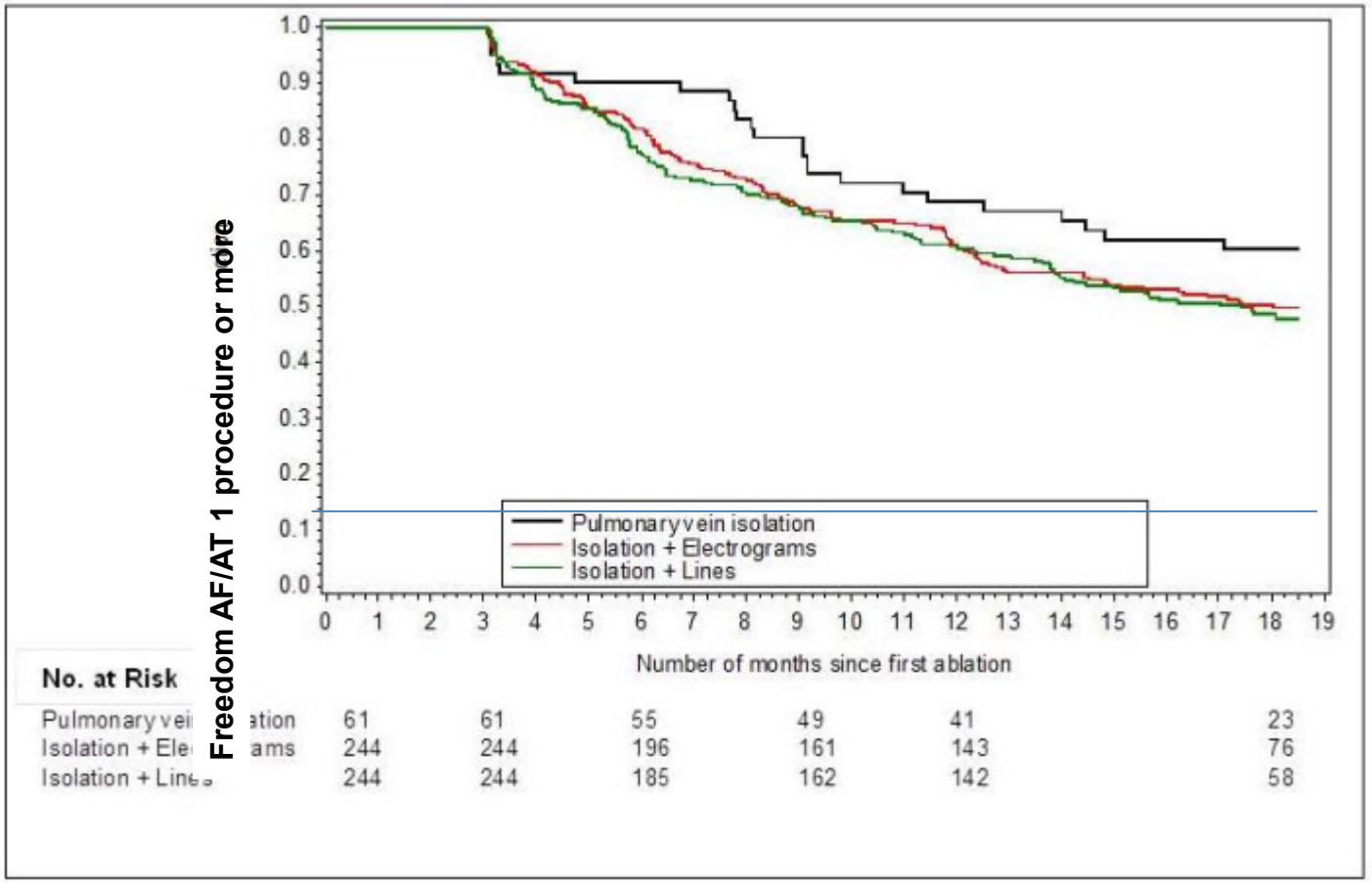
ORIGINAL ARTICLE

Approaches to Catheter Ablation for Persistent Atrial Fibrillation

Atul Verma, M.D., Chen-yang Jiang, M.D., Timothy R. Betts, M.D., M.B., Ch.B., Jian Chen, M.D., Isabel Deisenhofer, M.D., Roberto Mantovan, M.D., Ph.D., Laurent Macle, M.D., Carlos A. Morillo, M.D., Wilhelm Haverkamp, M.D., Ph.D., Rukshen Weerasooriya, M.D., Jean-Paul Albenque, M.D., Stefano Nardi, M.D., Endrj Menardi, M.D., Paul Novak, M.D., and Prashanthan Sanders, M.B., B.S., Ph.D., for the STAR AF II Investigators*

- Ablation of persistent and long persistent AF:
- 3 methods :
- - PVI
- - PVI + lines
- - PVI + CFAE

Verma et al. NEJM 2015



Results of 589 patients

no difference between the 3 methods :

~ 40 % stable sinus rythm after 1 abl.

~ 50% stable sinus rythm after several abl .

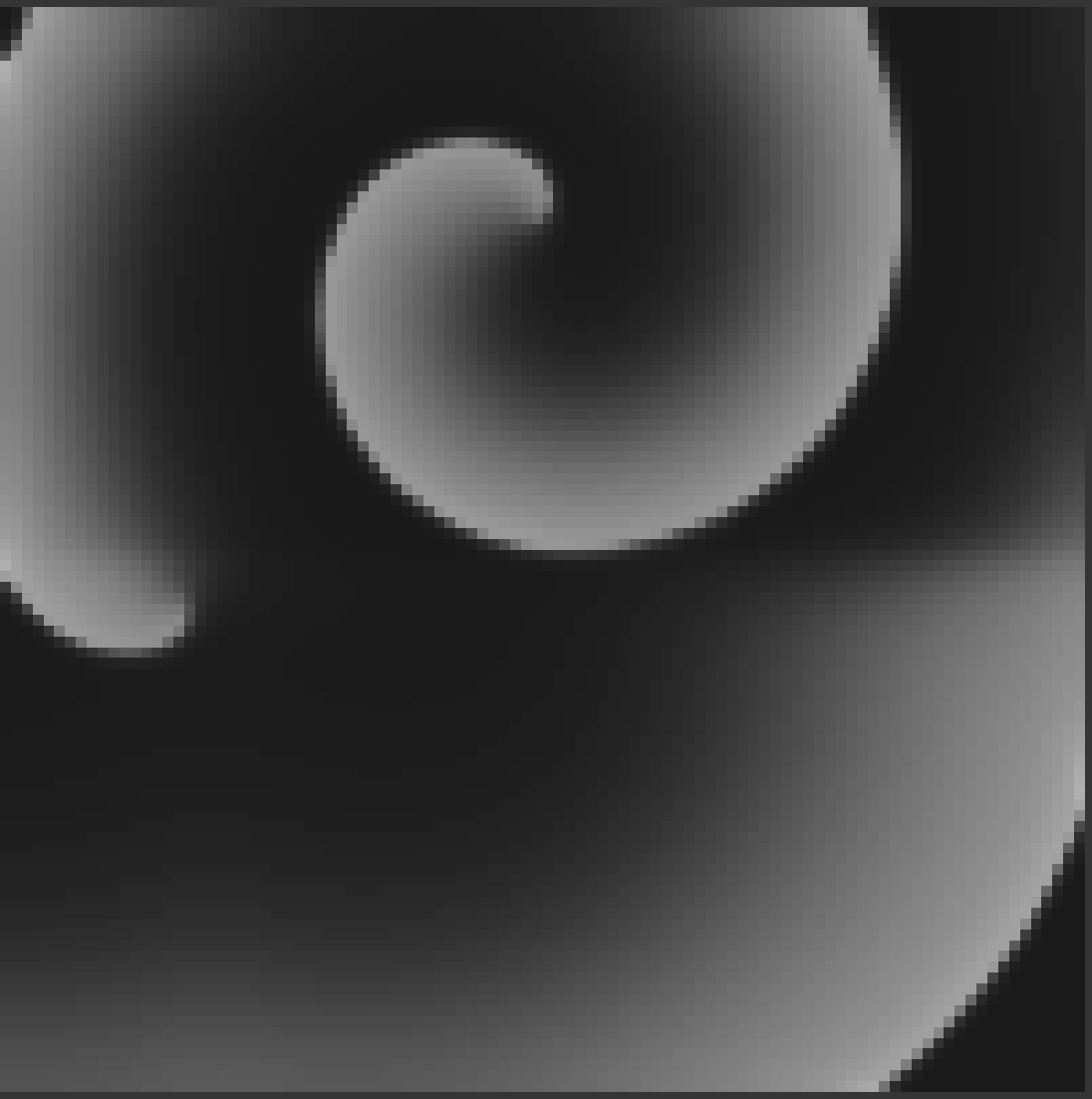
High density mapping in AF

Is CFAE an incorrect target for AF ablation ?

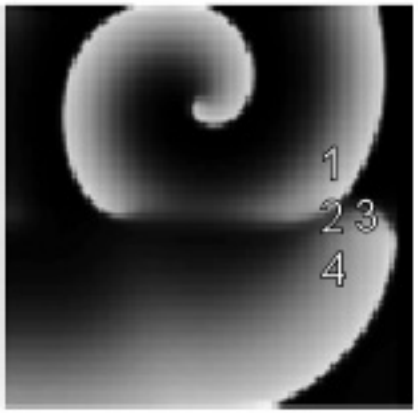
High density mapping in AF

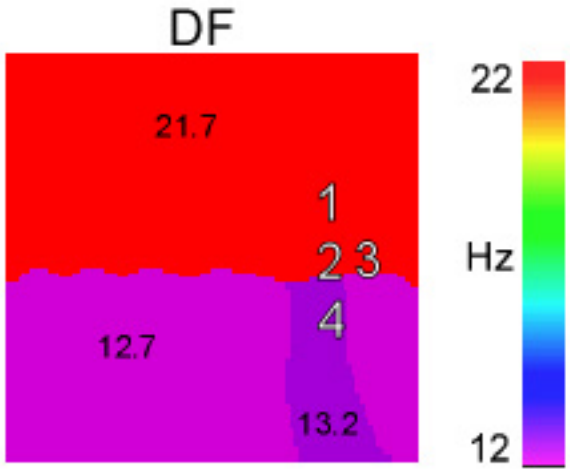
Are CFAE sites AF substrate sites ?

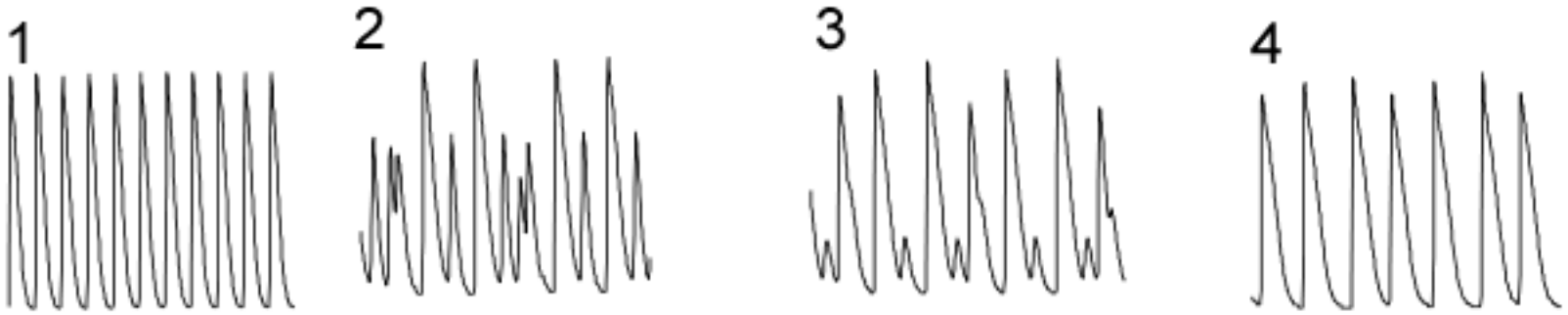
- Recent interest in the role of rotors as the main mechanism of AF and its association with CFAE
- Khalifa demonstrated that CFAE are predominantly found at the limits of the highest frequency of excitation
- High degree of irregularity and fractionnation is present at the rotor type



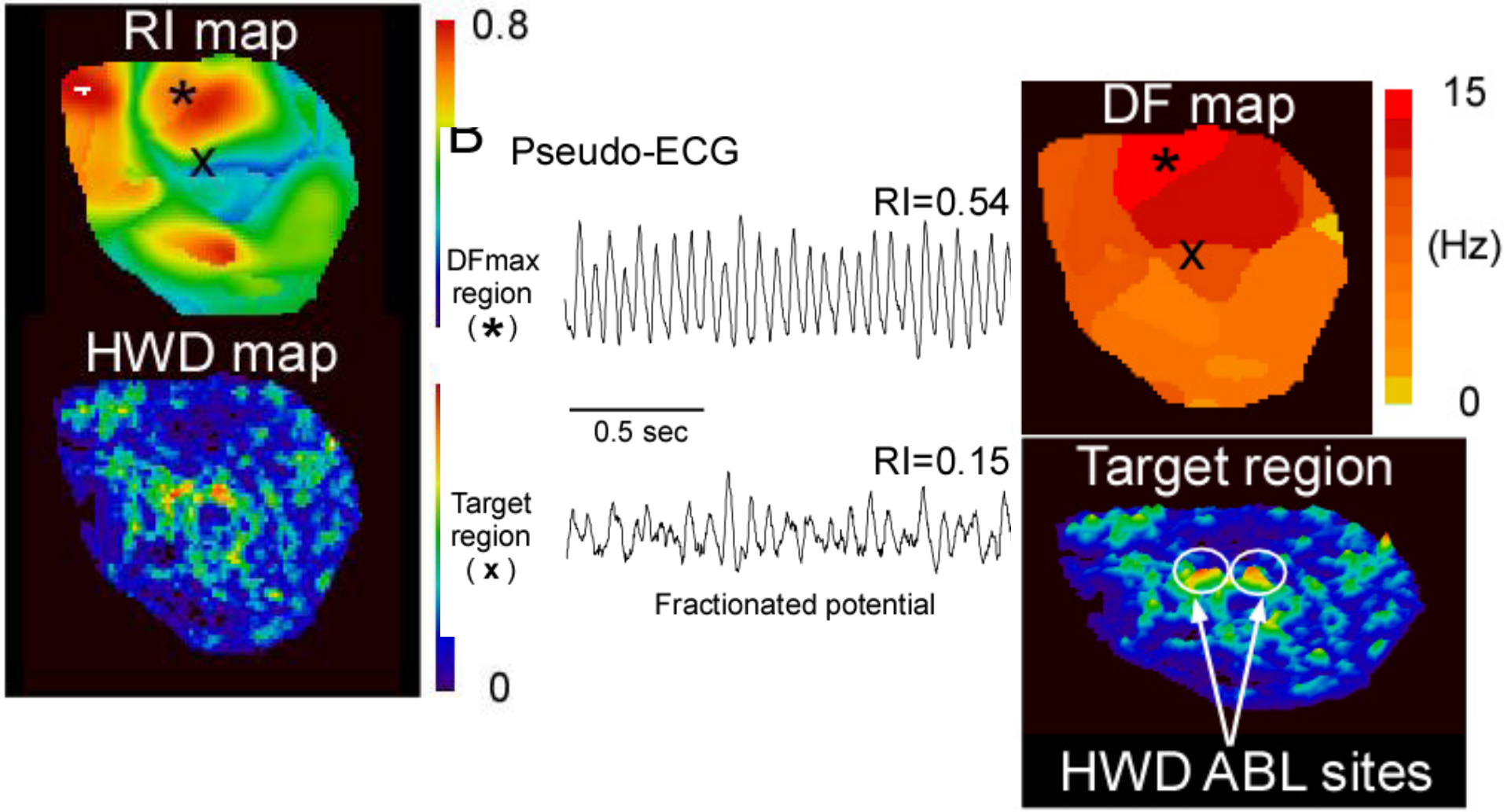
ROTOR

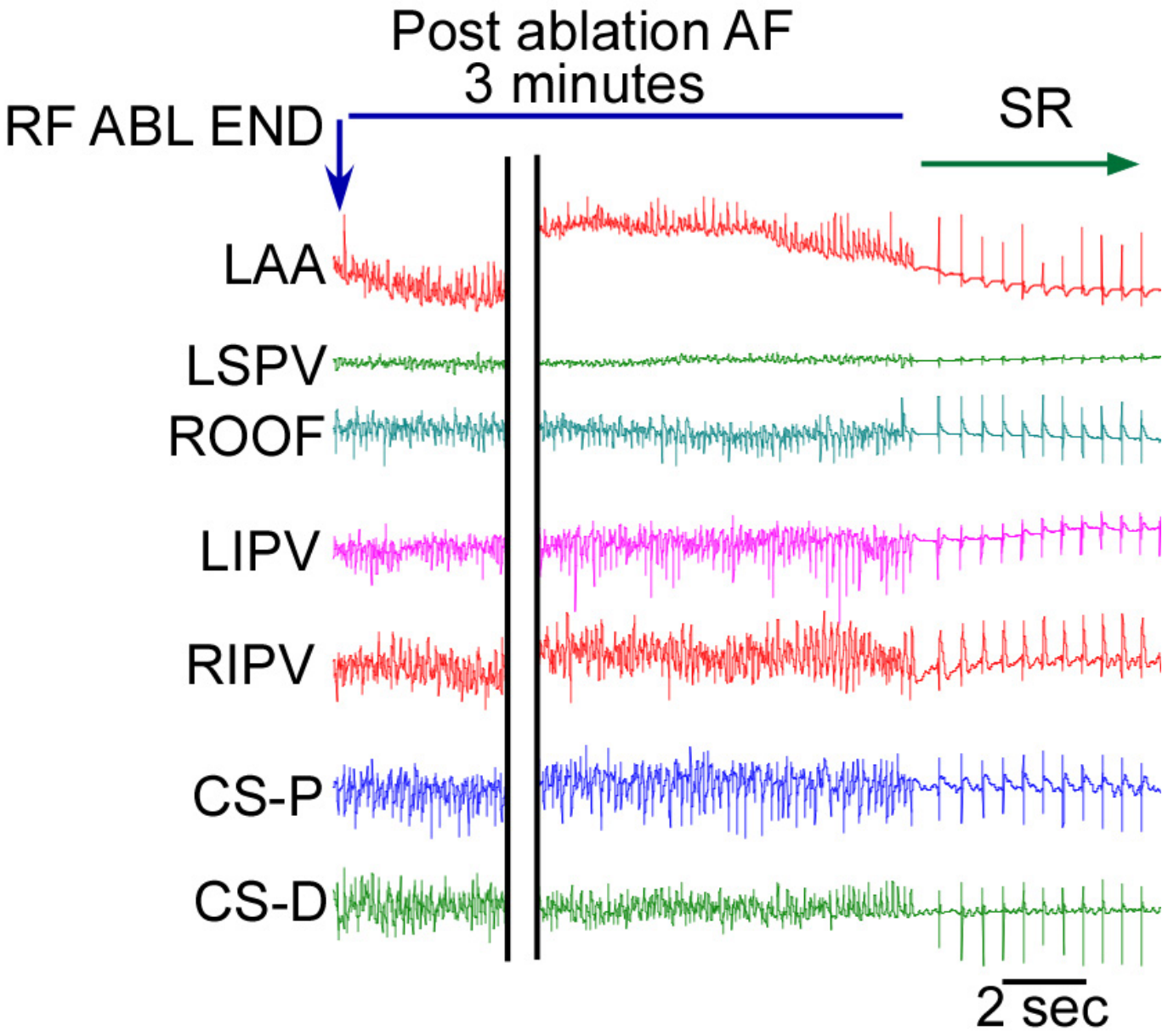






WITH A COURTESY OF J KHALIFA


RI map
HWD map
0.8
0
DFmax region (*)
Target region (x)
Pseudo-ECG
RI=0.54
0.5 sec
RI=0.15
Fractionated potential
DF map
15
(Hz)
0
Target region
HWD ABL sites


Post ablation AF
3 minutes
RF ABL END
SR
LAA
LSPV
ROOF
LIPV
RIPV
CS-P
CS-D
2 sec

High density mapping in AF

Application in a human heart

Journal of the American College of Cardiology
© 2004 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 43, No. 11, 2004
ISSN 0735-1097/04/$30.00
doi:10.1016/j.jacc.2003.12.054

Electrophysiology

A New Approach for Catheter Ablation of Atrial Fibrillation: Mapping of the Electrophysiologic Substrate

Koonlawee Nademanee, MD, FACC,* John McKenzie, MD,* Erol Kosar, MD,* Mark Schwab, MD,* Buncha Sunsaneewitayakul, MD,† Thaveekiat Vasavakul, MD,* Chotikorn Khunnawat, MD,* Tachapong Ngarmukos, MD‡

Inglewood, California; and Bangkok, Thailand

N=121 pts with PAF, PeAF & LS-PeAF.
EGM-based ablation approach (CFAE) +/- Ibutilide
AF termination rate >95% (SR conversion rate =95%)

Continuous low voltage fractionnated potentials

Nademanee et al. JACC. Vol. 43, No. 11, 2004

Issues

EGM – based Substrate ablation is very effective but:

- So far proving to be a quite difficult technique with a poor reproducibility rate
- Poor understanding of EGM significance & no consensus about targets

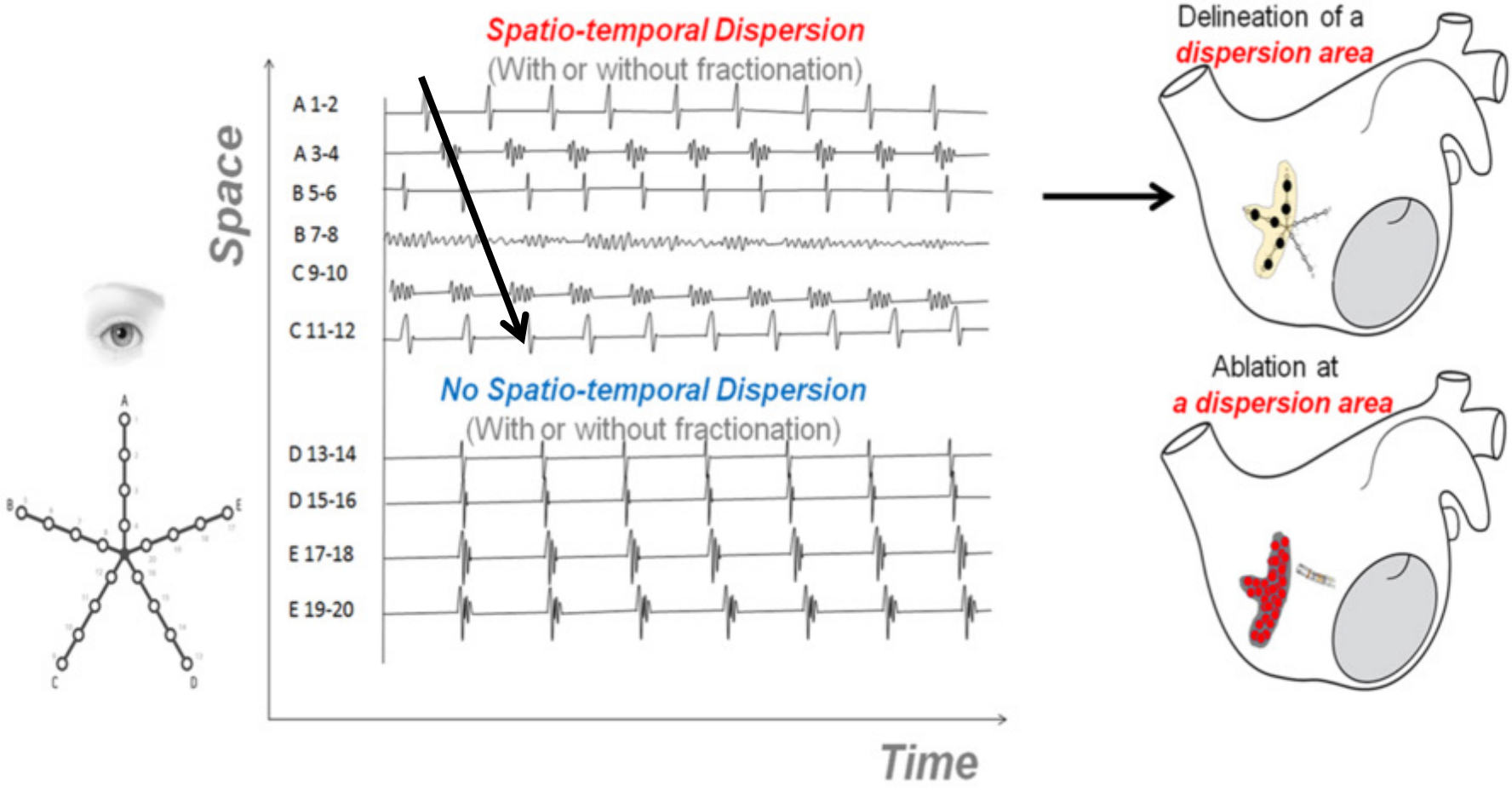
> A real rationalization and systematization of EGM-based ablation is needed in order to make the technique more user friendly and efficient.

High density mapping in AF

Concept of Spatio-temporal dispersion

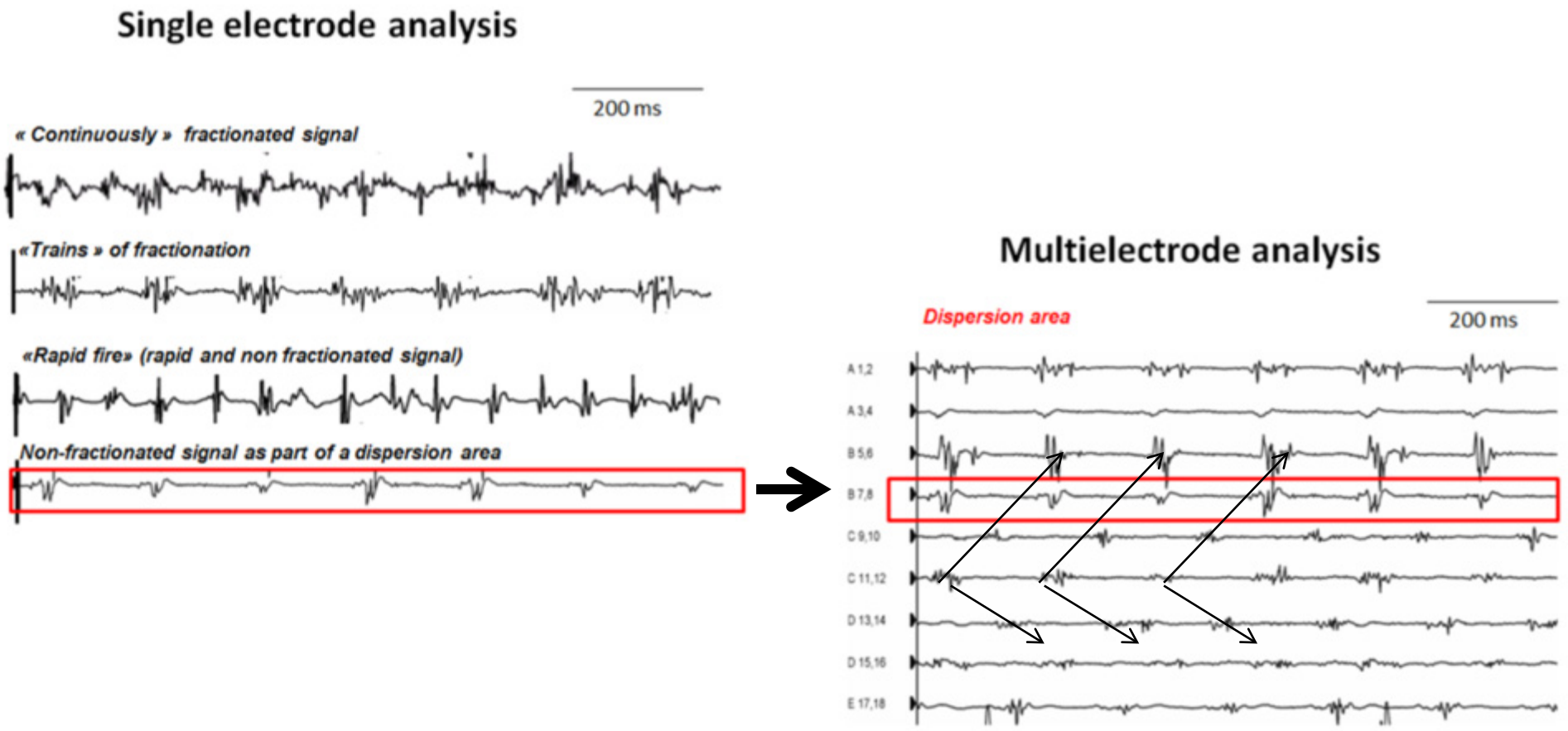
(Ann Arbor – St Joseph)

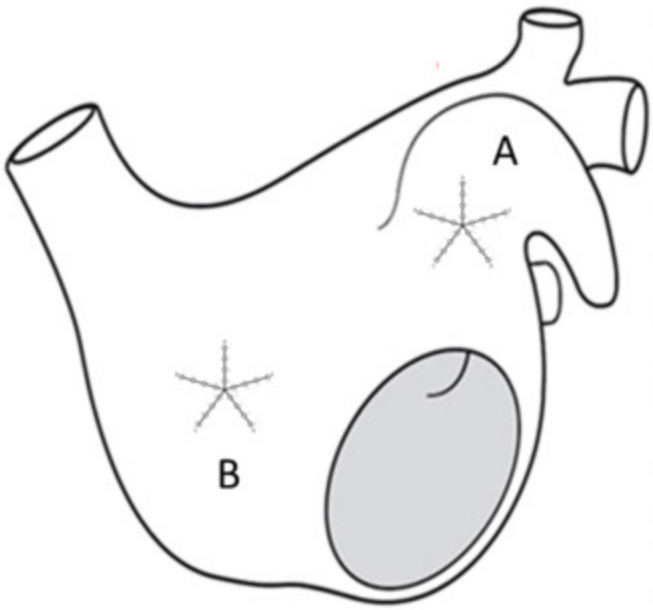
Concept of *Spatio-temporal dispersion*



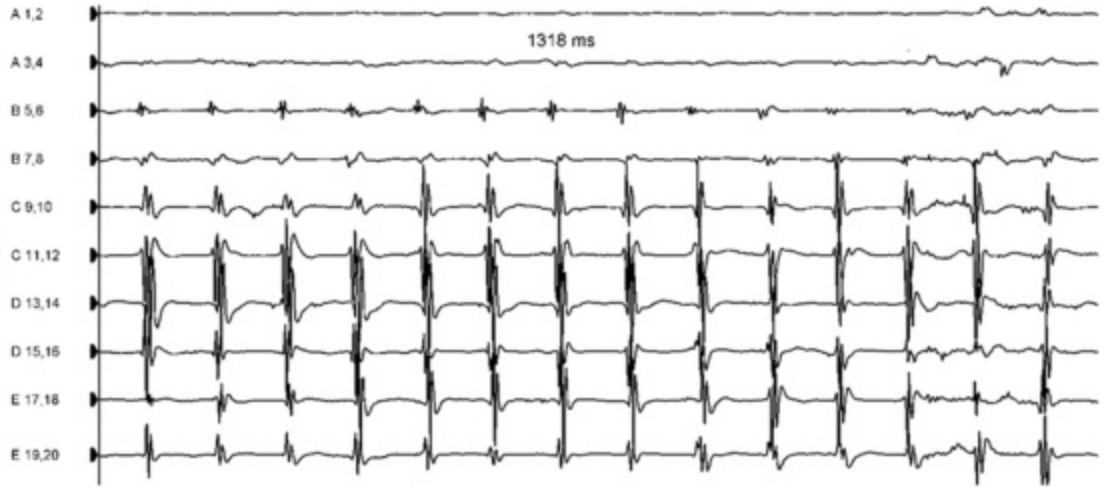
"Dispersion areas were defined as **clusters of electrograms, either fractionated or non-fractionated,** that displayed inter-electrode time and space dispersion at a minimum of three adjacent bipoles such that **activation was spread out over all the AF cycle length**"

Example of EGMs from dispersion regions





A: LAA (Reference cycle lenght = 131 ms)



B: Dispersion area (covering 100% of AF reference cycle lenght)


D
Dispersion


B
Dispersion

HOPITAL SAINT JOSEPH MARSEILLE

University of Michigan Health System

Substrate HD

Clinical study

L'INSTITUT MUTUALISTE MONTSOURIS

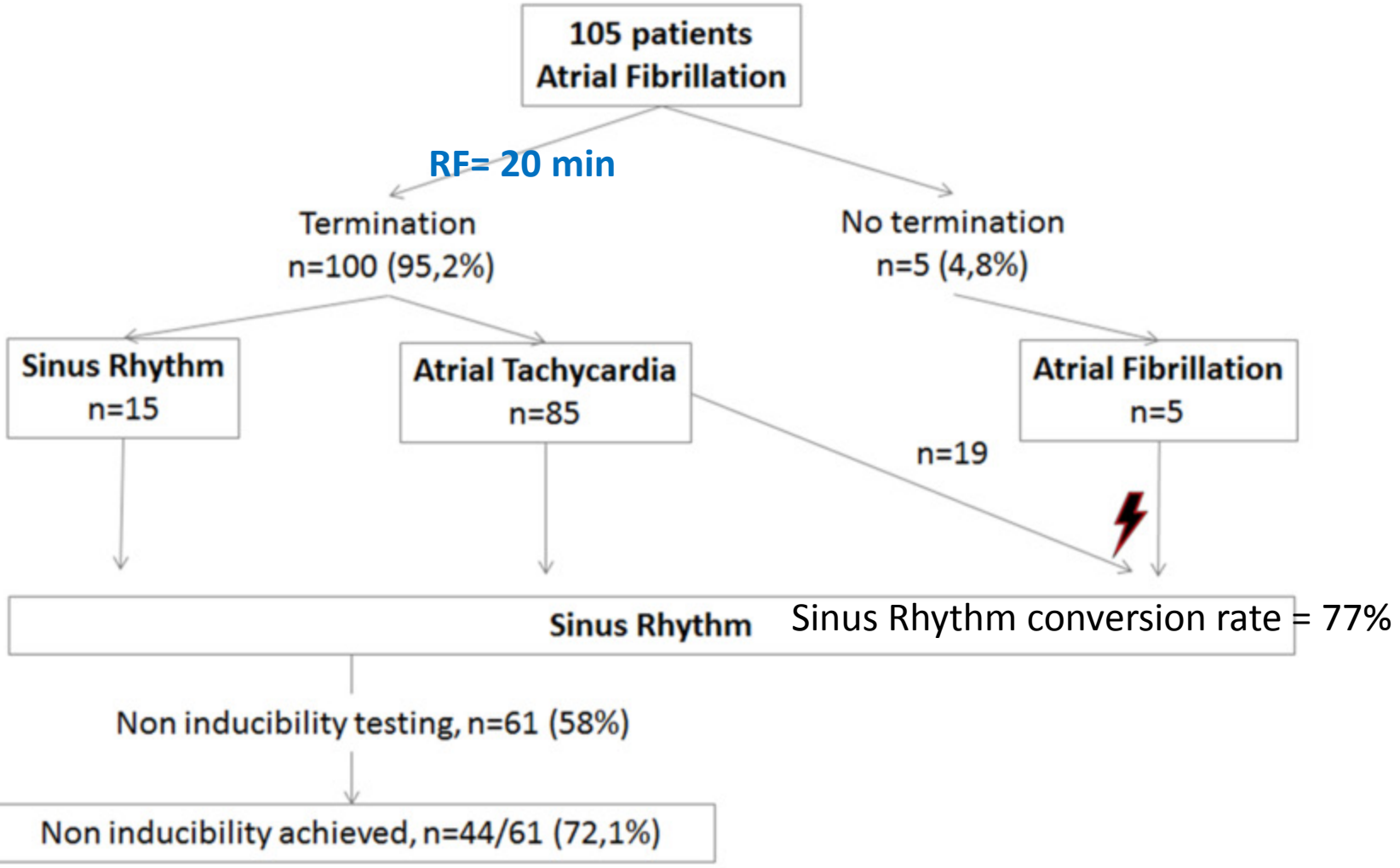
Centre Hospitalier Universitaire de Nice

Clinical Study

- **Prospective enrollment of 105 patients** in 3 centers for AF ablation
- **AF sequential mapping in both atria** using a 20-pole catheter PentaRay.
- **Tagging and ablation** of regions harboring clusters of fast and fractionated electrograms spanning the majority of the AF cycle length (active fibrillatory regions with **spatio temporal dispersion**)
- **No PV isolation**
- **Ablation endpoints** : AF termination acutely, and freedom from AF/AT (after 18 m follow-up with or without AA drugs).

	Study population (n=105)	Validation set (n=47)	p
Age (years), mean + SD	63 +11	58±11	0.0046
Male, n (%)	80 (76.2%)	35 (74%)	0.8191
AF type			
Paroxysmal AF, n (%)	24 (22.8%)	9 (19,2%)	0,6
non-paroxysmal AF, n (%)	81 (77,2%)	38(80,8%)	0,6
Maximum sustained AF duration (months), mean + SD	12.2 + 20	19.4±31.6	0.2457
Structural heart disease, n(%)	38 (36%)	14 (35%)	0.4665
Hypertension, %	48(45,7%)	20 (42,5%)	0.5217
Diabetes, %	13(12.4%)	5(10,6%)	0,5995
LA diameter, mean + SD	45,6± 7,6	42,4±12,4	0,09
LVEF (%), median mean + SD	52 ± 11	54 ± 12	0,20
Amiodarone before ablation, %	32%	NA	

Immediate results



Total RF time = 49±21 minutes (Ablated surf= 17±10% LA surf and 10±5 % biatrial surf)

Sinus Rhythm conversion rate = 77%

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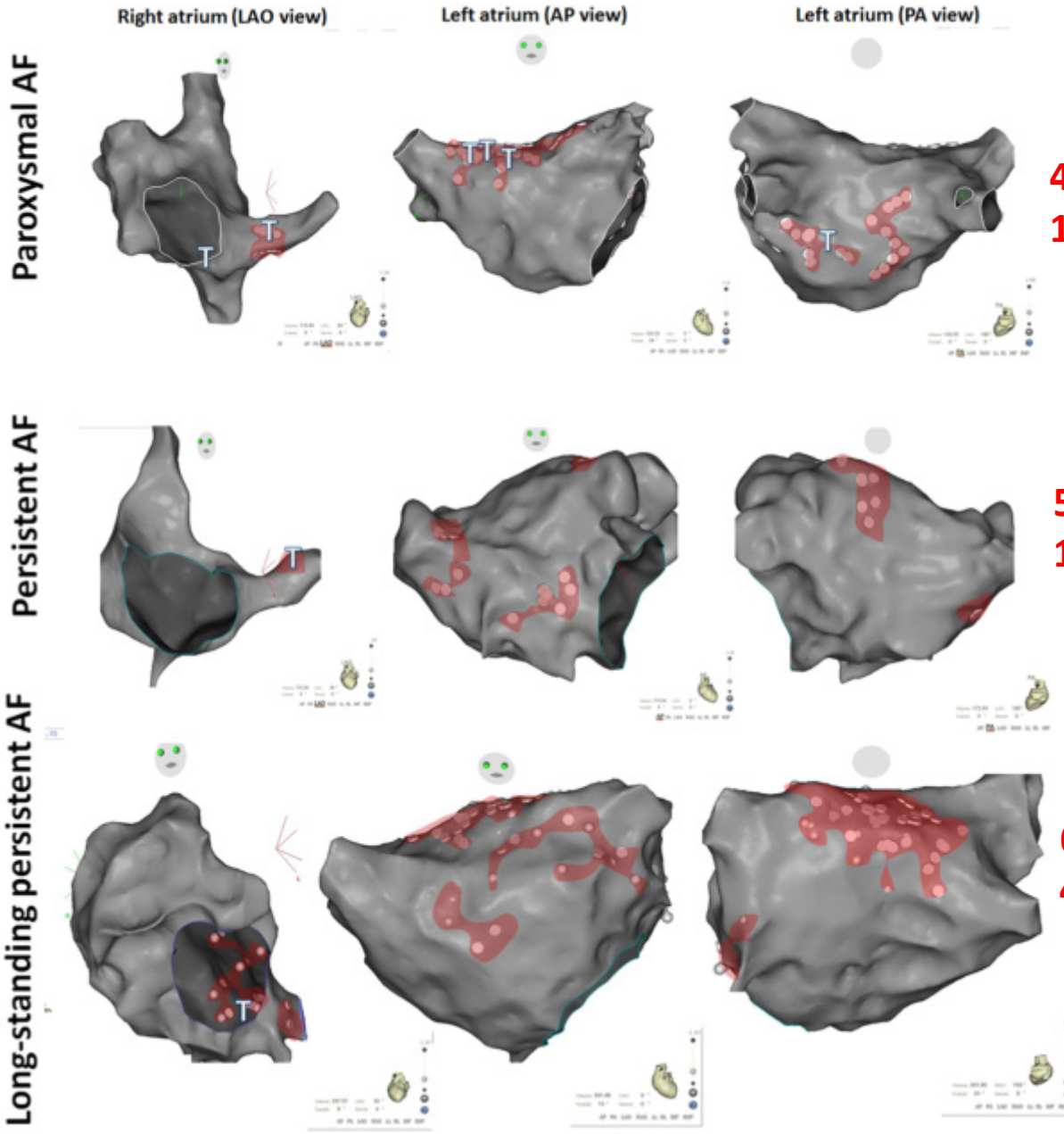
University of Michigan Health System

Substrate HD

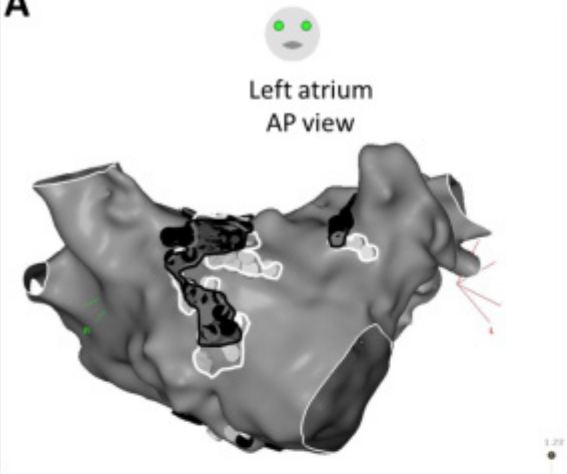
Mechanistic study

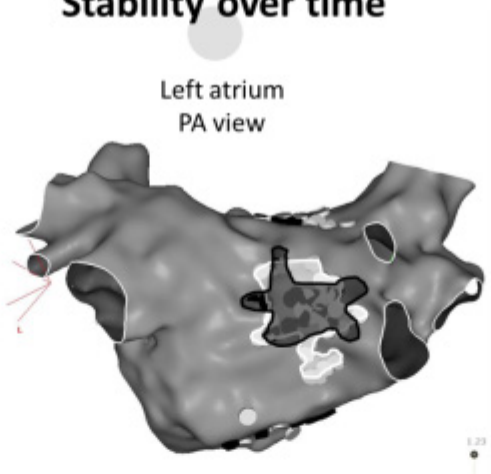
Dispersion regions characteristics

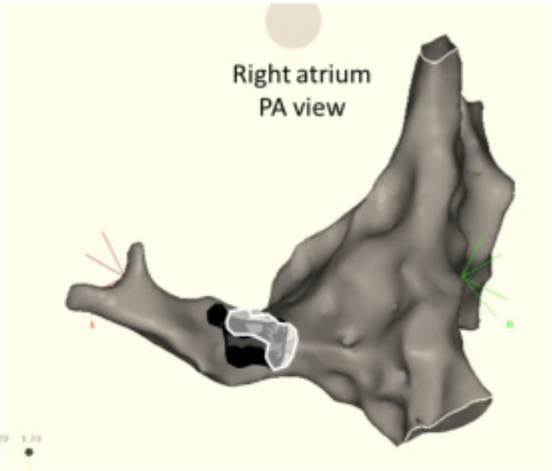


A

Stability over time



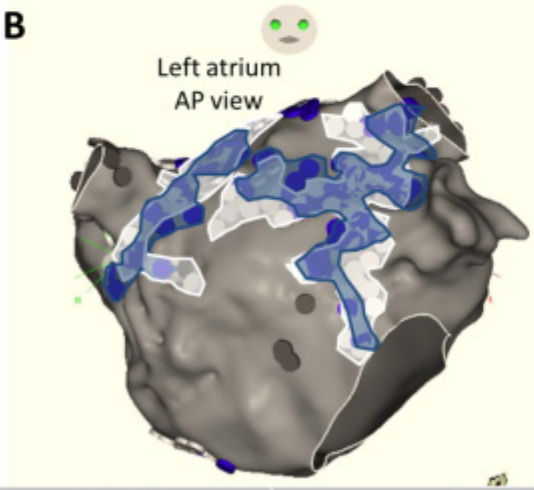


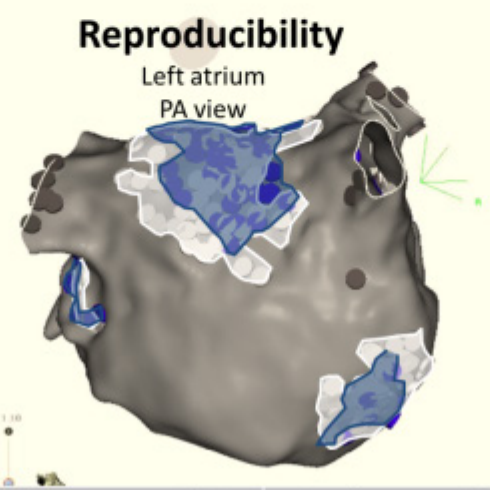


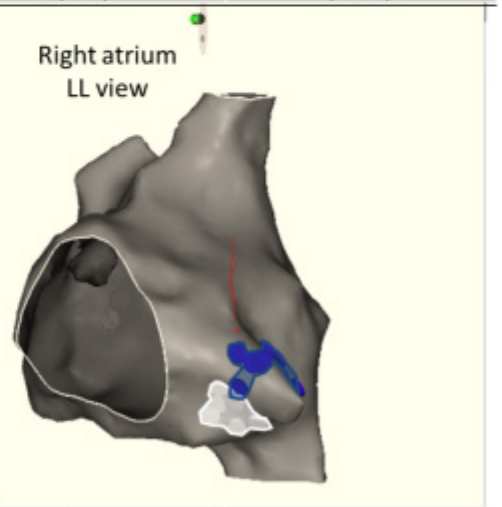
N=13 patients	Mapping 1	Mapping2	Match mapping 1 & 2	Mismatch mapping 1	Mismatch mapping 2
Mapping surface (cm2)	30±12	28±12	26±13	4±3	2±2
% biatrial surface	14±8	13±9	12±9	2±1	1±1
Involved areas	5,6±0,9	5,3±1	5,2±0,9	0,4±0,6	0,07±0,3

B

Reproducibility

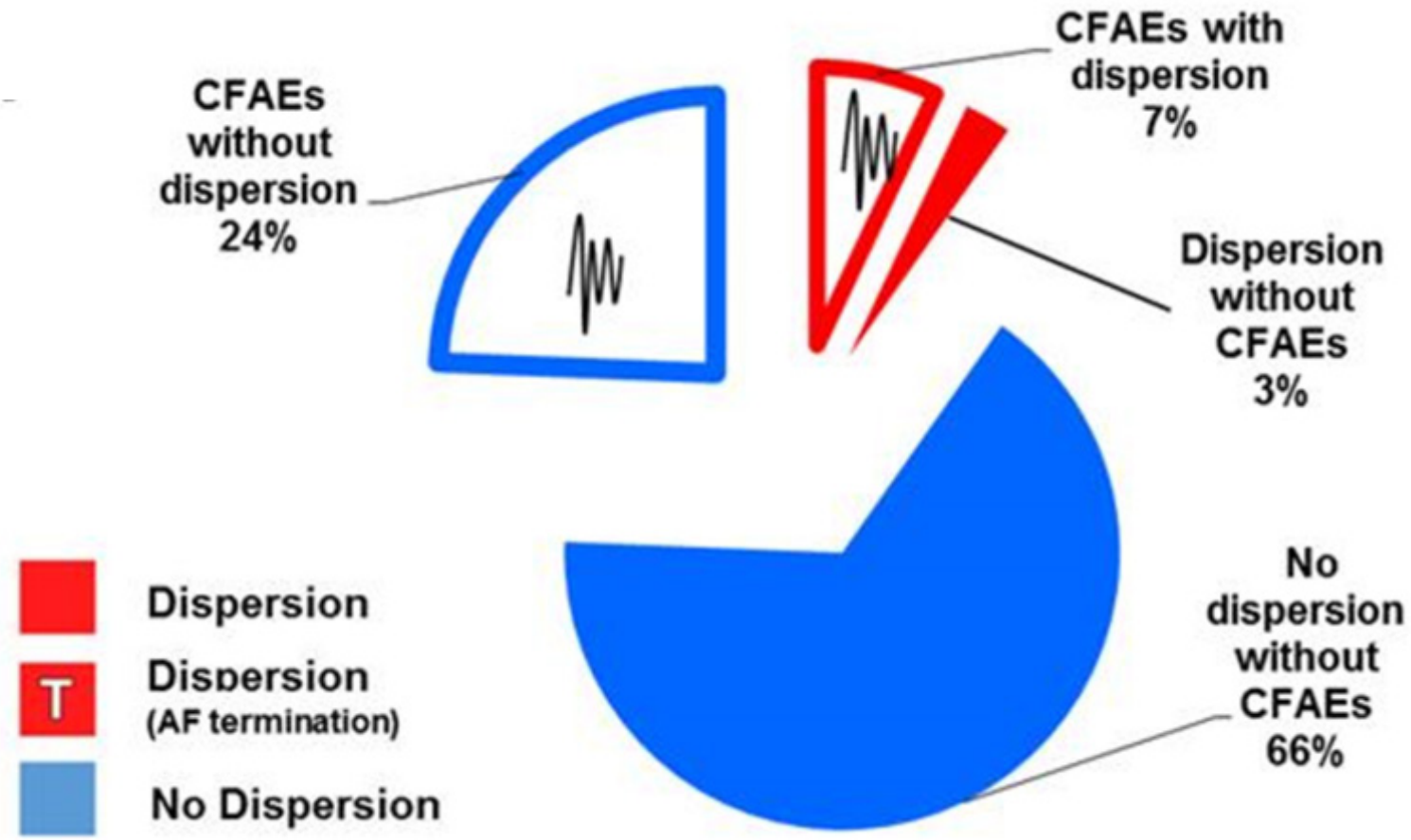






N=7 patients	operator 1	operator 1	Match operator 1 & 2	Mismatch operator 1	Mismatch operator 2
Mapping surface (cm2)	32±11	29±8	23±7	12±3	7±4
% biatrial surface	11±4	10±3	8±2	4±1	2±1
Involved areas	6±0,8	6,3±0,7	6±0,8	0	0,3±0,5

Fractionation & Dispersion



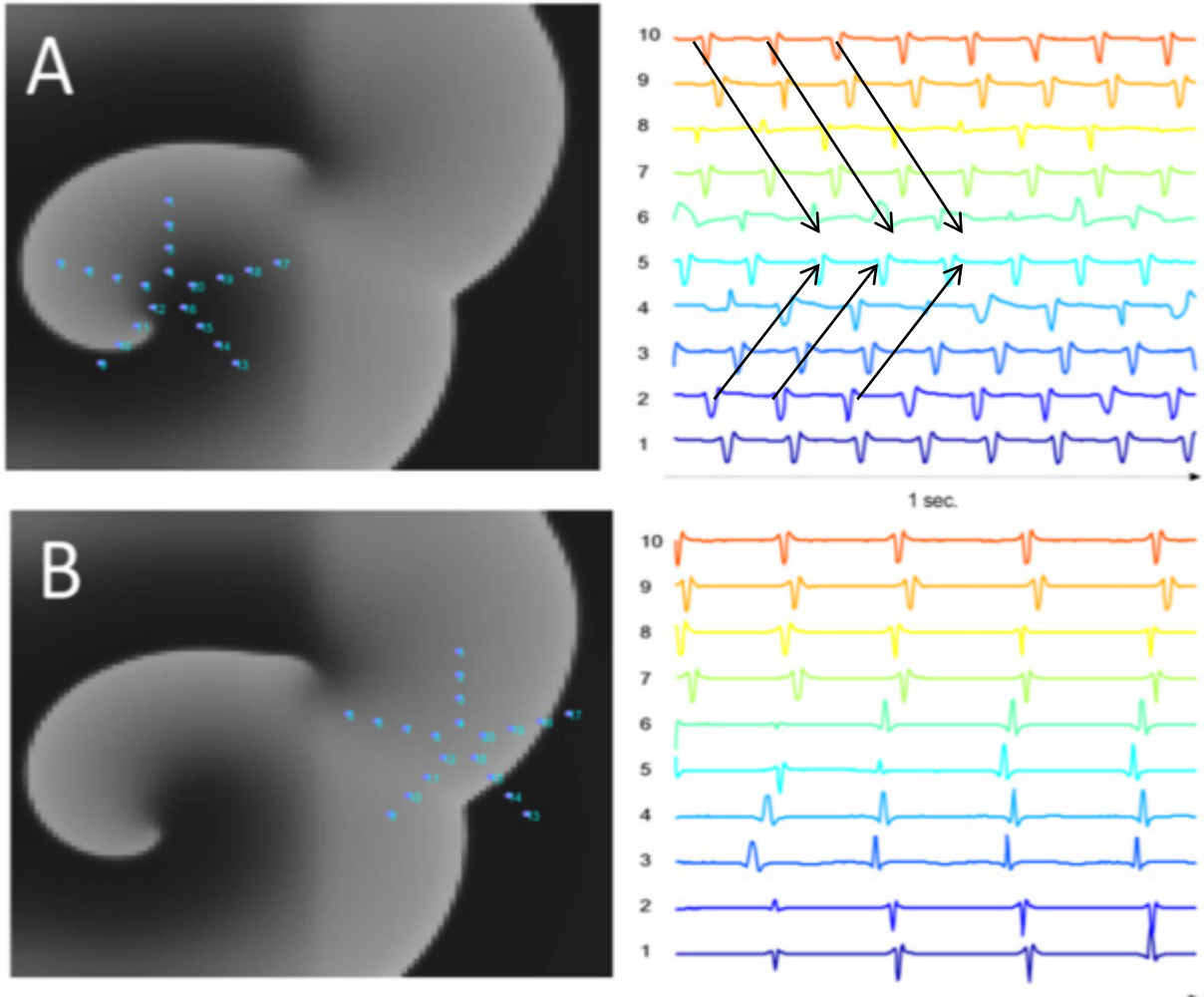
« The great majority of EGMs in dispersion regions are fractionated…

…but fractionated EGMs can also be observed in non-disperion regions »

What are these dispersion regions?

Numerical simulations

Human atrial model, homogeneous substrate:

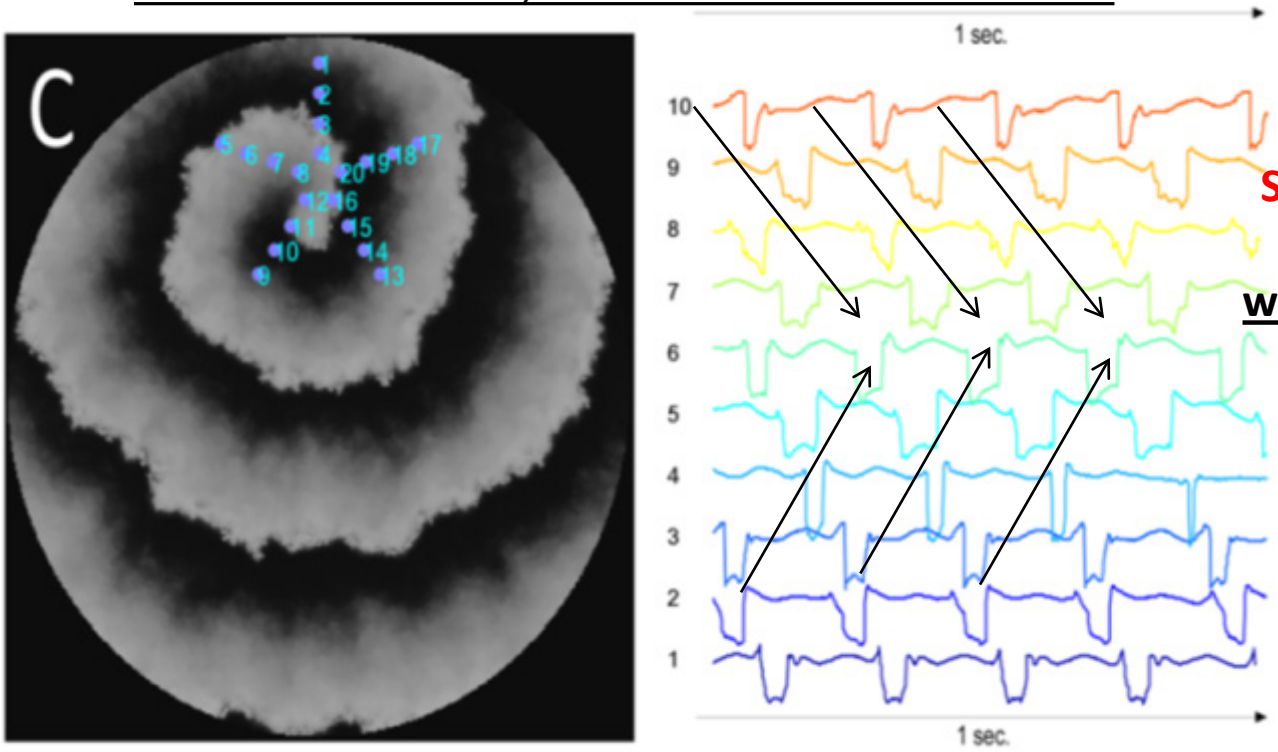


Spatio-temporal dispersion

No dispersion

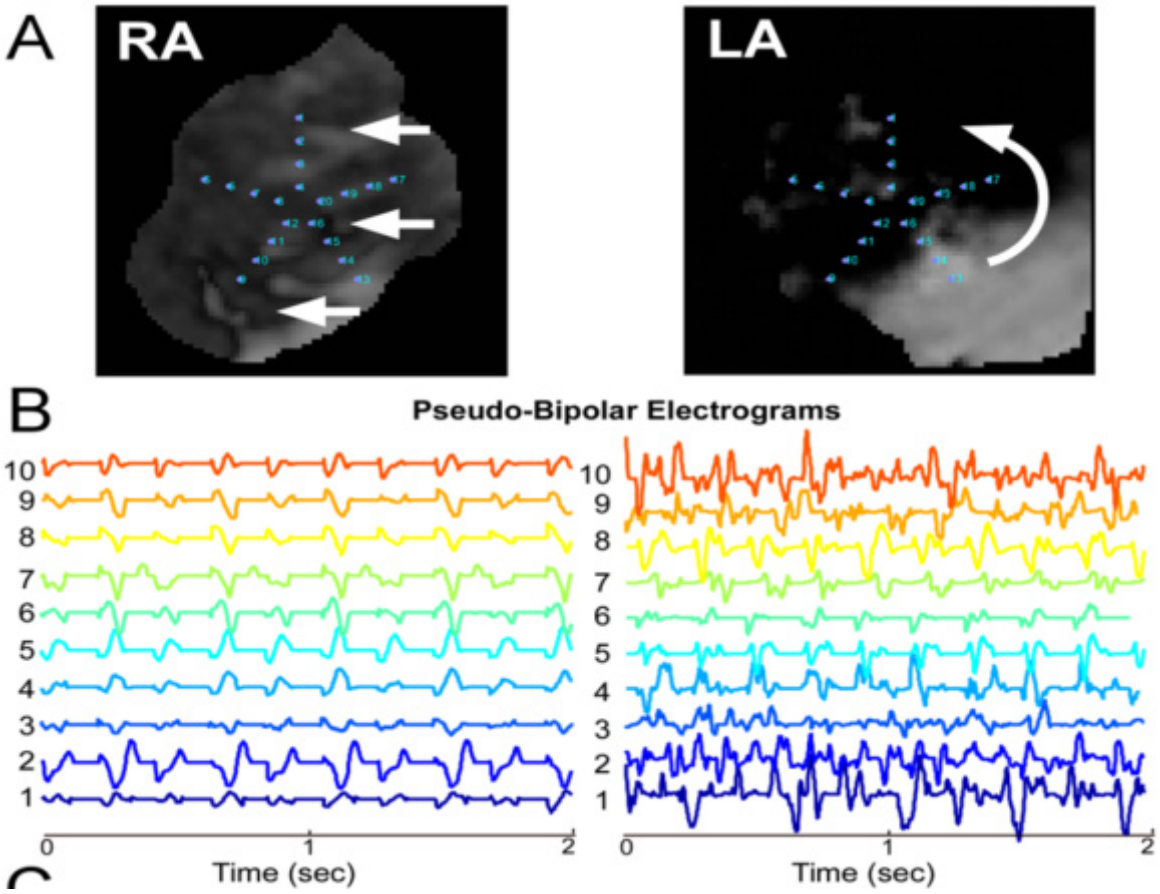
Numerical simulation

Human atrial model, Interstitial fibrosis condition :



Spatio-temporal Dispersion with fractionation

Optical mapping



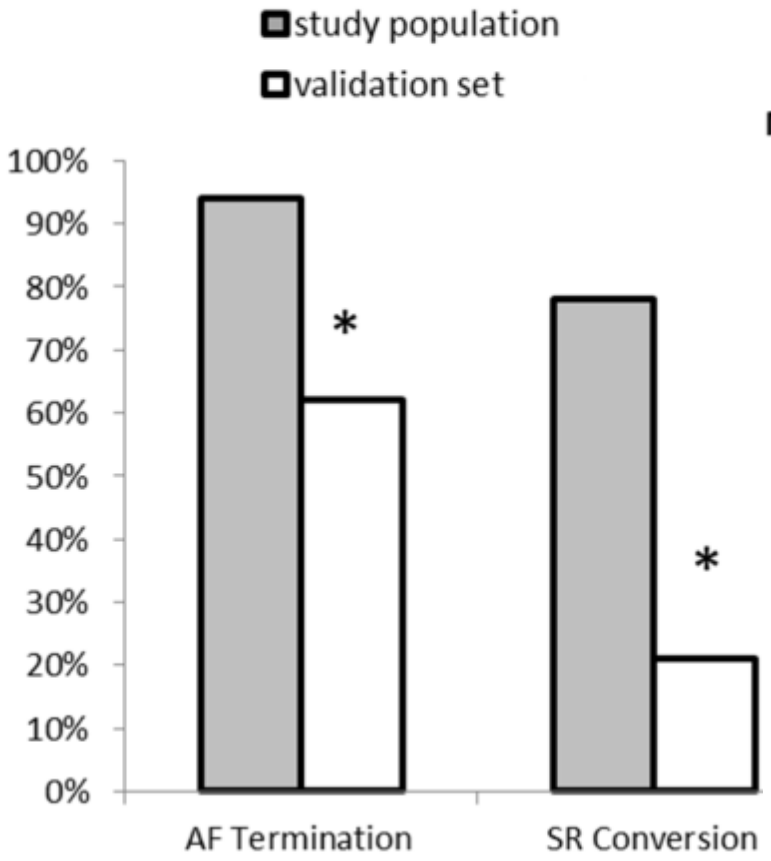
No dispersion

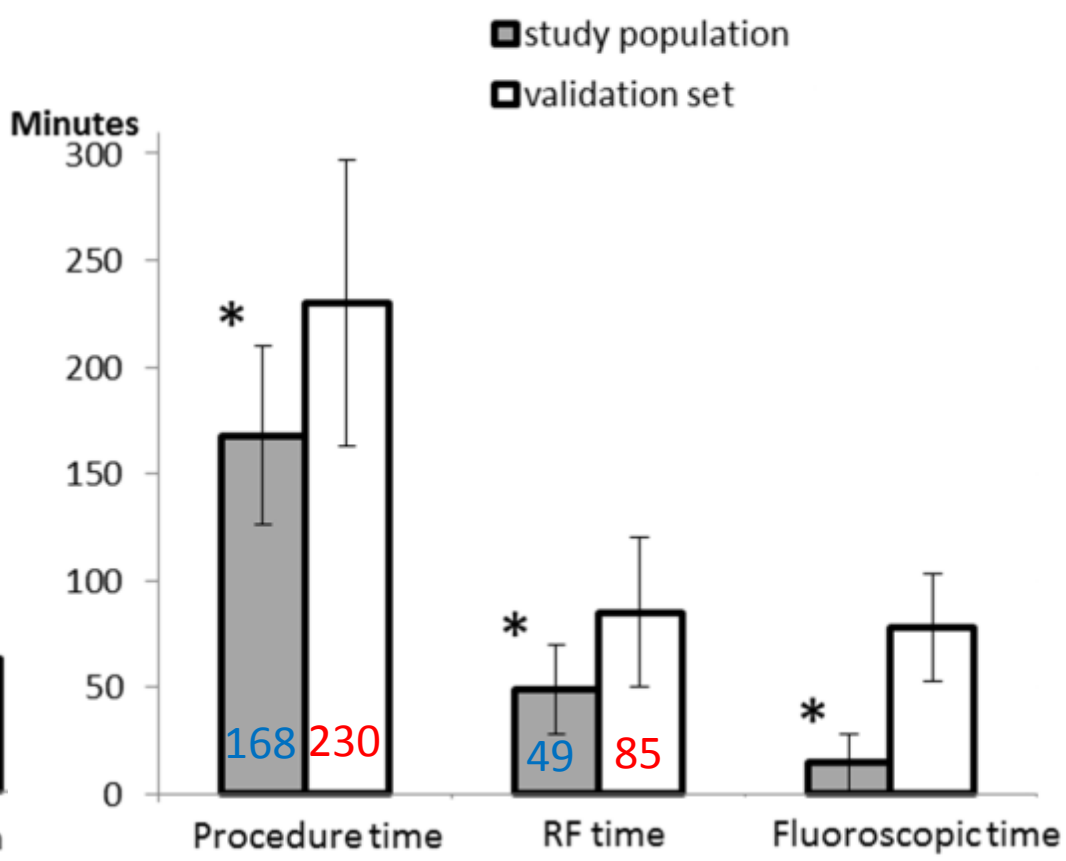
Spatio-temporal dispersion with fractionation

18 month-follow up

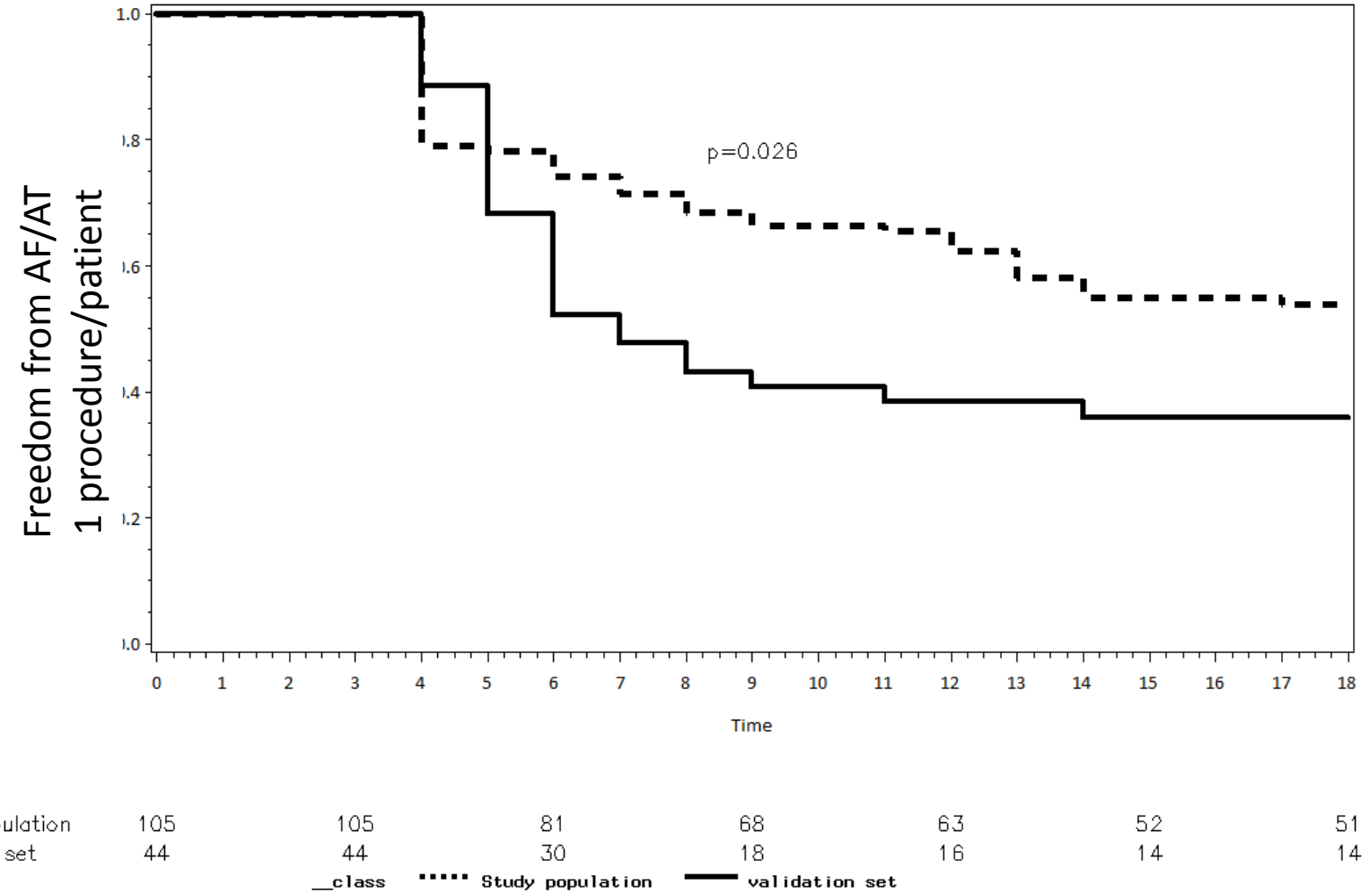
Completed in 91% of the patients: follow-up visits and 24-hour Holter , 7days holter-monitor/ PM-ICD memory card in 20 pts

Better acute efficacy with shorter and less extensive ablation



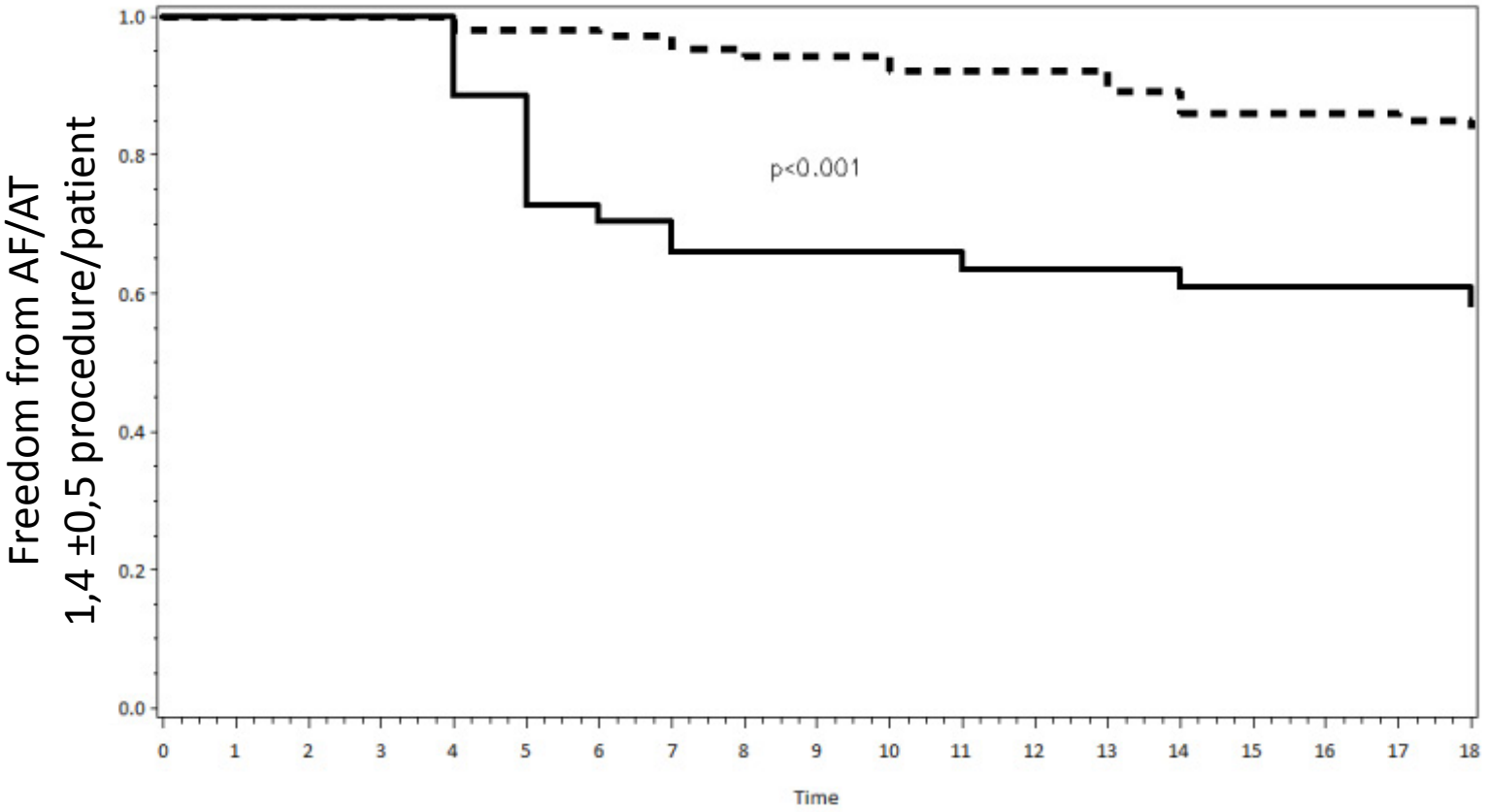


18 month-FU: 55% of stable sinus Rhythm



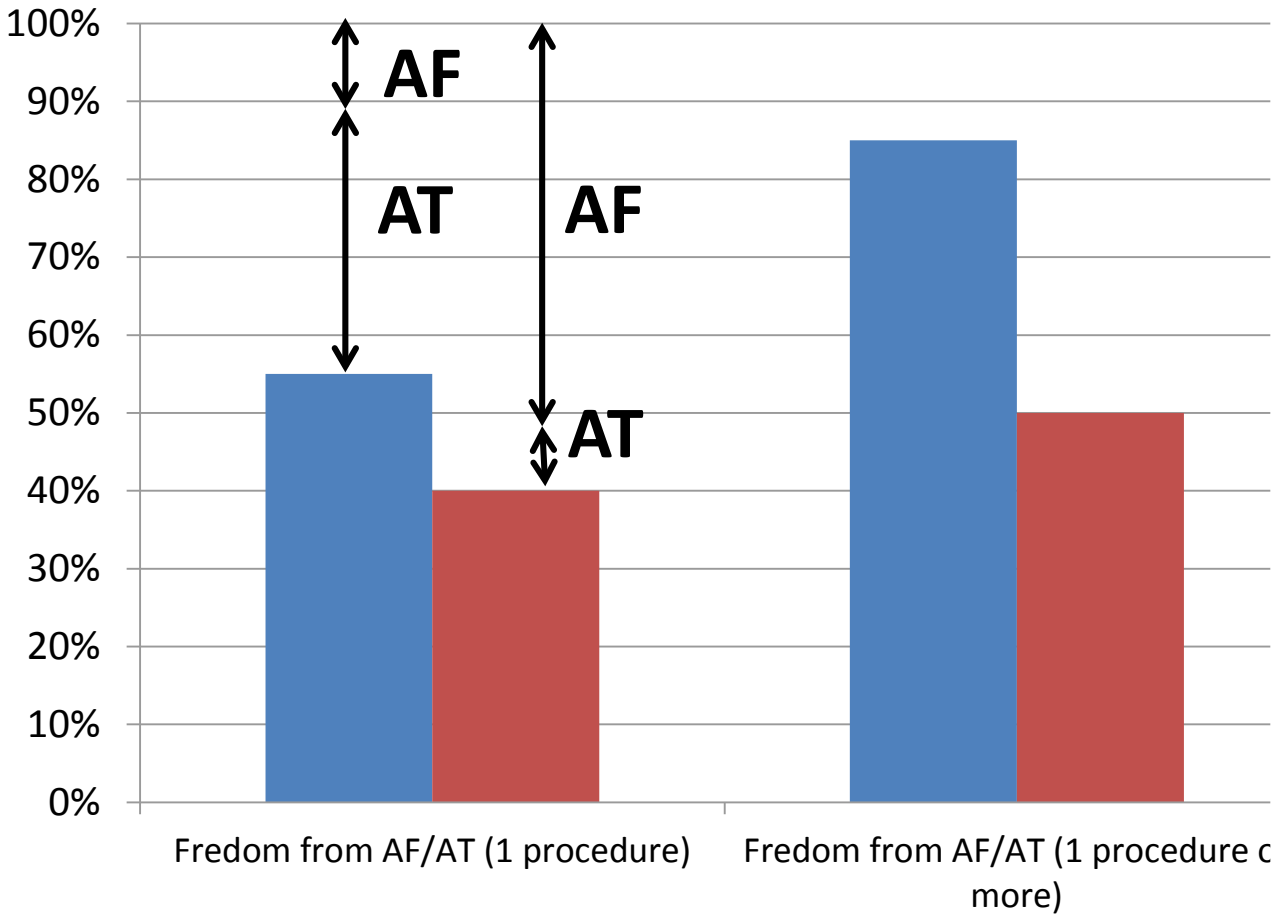
with or without AA drugs

18 month-FU: 85% of stable sinus Rhythm



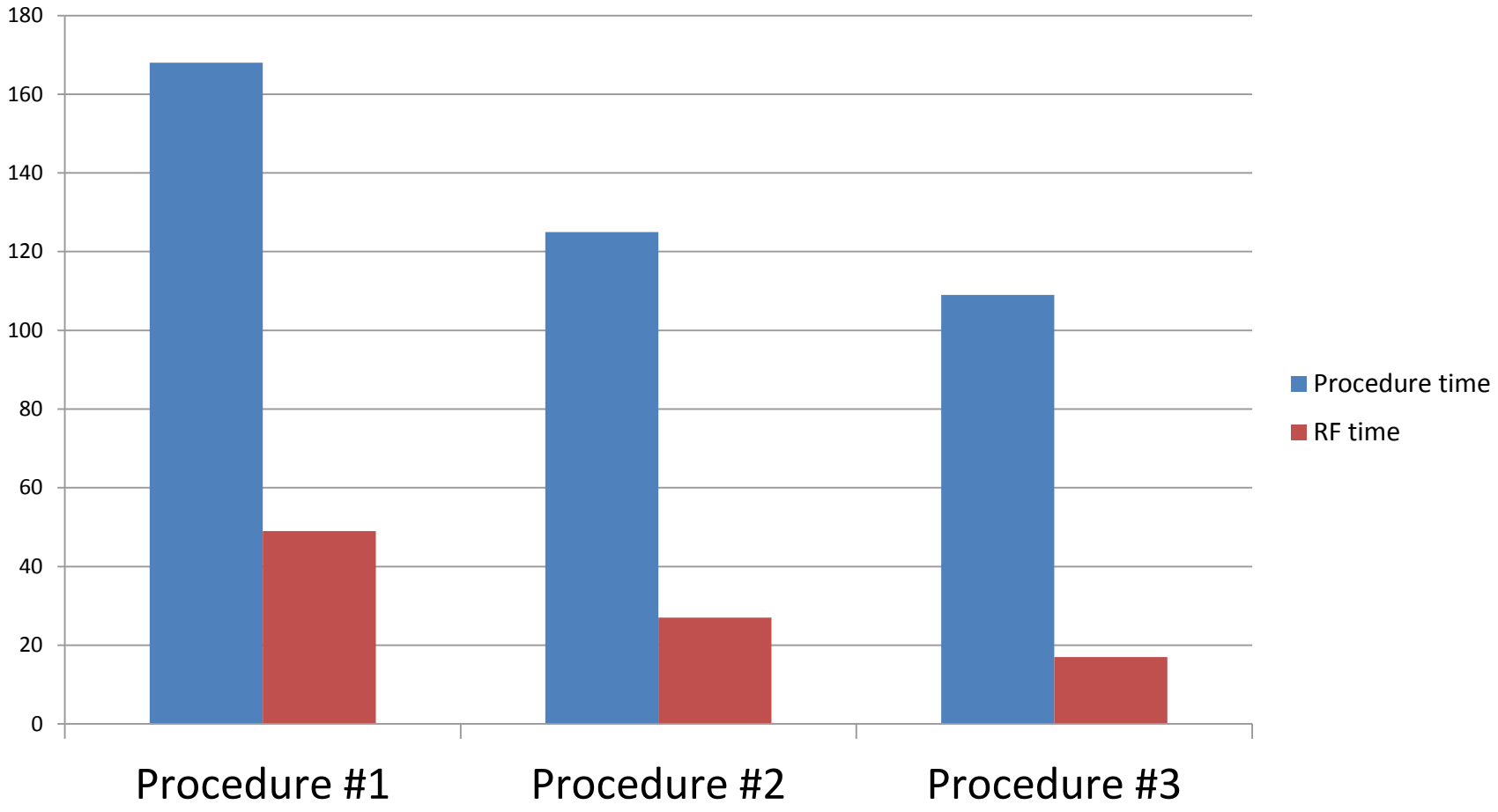
with or without AA drugs

Substrate HD vs STAR AF2*

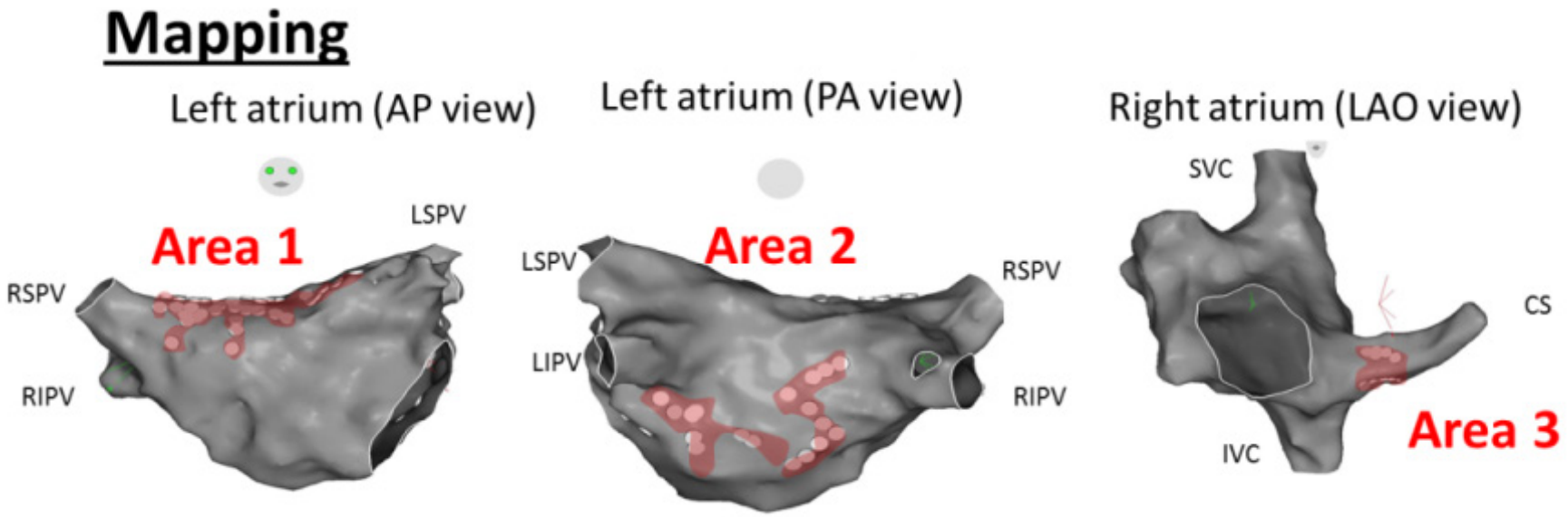


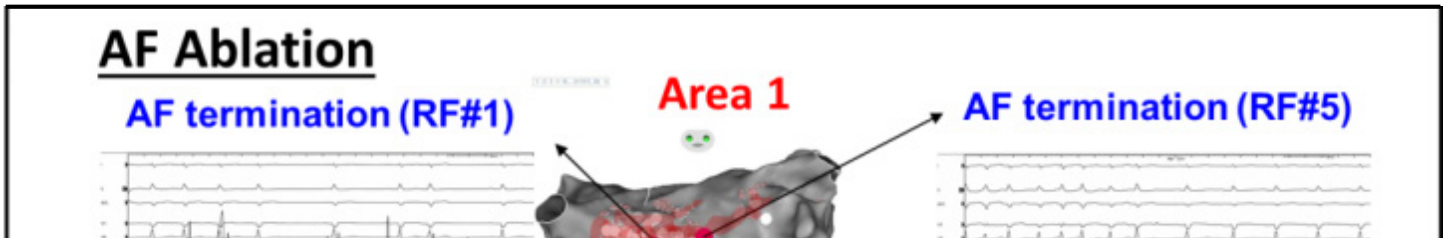
* average results of the comparable 3 groups (PVI, PVI+cfe, PVI+lines)

AT are much easier to ablate than AF



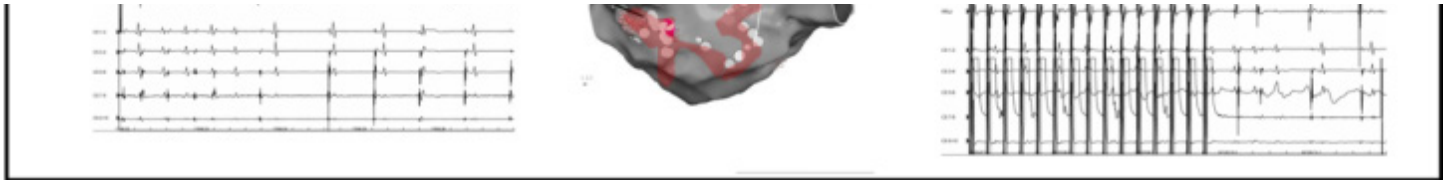
Mechanisms of AT and its relationship with the original AF





Analysis in 21 patients:
44 ATs, 22 macroreentries & 22 localized AT (88,6% in non- ablated areas).

Importantly 17/22 (77,3%) localized ATs arose from dispersion regions that were not previously ablated!



The 2 ATs were located in dipersion areas non already ablated

Since the majority of ATs arise from the dispersion regions that were not previously ablated, it implies that such ATs may be the primary arrhythmias that were unmasked after the areas of fibrillatory conductions had been ablated…

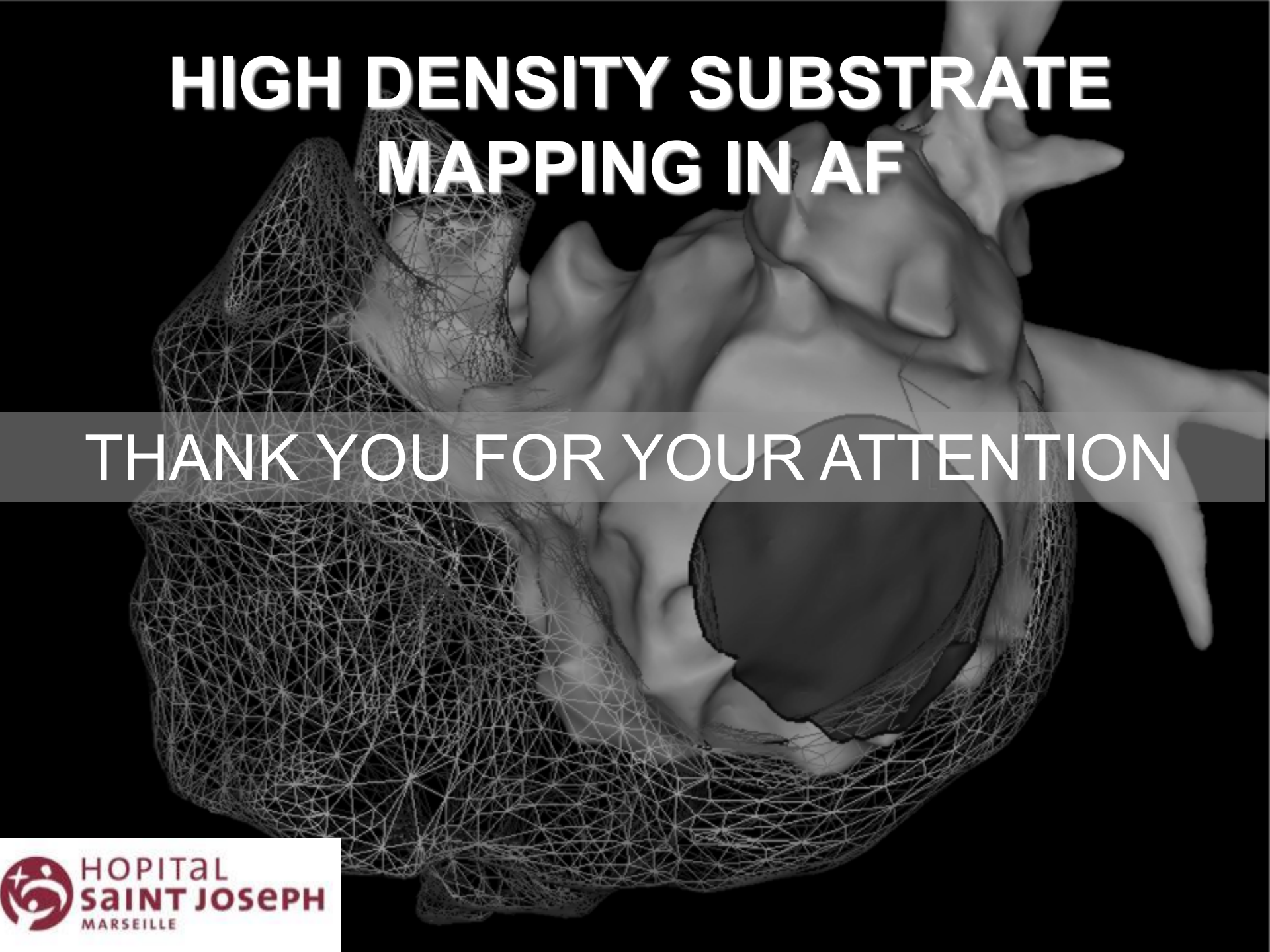
Conclusion

- Spatio-temporal dispersion of electrograms represents an electrical footprint of waves emanating from rapid fibrillatory drivers and propagating within a heterogeneous atrial muscle.

- The clustering of intra-cardiac electrograms exhibiting spatio-temporal dispersion will result in patient-tailored ablation of all types of AF especially for persistent AF.

- Atrial tachycardias are probably a part of AF substrate and are able to be unmasked by ablation at dispersion regions

HIGH DENSITY SUBSTRATE MAPPING IN AF



THANK YOU FOR YOUR ATTENTION

HOPITAL SAINT JOSEPH MARSEILLE