

Ablation of persistent atrial fibrillation: What is beyond pulmonary vein isolation?

João de Sousa

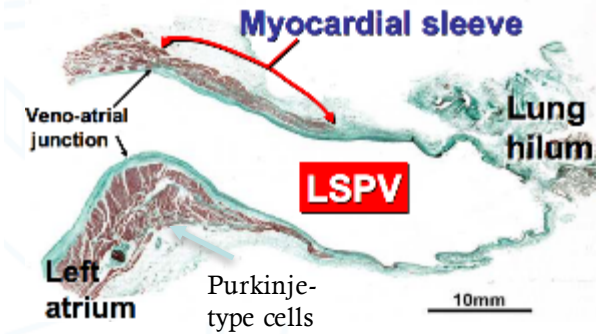
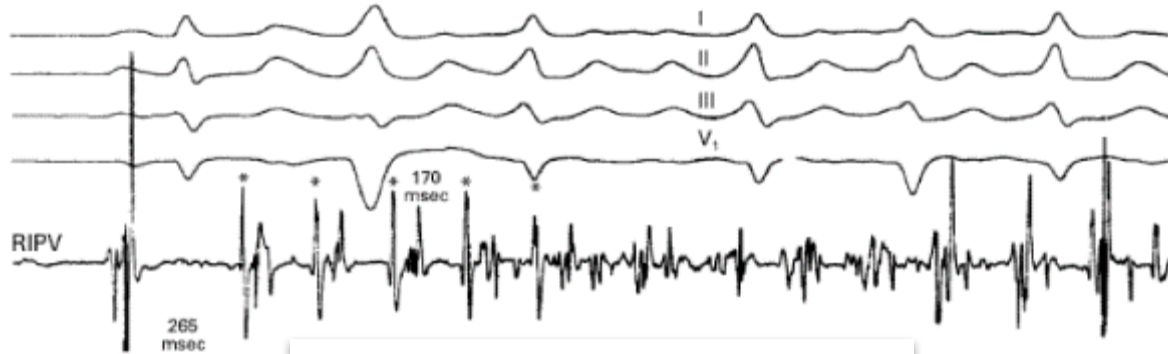
Faculdade de Medicina de Lisboa
Hospital de Santa Maria, CHLN



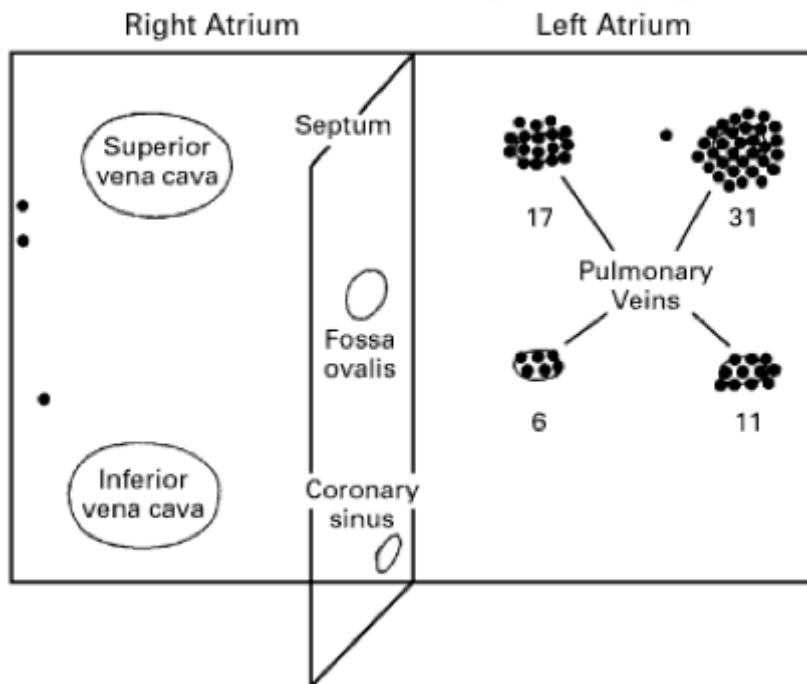


- Proctoring activities
 - Boston Scientific, Medtronic
- Investigator
 - Boston Scientific, Medtronic, St. Jude, Biotronik, Livanova
- Advisory Board
 - St. Jude, Bayer
- Speaker honorarium
 - Livanova, Biosense-Webster, St. Jude

AF Catheter Ablation: PV foci



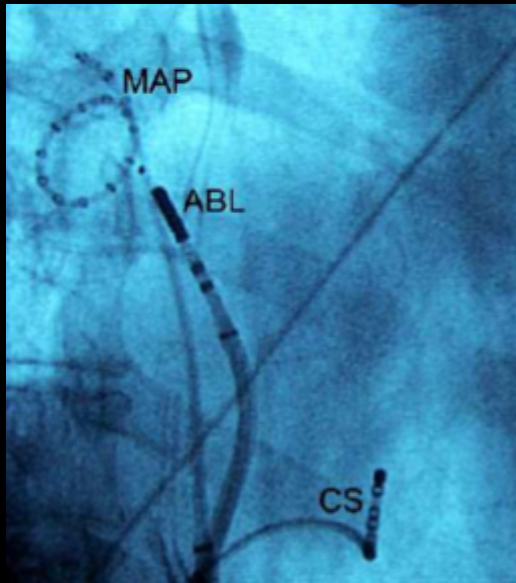
- AF triggers are mostly localized in the Pulmonary Vein ostia (94%)



Haissaguerre, NEJM 1998.

AF Ablation: Technique evolution

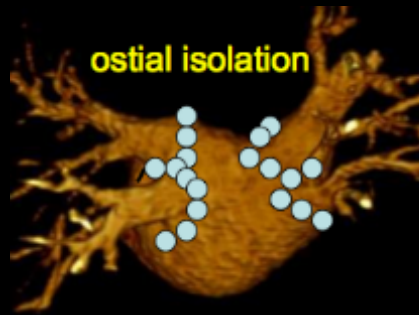
Focal VP Ablation



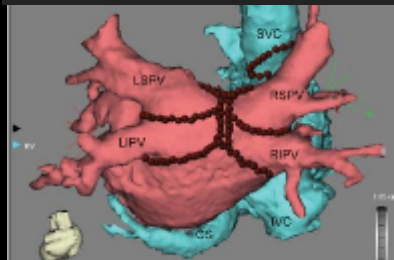
M. Haissaguerre (1998)

PV electrical isolation

Segmentar, Circunferencial, Antral



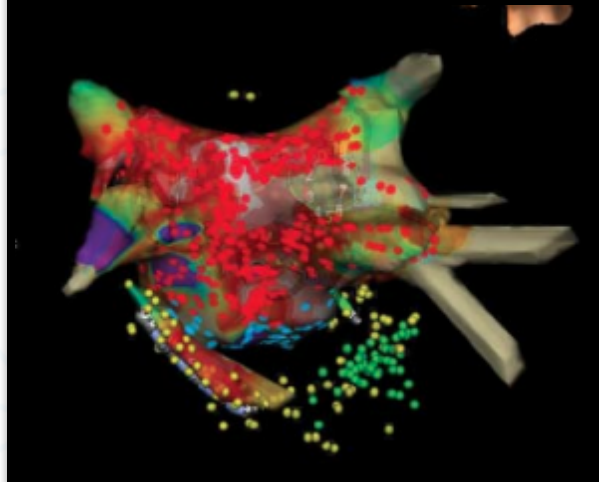
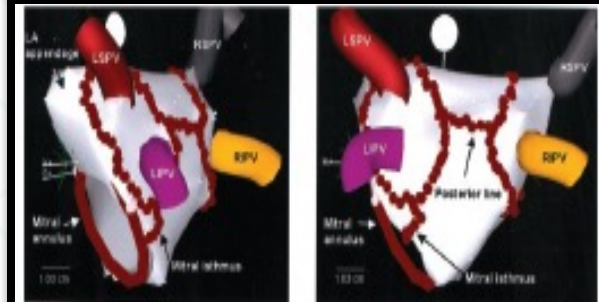
Extensive antral ablation



Haissaguerre, Kuck, Natale, PaponneNadamanee, Haissaguerre, Morady

Substrate modification

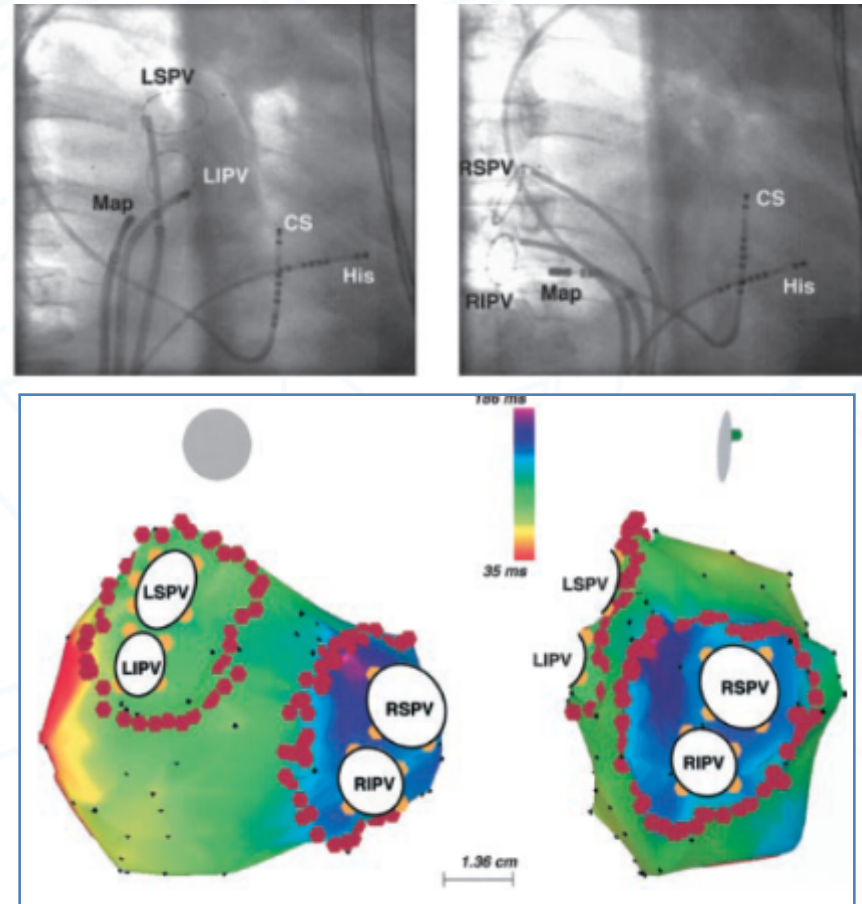
Linear ablation, CAFE, SNA ganglia



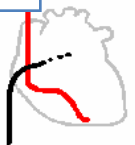
AF ablation: PVI results

Electrogram guided circumferential pulmonary vein isolation (2004)

- Carto/Navex reconstruction
- Single / Double circular mapping
- Encircling lesions in both ipsilateral PV
- End-point of electrical PVI
- 95% acute success in PAF
- 22% pts needed two ablation procedures



Ouyang F, Bansch D, Ernst S et al: Complete isolation of left atrium surrounding the pulmonary veins: new insights from the double-Lasso technique in paroxysmal atrial fibrillation. Circulation 2004;110:2090-6

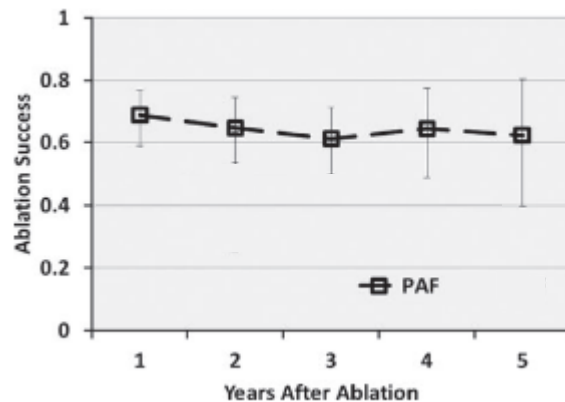




Ablation success in Paroxysmal AF

Metanalysis (19 studies; 6.167 pts)

- Diverse ablation strategies for **PVI**



	1 year	3 year
Single ablation	68,6% (58,9-77,0)	61,1% (49,8-71,2)
Multi-ablation	85,7% (81,9-88,7)	79,0% (67,6-87,1)

Worldwide Survey of Catheter Ablation for Human Atrial Fibrillation

Success Rates Relative to Follow-Up Duration

Range of Follow-Up Duration, mo	No. of Patients (N=8,586)	Overall Success
0-3	179	68.2%
4-6	906	67.8%
7-9	1271	73.9%
10-12	1537	89.9%
13-18	2607	78.1%
19-24	467	69.8%
>24	1619	69.5%

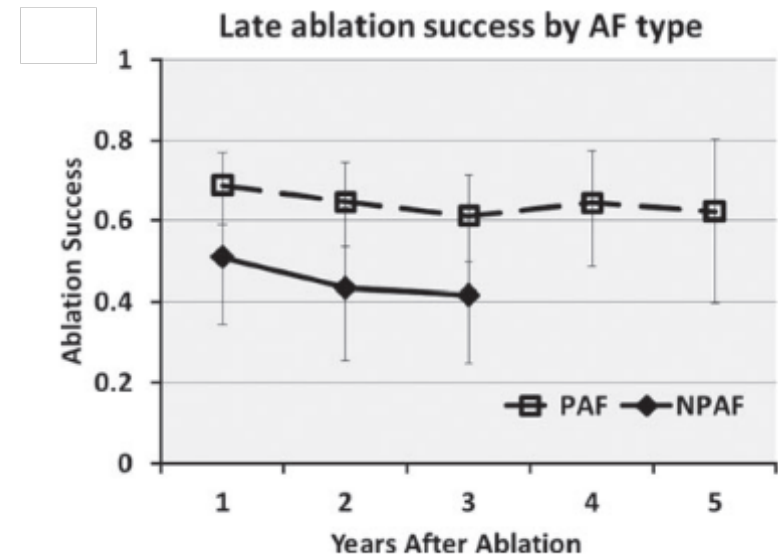


Ablation success in Persistent AF

Metanalysis (19studies)

	1 ano	3 anos
Persistent AF	50,8% (34,3-67,2)	41,6% (24,7-60,8)

Ganesan A. *J Am Heart Assoc.* 2013;2:e004549.



Ablation strategies were designed trying to produce wide substrate modification in patients with lower probability of success (ie. long-term persistent AF)

Persistent AF: long-term results

Catheter Ablation of Long-Standing Persistent Atrial Fibrillation

5-Year Outcomes of the Hamburg Sequential Ablation Strategy

Roland Richard Tilz, MD, Andreas Rillig, MD, Anna-Maria Thum, Anita Arya, MD, Peter Wohlmuth, Andreas Metzner, MD, Shibu Mathew, MD, Yasuhiro Yoshiga, MD, Erik Wissner, MD, Karl-Heinz Kuck, MD, Feifan Ouyang, MD

Hamburg, Germany

Objectives This study describes the 5-year efficacy of catheter ablation for long-standing persistent atrial fibrillation (LS-AF).

Background Long-term outcome data after catheter ablation for LS-AF are limited.

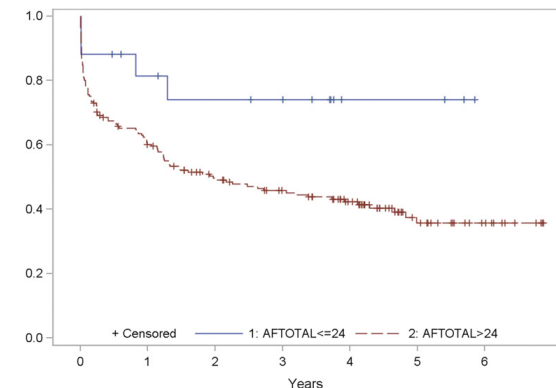
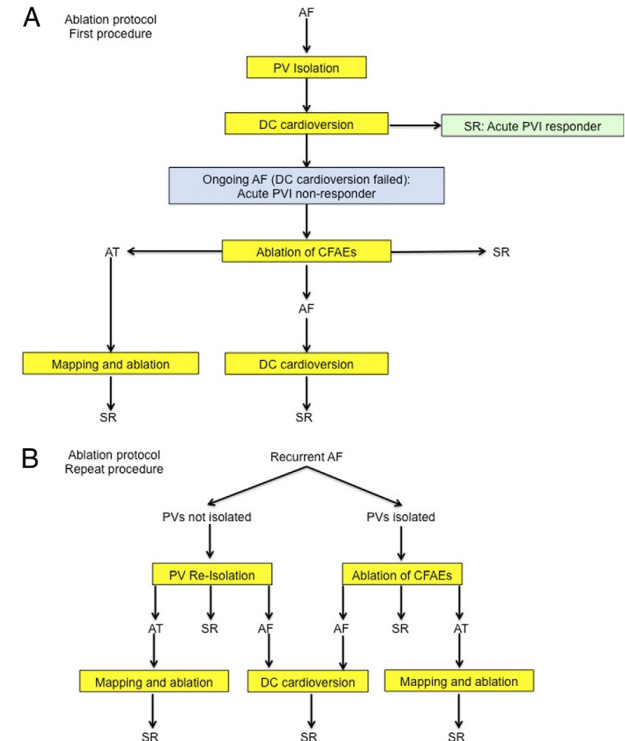
Methods Long-term follow-up of 56 months (range 49 to 67 months) was performed in 202 patients (age 61 ± 9 years) who underwent the sequential ablation strategy for symptomatic LS-AF. Initial ablation strategy was circumferential pulmonary vein isolation (PVI). Additional ablation was performed only in acute PVI nonresponder, if direct current cardioversion failed after PVI.

Results After the first ablation procedure, sinus rhythm was documented in 41 of 202 (20.3%) patients. After multiple procedures, sinus rhythm was maintained in 91 of 202 (45.0%) patients, including 24 patients receiving antiarrhythmic drugs. In 105 patients, PVI was the sole ablative therapy, 49 (46.7%) of those patients remained in sinus rhythm during follow-up. Patients with a total AF duration of <2 years had a significantly higher ablation success rate than patients whose AF duration was >2 years (76.5% vs. 42.2%, respectively; $p = 0.033$). Persistent AF duration (hazard ratio: 1.09 [95% confidence interval: 1.04 to 1.13]; $p < 0.001$) independently predicted arrhythmia recurrences, and acute PVI responders had a reduced risk of relapse (hazard ratio: 0.57 [95% confidence interval: 0.41 to 0.78]; $p < 0.001$) after the first ablation.

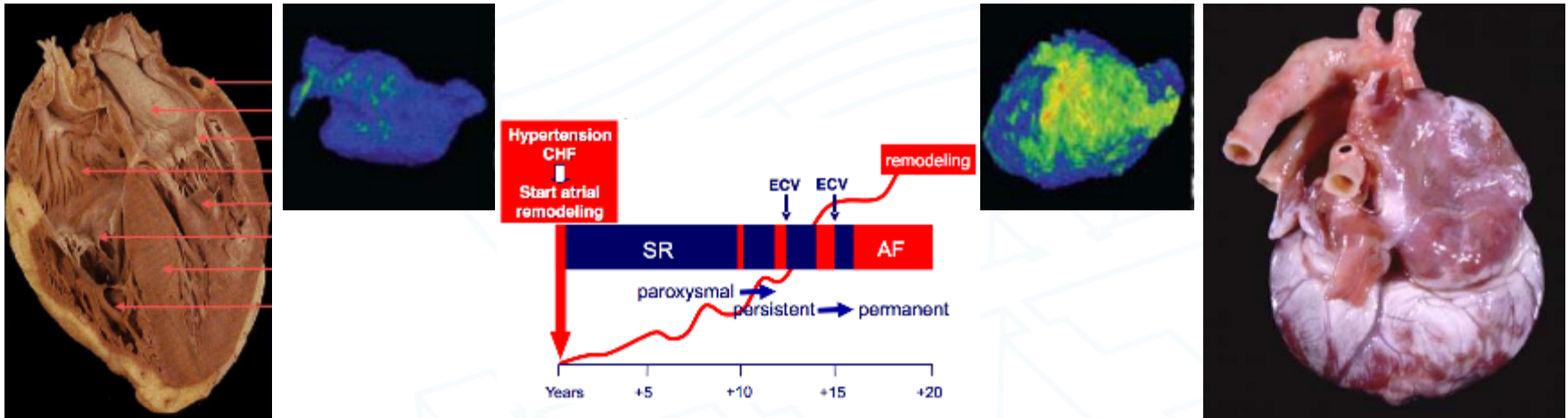
Conclusions During 5-year follow-up, single- and multiple ablation procedure success was 20% and 45%, respectively, for patients with LS-AF. For patients with a total AF duration of <2 years, the outcomes were favorable. (J Am Coll Cardiol 2012;xxx:xx) © 2012 by the American College of Cardiology Foundation

Table 2 Summary of Ablation Procedures

Procedure	PVI Only Until This Procedure	PVI and Additional Ablation		
		CFAE	LA Line	SVC/AES
First procedure (n = 202)	165 (165)	29 (29)	12 (12)	7 (7)
Second procedure (n = 126)	0 (60)	15 (21)	24 (26)	13 (0)
Third procedure (n = 42)	0 (5)	15 (20)	21 (26)	1 (0)
Fourth procedure (n = 11)	0 (0)	1 (2)	3 (6)	0 (0)
Fifth procedure (n = 2)	0 (0)	0 (0)	0 (2)	0 (0)
Ablation summary (last procedure)	105	60	60	21



AF: Natural history



Electrical

Electro-Structural

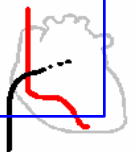
Paroxysmal AF

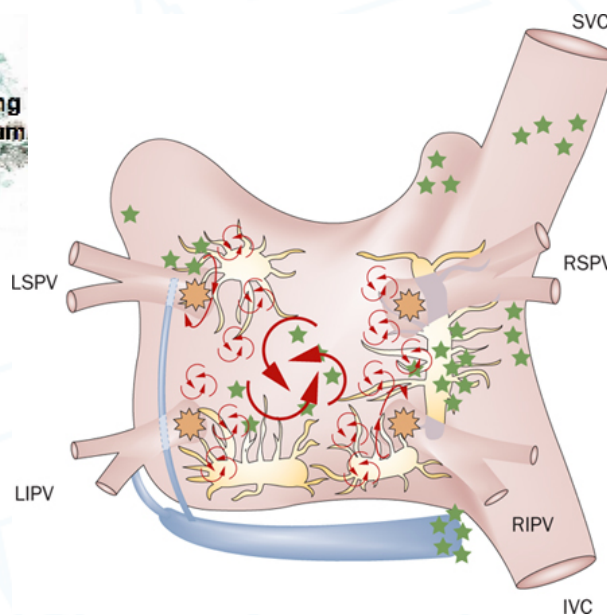
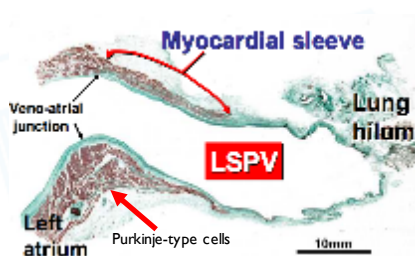
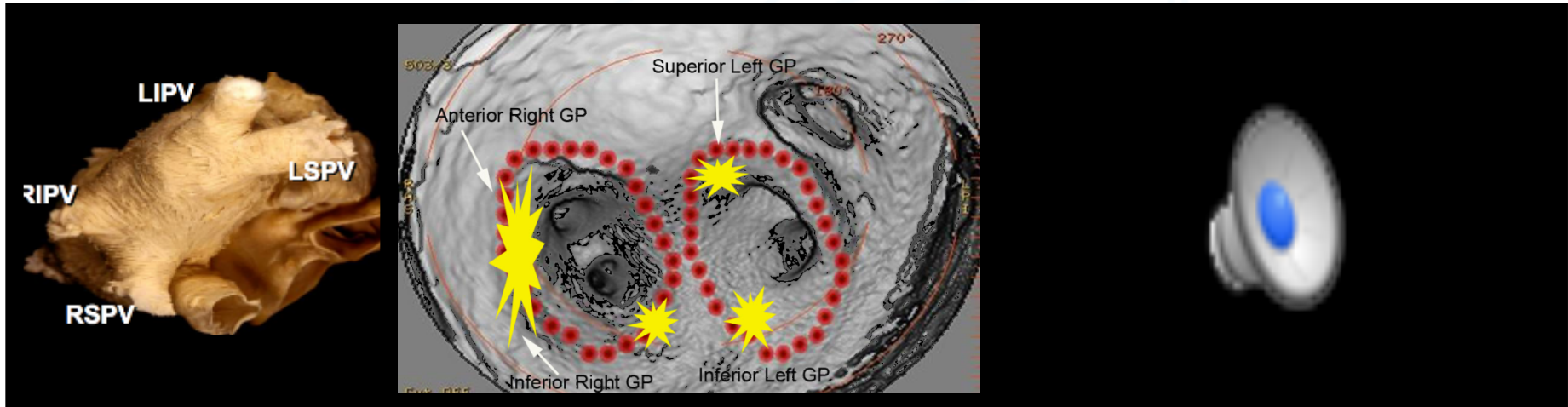
- Pulmonary veins Focal Triggers
- Rotors (micro-reentry circuits) in PV antrum
- No atrial fibrosis

Permanent AF

- Extensive atrial fibrosis, LA dilatation
- Complex substrate
- Focal Triggers (PV, Post LA, SVC, CS)
- Rotors in PV antrum and post LA antrum
- Drivers to perpetuate AF

- Re-Confirm PVI
 - Electric substrate:
 - Trigger ablation
 - Ganglionic plexus ablation
 - CFAE ablation
 - Rotor ablation
 - Anatomy substrate
 - Linear lesions
 - “Fibrosis” ablation
- Surgery
 - Rate control
 - Drugs
 - Ablate & pace





Triggers in 94% localized in PV ostium in paroxysmal AF

Additional Triggers Often localized in PV antrum

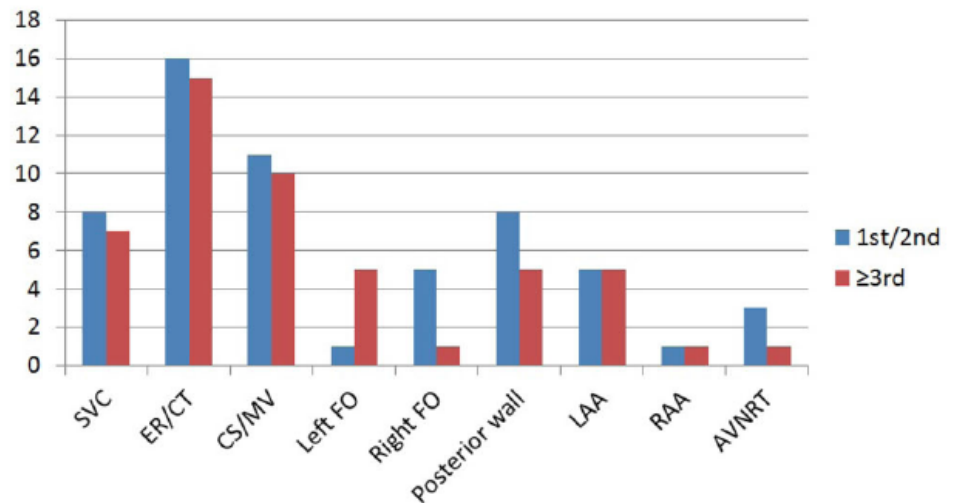
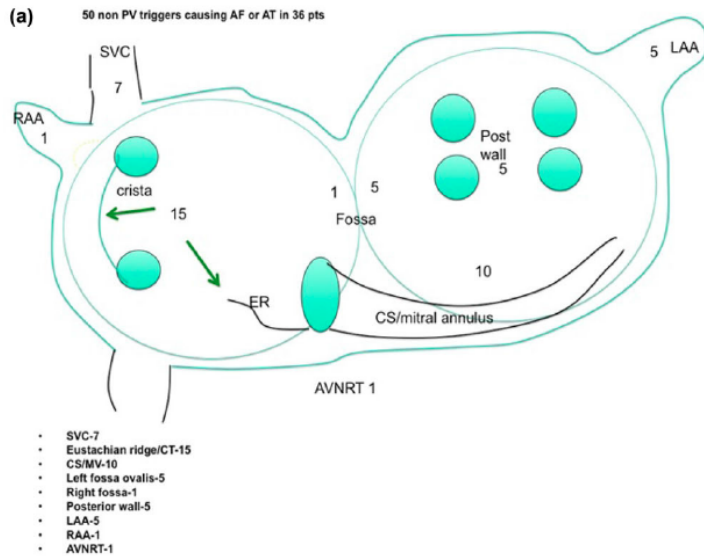
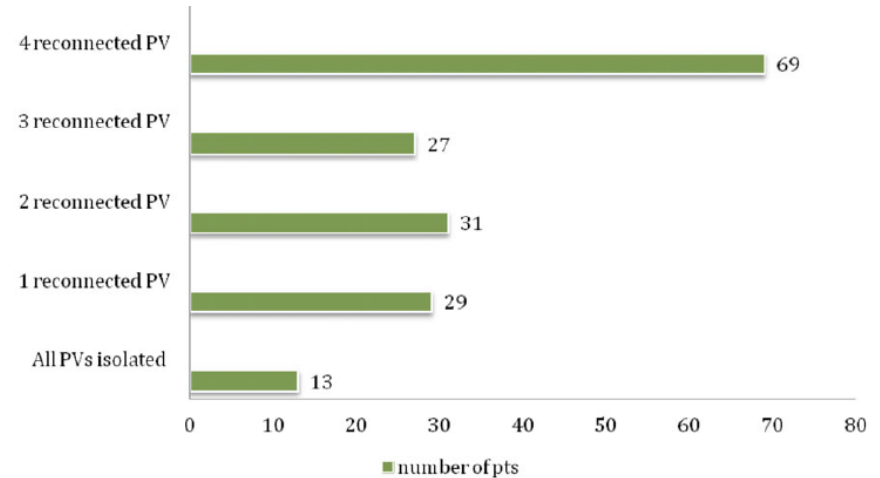
Rotors Often localized in PV antrum

Autonomic ganglionic plexus Localized around PV ostium





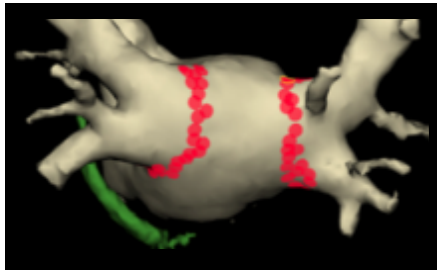
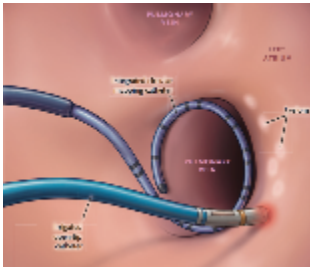
- N=2886 initial PVI
- 181 (6%) > 2 PVI; > 4 PVI in 35
- 69 (41%) had all 4 PV reconnected
- Only 13 (8%) had all the veins isolated
- 72% had non-pulmonary triggers





PVI is the central element in AF ablation and is the only efficacy-tested technology

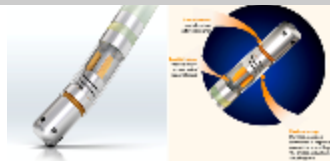
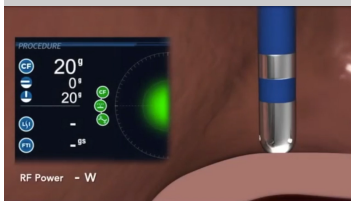
Point-by-point ablation



3D – Carto™, NavX™



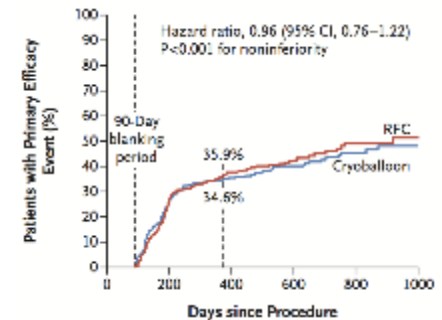
Contact-monitoring



“Single-Shot” Ablation



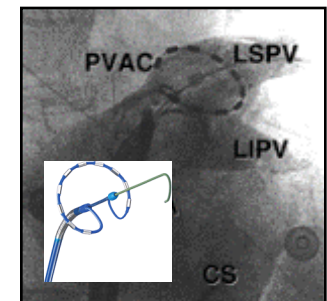
Cryoablation



Kuck KH. N Engl J Med. 2016

PVAC

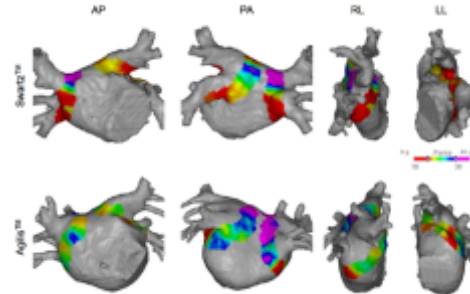
Pulmonary Vein
Ablation Catheter



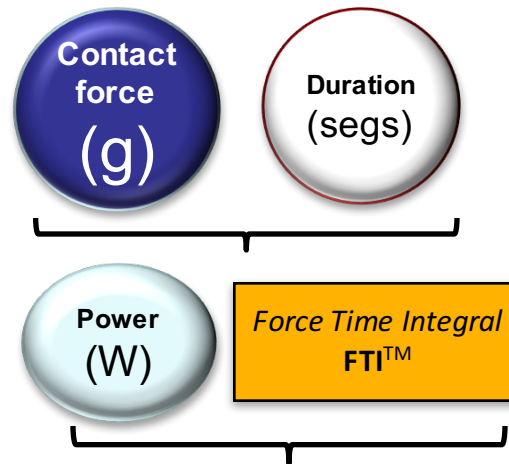


Improve lesion “quality” to obtain sustained PV isolation

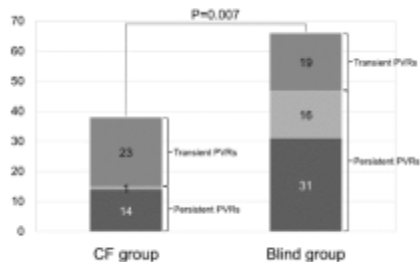
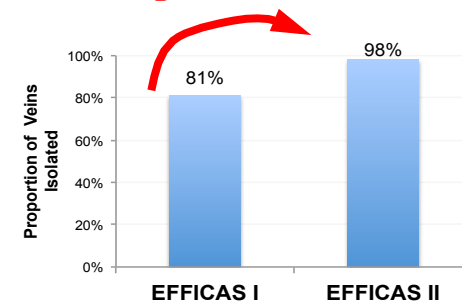
- Steerable sheet
- Contact-monitoring technology
- RF application monitoring (Visitag™, Automark™)



Kimura T. *International J Cardiol* 2014; 177:970-76

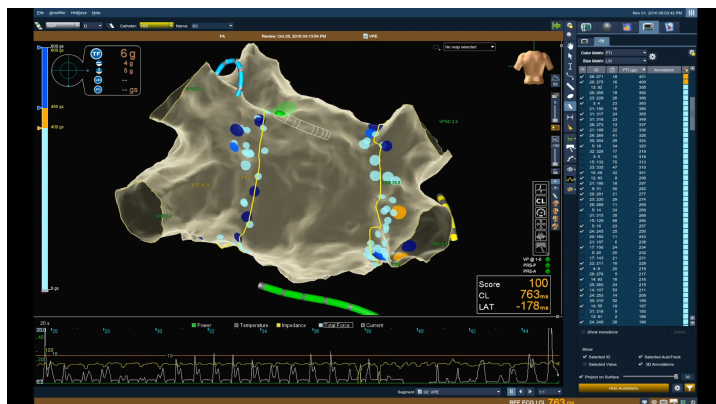


Jump Index <6



↓PV acute reconnection

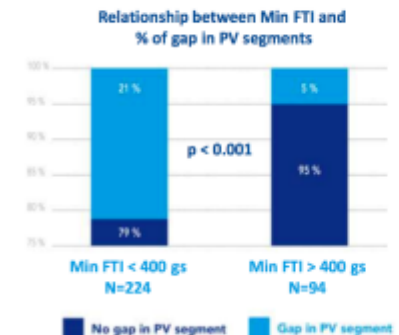
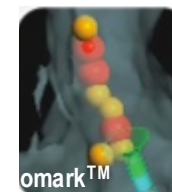
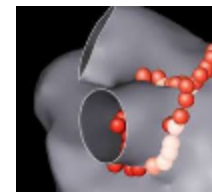
Nakamura K. *J Interv Card Electrophysiol* 2015;44:235-45



Lesion Index



Ablation Index



Neuzil P. *Circ Arrhythm Electrophysiol* 2013



Conventional AF ablation

- Irrigated conventional catheter
- Non-steerable sheath
- EGM guided-ablation

Contact Force-guided & Continuity-guided ablation

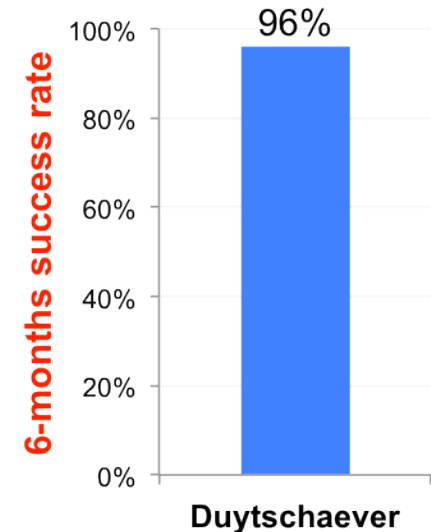
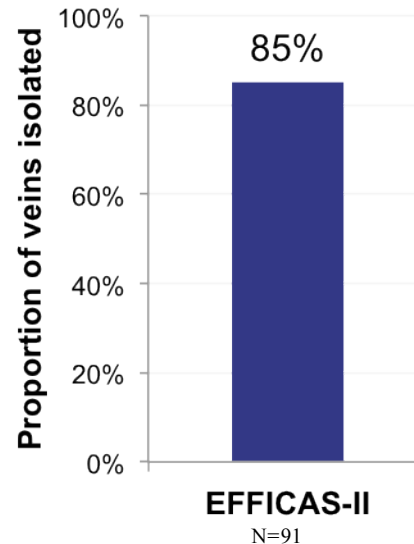
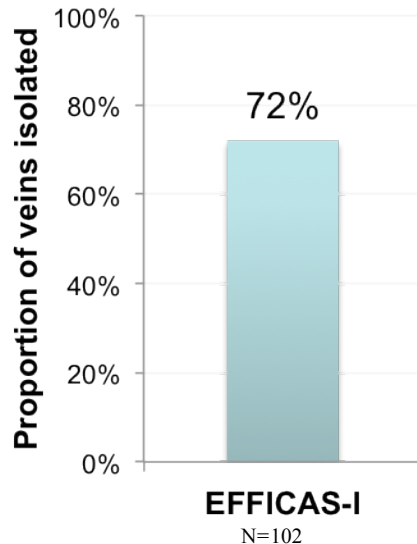
Targets:

- Force: 20 g (min: 10g; max: 30g)
- FTI: >400gs for any ablation point
- Jump index <6.0

LSI -guided ablation

Ablation Index-guided ablation

Target: **550** at anterior wall
400 at posterior wall

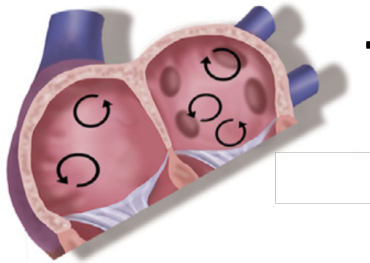


M Duytschaever, Bruges, *Not published*

Contiguous lesions. Settings: Stability: 8 sec, 3 mm; FTI: >3g, >30%; Target CF: 10-40g, Target Power: 35-40 W

1. Atrial Compartmentalization: Linear lesion

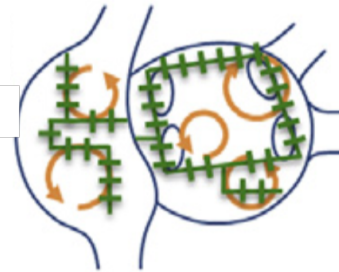
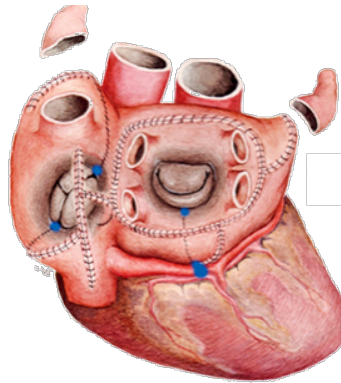
Multiple wavelet reentry theory



“Persistence of fibrillation depends on a critical mass of tissue large enough to support multiple reentrant waves that prevent simultaneous termination of all underlying re-entrant activity.”

Gordon Moe

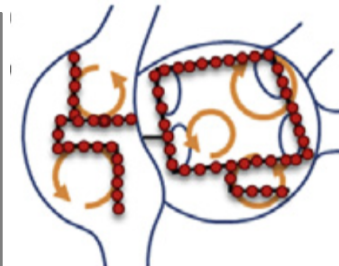
Cox-Maze Surgery



- Reduced success (difficult to produce trans-mural linear lesions)
- Acute complications (stroke, AE fistulae)
- Iatrogenic atrial macro-reentry

Linear LA Ablation

LA posterior Box
RA linear ablation
Roof line
Mitral isthmus line

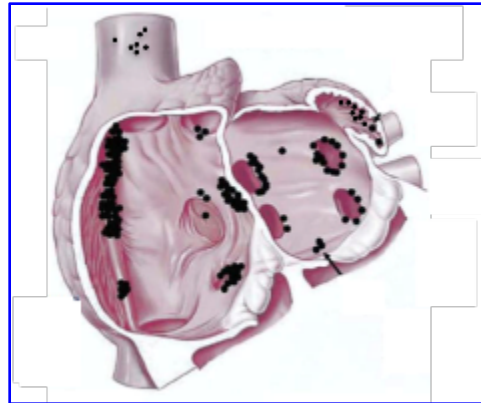


N=2.168

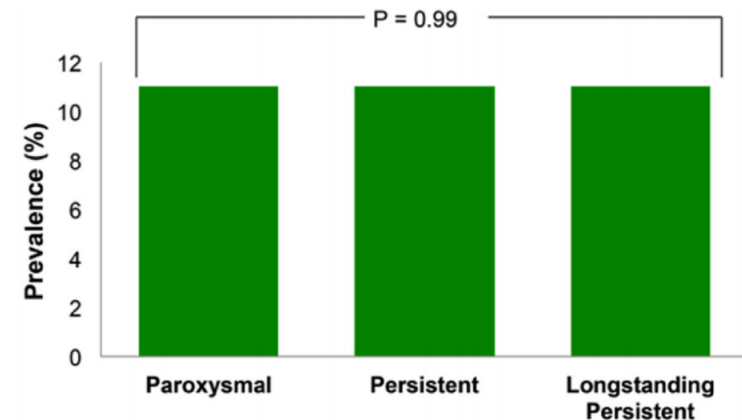
2. Ablation of *non-PV focal triggers*

Present in **11%** of patients:

- Crista terminalis/Eustaquien valve – 36%
- CS / mitral annulus/ lig. of Marshall – 15%
- Superior vena cava– 14%
- LA posterior wall – 5%
- LA appendage



Sustained PV triggers were identified in 70% of pts with PAF and in 50% of pts with non-PAF. Prevalence of non-PV triggers was similar : 11%



- Utility of systematic non-PV focal triggers search is not well demonstrated
- Benefit of empirical LAA ablation is debatable (BELIEF-AT trial)

Provocative manoeuvres:

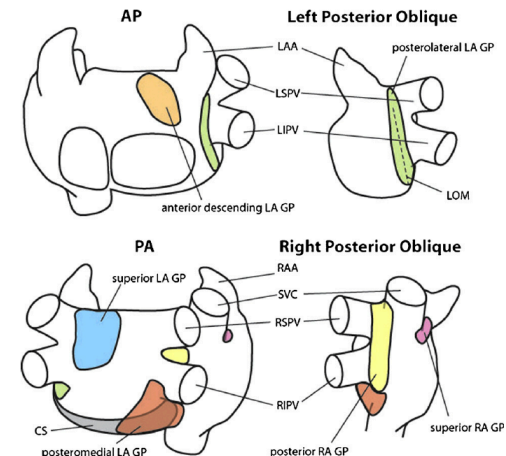
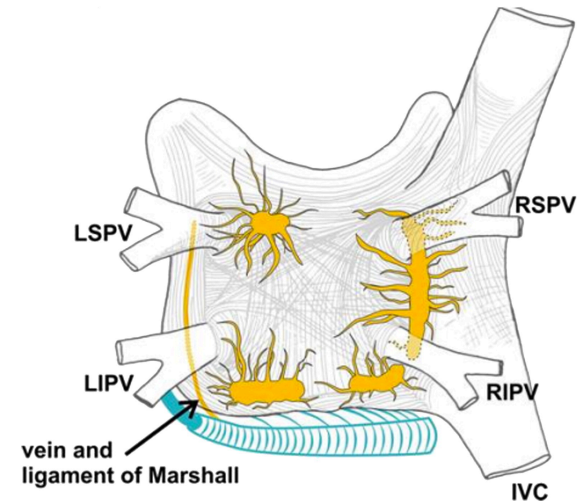
- Isoprenaline infusion (up to 20 µg/min)
- Premature beats after CV / Overdrive pacing



3. Autonomic ganglionic ablation

- Autonomic system has relevant role in AF initiation (AF episodes during sleep, related to sleep-apnea, post-prandial)
- Ganglionic plexus are located in epicardial fat pads, close to PV ostium

- Utility of selective mapping and ablation of ganglionic plexus is not demonstrated
- Concomitant ganglionic plexus ablation is usual during antrum of PV ablation
- Autonomic re-enervation occurs in the long-term



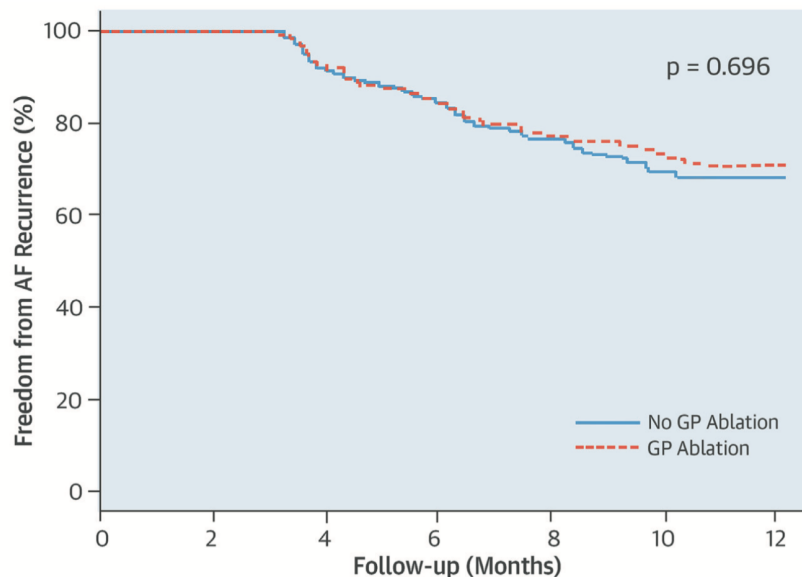
Ganglionic plexus are mapped with stimulation manoeuvres:

- Vagal response (bradycardia, pause or AVB) during high frequency pacing (5 secs at 20 Hz, with 30 mA and 10msecs impulses)



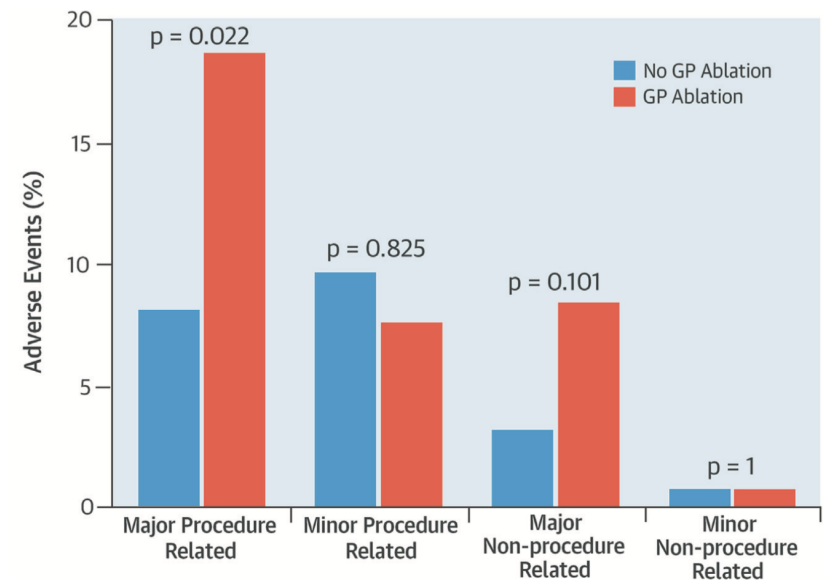
3. Ablation of ganglionic plexus

AFACT Study: randomized controlled trial evaluating the efficacy and safety of additional ganglionic plexus ablation in pts undergoing thoracoscopic AF surgery



Ganglionic ablation had no effect on the ablation success, but increased the risk of serious post-op complications

	No GP Ablation (n = 123)	GP Ablation (n = 117)	p Value
Baseline			
Age, yrs	60.2 ± 8.2	59.5 ± 8.2	0.525
LA diameter, mm	42.3 ± 5.5	42.1 ± 5.6	0.740
LAVI, ml/m ²	40.3 ± 13.0	38.3 ± 10.4	0.198
LVEF, %	51.2 ± 9.1	47.9 ± 18	0.071
AF characteristics			
Duration, yrs	5 (2-10)	4 (2-6)	0.063
Paroxysmal AF	55 (45)	43 (37)	0.238
Persistent AF	68 (55)	74 (63)	0.238
CHA ₂ DS ₂ -VASc (range)	1.4 ± 1.3 (0-7)	1.4 ± 1.2 (0-6)	0.770





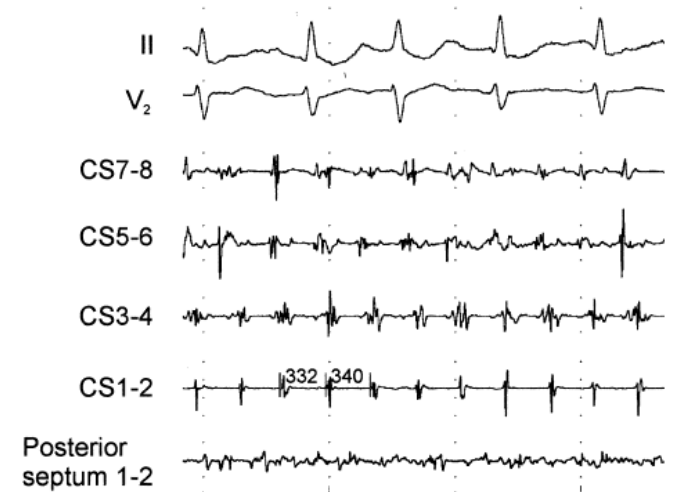
4. Modification of electric substrate

To eliminate critical factors that precipitate or maintain AF

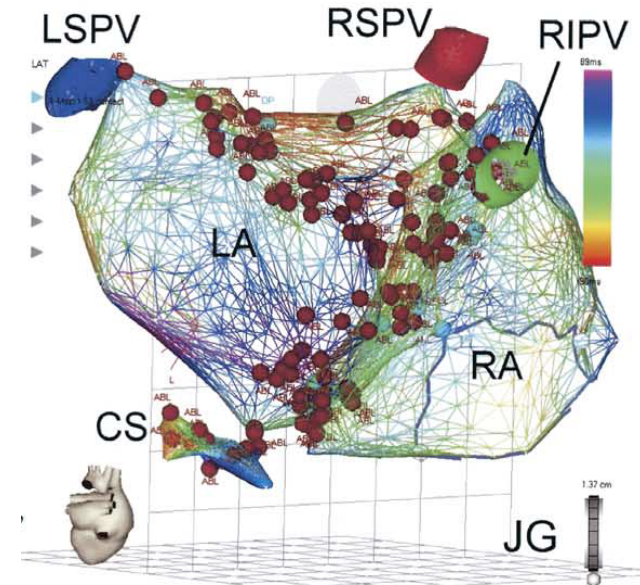
Complex fractionated atrial electrograms (CFAEs)

- (1) Low-voltage EGMs (0.06-0.25 mV)
- (2) ≥ 2 deflexions, continuous activity or cycle < 120 ms
- (3) Stable in time and space

- N = 121 refractory AF (64 persistent)
- Electroanatomic mapping (CARTO) - CFAE were found in interatrial septum, PV, roof of LA, and left posteroseptal MA and CS ostia
- Ablation resulted in termination of AF in 115 of the 121 patients (95%)
- 1-year follow-up, 110 (91%) pts were free of arrhythmia, 92 after one ablation and 18 after two



Complex fractionated atrial electrogram map

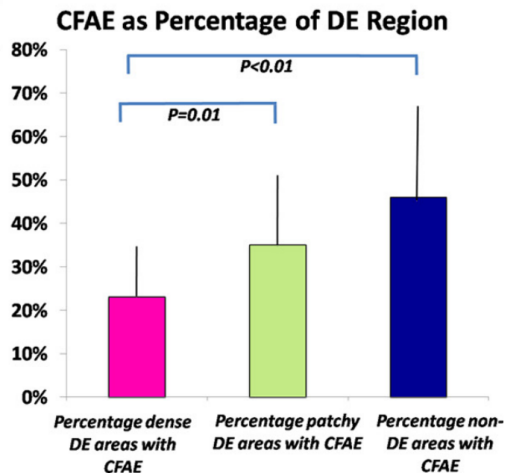




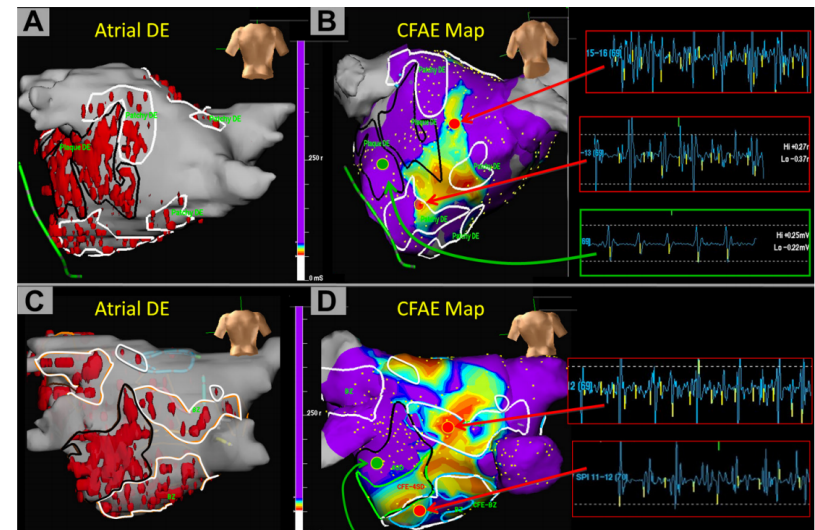
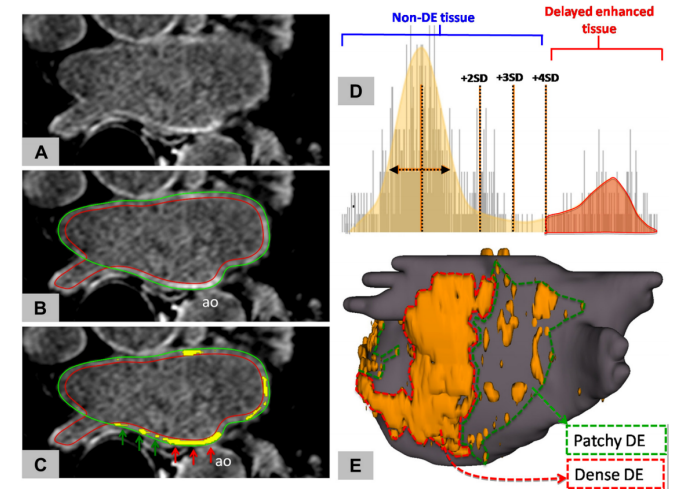
4. Modification of electric substrate

Complex fractionated atrial electrograms (CFAEs)

- There is no correspondence between areas of CFAEs and the distribution of atrial fibrosis (delayed enhancement or low voltage)



- Experimental studies suggest that CFAEs could represent anchors or reentry rotors (38%) and triggered activity (1%), but they are in the majority **bystander complexes** resulting from multiple wave collision (47%)



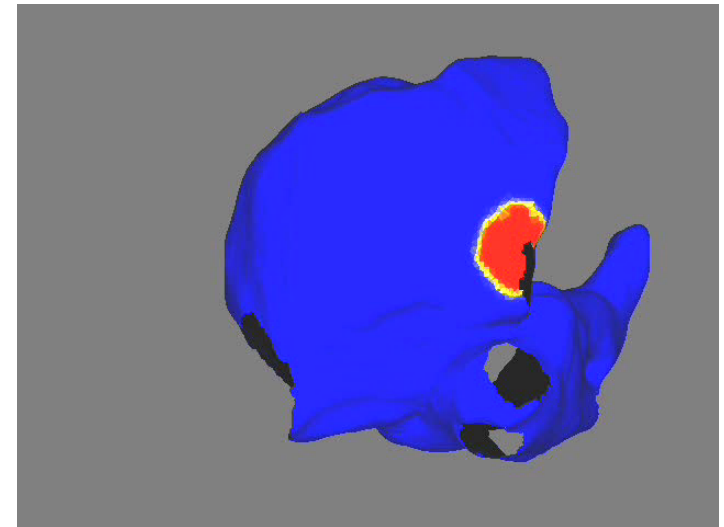
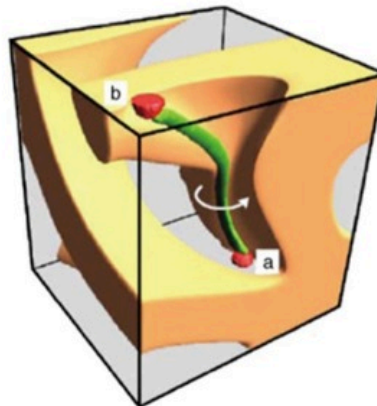
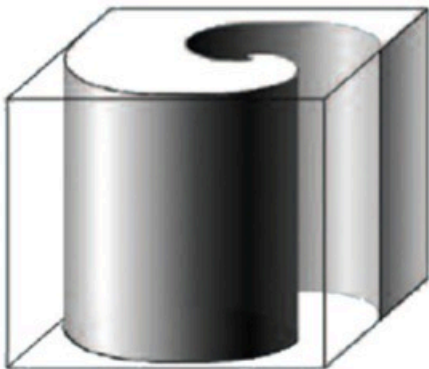
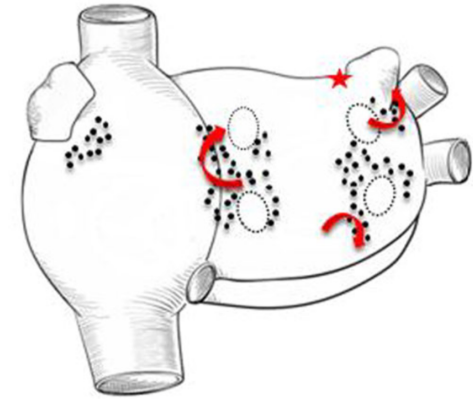


4. Modification of electrical substrate

To eliminate critical factors that precipitate / maintain AF

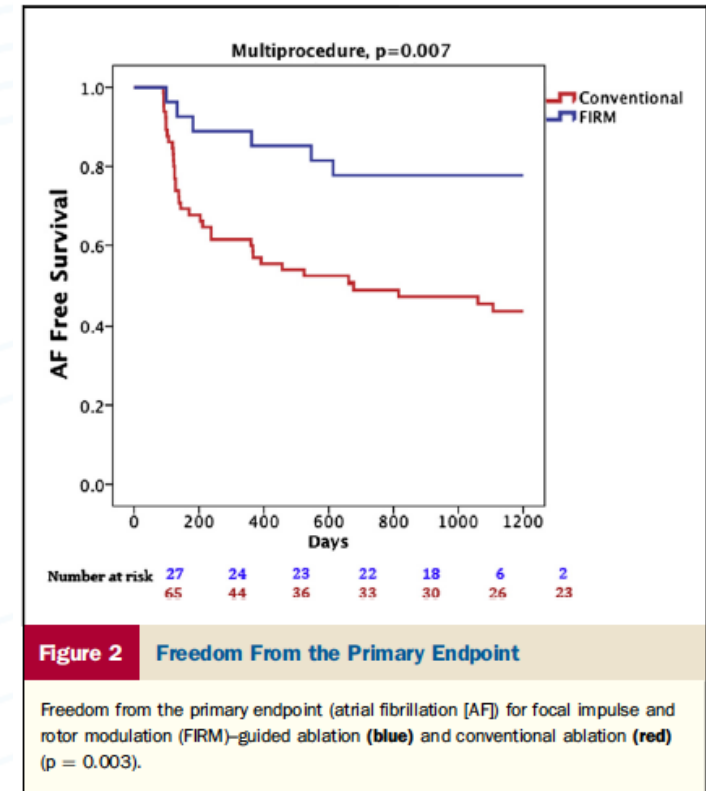
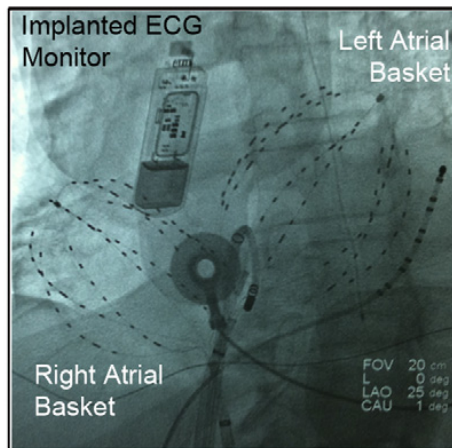
- **Rotors** – unstable circular reentry activation that behavior as drivers to maintain AF
- *Rotors have preferred anchor localization areas in each particular patient*
- *Rotor ablation can increase sinus rhythm maintenance*

structural heterogeneities hypothesis

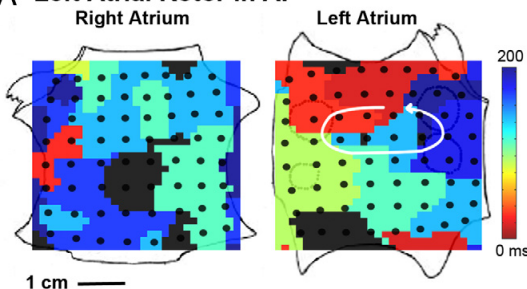


AF Ablation: focal and rotor ablation

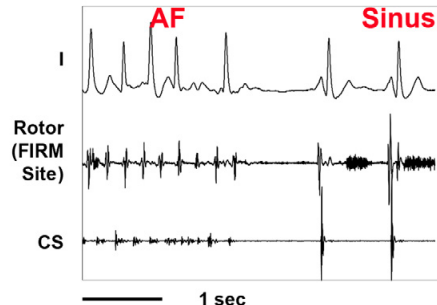
- “Focal impulse and Rotors modulation” (FIRM) in addition to conventional ablation:
 - Rotor (stable microreentrant rotational activity) or focal sources in 86 (97,7%) with 1,9 rotors/patient, 67% in LA and 33% in RA



A Left Atrial Rotor in AF



B FIRM: Sinus Rhythm in < 1minute



Narayan et al: JACC 2012; 60 (14); 628-636
 Narayan et al: JACC 2014; 63 (17); 1761-8
 Extended Follow-up

Surface ECG Mapping (Haissaguere)

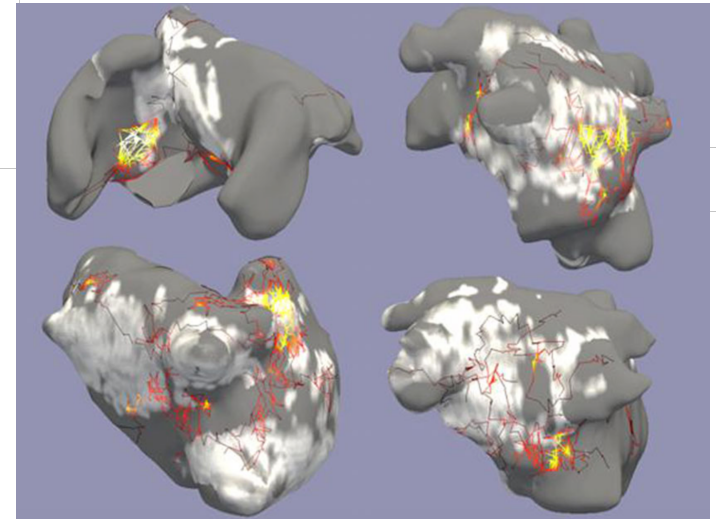
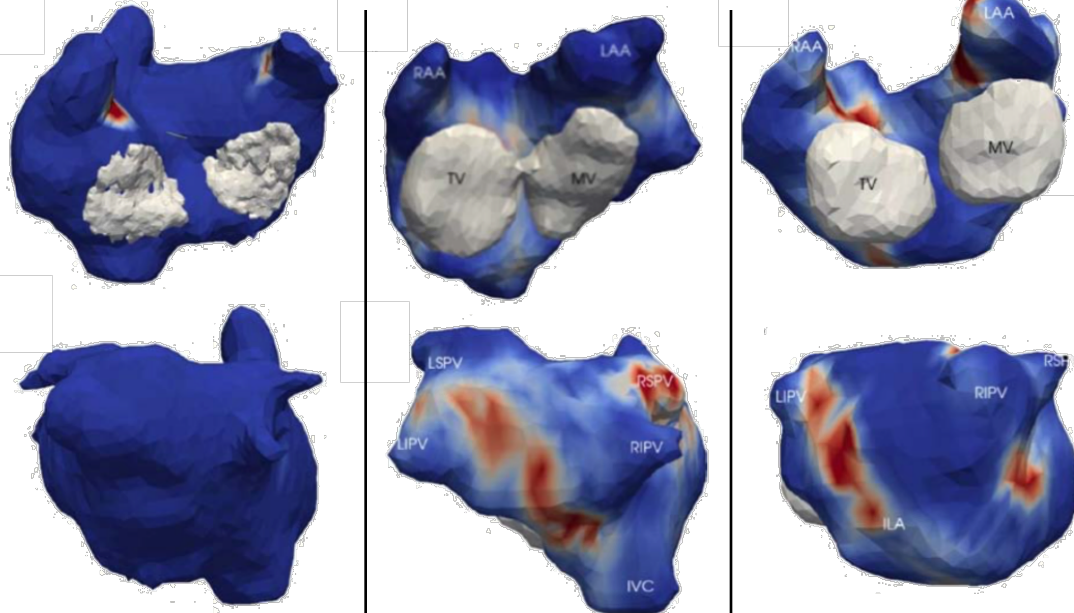
Rotors are unstable and self-limited but tend to reappear spacially in the same spot, have preferential anchor locations in each patient .

Number of drivers increased with the AF type and duration, atrium dimension and fibrosis area.

- Rotors anchor zones were mostly localized in the scar borders



Arrhythmogenic driver-density maps

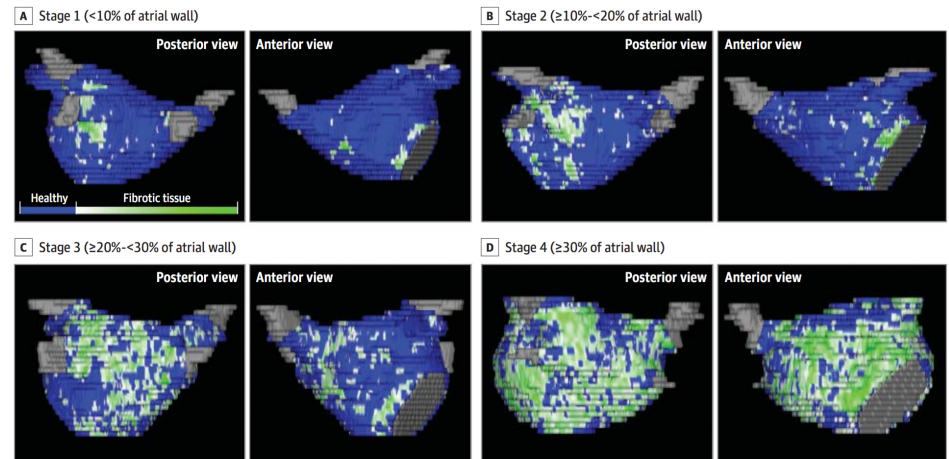


Yellow trajectories indicate sites of anchoring; **Red** trajectories indicate transit paths; **White** indicates late gadolinium enhancement focal fibrosis MRI

5. Modification of the anatomy substrate

DECAAF Study; N=272

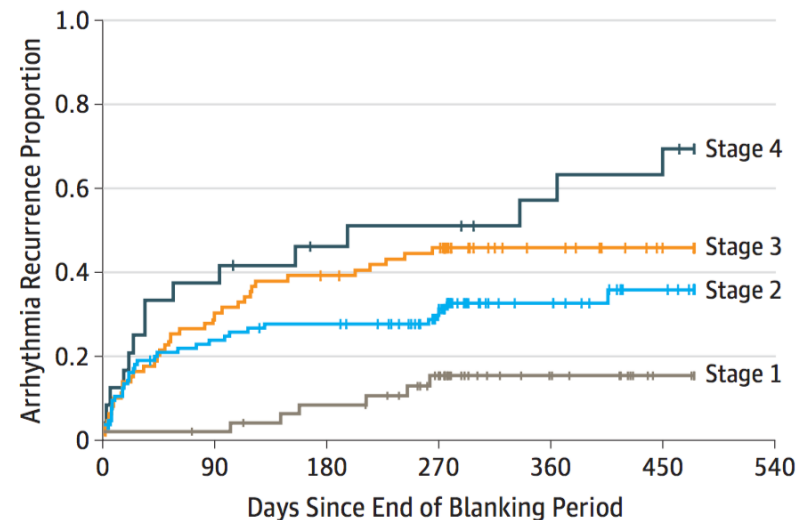
- Atrial fibrosis degree identified by delayed-enhancement – MR in a good predictor of the ablation result



What is the role of atrial fibrosis in AF progression?

- Anatomy barrier to reentry
- Areas of slow conduction
- Anchor of rotors

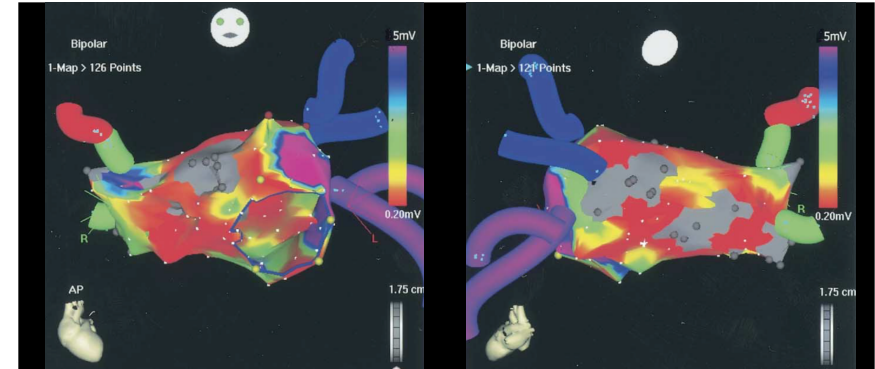
...still no evidence!



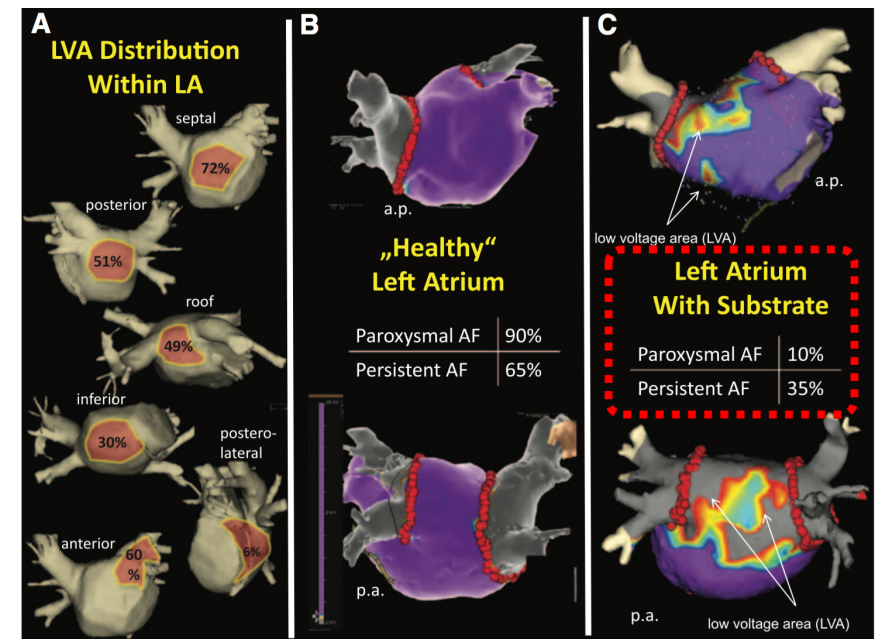
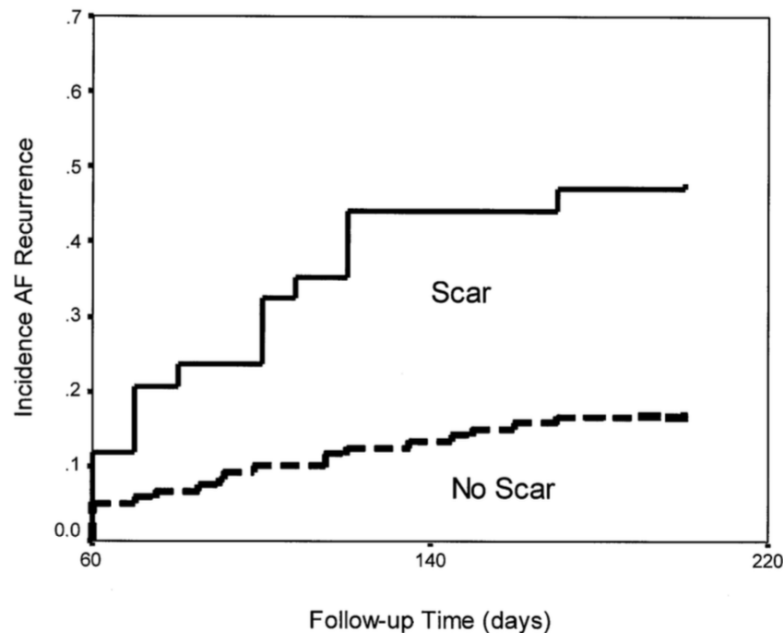


5. Modification of anatomy substrate

- Extension of **low voltage area** (dense scar <0,2 mV; diseased myocardium 0,2-0,5 mV; healthy myocardium >0,5 mV) is a **good predictor of unfavorable ablation result**



Verma A. *J Am Coll Cardiol.* 2005;45:285–292.



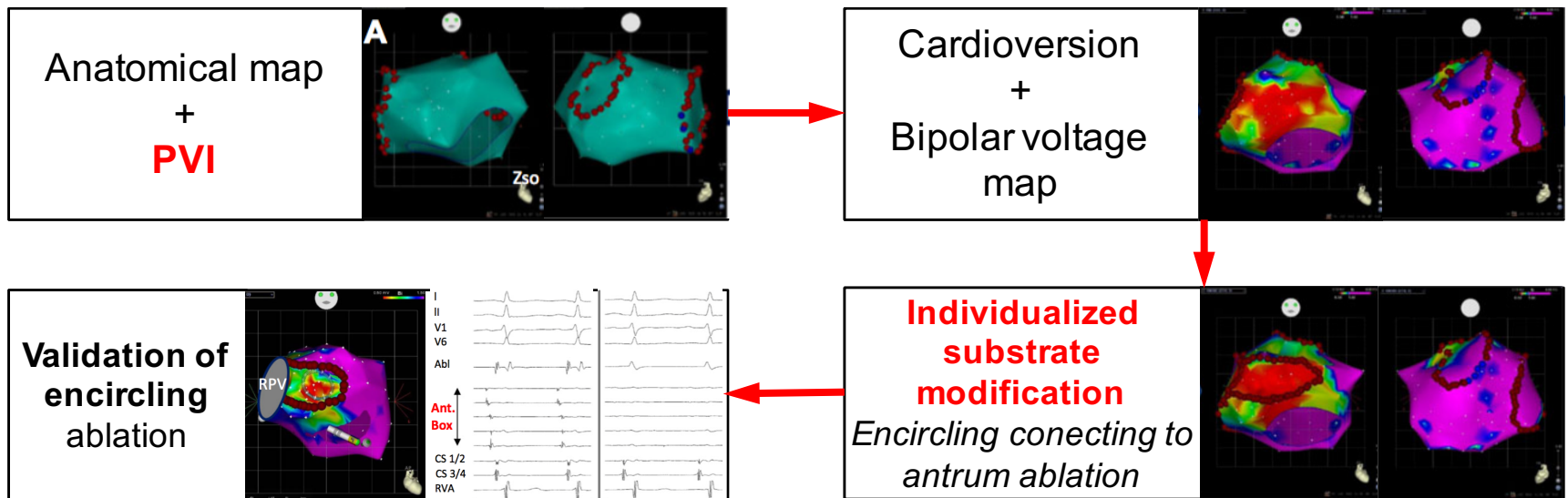
Rolf S. *Circ Arrhythm Electrophysiol.* 2014;7:825-833



5. Modification of anatomy substrate

- Isolation of **low voltage area** (BIFA: Box Isolation of Fibrotic Area)

Persistent AF (N=31) or Paroxysmal AF redo with isolated PV (N=10)





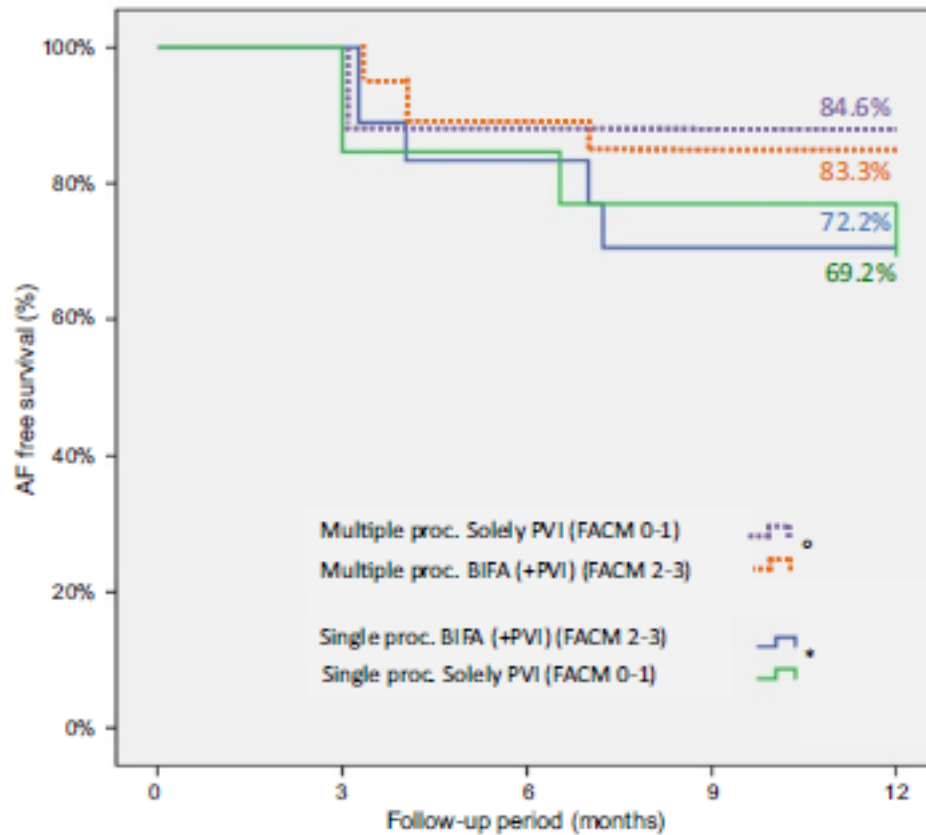
5. Modification

- Isolation of left

Persi

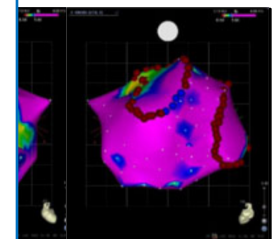
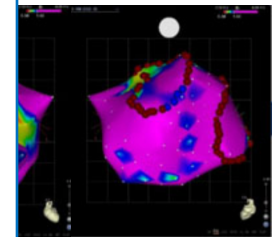
Anatomica
+
PVI

Validation of
encircling
ablation



Patients at risk	0 mo	3 mo	6 mo	12 mo
Total n=31	31	31	26	23
Solely PVI n=13	13	13	11	10
PVI+BIFA n= 18	18	18	15	13

10)

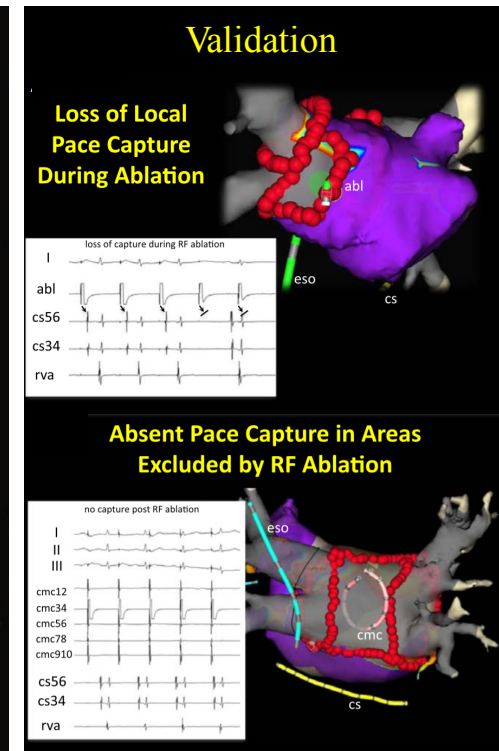
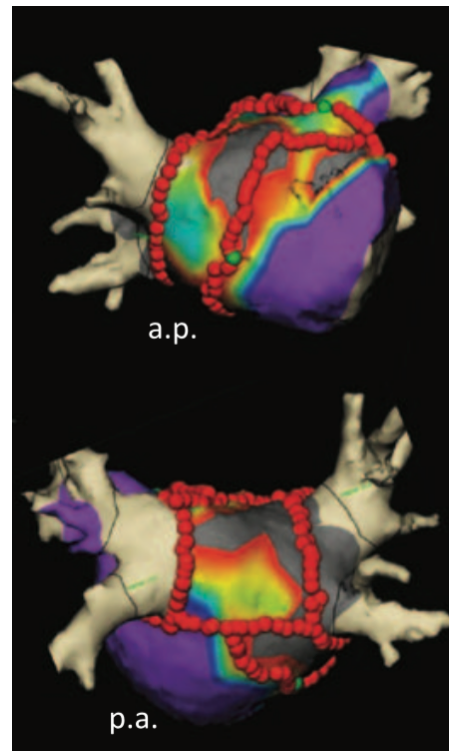
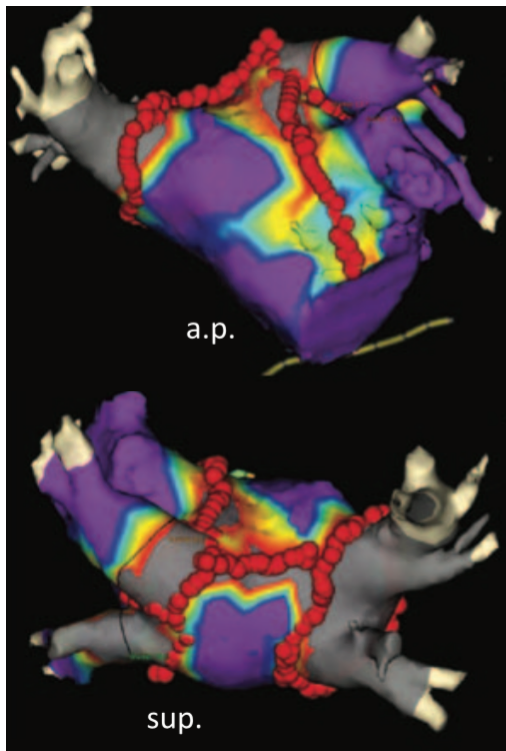
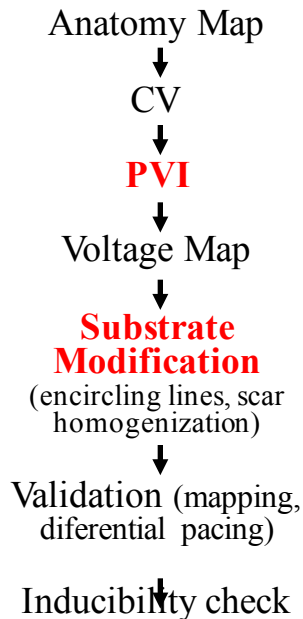


5. Modification of anatomy substrate

- Isolation of **low voltage area**

1st Ablation Paroxysmal / Persistent AF

Low voltage area in **10%** of Paroxysmal and in **35%** of Persistent AF

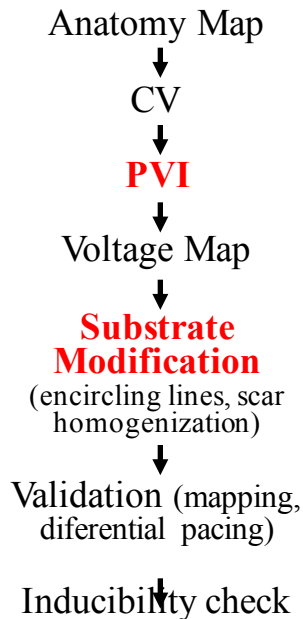




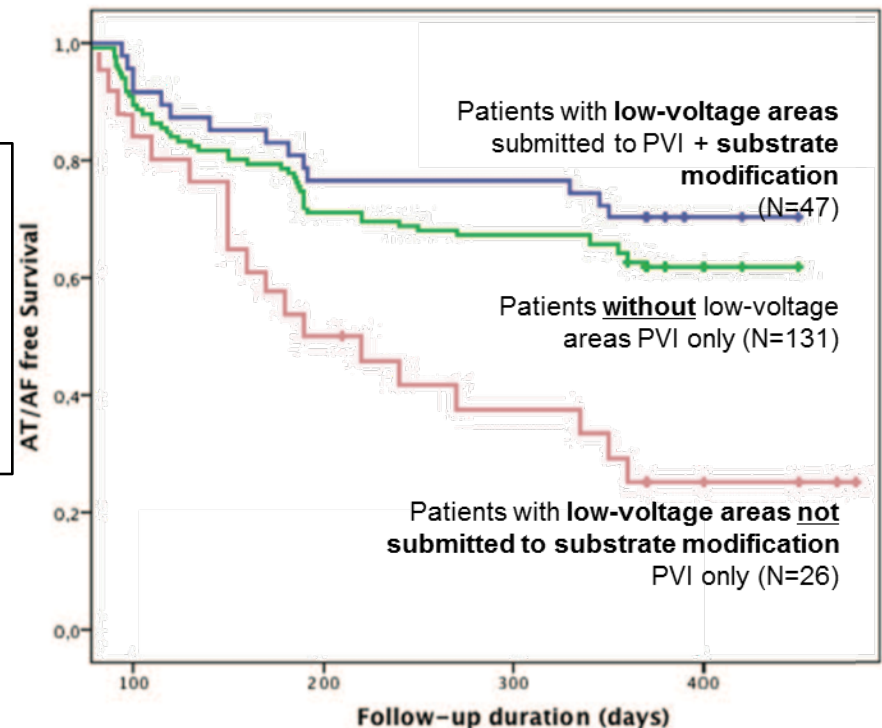
5. Modification of anatomy substrate

- Isolation of **low voltage area**

1st Ablation Paroxysmal / Persistent AF



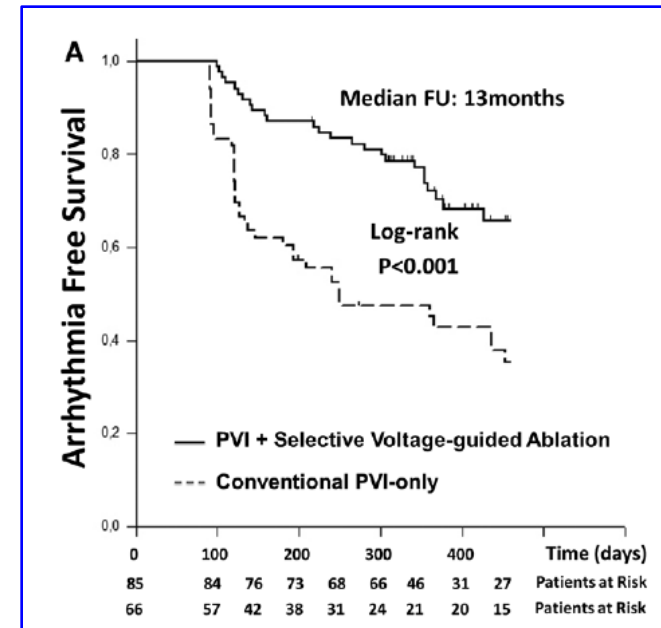
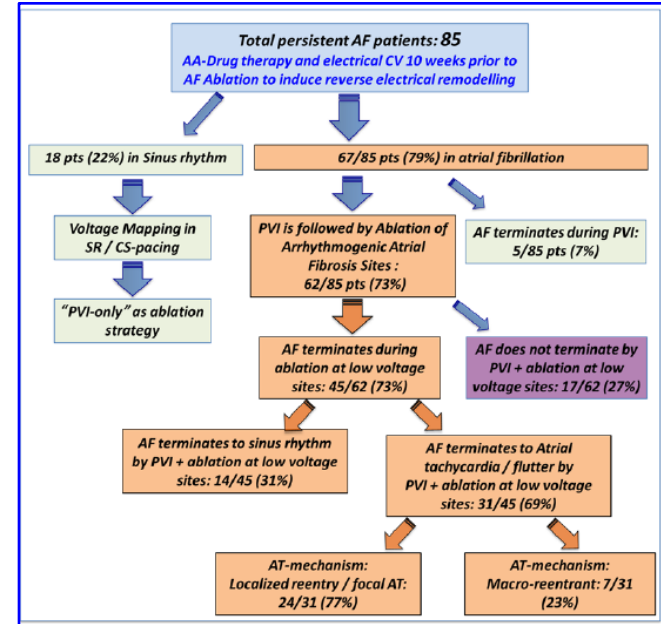
Ablation success rate among patients with fibrosis submitted to substrate modification was similar to those without low voltage area





Selective voltage-guided AF ablation

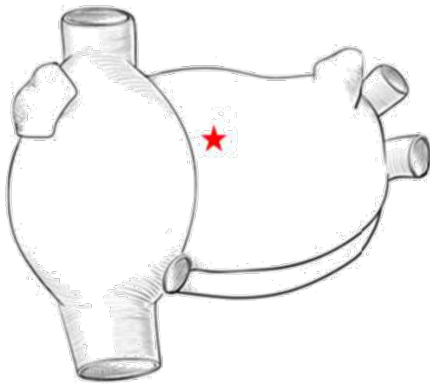
- N= 85 pts with persistent AF
- High-density atrial voltage mapping, PVI, and ablation at low-voltage areas (LVA<0.5 mV in AF) associated with electric activity lasting >70% AF cycle length, or rapid local activity (group I) compared to PVI only (Group II in 66 pts).
- Procedural end point: AF termination.
- Termination of AF occurred in 45 (73%) after 11 ± 9 minutes RF delivery.
- AF-termination sites localized within LVA (80%) and at border zones (20%).
- Single procedural arrhythmia freedom at 13 months f/u: 69% in Group I



AF: MECHANISMS AND ABLATION STRATEGIES

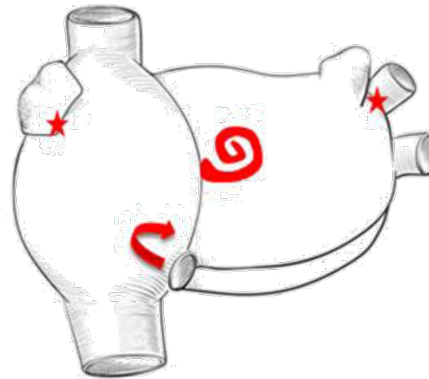
Single stable focal or reentrant source

(Focal ablation, PVI)



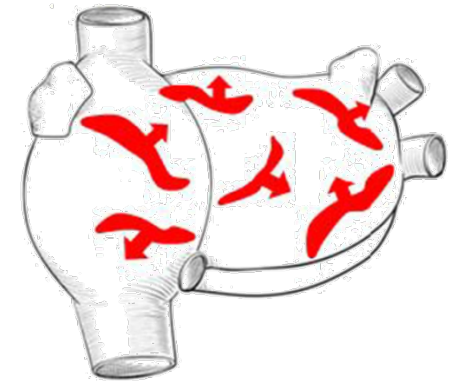
Multiple focal or reentrant sources

(PVI, non-PV triggers, CFAEs, rotors)



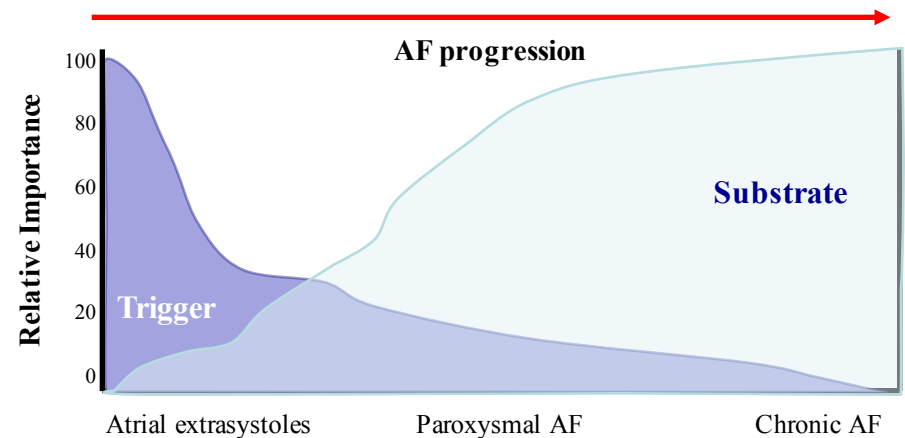
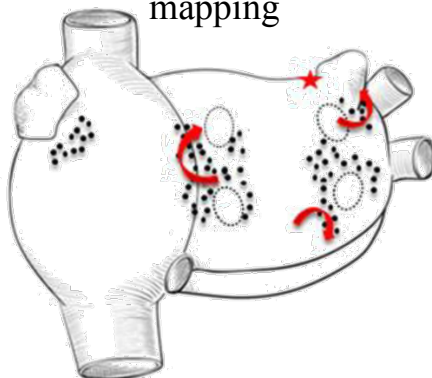
Multiple wavelets

(Surgical MAZE, linear LA ablation)



Unstable drivers at structural heterogeneities

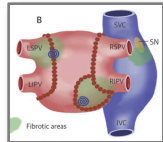
(Substrate modification guided by voltage mapping)



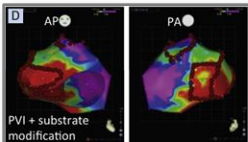


Ablation of Persistent AF

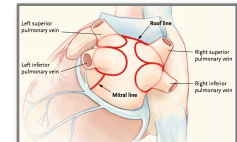
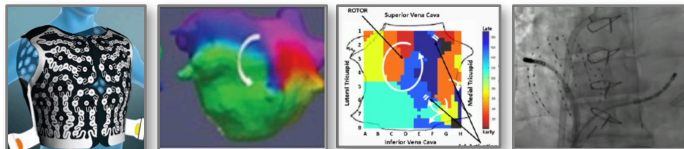
PVI (Pulmonary vein isolation)



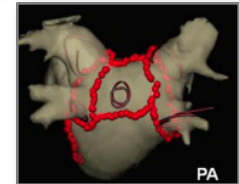
PVI + encircling low voltage area (fibrosis)



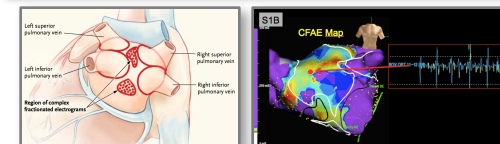
PVI + Rotor ablation (endoc. / surface mapping)



PVI + Linear LA lesions (Roof, posterior wall, mitral isthmus)



PVI + CFAEs



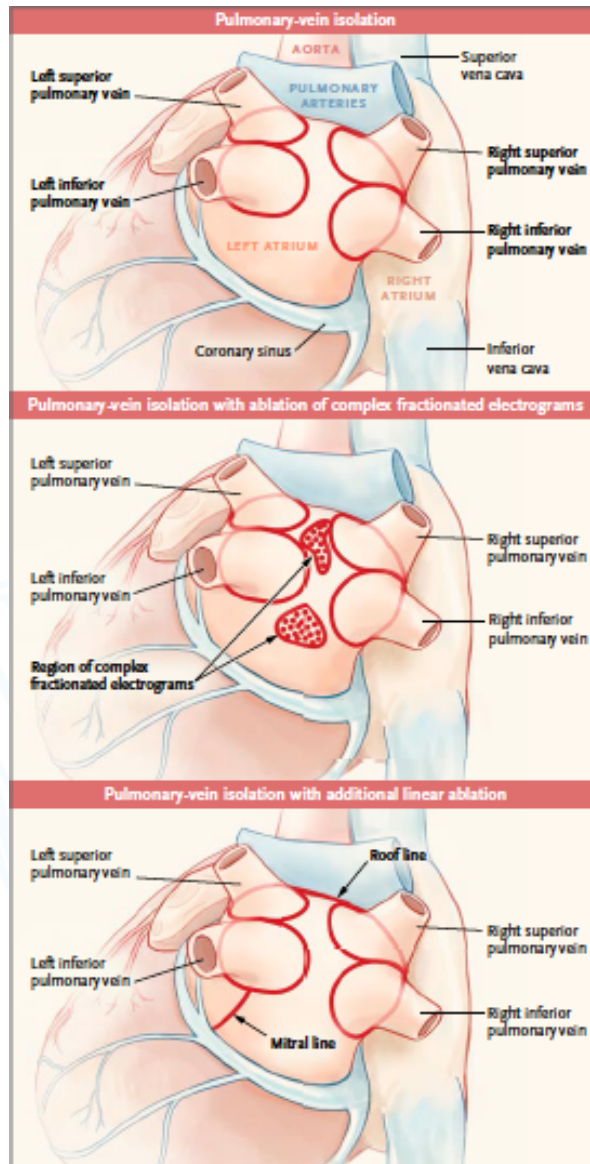
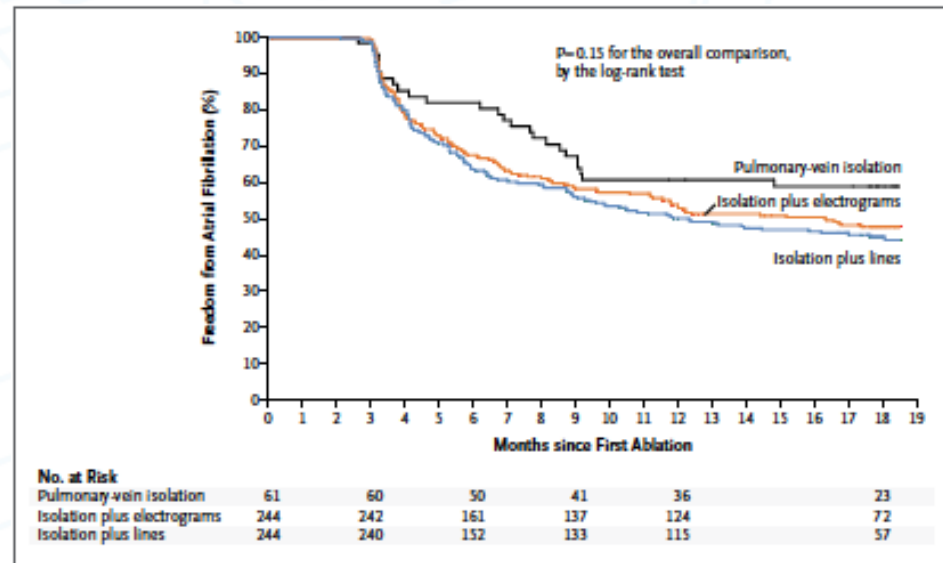


Table 1. Characteristics of the Patients at Baseline.*

Characteristic	Isolation Alone (N= 67)	Isolation plus Electrograms (N = 263)	Isolation plus Lines (N = 259)
Age — yr	58±10	60±9	61±9
Male sex — no. (%)	52 (78)	213 (81)	196 (76)
Ejection fraction — %	55±11	57±10	57±10
Left atrial diameter — mm	44±6	44±6	46±6
Time from first diagnosis of atrial fibrillation — yr	4.3±6.3	4.2±5.0	3.6±4.2
Burden of atrial fibrillation at baseline — hr/mo†	83±36	85±33	80±37
Constant atrial fibrillation for >6 mo — no. (%)	52 (78)	207 (79)	186 (72)



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 Nenadi, M.D., Paul Novak, M.D., and Prashanthan Sanders, M.B., B.S., Ph.D., for the STAR AF II Investigators*

What is FIRM success?

- N = 43 pts (Persistent in 44%)
- 2,6 rotors/patient (77% in LA)
- Acute complications: 9%
- Acute success in 47%:
 - AF termination: 4 (9%)
 - AF organization: 7 (16%)
 - > 10% CL slowing : 9
- Long-term success:
 - Follow-up: 18 ± 7 months
 - 37% without AF recurrence
 - 21% without AA drugs

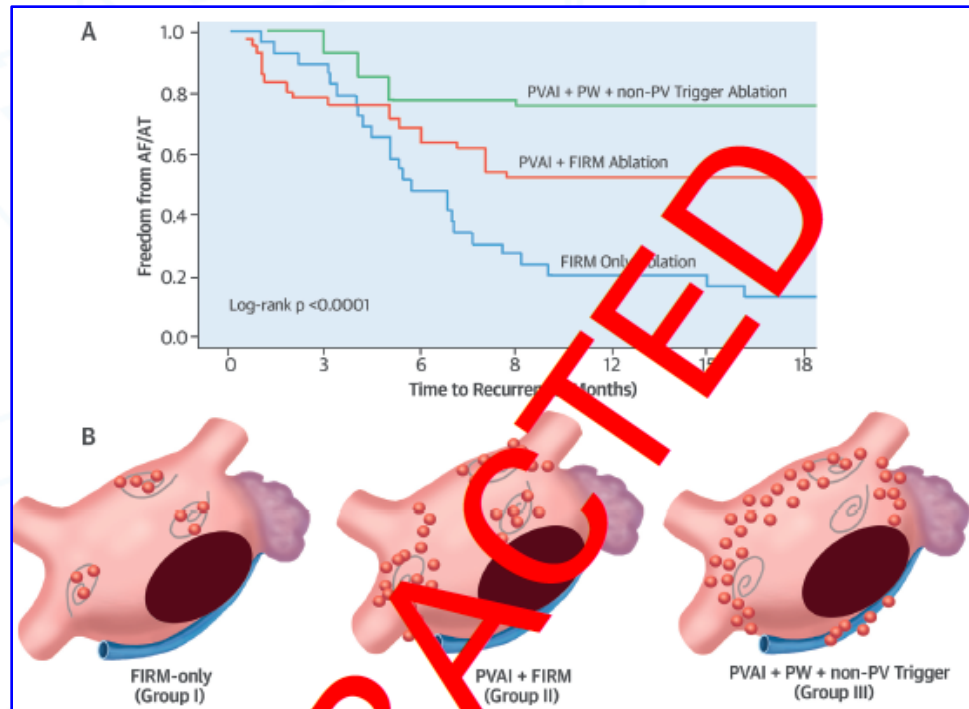
Buch E et al: Long-term clinical outcomes of focal impulse and rotor modulation for treatment of atrial fibrillation: A multicenter experience. Heart Rhythm 2016; 13(3): 636-641

OASIS Trial (N = 113 pts persistent AF)

Follow-up: 12 ± 7 months

Success:

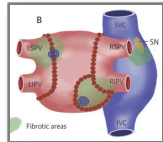
- Group I (FIRM)– 14%
- Group II (FIRM+PVI)– 52,4%
- Group III (PVI+Triggers+Posterior LA) - 76%



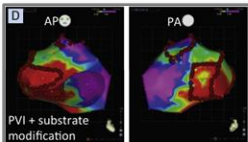


Ablation of Persistent AF

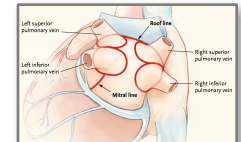
PVI (Pulmonary vein isolation)



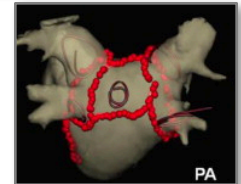
PVI + encircling low voltage area (fibrosis)



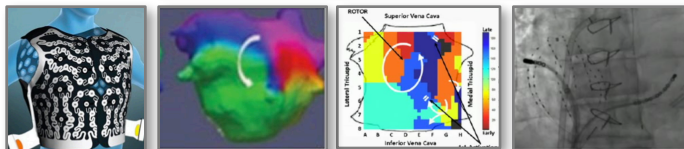
Pro-arrhythmic LA scar
(spontaneous + iatrogenic)
Atypical LA flutter



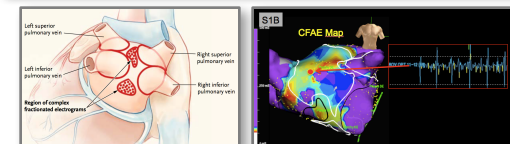
PVI + Linear LA lesions
(Roof, posterior wall, mitral isthmus)



PVI + Rotor ablation
(endoc. / surface mapping)



PVI + CFAEs

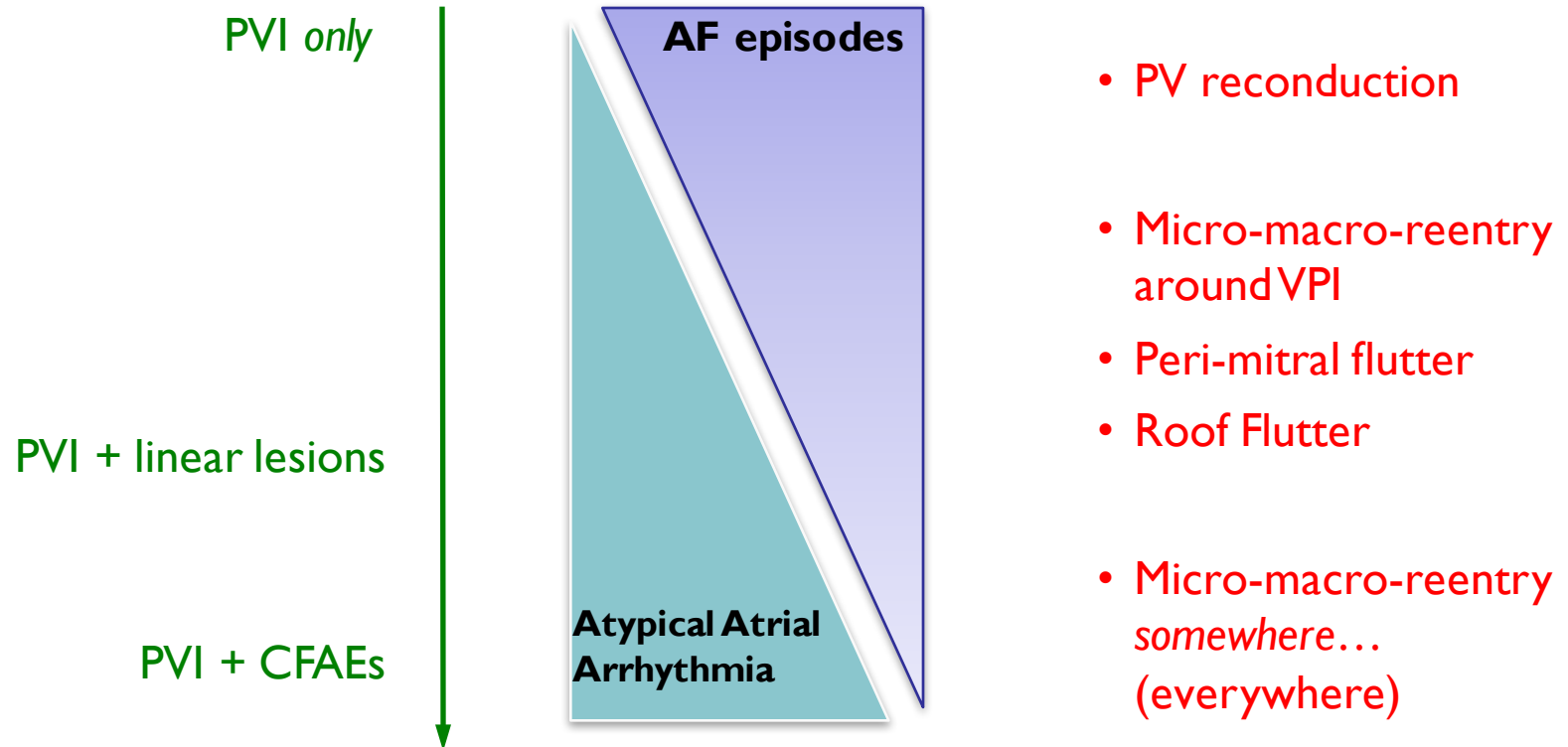




Initial Ablation Strategy

Arrhythmia recurrence

Mechanism



Individual patient

- AF type
- Extent of structural heart disease
- Co-morbidities
- Technique considerations
- Cost-effectiveness



Benefits



Complications: short/long term



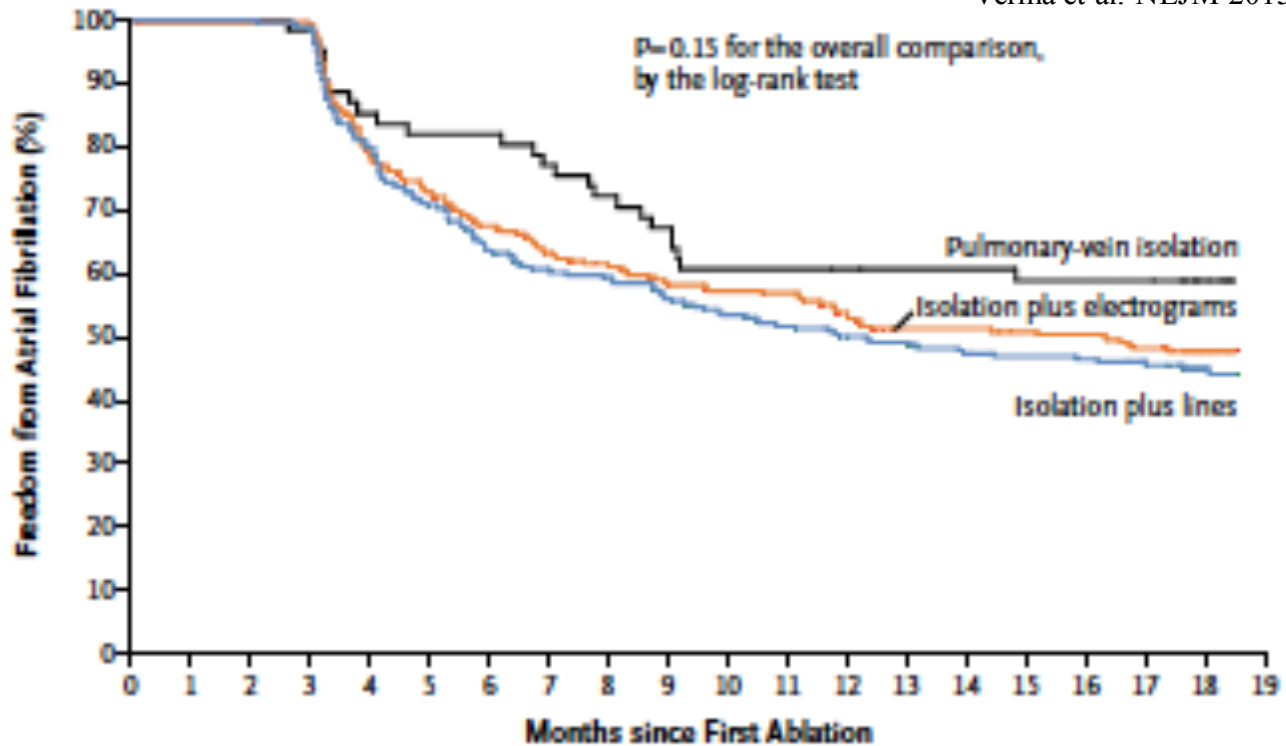
Symptoms / QOL
Morbidity
Mortality





Star-II AF Trial

Verma et al: NEJM 2015



No. at Risk

Pulmonary-vein isolation	61	60	50	41	36	23
Isolation plus electrograms	244	242	161	137	124	72
Isolation plus lines	244	240	152	133	115	57

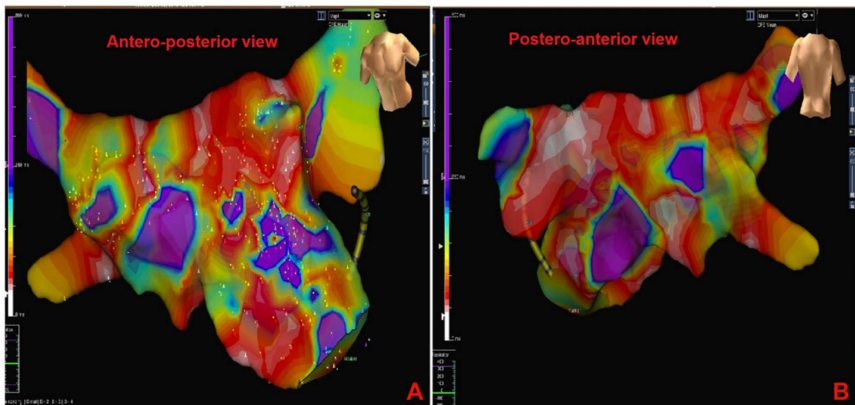
4. Modification of electrical substact

Eliminar factores críticos para precipitação/manutenção da FA

➤ Complexos fraccionados (CFAEs)

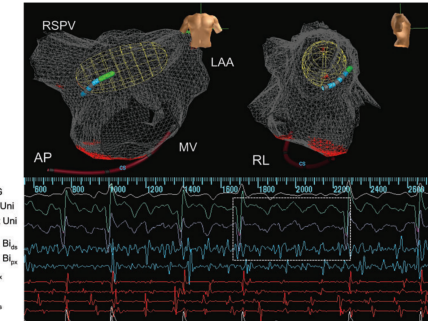
- (1) EGMs de baixa voltagem (0.04-0.25 mV)
- (2) ≥ 2 deflexões, actividade contínua ou ciclo <120ms
- (3) Estáveis em termos temporais e espaciais

- Estudos experimentais sugerem que apesar de poderem traduzir ancoragens/reentrada de rotores (38%) e actividade *trigger* (1%), são maioritariamente bystanders resultantes da colisão de ondas (47%)

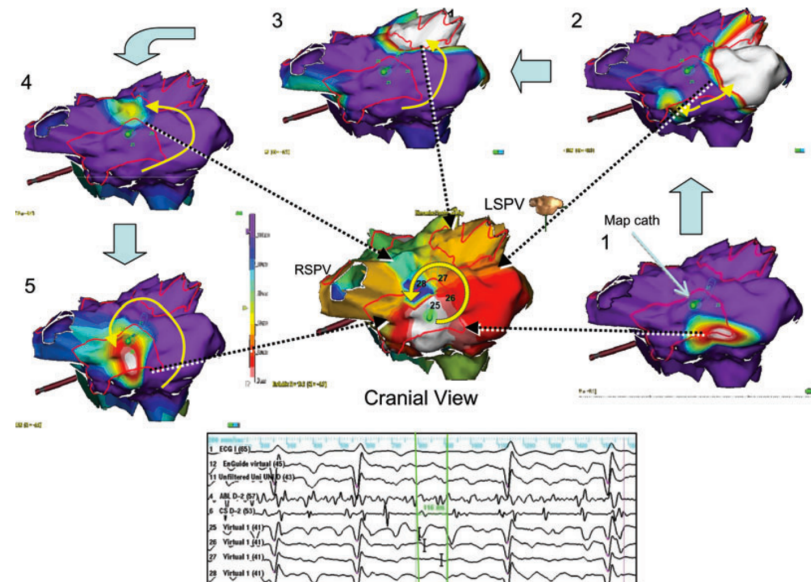


Complex fractionated atrial electrogram map

Estudo experimental em modelo canino, comparando mapeamento de CFAEs por NavX e por Ensite Array



Comparison of CFAE and non-contact map



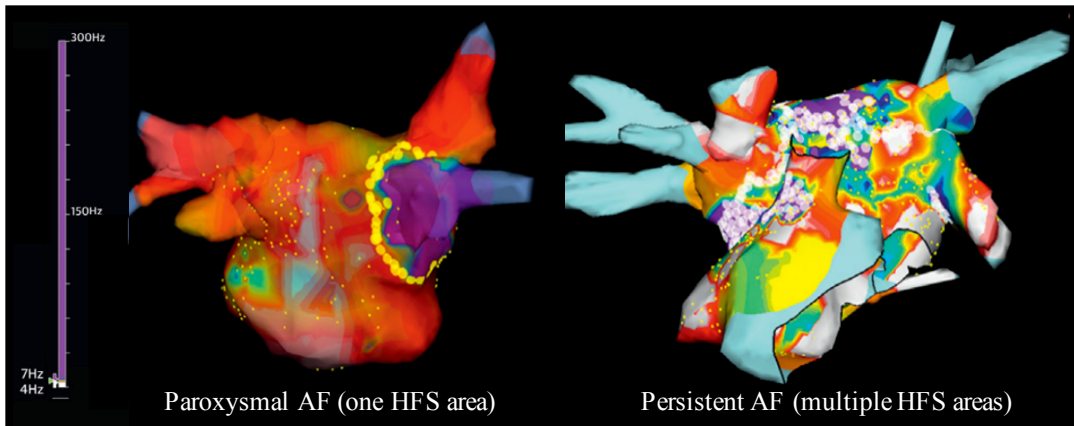


4. Modificação do Substrato Eléctrico

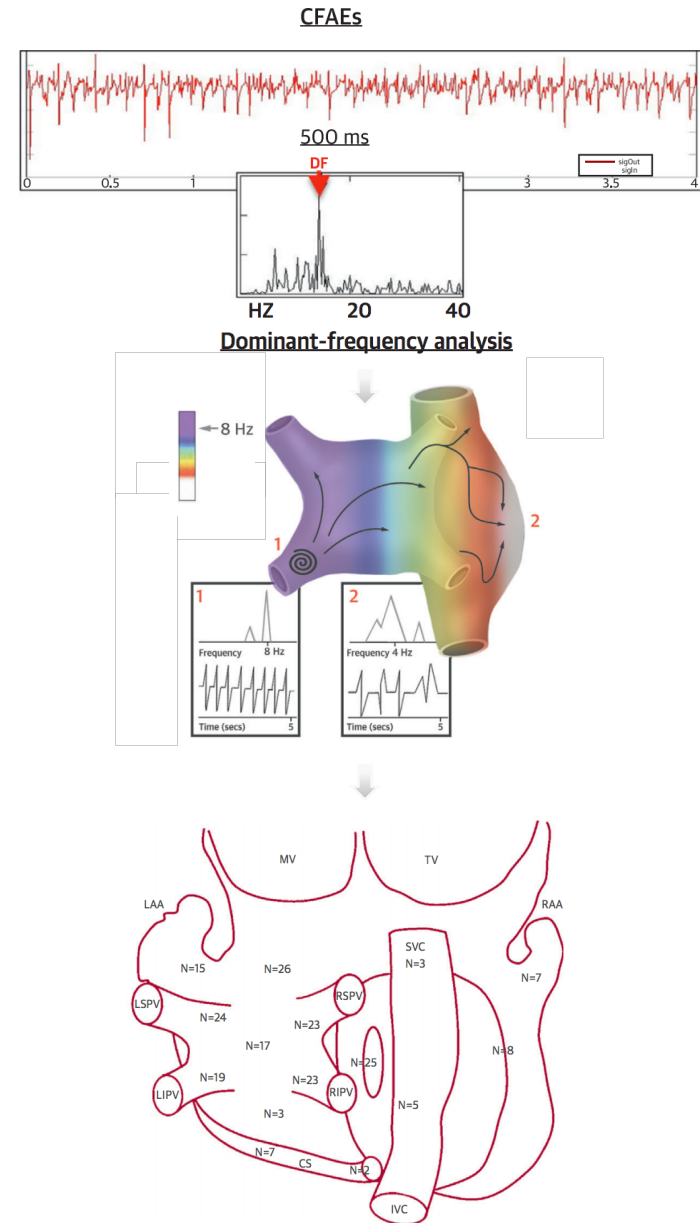
Eliminar factores críticos para precipitação/manutenção da FA

➤ Complexos fraccionados seleccionados pela análise da frequência dominante (elevada)

- Nos doentes com FA paroxística, as áreas com *high-frequency activity* localizam-se nas VPs
- Nos doentes com FA persistente, a ablação das áreas com *high-frequency activity* não aumentou a taxa de sucesso



Dominant frequency maps depicting high-frequency source ablation targets





- Universo de doentes em que a ablação pode ser útil expandiu-se...

Doença puramente eléctrica



FA Paroxística

FA Persistente
Curta Duração



**Tratamento com
potencial curativo**

Sucesso a longo prazo: 60-65%
(80-85% com 2 procedimentos)

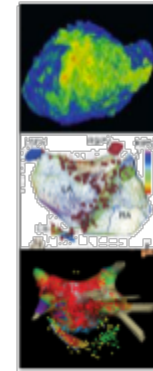
Doença estrutural da aurícula com repercussão sobre a função eléctrica

FA no Idoso
(e muito idoso...)

FA e
comorbilidades

FA em contexto de
card estrutural

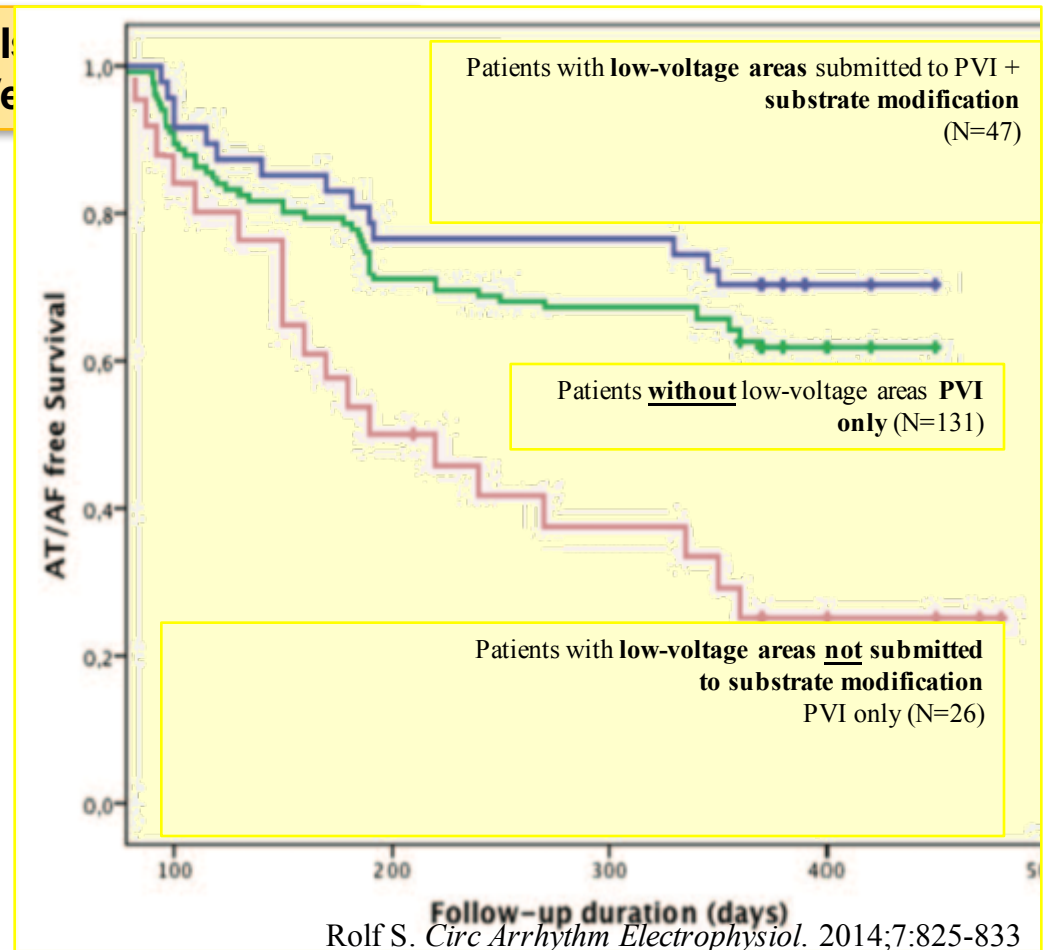
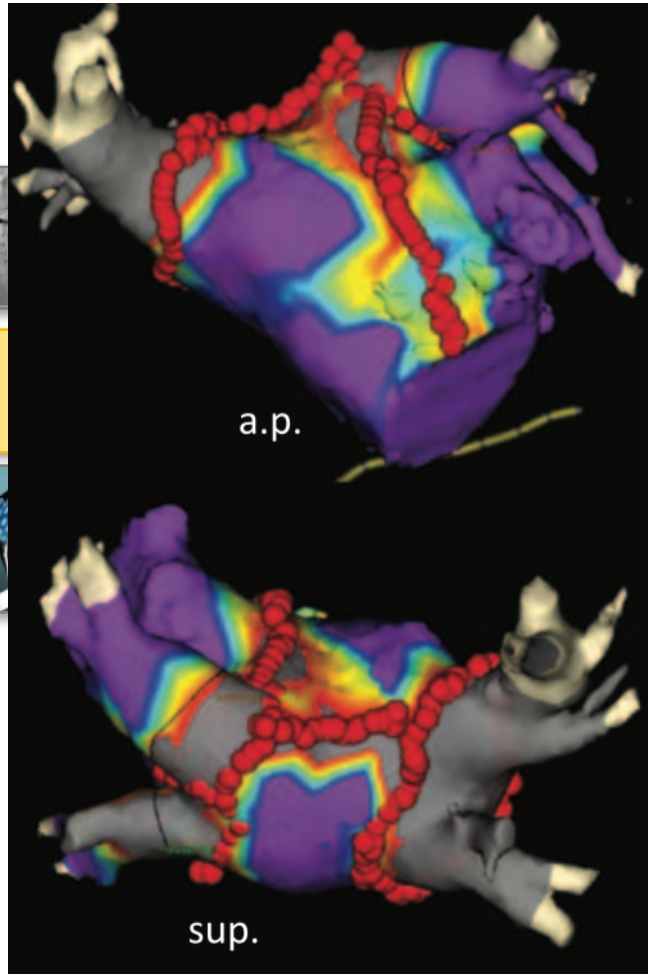
FA Persistente
Longa Duração



**Atraso da história natural da
doença em 5-10 anos**

... progressão para FA permanente

PVI + Isolamento áreas fibrose



Rolf S. *Circ Arrhythm Electrophysiol.* 2014;7:825-833

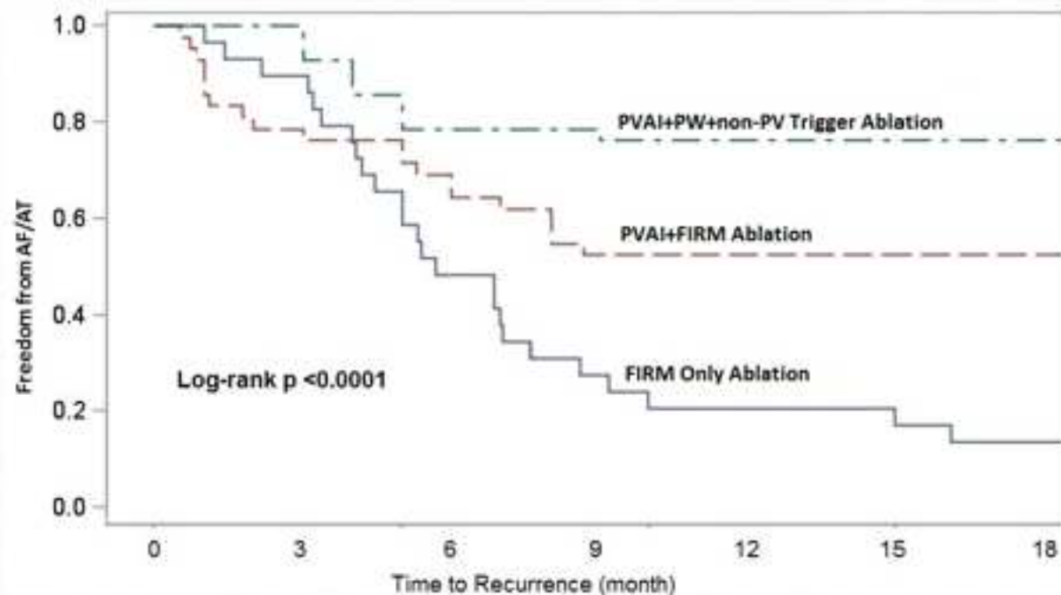


Rotor Guided Ablation (FIRM)

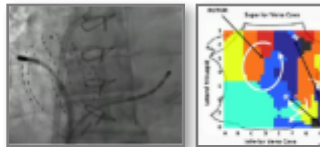
OASIS Trial:

113 pts, persistent AF

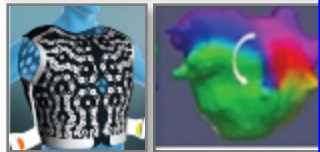
- FIRM (n=29)
- FIRM+IVP (n=42)
- IVP+Posterior wall+Non-PV trigger (n=42)



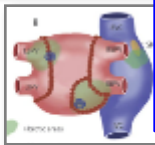
Natale et al, OASIS, HRS 2016



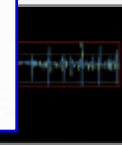
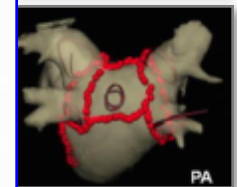
IVP + ablação d
(map endocárdico)



IVP + end
de baixa v



neares AE
istmo mitral)



CFAE Ablation

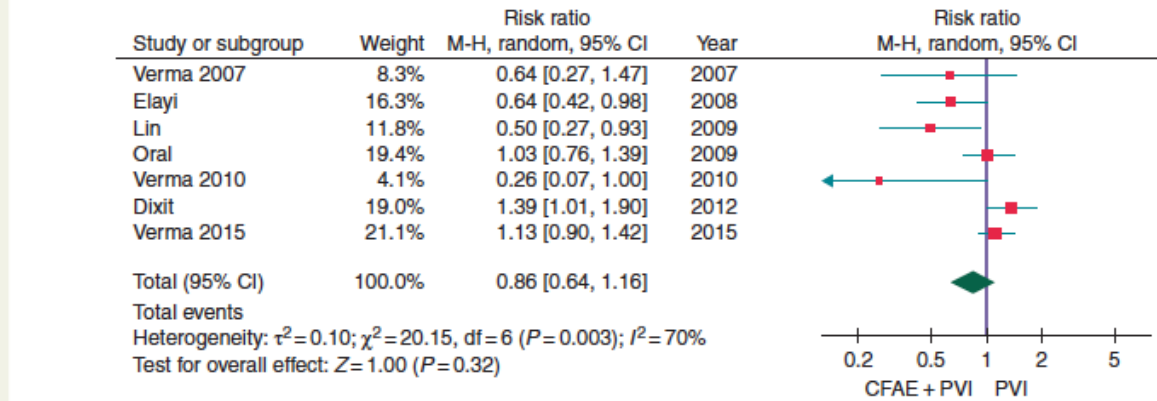


Figure 2 Summary of the RR of recurrent AF/AT after a single procedure with adjunctive CFAE ablation compared with PVI alone.

Linear Ablation

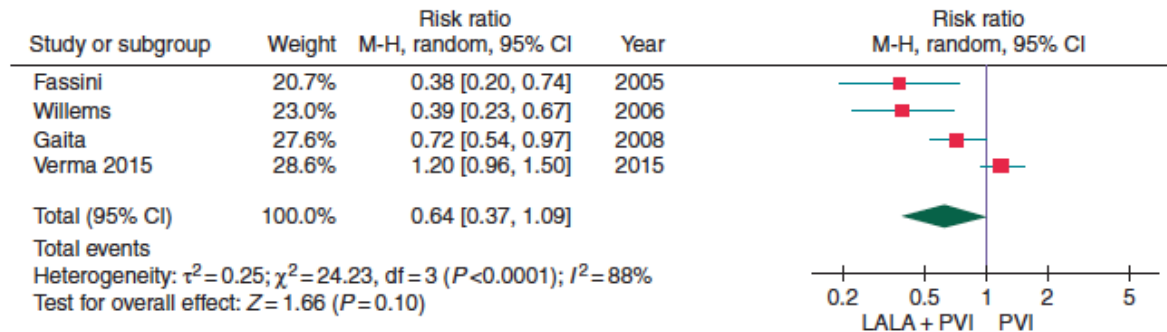


Figure 4 Summary of the RR of recurrent AF/AT after a single procedure with adjunctive LALA compared with PVI alone.

Long-term Outcomes of Catheter Ablation of Atrial Fibrillation: A Systematic Review and Meta-analysis

Anand N. Ganesan, MBBS, PhD; Nicholas J. Shipp, PhD; Anthony G. Brooks, PhD; Pawel Kuklik, PhD; Dennis H. Lau, MBBS, PhD; Han S. Lim, MBBS, PhD; Thomas Sullivan, BMA, CompSc; Kurt C. Roberts-Thomson, MBBS, PhD; Prashanthan Sanders, MBBS, PhD

Background—In the past decade, catheter ablation has become an established therapy for symptomatic atrial fibrillation (AF). Until very recently, few data have been available to guide the clinical community on the outcomes of AF ablation at ≥ 3 years of follow-up. We aimed to systematically review the medical literature to evaluate the long-term outcomes of AF ablation.

Methods and Results—A structured electronic database search (PubMed, Embase, Web of Science, Cochrane) of the scientific literature was performed for studies describing outcomes at ≥ 3 years after AF ablation, with a mean follow-up of ≥ 24 months after the index procedure. The following data were extracted: (1) single-procedure success, (2) multiple-procedure success, and (3) requirement for repeat procedures. Data were extracted from 19 studies, including 6167 patients undergoing AF ablation. Single-procedure freedom from atrial arrhythmia at long-term follow-up was 53.1% (95% CI 46.2% to 60.0%) overall, 54.1% (95% CI 44.4% to 63.4%) in paroxysmal AF, and 41.8% (95% CI 25.2% to 60.5%) in nonparoxysmal AF. Substantial heterogeneity ($I^2 > 50\%$) was noted for single-procedure outcomes. With multiple procedures, the long-term success rate was 79.8% (95% CI 75.0% to 83.8%) overall, with significant heterogeneity ($I^2 > 50\%$). The average number of procedures per patient was 1.51 (95% CI 1.36 to 1.67).

Conclusions—Catheter ablation is an effective and durable long-term therapeutic strategy for some AF patients. Although significant heterogeneity is seen with single procedures, long-term freedom from atrial arrhythmia can be achieved in some patients, but multiple procedures may be required. (*J Am Heart Assoc.* 2013;2:e004549 doi: 10.1161/JAHA.112.004549)



Endocardial bipolar mapping

- 64-pole basket catheter (Topera) recording 5 segs periods
- Difficult map interpretation (low reproducibiliy)
- No contact with all the poles, unstable catheter positioning

Utility not confirmed in multicenter study
(OASIS)

