

Long Standing Persistent AF ; CPVI is enough for it

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Boston AF Symposium 2012

In a patient undergoing AF ablation with long-standing persistent AF, which of the following reflects your first procedure ablation strategy?

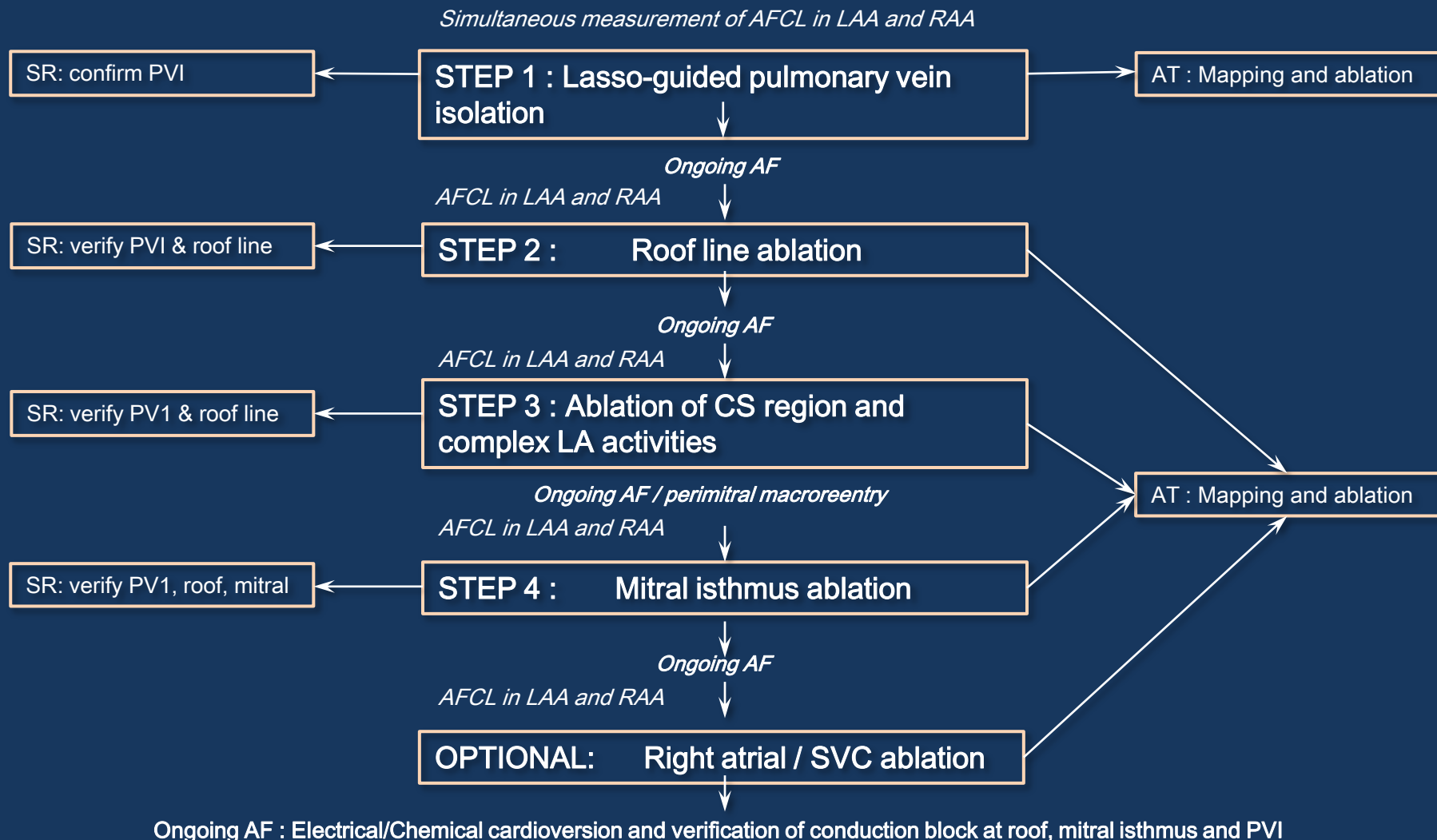
- PV isolation only
- PV isolation + more line
- PV isolation + more line + CFAEs
- PV isolation + CFAEs
- CFAEs only

Boston AF Symposium 2012

In a patient undergoing AF ablation with long-standing persistent AF, which of the following reflects your first procedure ablation strategy?

- 9% PV isolation only
- 34% PV isolation + more line
- 34% PV isolation + more line + CFAEs
- 19% PV isolation + CFAEs
- 3% CFAEs only

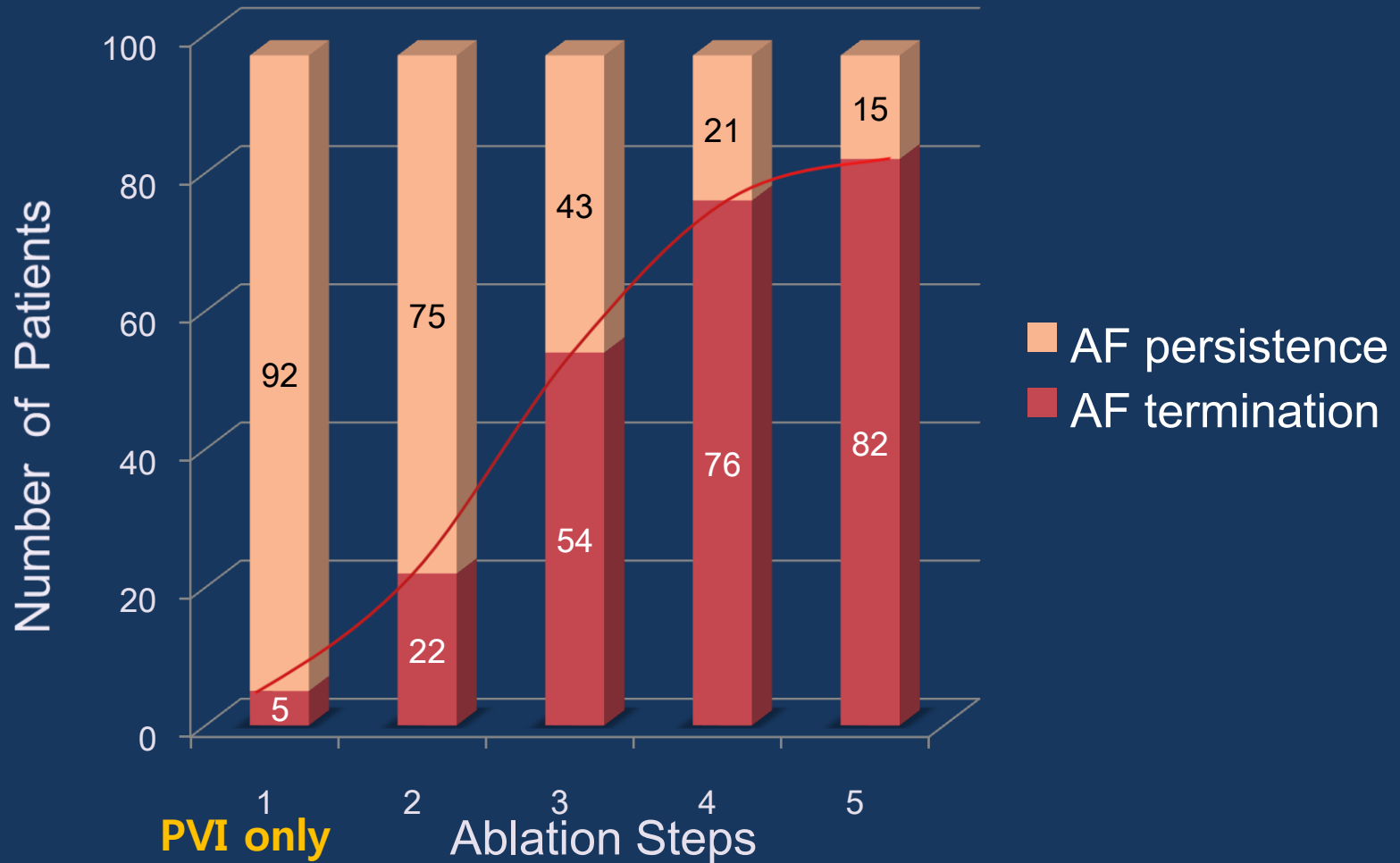
The Stepwise Ablation Approach for Chronic AF



Ongoing AF : Electrical/Chemical cardioversion and verification of conduction block at roof, mitral isthmus and PVI

Fig. 1 Algorithm for stepwise ablation in chronic AF

The Stepwise Ablation Approach for Chronic AF



CONTENTS

- PVI ablation data in Persistent / L-S PeAF
- Beneficial effects of CAFÉ / Line lesion?
- Complication with additional ablation, including radiation hazard

1. PVI ablation in persistent AF

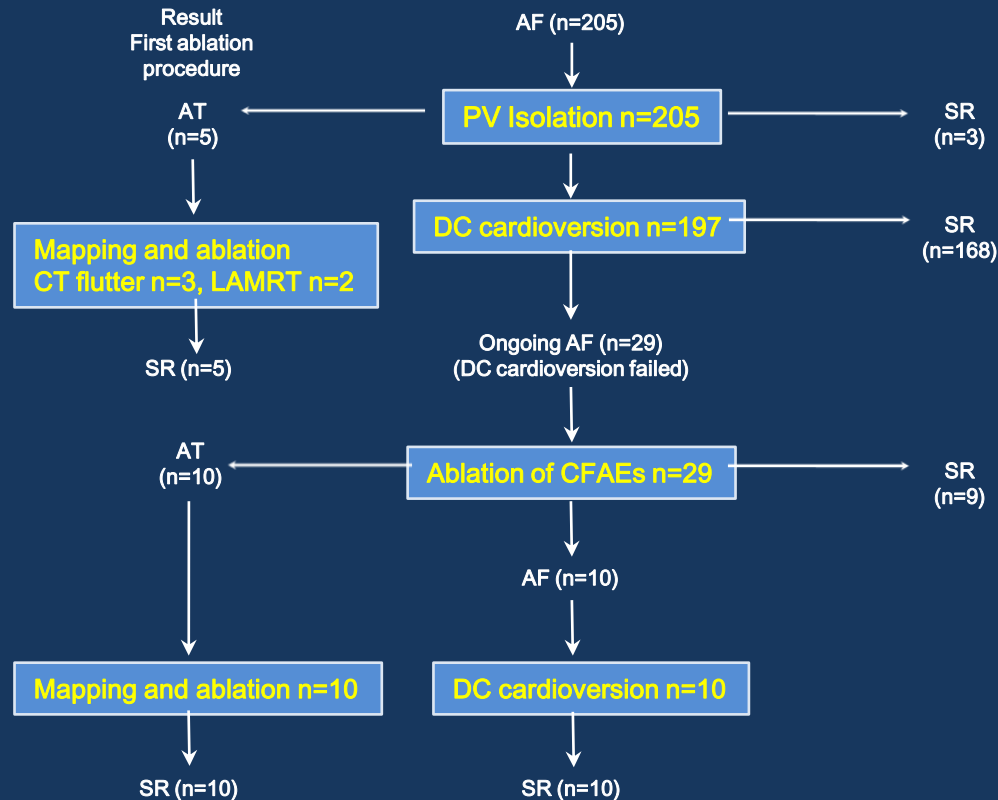
- N=40 persistent AF (for 7d-1y)
- Complete PV isolation with double Lasso
→ AF termination to SR in 12, conversion to macroreentrant AT/AFL in 10 (55%)
- Repeat ablation in 14
→ recovered PV conduction in 13
: only re-PVI in 10, macro-AT ablation in 4
- AF free : 38 (95%) after 8±2m F/U

PVI ablation in L-S persistent AF

- 340 procedures in 205 pts with L-S persistent AF
 - CPVI alone in 165 procedure in 124 pts (60.5%)
 - Additional CFAE ablation in 45 pts
 - Left linear lesions in 44 pts
 - SVC isolation in 15 pts
- After 1.7 ± 0.8 procedure, F/U of 19 ± 11 months, 135/199 pts (67.8%) in SR
- **86 pts (43.2%) in SR following CPVI alone**

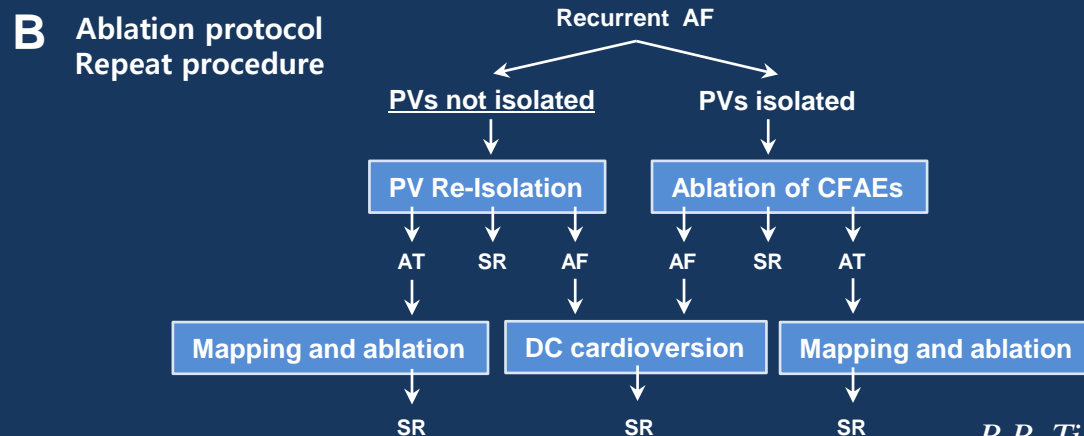
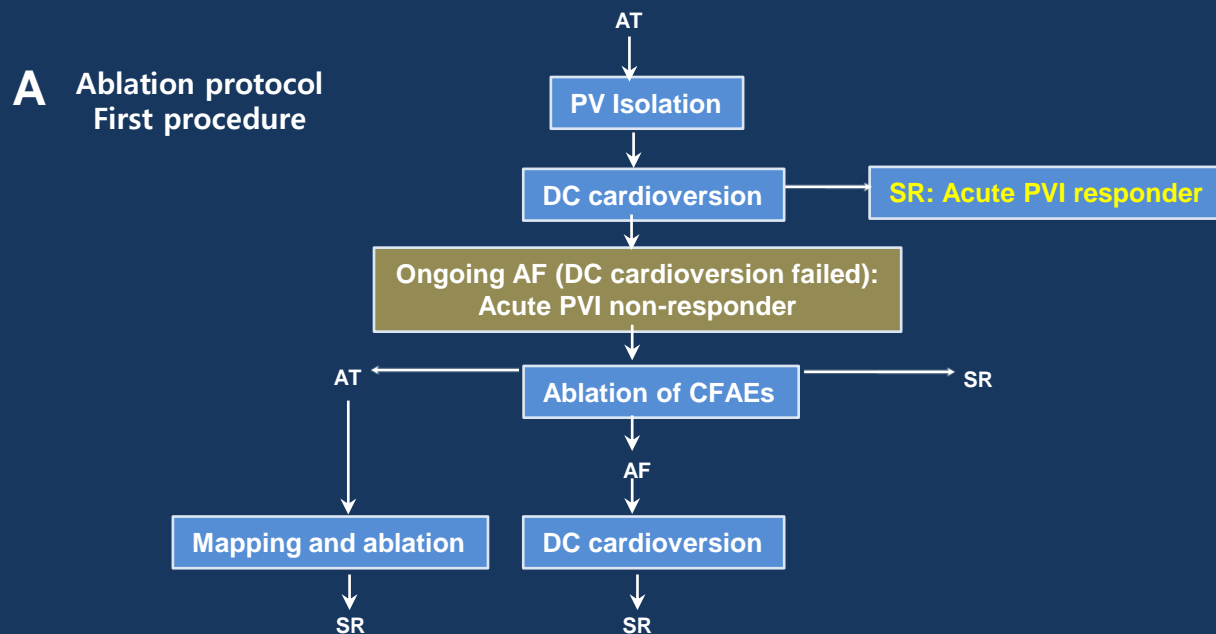
R.R. Tilz et al. J Cardio Electrophysiol (2010) 21:1085

PVI ablation in L-S persistent AF



	PVI Only Until This Proc. (n)	CFAE	CT Isthmus (n)	LA Line (n)	SVC (n)	AES (n)	LAA Isolation (n)
First procedure (N=205)	168 (82%)	29 (14%)	16 (8%)	12 (6%)	6 (3%)	1 (0.5%)	0
Second procedure (n=101)	53 (52%)	13 (13%)	14 (14%)	17 (17%)	8 (8%)	5 (5%)	4 (4%)
Third procedure (n=26)	3 (12%)	12 (26%)	3 (12%)	12 (46%)	1 (4%)	0	2 (8%)
Fourth procedure (n=7)	0	1 (14%)	3 (42%)	5 (71%)	0	0	3 (42%)

PVI ablation in L-S persistent AF -5 year outcome, Sequential Ablation Strategy -



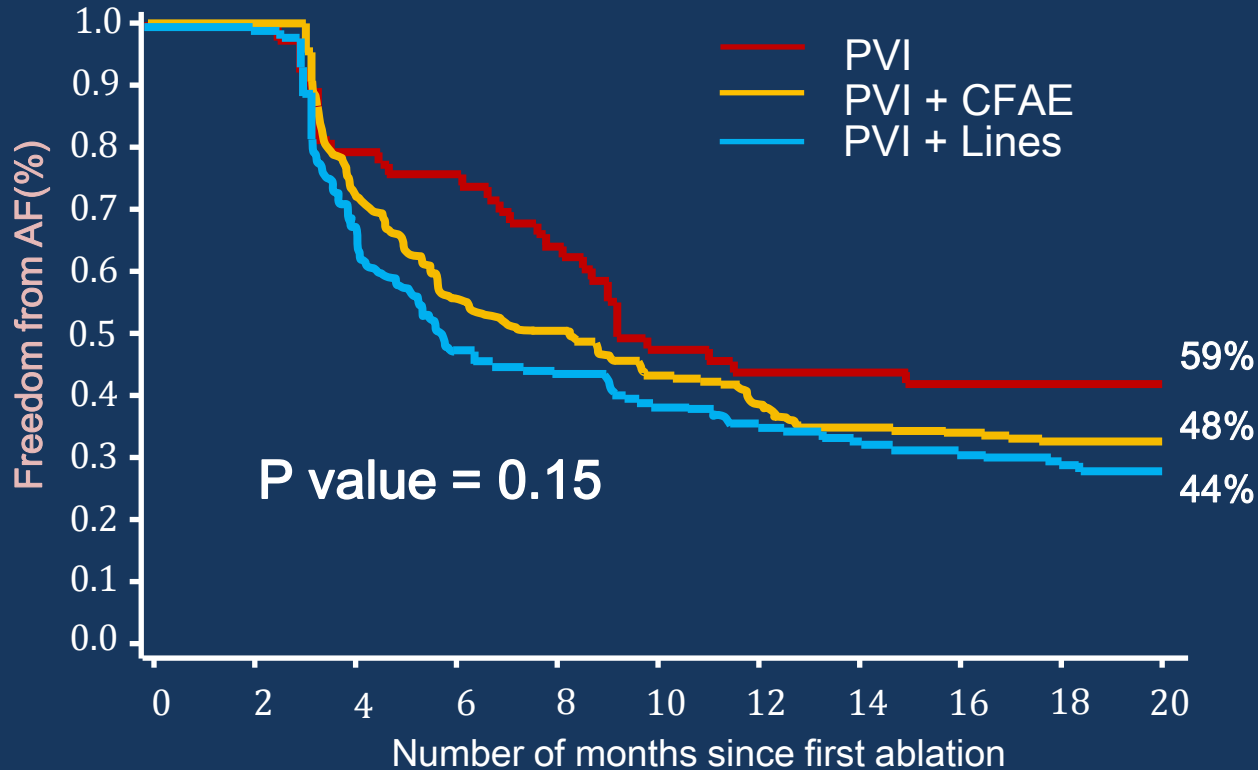
PVI ablation in L-S persistent AF -5 year outcome, Sequential Ablation Strategy -

- Long-term F/U of 56 months in 202 pts
- Initial ablation strategy of CPVI and additional ablation only in *acute PVI non-responder*, if DC cardioversion failed after PVI
- Only CPVI therapy in 105 pts → 49 (46.7%) of those pts remained in SR during F/U
- Acute PVI responders had a reduced risk of relapse (HR: 0.57, $p < 0.001$) after the first ablation

2. Beneficial effects of CFAE/Line?

- STAR AF II -


Sx Persistent AF (7d-3years)



No. at risk

PVI	61	50	36	23
PVI+CFAE	244	161	124	72
PVI+Lines	244	152	115	57

Conclusions of STAR AF II

- **No benefit** in AF reduction when additional substrate ablation (**CFAE** or **Lines**) was performed in addition to PVI in persistent AF
 - **PVI alone achieved** freedom from recurrence in about 50% of patients
- 
- **No longer need to use additional strategies**
 - Empiric lines, CFAE, etc
 - **Other strategies** should be further investigated if we can improve outcomes
 - Rotors, non-PV foci, ablation of scar regions, etc

Beneficial effects of CFAE?

- Michigan random study in L-S PeAF -

A Randomized Assessment of the Incremental Role of Ablation of Complex Fractionated Atrial Electrograms After Antral Pulmonary Vein Isolation for Long-Lasting Persistent Atrial Fibrillation

- In persistent AF group after PVI, no further ablation and CV (N=50) or CFAEs ablation up to **2 additional hours** (N=50)
- 36% vs 34% in SR without antiarrhythmic drugs (p=0.84) after 10±3 months
- Additional CFAEs ablation **does not improve** clinical outcomes in patients with long-lasting persistent AF

Beneficial effects of CFAE?

- RASTA study in persistent AF -

- N=156 PeAF / long lasting PeAF
(AF duration : 47 ± 50 m)
- Gr 1: PVI + identified non-PV trigger ablation
(standard approach)
- Gr 2: standard + empirical common non-PV ablation
- Gr 3: standard + LA CFAE ablation



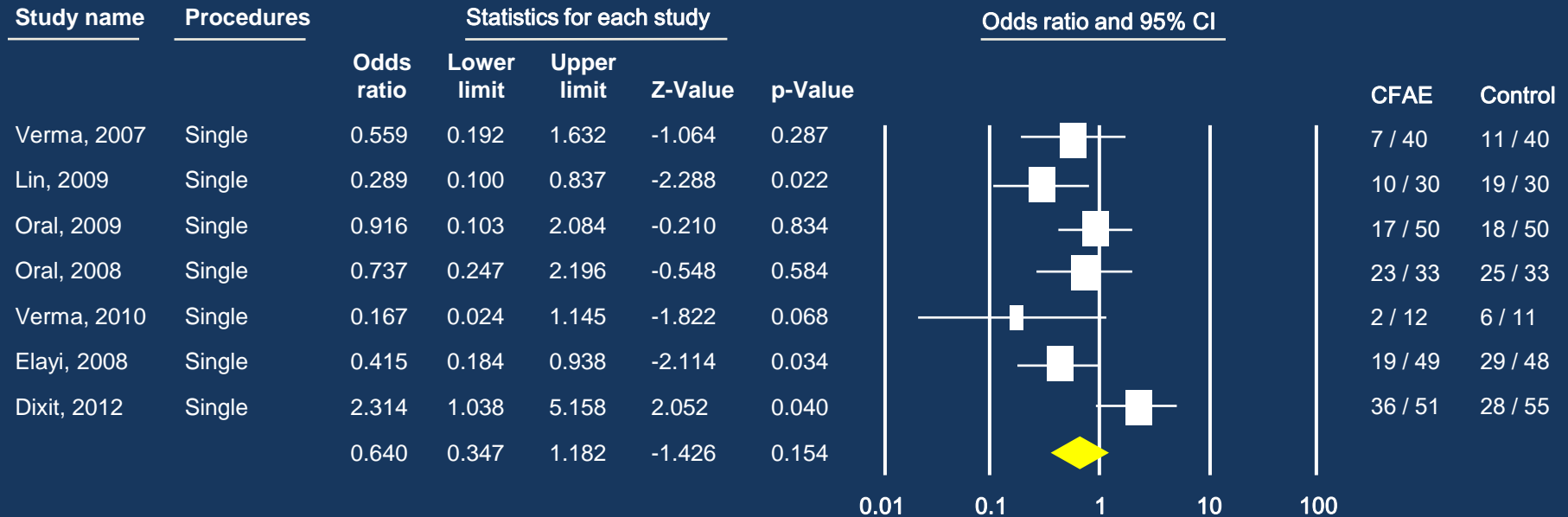
- Atrial arrhythmia free at 1y after single ablation
: Gr 1 - 49%, Gr 2 - 58%, Gr 3 - 29% (p<0.05)

Beneficial effects of CFAE?

- meta-analysis of additional CFAE -

- Overall, CFAE ablation showed **no additional benefit** in PeAF/L-S PeAF (OR, 0.64; 95% CI, 0.35–1.18; $P=0.15$)

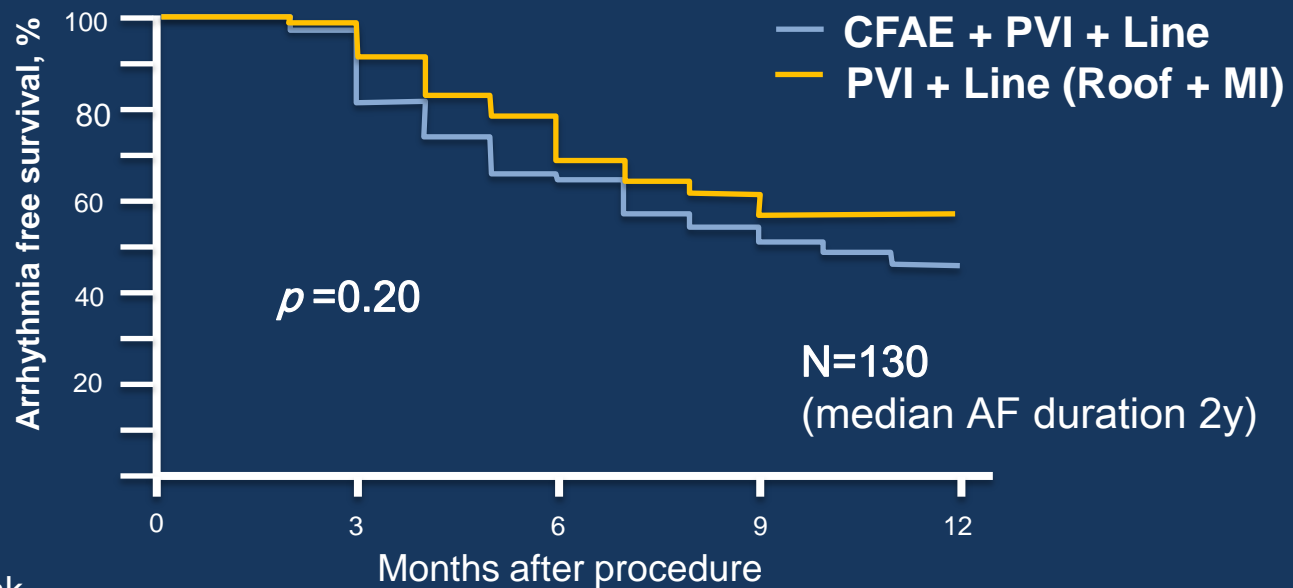
Meta analysis of the impact of additional CFAE ablation on single procedure efficacy



Beneficial effects of CFAE?

- Benefit of Complex Ablation Study -

Freedom from AF/AT after first ablation procedure

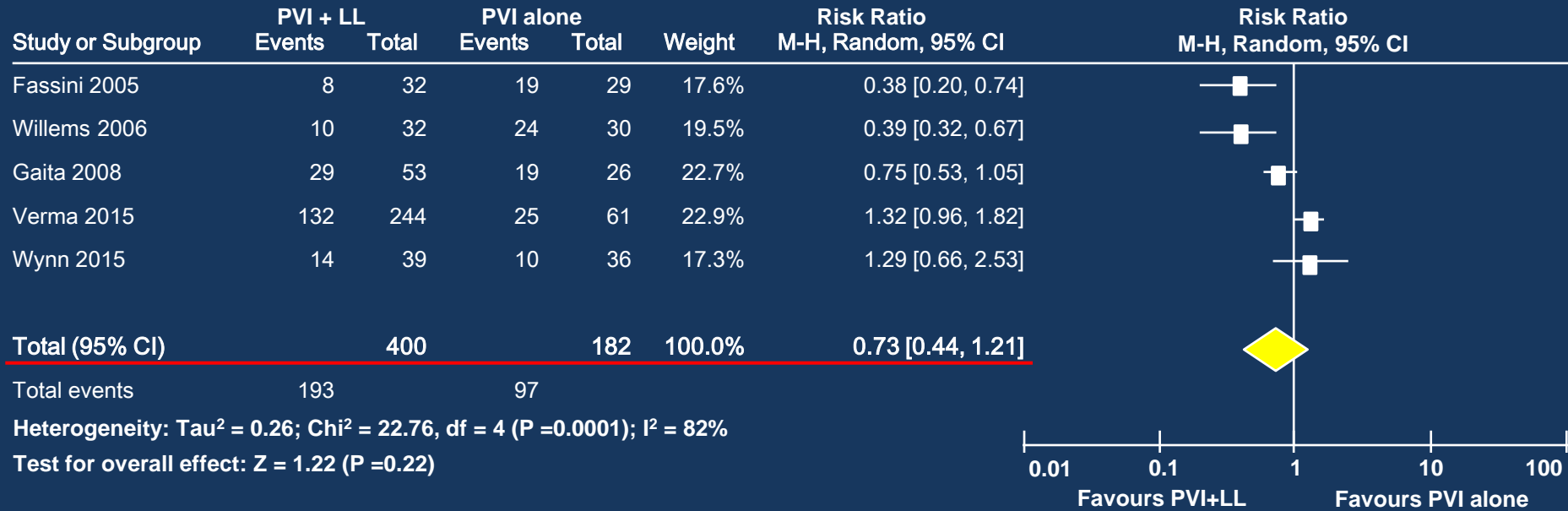


- Additional CFAE ablation **did not improve** procedural success at 12 months in symptomatic persistent or long-lasting persistent AF

Beneficial effects of Line?

-Meta analysis of Linear ablation following PVI-

Forest plot comparing PVI plus additional LL with PVI alone in PeAF patients



- Pooled analysis of 5 persistent AF trials : **addition of LL (linear lesion) following PVI does not lead to a significant reduction in recurrent atrial tachyarrhythmias** compared with PVI alone
- **No additional benefit of LL following PVI** to sinus rhythm maintenance in patients with PeAF

3. Increased Complications with additional Linear /CFAE ablation in STAR AF II

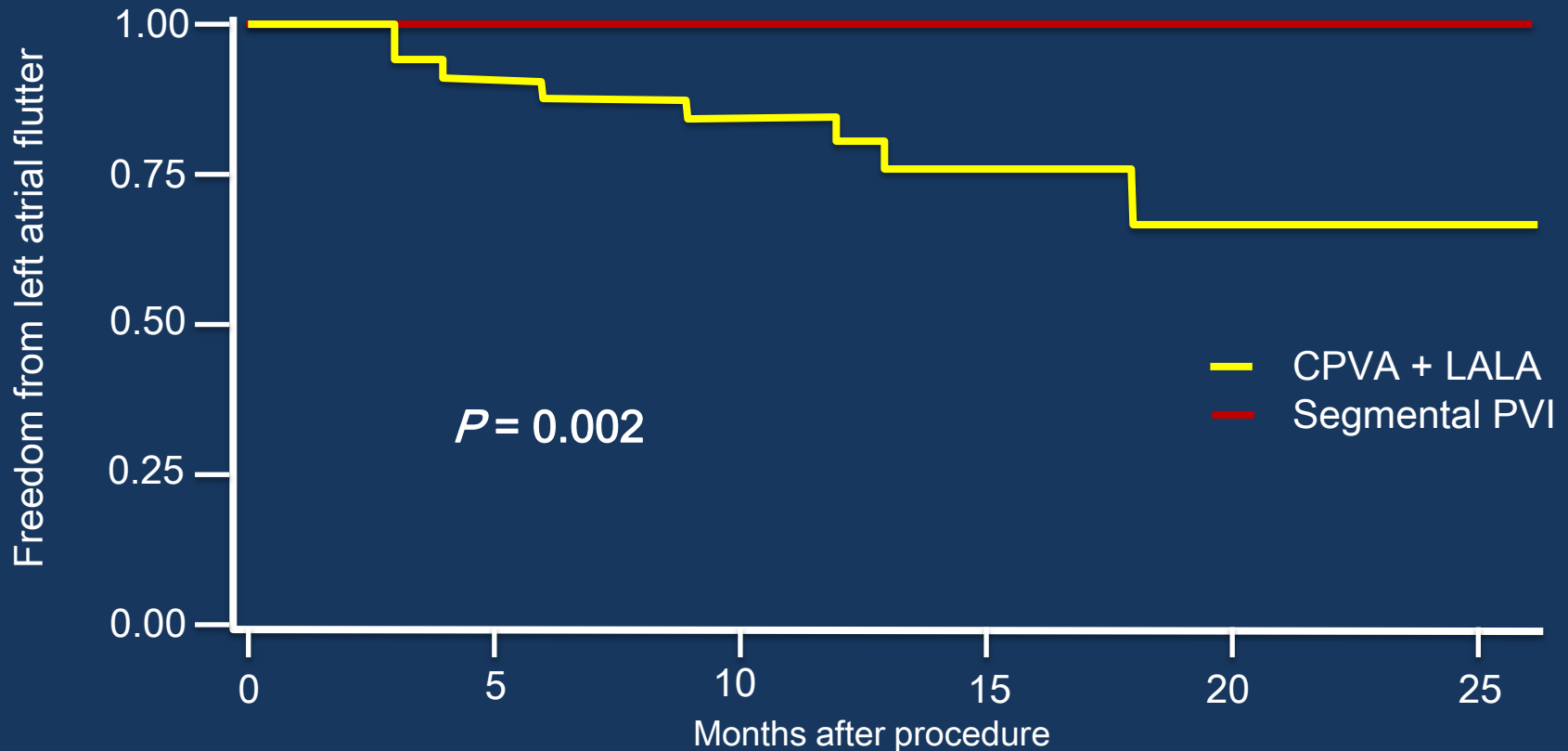
Procedural Adverse Events

Adverse Event	Isolation Alone (N=64)	Isolation plus Electrograms (N=254)	Isolation plus Lines (N=250)	Total (N=568)
	<i>Number of events</i>			
Hematoma at access site	2	0	3	5
Atriovenous fistula or pseudo-aneurysm at access site	0	3	3	6
Pericarditis	0	1	2	3
Fluid overload	0	1	3	4
Sedation-related complication	0	3	5	8
Skin burn	1	0	0	1
Cardiac tamponade	1	0	2	3
Transient ischemic attack or stroke	0	2	1	3
Death due to atrioesophageal fistula	0	1	0	1

Increased Incidence of Left Atrial Flutter with Additional Linear Ablation

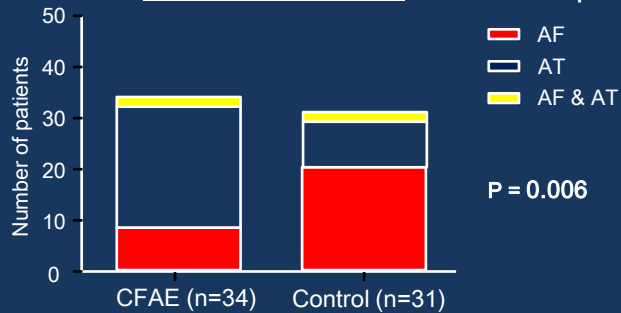
- Segmental PVI vs Circumferential PVI+additional Linear lesion in PAF (N=66)

Kaplan Meier curve showing the possibility of developing LAFL between the 2 groups

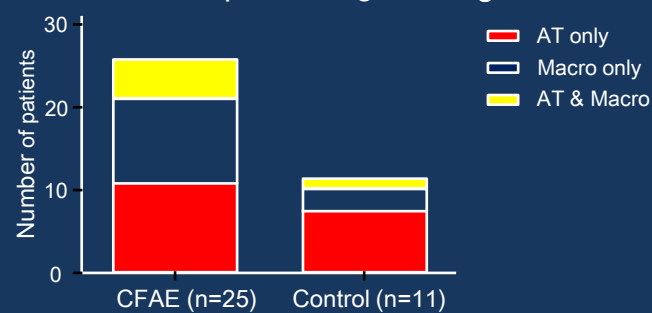


Increased organised AT/AFL with additional CFAE ablation in *Complex Ablation Study*

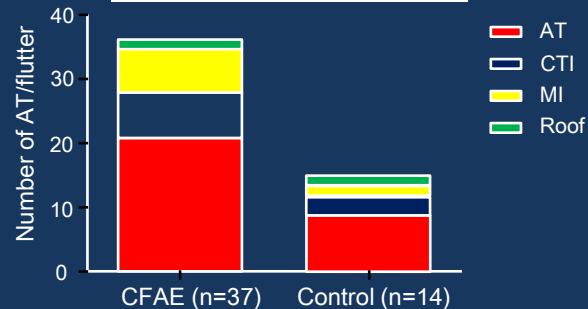
A. Patients with AT/AF recurrence at first redo-procedure



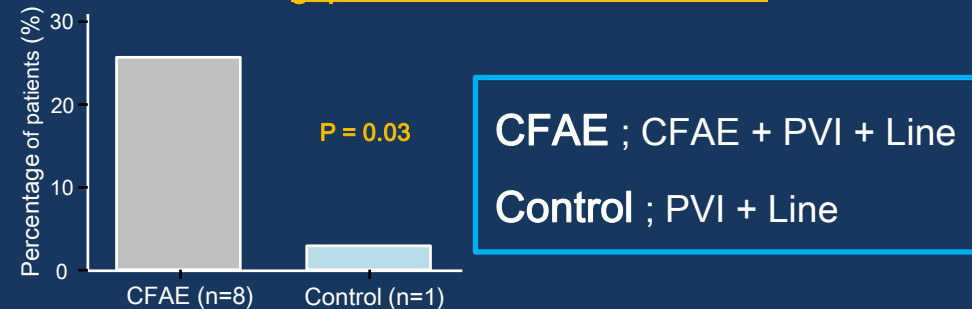
B. Patients presenting with organized AT/flutter



C. Number of AT/macroeentrant flutter



D. Patients with gap-related macroreentrant flutter



- There was a significantly higher incidence of **gap-related AFL** in the CFAE group
- ✓ Inability to obtain bidirectional block in LA linear lesion greatly increased the **incidence of left atrial flutter**

Increased stroke and thrombi with LAA electrical isolation

- In a cohort of 40 patients with electrical isolation of the LAA



- Thromboembolic complications documented in 8%
- Thrombus formation demonstrated in LAA in another 5% despite anticoagulation

Complications in worldwide surveys

	Previous Survey	Current Survey
Period Investigated	1995-2002	2003-2006
Proportion of centers (%) performing ablation of		
Paroxysmal AF	100	100
Persistent AF	53.4	85.9
Long-lasting AF	20	47.1
Overall complication rate, %	4.0	4.5
Iatrogenic flutter	3.9	8.6
Periprocedural death (%)	0.05	0.15
Tamponade	1.22	1.31
Pneumothorax	0.02	0.09
Femoral pseudoaneurysm	0.53	0.93
A-V fistulae	0.42	0.54
Valve damage	0.01	0.07

Procedural Characteristics

- Benefit of complex ablation study

	CFAE (n=65)	Non-CFAE (n=65)	P value
Total procedure time, min	201±35	152±45	<0.0001
Total ablation time, min	70±20	55±17	0.0003
Total fluroscopy time, min	<u>47±22</u>	<u>39±13</u>	0.03

Circ Arrhythm Electrophysiol. 2015;8:1316-1324

- Meta-analysis of linear ablation after PVI

Continuous	Study (n)	MD [95% CI] (min)	p value	I ² (%)
RF time	7	18.63 [8.86,28.40]	0.0002	95
Fluroscopy time	7	<u>6.97 [4.18, 9.75]</u>	<0.00001	51
Procedure time	7	23.61[12.56, 34.67]	<0.0001	84

Pacing Clin Electrophysiol. 2016 Mar(E-Pub)

STAR AF II

Procedural Characteristics

	PVI	PVI+CFAE	PVI+LINES	p value
Procedure time (min)	167.0 ± 54.8	229.2 ± 83.2	222.6 ± 89.4	<0.0001
Mapping time (min)	13.9 ± 6.6	18.8 ± 14.0	14.4 ± 7.7	<0.0001
Fluoroscopy time(min)	29.4 ± 16.2	42.1 ± 21.7	40.9 ± 25.0	0.0003



Radiation

Deterministic effects:

Skin burns

Ulceration

Desquamation

Stochastic effects:

Leukemia

Cancers

Radiation hazard :Brain/Neck tumors in interventional physicians

Patient characteristics

	Country	Year Diagnosed	Age at Diagnosis (yrs)	Gender	Radiation Exposure (Latency Period) (yrs)	Tumor Type	Side Involved
1	Toronto, Canada	1997	62	M	20	GBM	Left side
2	Toronto, Canada	1997	53	M	20	GBM	Left side
3	Haifa, Israel	1998	48	M	12	Meningioma	Left temporal
4	Paris, France	2001	56	M	25	GBM	Left temporal
5	Paris, France	2005	49	M	22	GBM	Left temporo-occipital
6	Haifa, Israel	2009	62	M	32	GBM	Left frontal
7	Sweden	NA	NA	M	20	Acoustic neuroma	NA
							NA
							NA
							Left
							Left frontal
							Left
							Left
							Midline
							Left occipital lobe
							Left frontal
							Left temporal
							Right
							Left
							Left frontal lobe
							Left
							Left temporal
							Right
							NA
							NA
26	Belgium	1990s	NA	M	NA	GBM	
27	Ireland	2011	55	M	31	Neck lymphoma	Left
28	Israel	2012	62	M	32	Parotids	Right
29	Germany	2003	49	M	19	Meningioma	Left
30	Middle East	2009	62	M	30	Meningioma	Left
31	Middle East	2009	52	M	19	Tonsillar tumor	Left

Total: 31
N/A: 5
Left: 22 / 26(85%)
Right: 4 / 26



EP = electrophysiologist; F = female; GBM = glioblastoma multiforme; IC = invasive cardiologist; IR = invasive radiologist; M = male; NA = not available.

Take Home Messages

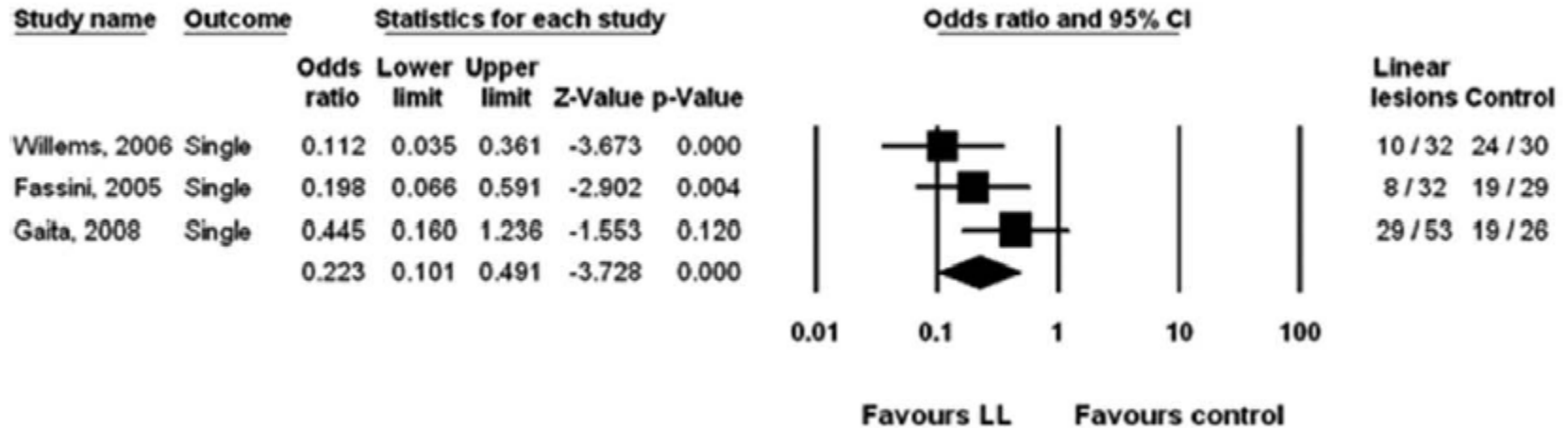
- In some patients with persistent /long standing PeAF, circumferential PVI is enough.
- **Additional CFAEs ablation** does not improve clinical outcomes.
- **Line lesions (esp. roof and perimitral line)** can be beneficial, but complete bidirectional block should be made.
- **Radiation hazard** should be considered.

감사합니다!

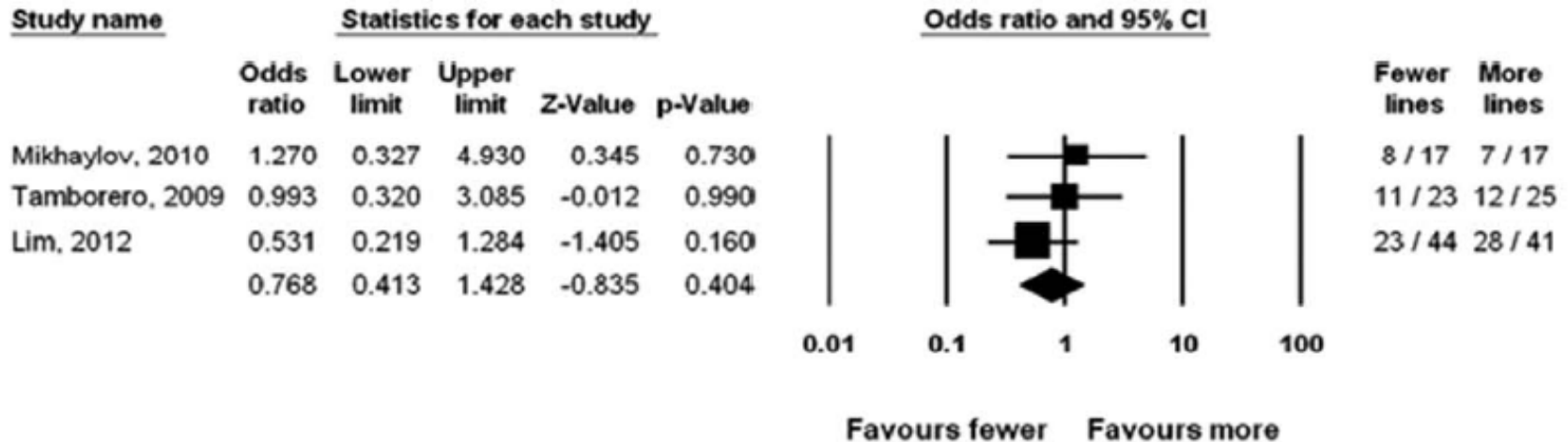


- PVI ablation data in LSP AF
 - PVI 중요성(2005 Circulation)
 - PVI in persistent AF(2005 Circulation)
 - LSP AF with PVI(2010, JCE)
 - LSP AF with CPVI(JACC, 2012)
- No benefit of CAFÉ/Line
 - STAR AF II
 - CAFÉ(2015 Circulation AE)
 - Linear ablation, meta analysis(2016-03 PACE)
- Complication with additional ablation
- Radiation hazard

Meta analysis of the impact of linear ablation lesions



Meta analysis of the impact of less more extensive linear ablation

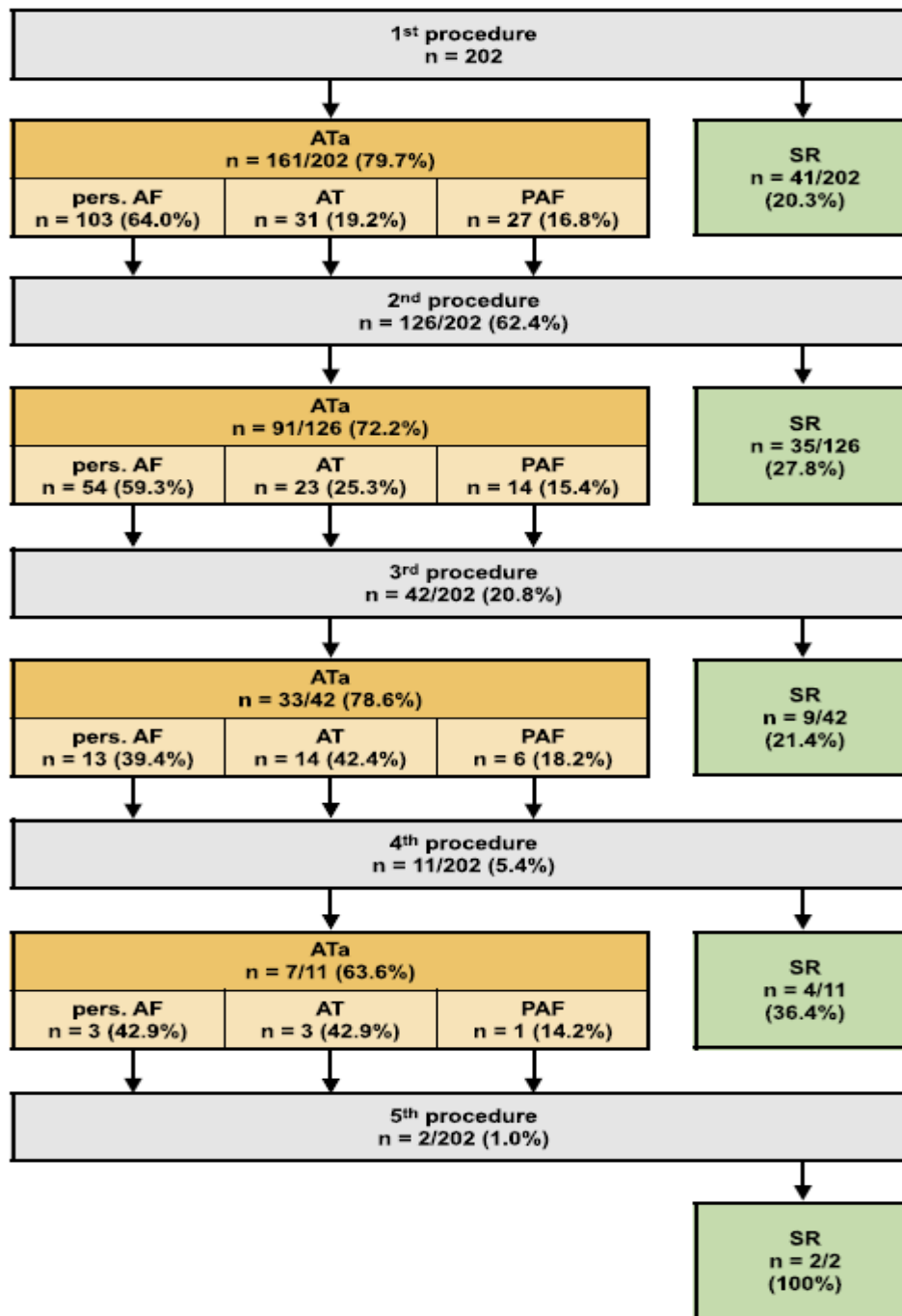


Meta analysis

Table 5. Ablation Strategy

Ablation Strategy	Description	No. of Studies	% Pooled Complication Rate (95% CI)	<i>P</i> Value	<i>I</i> ² Statistic
1	PVI alone	23	2.8 (2.05–3.70)	...	74.2
2	PVA ablation/PVAI	34	2.7 (1.89–3.70)	0.874	86.7
3	Linear substrate	25	2.5 (1.81–3.22)	0.545	75.1
4	CFAE alone	3	4.2 (2.86–5.86)	0.091	12.2
5	CFAE as adjunct	10	2.0 (1.51–2.57)	0.098	53.6
6	Tailored	49	3.2 (2.62–3.74)	0.509	84.5
7	Stepwise	8	3.0 (2.06–4.04)	0.800	47.7

CFAE indicates complex fractionated atrial electrogram; CI, confidence interval; PVA, pulmonary vein antral; PVAI, pulmonary vein antrum isolation; and PVI, pulmonary vein isolation.



RR Tilz, KH Kuck,
F Ouyang. 2012 JACC

105/202 PVI only →
49(46.7%) in SR

Catheter Ablation of Long-Standing Persistent Atrial Fibrillation: A Lesson from Circumferential Pulmonary Vein Isolation

ROLAND RICHARD TILZ, M.D., K.R. JULIAN CHUN, M.D., BORIS SCHMIDT, M.D.,
ALEXANDER FUERNKRANZ, M.D., ERIK WISSNER, M.D., ILKA KOESTER, M.D.,
DIETMAR BAENSCH, M.D., SIGRID BOCZOR, BUELENT KOEKTUERK, M.D.,
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From the II. Medizinische Abteilung, Asklepios Klinik St. Georg, Hamburg, Germany

Catheter Ablation of Long-Standing Persistent AF. *Introduction:* Circumferential pulmonary vein isolation (CPVI) is associated with a high success rate in patients with paroxysmal and persistent atrial fibrillation (AF). However, in patients with long-standing persistent AF, the ideal ablation strategy still remains a matter of debate.

Methods and Results: Two-hundred and five patients underwent catheter ablation for long-standing persistent AF defined as continuous AF of more than 1-year duration. In a first step, all patients underwent CPVI. If direct-current cardioversion failed following CPVI, ablation of complex fractionated atrial electrograms (CFAEs) was performed. The goal was conversion into sinus rhythm (SR) or, alternatively, atrial tachycardia (AT) with subsequent ablation.

A total of 340 procedures were performed. CPVI alone was performed during 165 procedures in 124 of 205 (60.5%) patients. In the remaining 81 patients, additional CFAE ablation was performed in 45, left linear lesions for recurrent ATs in 44 and SVC isolation in 15 patients, respectively, resulting in inadvertent left atrial appendage isolation in 9 (4.4%) patients. After the initial ablation procedure, 67 of 199 patients remained in SR during a mean follow-up of 19 ± 11 months. Six patients were lost to follow-up. After a mean of 1.7 ± 0.8 procedures, 135 of 199 patients (67.8%) remained in SR. Eighty-six patients (43.2%) remained in SR following CPVI performed as the sole ablative strategy.

Conclusions: CPVI alone is sufficient to restore SR in 43.2% of patients with long-standing persistent AF. Multiple procedures and additional ablation strategies with a significant risk of inadvertent left atrial appendage isolation are often required to maintain stable SR. (*J Cardiovasc Electrophysiol*, Vol. 21, pp. 1085-1093, October 2010)