

Should hybrid ablation be the standard of care instead of transcatheter ablation techniques?

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Disclosures:

- Proctor and Consultant for Atricure.

What type of Atrial Fibrillation

- » Paroxysmal
- » Persistent (> 7 days)
- » Long-standing persistent (> 1 year)

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.

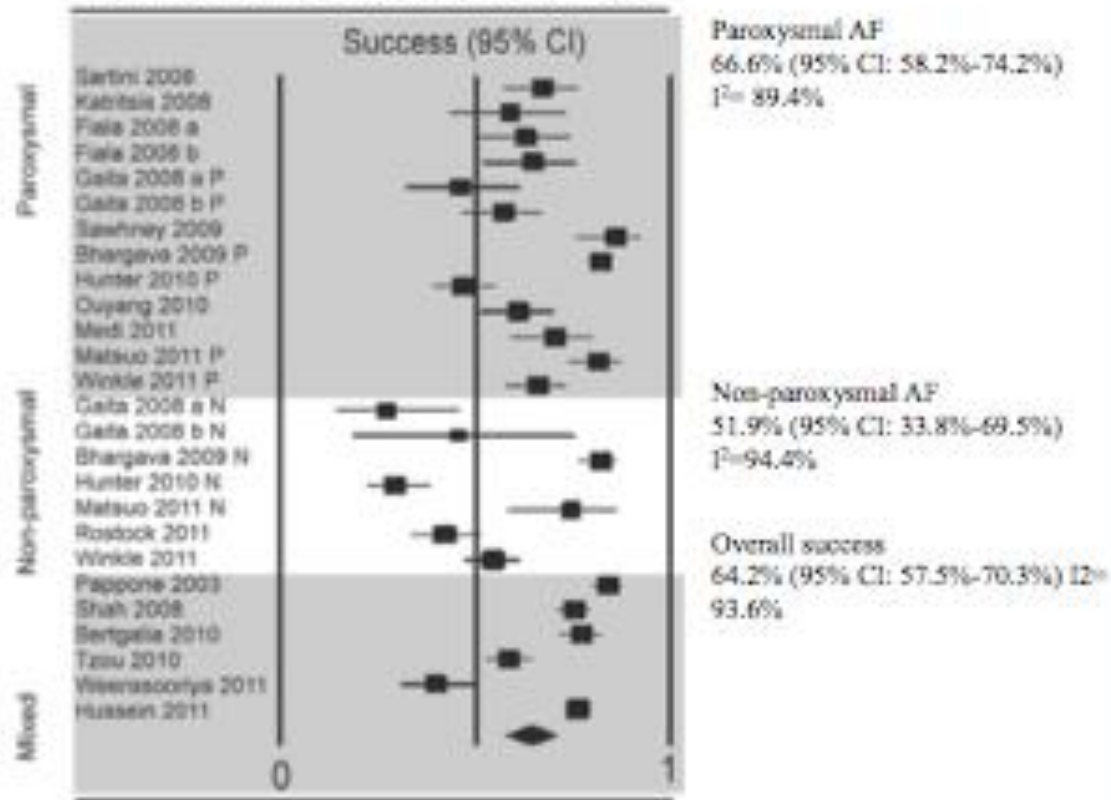
Methods and Results—A structured electronic database search (PubMed, Embase, Web of Science, Cochrane) of the scientific literature was performed for studies describing outcomes at ≥ 3 years after AF ablation, with a mean follow-up of ≥ 24 months after the index procedure. The following data were extracted: (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)

Key Words: ablation • arrhythmia • atrial fibrillation • long-term outcomes

A

12 month single procedure success

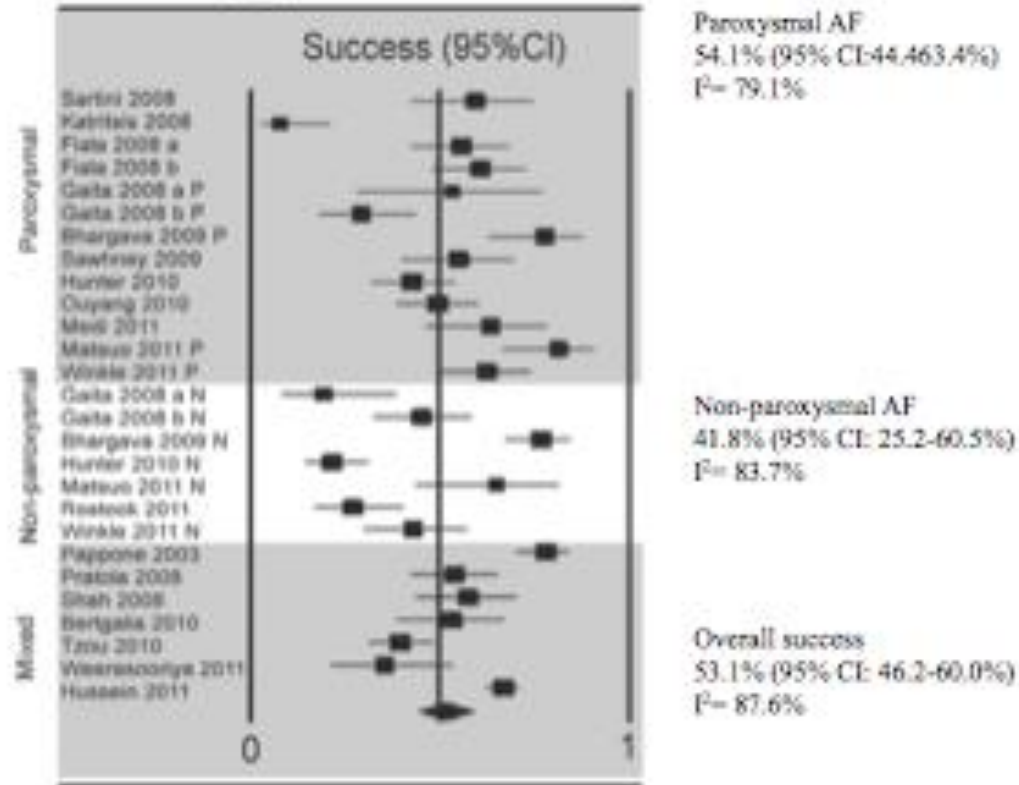


Fiala 2008 a – segmental pulmonary vein isolation arm; Fiala 2008 b Electroanatomic map guided ablation; Gaita 2009 a pulmonary vein isolation; Gaita 2009 b pulmonary vein isolation plus linear ablation. P = paroxysmal AF results for study. N = nonparoxysmal AF results for study. Single procedure success data for Shah et al., Bertaglia et al., and Tzou et al., were recalculated against original cohort size.

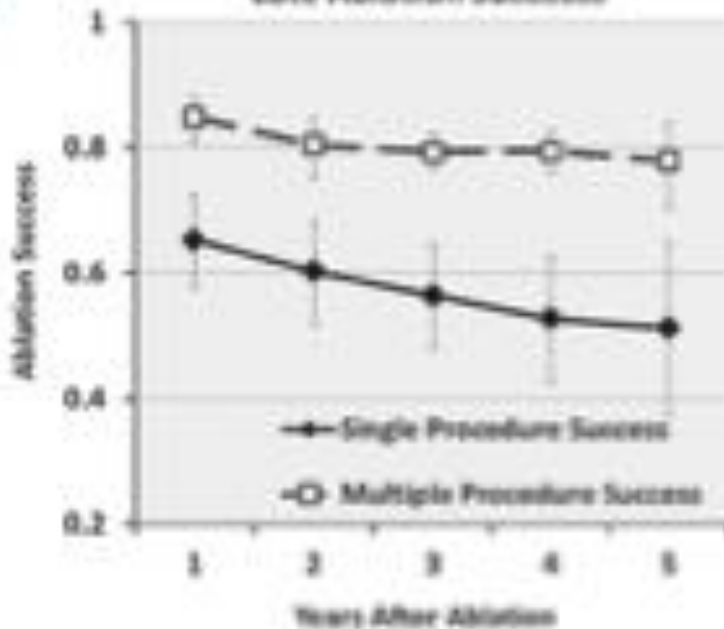


B

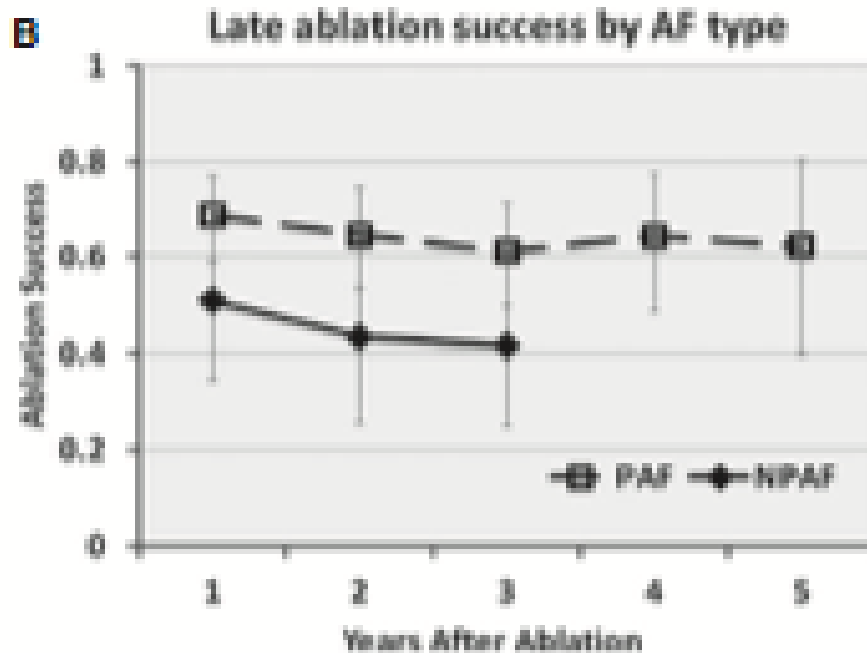
Late single procedure success



Fiala 2008 a – segmental pulmonary vein isolation arm; Fiala 2008 b Electroanatomic map guided ablation; Gaita 2009 a pulmonary vein isolation; Gaita 2009 b pulmonary vein isolation plus linear ablation. P = paroxysmal AF results for study. N = nonparoxysmal AF results for study. Single procedure success data for Shah et al., Bertaglia et al, and Tzou et al., were recalculated against original cohort size.

A**Late Ablation Success**

Years After Ablation	1	2	3	4	5
Single (number of studies)	17	17	17	13	6
Multiple (number of studies)	9	9	8	9	4



Years After Ablation	1	2	3	4	5
PAF (number of studies)	10	10	10	5	3
NPAF (number of studies)	8	6	6	2	1

Table 3. Risk Factors for Recurrence or Success After AF Ablation Were Presented for 13 Studies

Study	Predictive Model	Covariates Predictive of Recurrence/Success
Pappone, 2003 ⁹	Cox proportional hazards	LA diameter >45 mm predicted recurrence
Pratola, 2008 ¹⁰	Cochran-Mantel-Haenszel statistic	Age, presence of recurrent AF in 2 to 6 mo after ablation predicted recurrence
Sartini, 2008 ¹¹	Cox proportional hazards	Age, time of AF, number of drugs and associated flutter, delivery power predicted recurrence
Shah, 2008 ¹²	Cox proportional hazards	Hypertension, hyperlipidemia predicted recurrence
Sawhney, 2009 ¹⁸	Cox proportional hazards	Hypertension predicted recurrence
Bhargava, 2009 ¹⁷	Cox proportional hazards	NPAF predicted recurrence
Bertaglia, 2010 ¹⁸	Cox proportional hazards	No variables identified predictive of recurrence
Tzou, 2010 ¹⁹	Cox proportional hazards	PAF, smaller LA size, fewer AF triggers, fewer PVs isolated predicted success
Hunter, 2010 ²⁰	Cox proportional hazards	Structural heart disease, persistent AF, and female sex predicted recurrence
Weerasooriya, 2011 ²⁴	Cox proportional hazards	Long-standing persistent AF, valvular heart disease, nonischemic dilated cardiomyopathy predicted recurrence
Hussain, 2011 ²⁶	Cox proportional hazards	Male, older age, higher BMI, NPAF, hypertension, lower LVEF, hsCRP, BNP predictive of early recurrence Age, NPAF, left atrial size predicted late recurrence
Rostock, 2011 ²⁶	Cox proportional hazards	Male sex, duration of persistent AF >6 mo, congestive heart failure, shorter AFCL predicted recurrence AF termination predicted success
Winkles, 2011 ²⁷	Cox proportional hazards	Age, left atrial size, female sex, long-standing persistent AF, persistent AF, presence of CAD, predicted recurrence

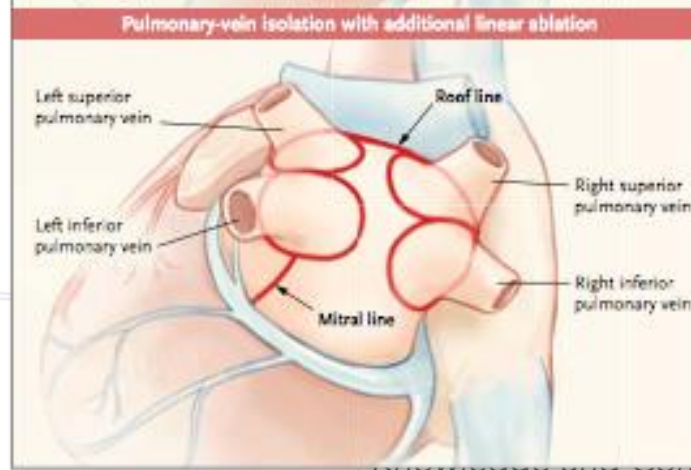
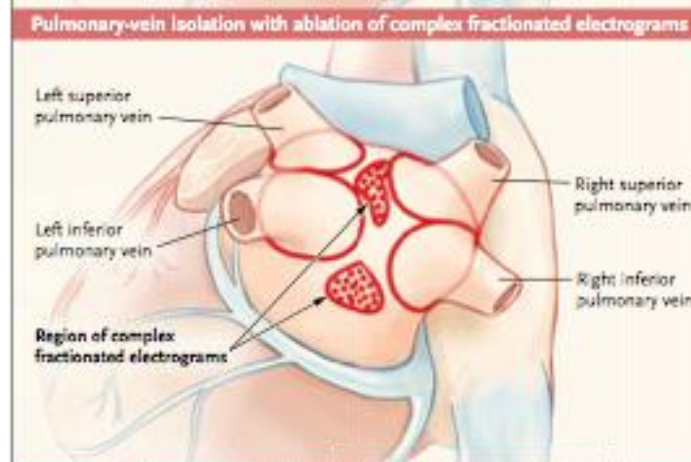
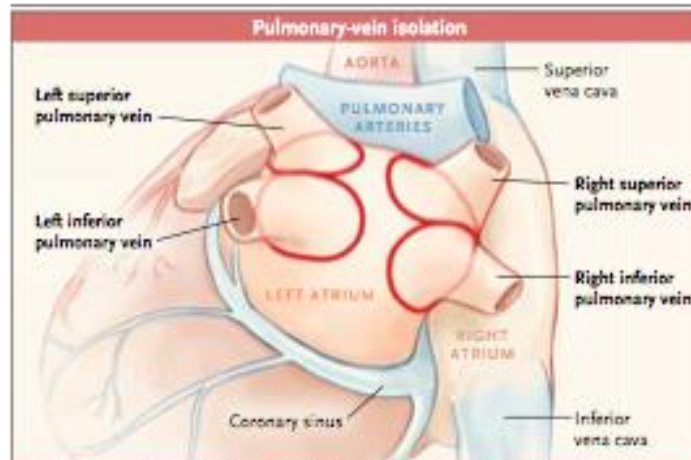
ORIGINAL ARTICLE

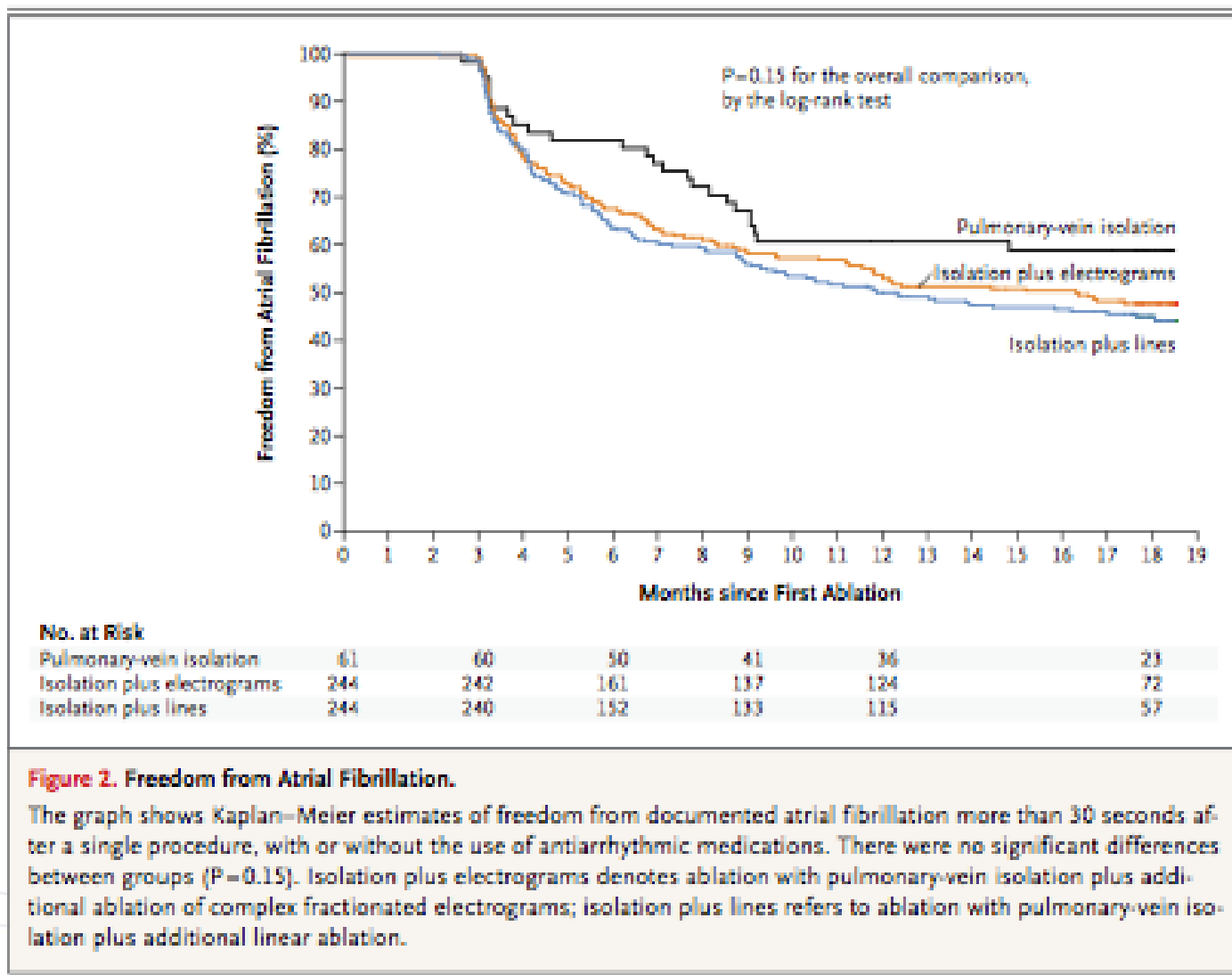
Approaches to Catheter Ablation for Persistent Atrial Fibrillation

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*

ABSTRACT

BACKGROUND





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

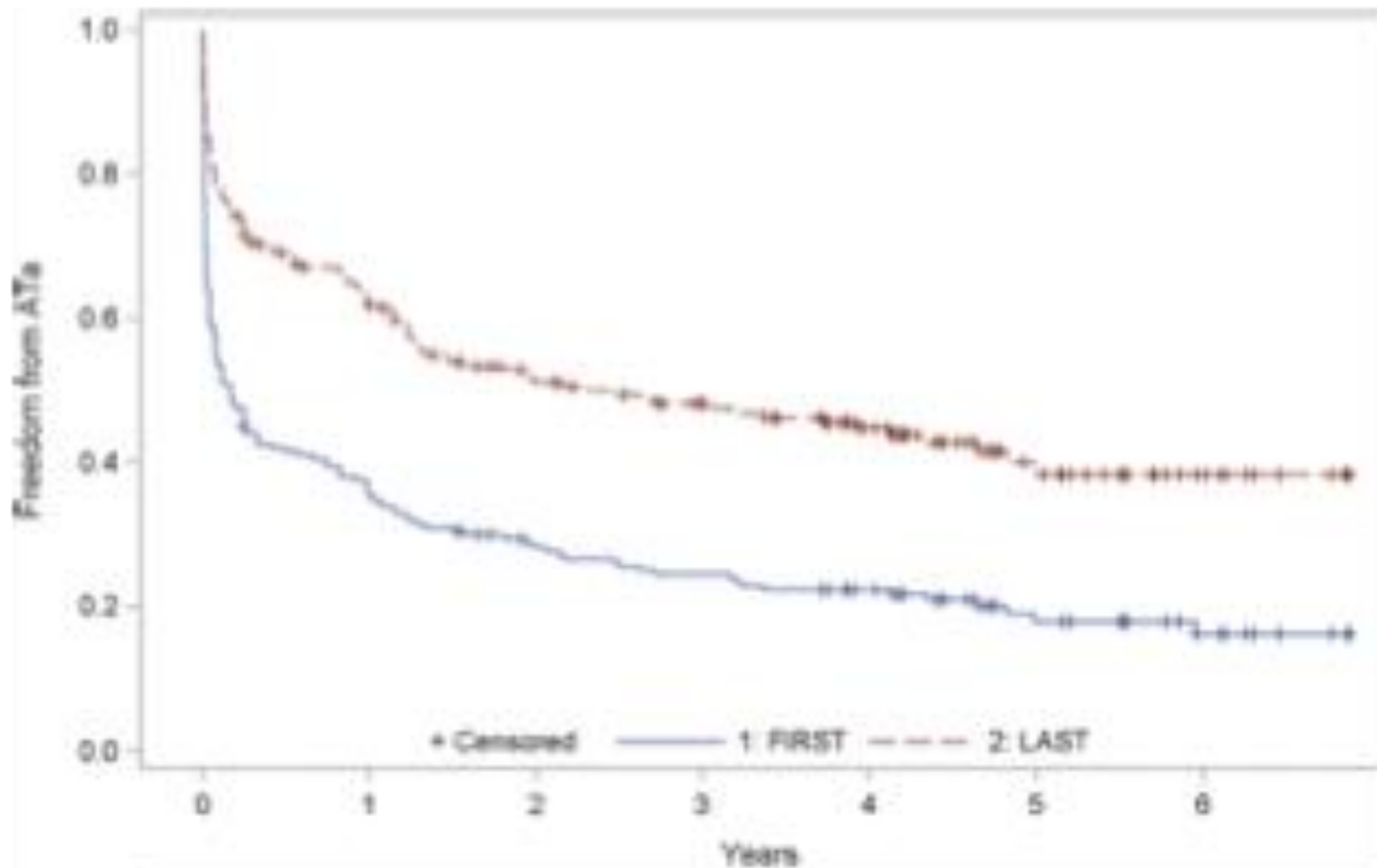
This study describes the 5-year efficacy of catheter ablation for long-standing persistent atrial fibrillation (LS-AF).

Background

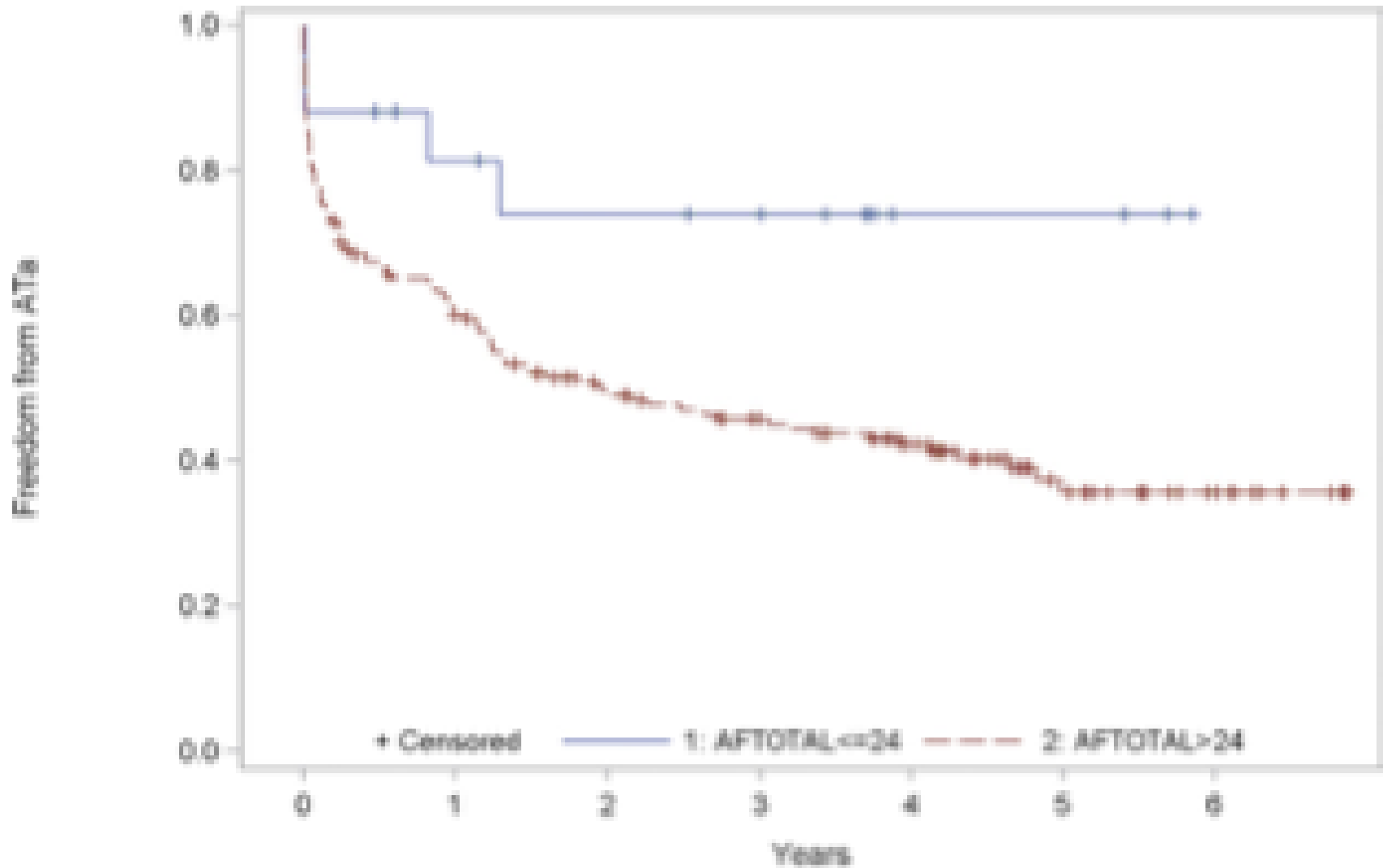
Long-term outcome data after catheter ablation for LS-AF are limited.

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.



1: FIRST	302	89	60	71	62	52	47	45	41	36	26	17	14	8	3
2: LAST	262	141	136	118	100	89	80	76	68	54	37	24	17	10	4



1: AFTOTAL ≤ 24	17	15	14	12	10	10	10	9	7	3	3	3	2	0	
2: AFTOTAL > 24	185	136	121	106	90	76	73	67	61	51	34	21	15	10	4

Limitations of Catheter Ablation Beyond PVI

Need to Address Chronic Progressive Disease

High Late Recurrence Rate (VLR) in Successfully ablated patients (e.g. SR off AADs @ 1 year).

- Persistent patients recur at a much higher rate than paroxysmal.
- Patients with multiple risk factors also have a much higher recurrence rate.

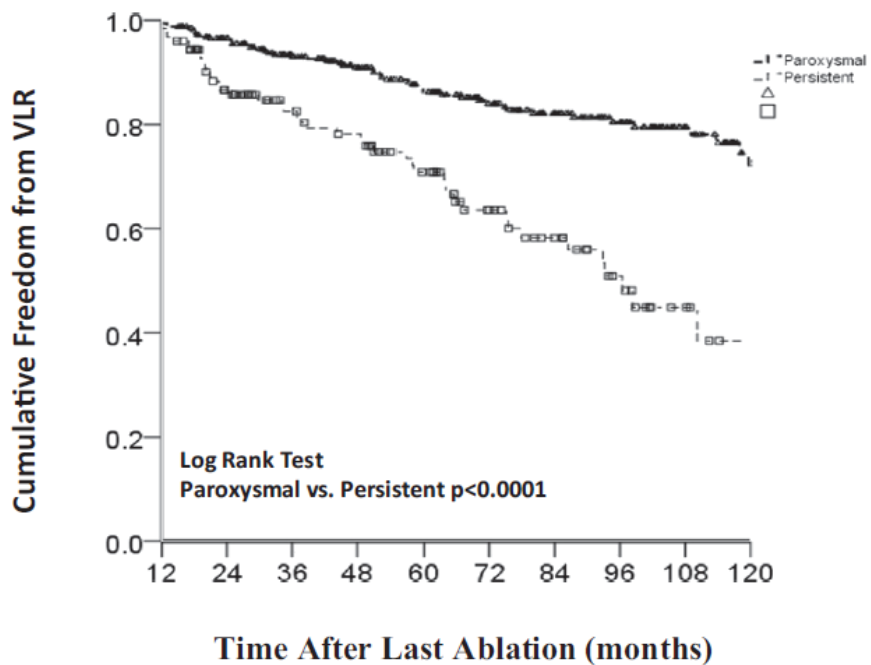


Figure 2 Kaplan-Meier plot for freedom from atrial fibrillation contrasting outcomes of patients with paroxysmal (n = 305) and persistent (n = 126) patterns of arrhythmia preablation. VLR = very late recurrence.

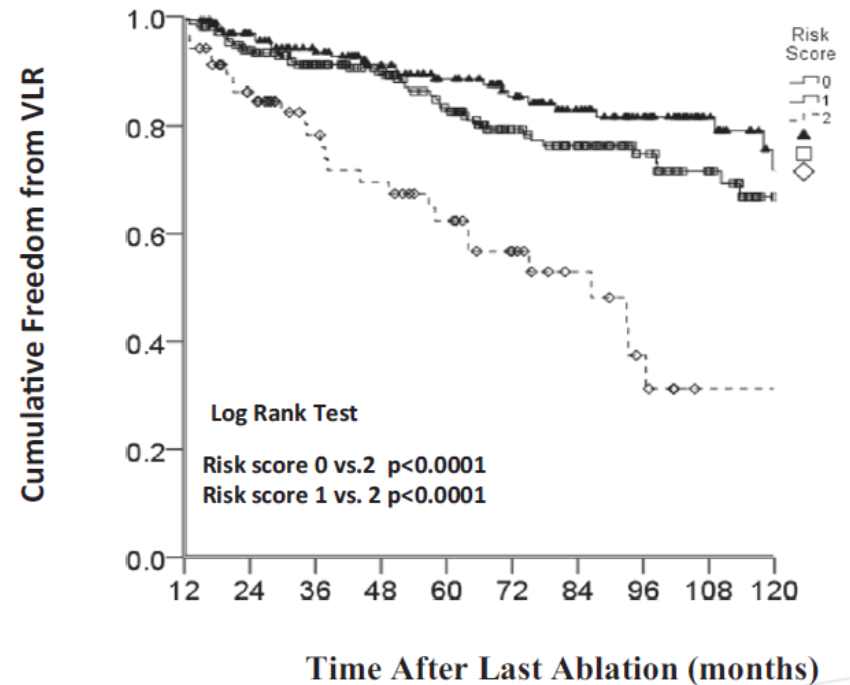
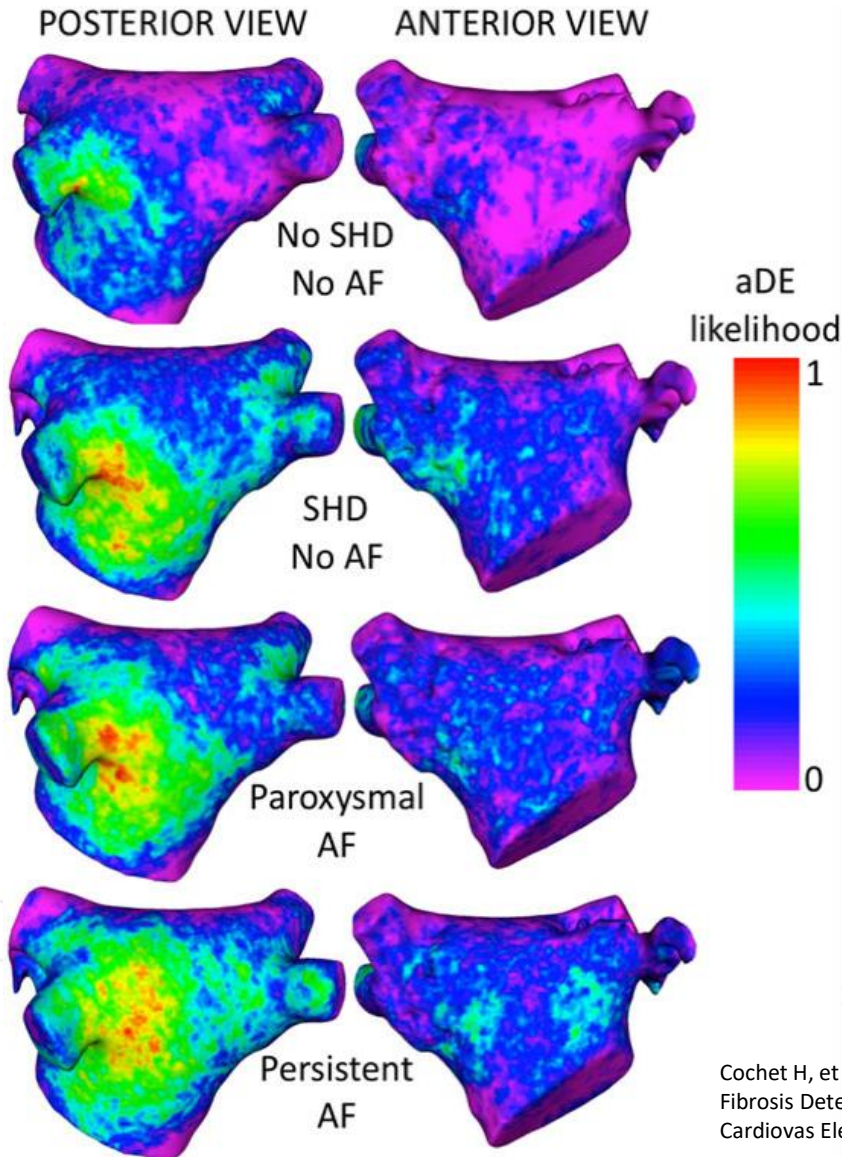


Figure 3 Kaplan-Meier plot for freedom from atrial fibrillation based on the presence of 0-2 independent risk factors (history of persistent atrial fibrillation and hypertension). VLR = very late recurrence.

Most Common Locations of Fibrosis in Left Atrium

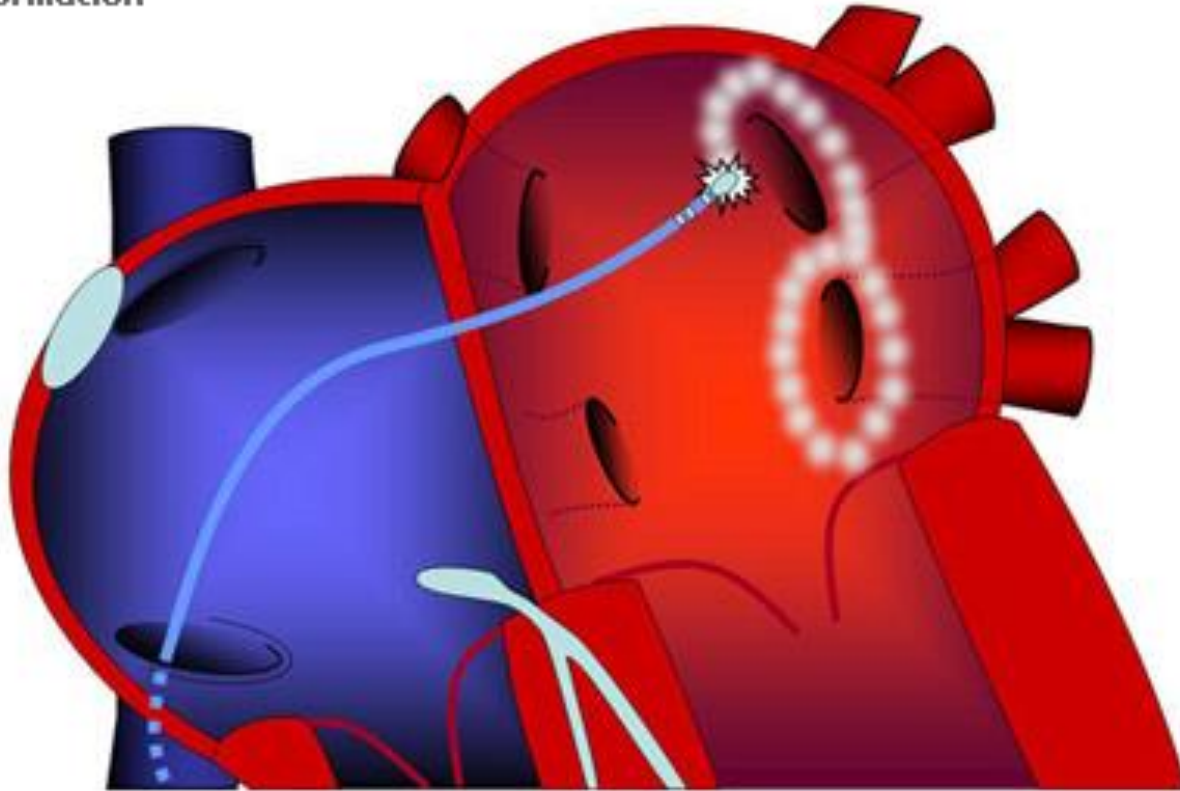
Extends from LIPV Inferiorly and Medially Along Posterior LA



Movement of left ventricle during contraction may cause atrial stretch at anchor locations (e.g. pericardial reflections).

Figure 4. Statistical distribution of atrial enhancement over the LA wall. Three-dimensional maps displaying the likelihood of DE over the LA wall template are shown in posterior (1st column) and anterior (2nd column) views in the 4 following clinically relevant subpopulations: no SHD and no AF (1st row, N = 55), SHD and no AF (2nd row, N = 75), paroxysmal AF (3rd row, N = 34), and persistent AF (4th row, N = 26). DE = atrial delayed enhancement; LA = left atrium; SHD = structural heart disease; AF = atrial fibrillation.

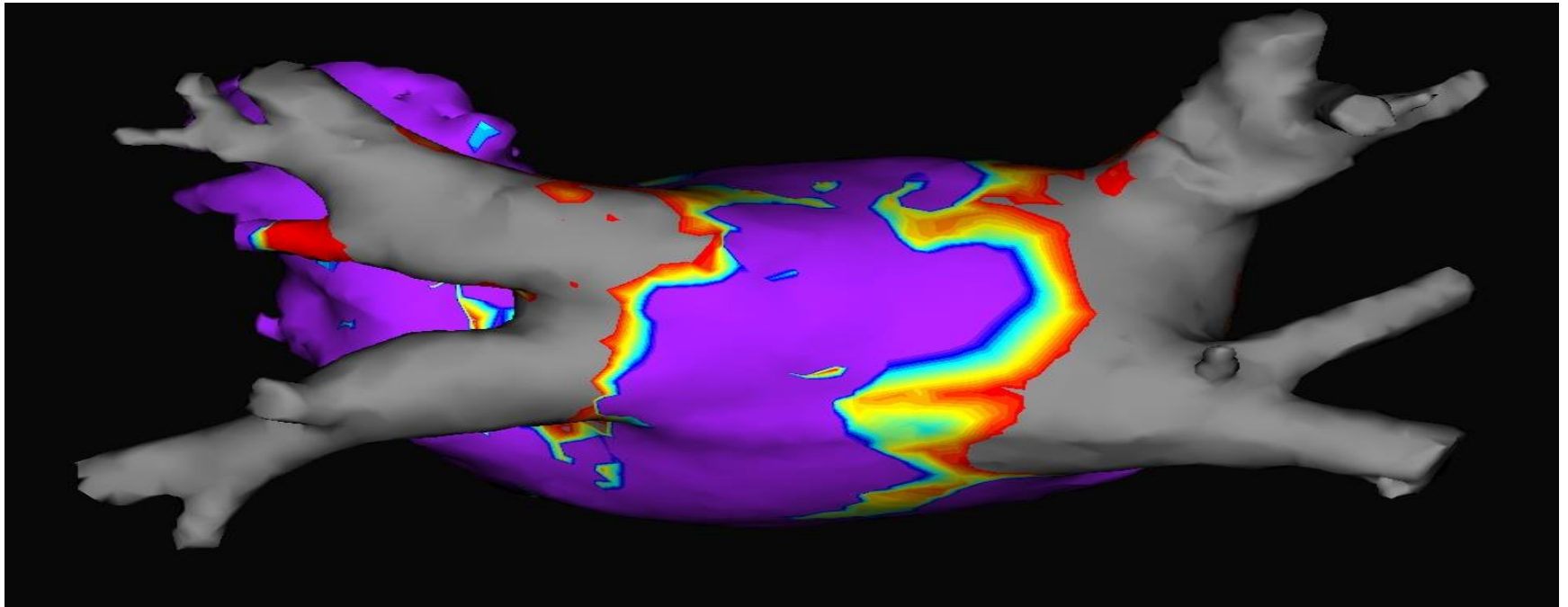
Left Atrial Ablation
for Atrial
Fibrillation



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Catheter Ablation Effectively Isolated the PVs

Electroanatomic Map of Cryoballoon Lesion Set





Europace (2008) 10, 265–272
doi:10.1093/europace/eun029

Treatment of atrial fibrillation by silencing electrical activity in the posterior inter-pulmonary-vein atrium

Jian Chen*, Morten Kristian Off, Eivind Solheim, Peter Schuster, Per Ivar Hoff, and Ole-Jørgen Ohm

Department of Heart Disease, Haukeland University Hospital, Institute of Medicine, University of Bergen, N-5021 Bergen, Norway

Received 25 October 2007; accepted after revision 19 January 2008

Conclusion Posterior inter-pulmonary-vein atrium electrical silence can greatly decrease the AF recurrence. The clinical AF recurrence may be related to an enlarged LA, a low percentage of electrically silent area, and low voltage in the LA.



Original Research

Journal of Atrial Fibrillation



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The Late Electrophysiological Consequences Of Posterior Wall Isolation In Patients With Atrial Fibrillation

Davies EJ, Lines I, Dalrymple-Hay M, Haywood GA

South West Cardiothoracic Centre, Plymouth, PL6 8DH. UK.

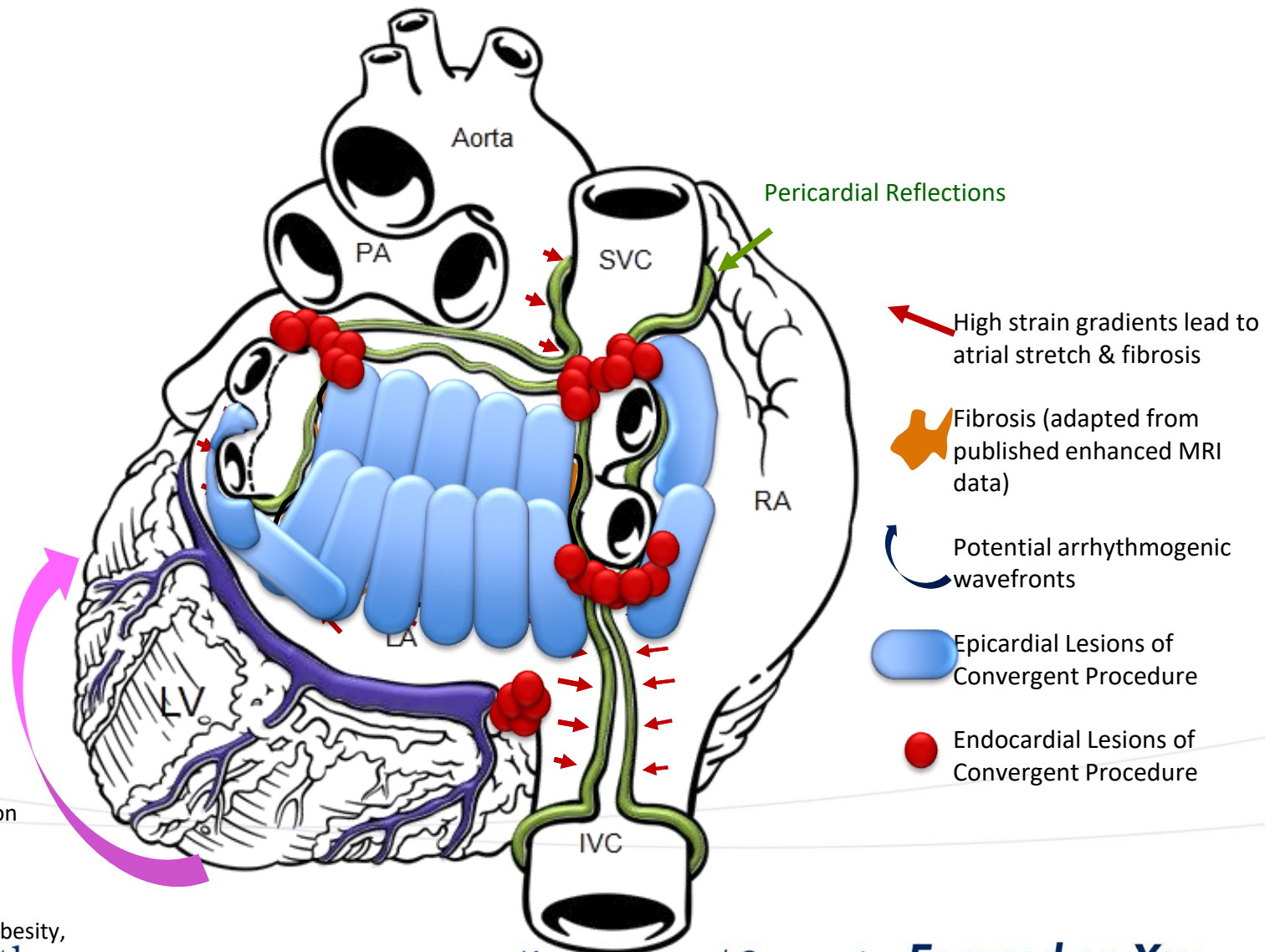
Conclusions

There appears to be a clear correlation between the successful restoration of long-term sinus rhythm and isolation / delayed conduction from the pulmonary veins and posterior wall. Given the advent of hybrid atrial fibrillation ablation techniques designed to deliver this lesion set, these findings are timely and highly relevant.

October 2015

High Strain Gradients Lead to Atrial Remodeling

Change in Conduction Due to Fibrosis Produces Substrates

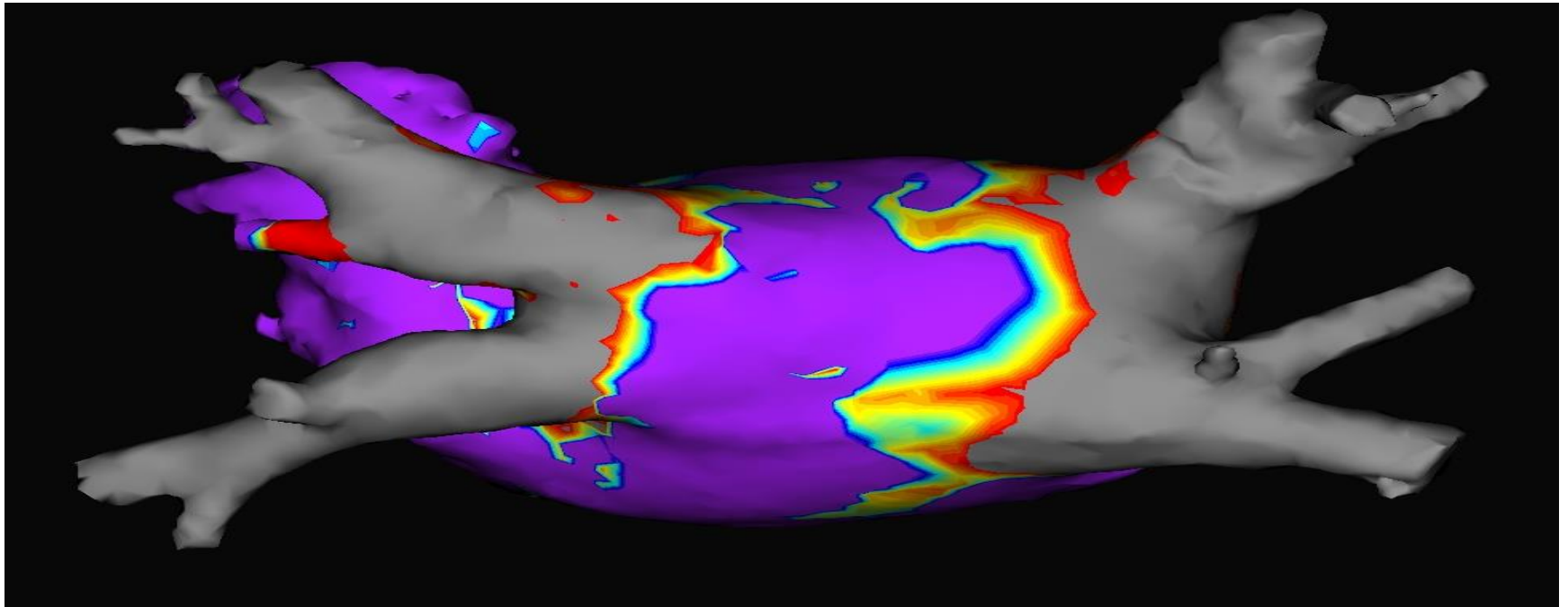


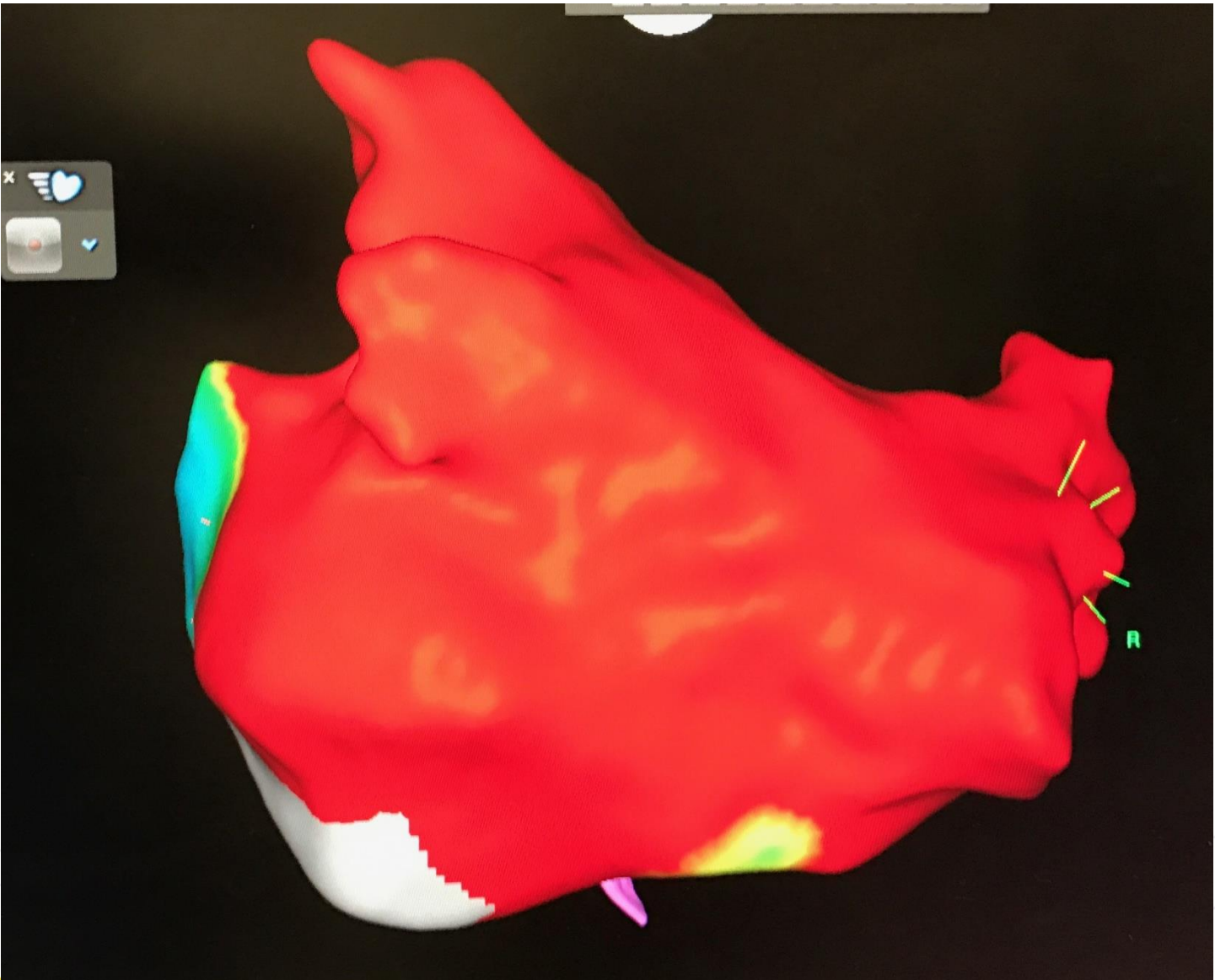
Movement During LV Contraction
(e.g. Axial Displacement &
Counterclockwise Rotation)

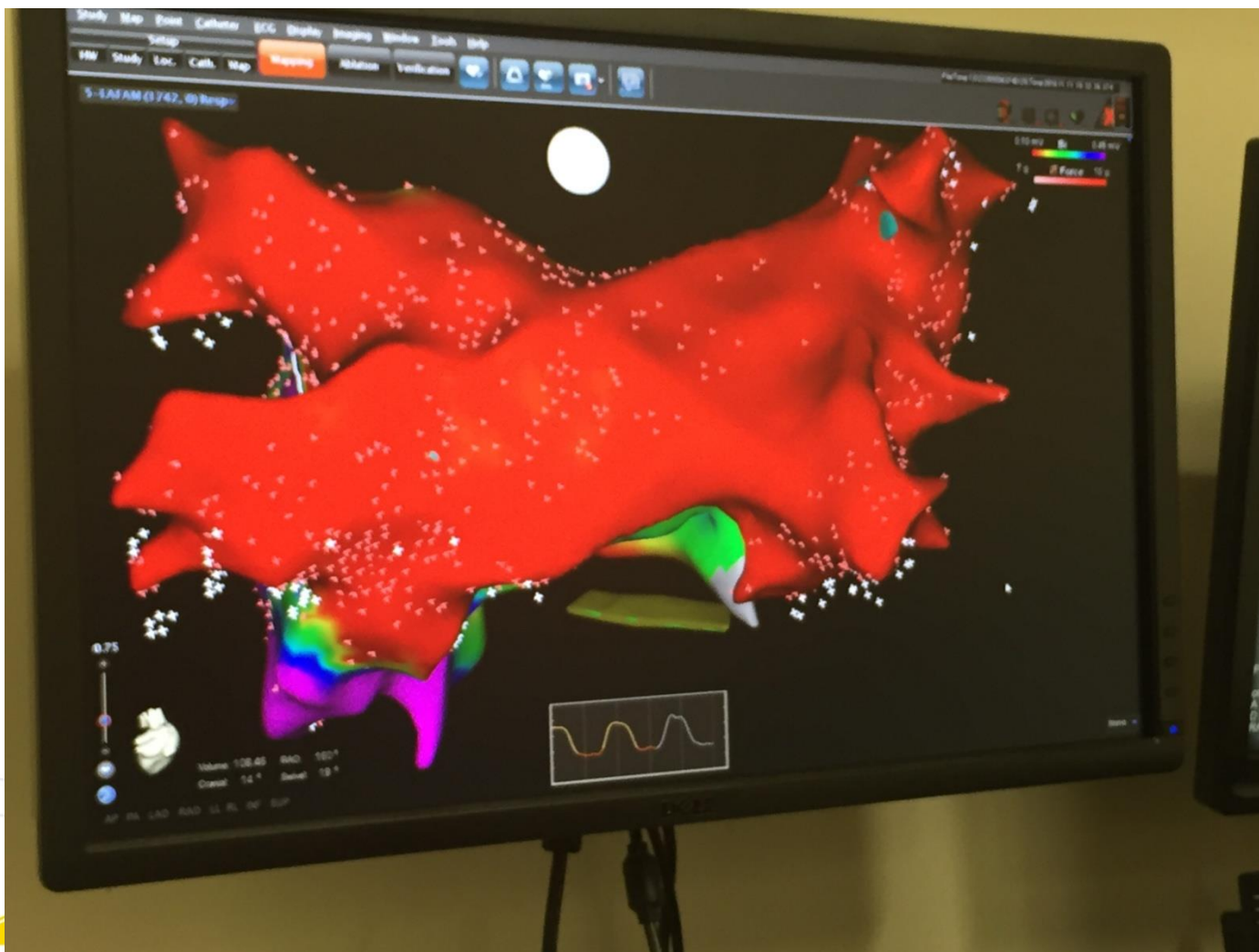
Displacement of Heart Due to Obesity,
Cardiomyopathy

Catheter Ablation Effectively Isolated the PVs

Electroanatomic Map of Cryoballoon Lesion Set



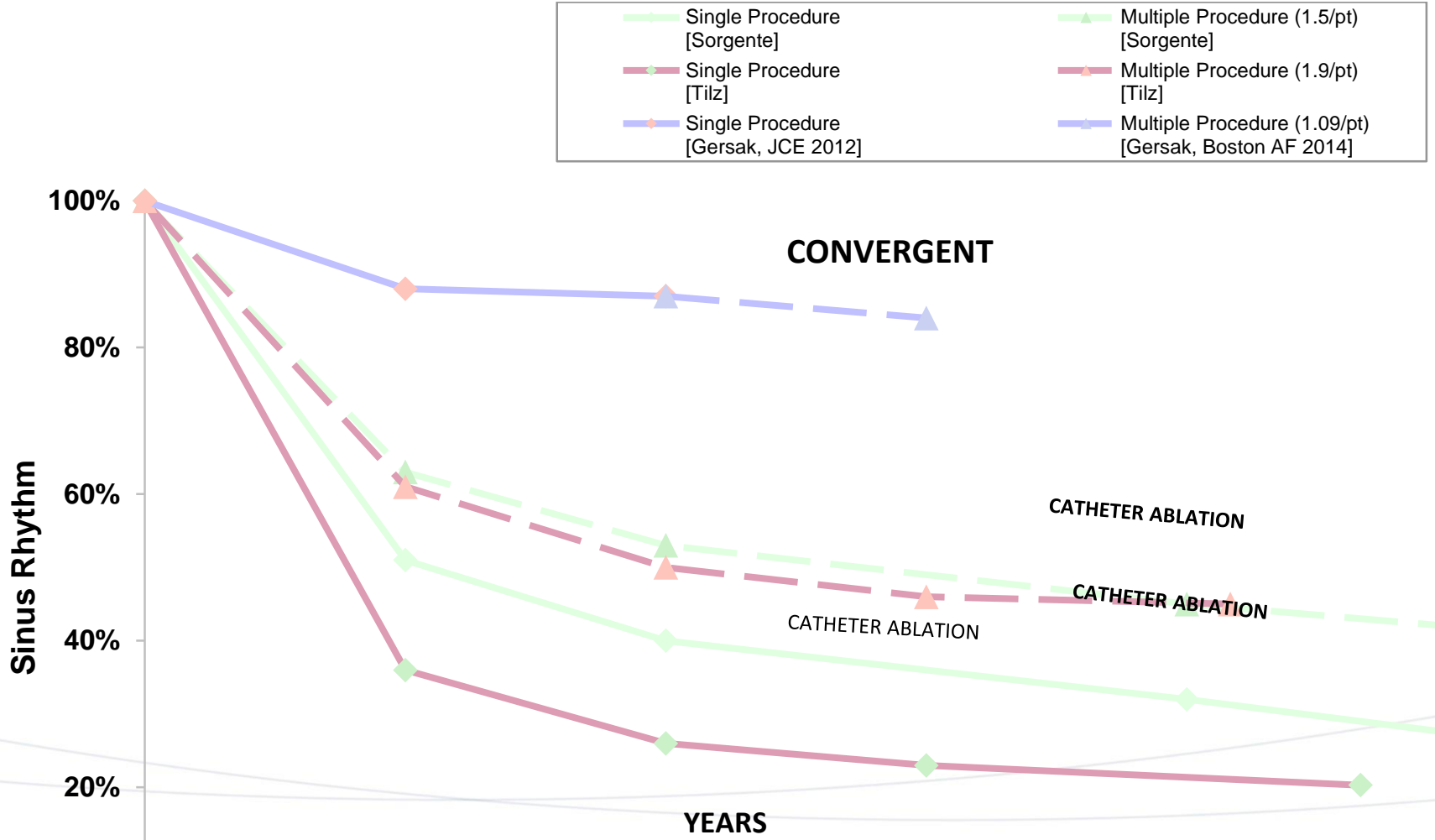




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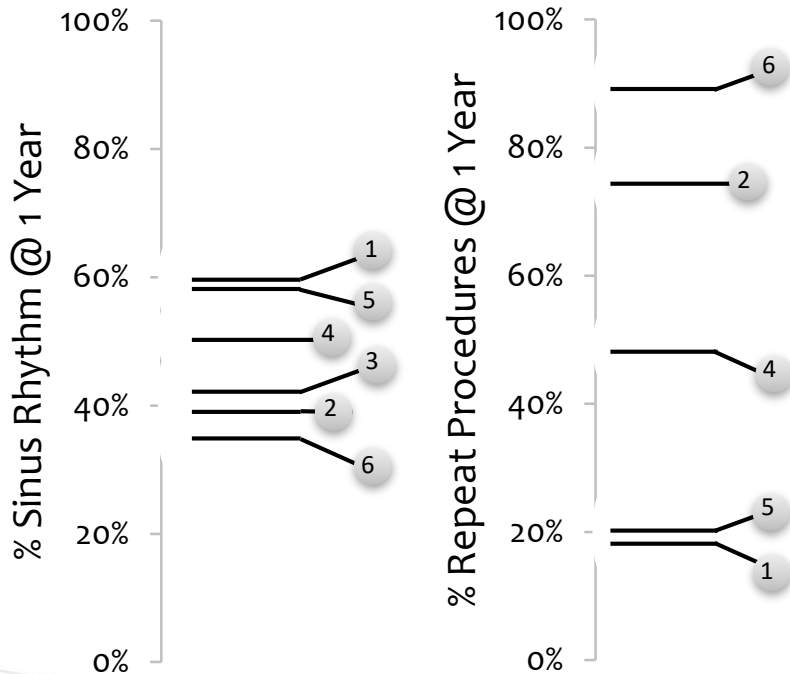
Evidence Based Outcomes for Posterior Silencing
Ability to Manage Patients Clinically



1.) Sorgente A, Tung P, Wylie J, Josephson ME. Six year follow-up after catheter ablation of atrial fibrillation: a palliation more than a true cure. Am J Cardiol. 2012;109:1179-1186.
 2.) Tilz RP. Posterior catheter ablation of long-standing persistent atrial fibrillation: 5-year outcomes of the Hamburg sequential ablation strategy. J Am Coll Cardiol. 2012; doi:10.1016/j.jacc.2012.04.060.
 3.) Gersak B, et al. Low rate of atrial fibrillation recurrence verified by implantable loop recorder monitoring following a Convergent epicardial and endocardial ablation of atrial fibrillation. JCE. 2012;23:1059-1066.
 4.) Gersak B, et al. Posterior Silencing Reveals XT Outcomes for the Convergent Atrial Fibrillation Ablation Procedure. Boston AF Symposium, 2014; Jan 9-11, Orlando, FL.

Catheter Ablation Outcomes

Sinus Rhythm & Repeat Ablation Procedures

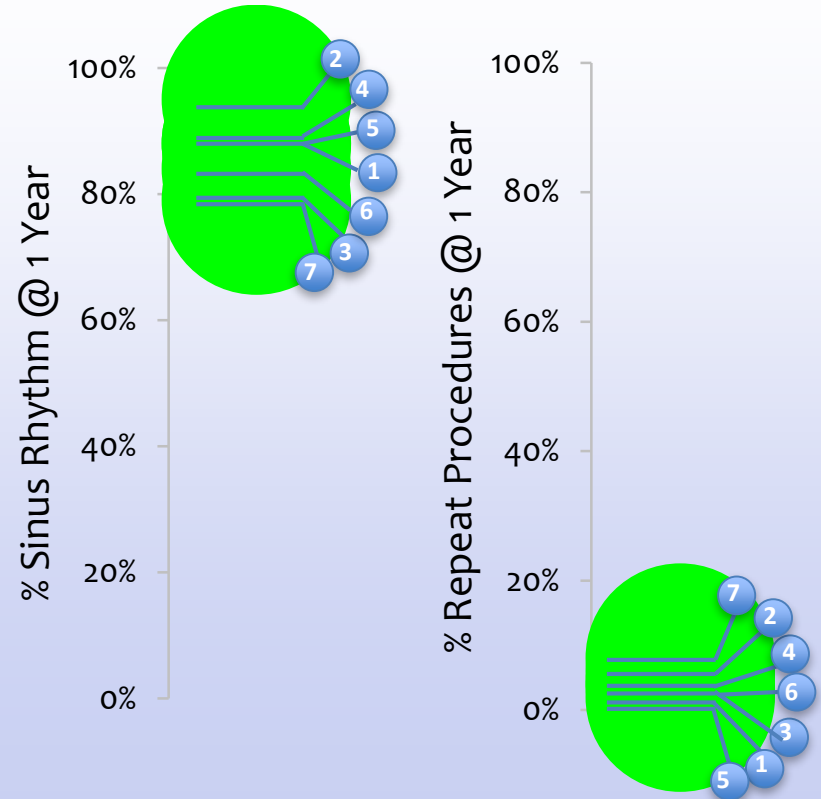


Published Catheter Ablation Articles / Presentations

1. Packer, et al. ACC Scientific Sessions. March 15, 2010.
2. Weerasooriya R, et al. J Am Coll Cardiol. 2011;57:160-6.
3. Boersma LVA, et al. Circulation. 2012;125(1):23-30.
4. Sorrento A, et al. Am J Cardiol. 2012;109:1179-1186.
5. Packer, et al. ACC Scientific Sessions. March 15, 2010.
6. Packer, et al. Am Coll Cardiol. 2012. doi:10.1016/j.jacc.2012.04.060.
7. Golden K, et al. HRS Scientific Sessions. May 2012.

Convergent Procedure Outcomes

Sinus Rhythm & Repeat Ablation Procedures



Published Convergent Articles / Presentations

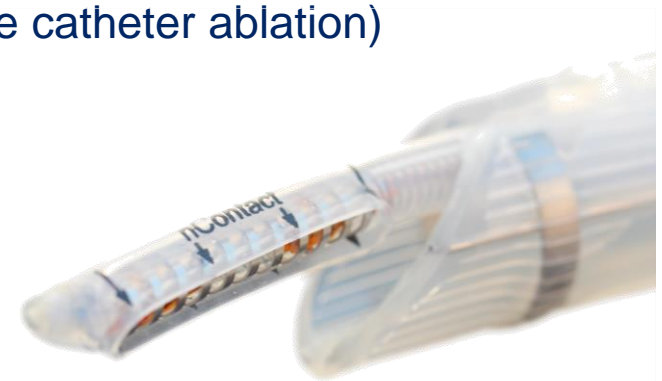
1. Civello, K, et al. J Innov CRM. Sept 2013:1-7. Epub
2. Gilligan DM, et al. J Innov CRM. Oct 2013:1-8. Epub
3. Gersak B, et al. J Thor Cardiovasc Surg. 2014;147:1411-6.
4. Robinson MC, et al. EP Lab Digest. 2012;13(6):34-36.
5. Gersak B, et al. JCE. 2012;23:1059-1066.
6. Packer, et al. Boston AFS Symposium. January 2012.
7. Golden K, et al. HRS Scientific Sessions. May 2012.

CONVERGE IDE Study

Convergence of Epicardial & Endocardial RF Ablation for The Treatment of Symptomatic Persistent AF

Study Design

- Multi-center, prospective, open label pivotal study
- Randomized 2:1 (convergent procedure : standalone catheter ablation)
- 15 US Sites, 2 OUS sites
- 153 patients
- Post procedure follow-up @ 12 months
- Long-term monitoring follow-up @ 18 months
- Annual phone follow-up @ 2, 3, 4, 5 years



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JACC March 21, 2017
Volume 69, Issue 11



Arrhythmias and Clinical EP

OUTCOMES OF THE HYBRID VIDEO-ASSISTED THORACOSCOPIC SURGERY (VATS) MAZE FOLLOWED BY CATHETER ABLATION IN PATIENTS WITH PERSISTENT AND LONGSTANDING PERSISTENT ATRIAL FIBRILLATION: CLINICAL RESULTS FROM A HIGH-VOLUME CENTER

Poster Contributions

Poster Hall, Hall C

Saturday, March 18, 2017, 9:45 a.m.-10:30 a.m.

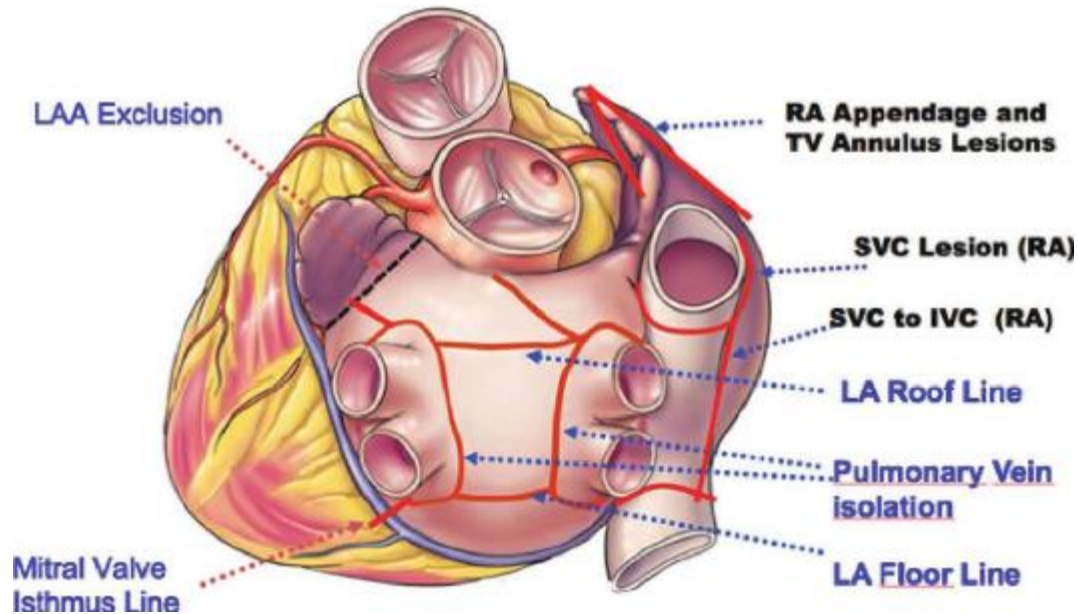
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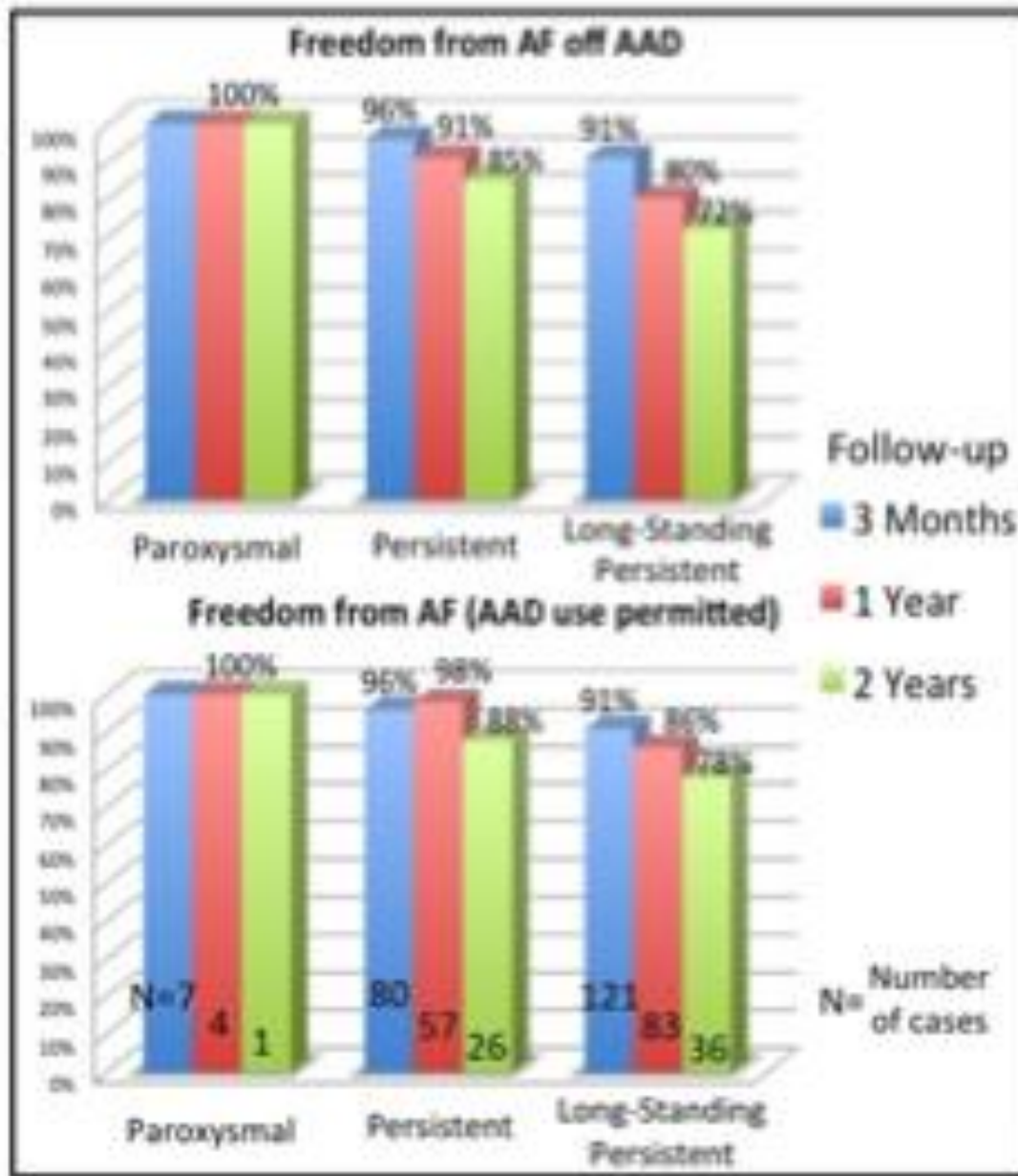


MedStar Health

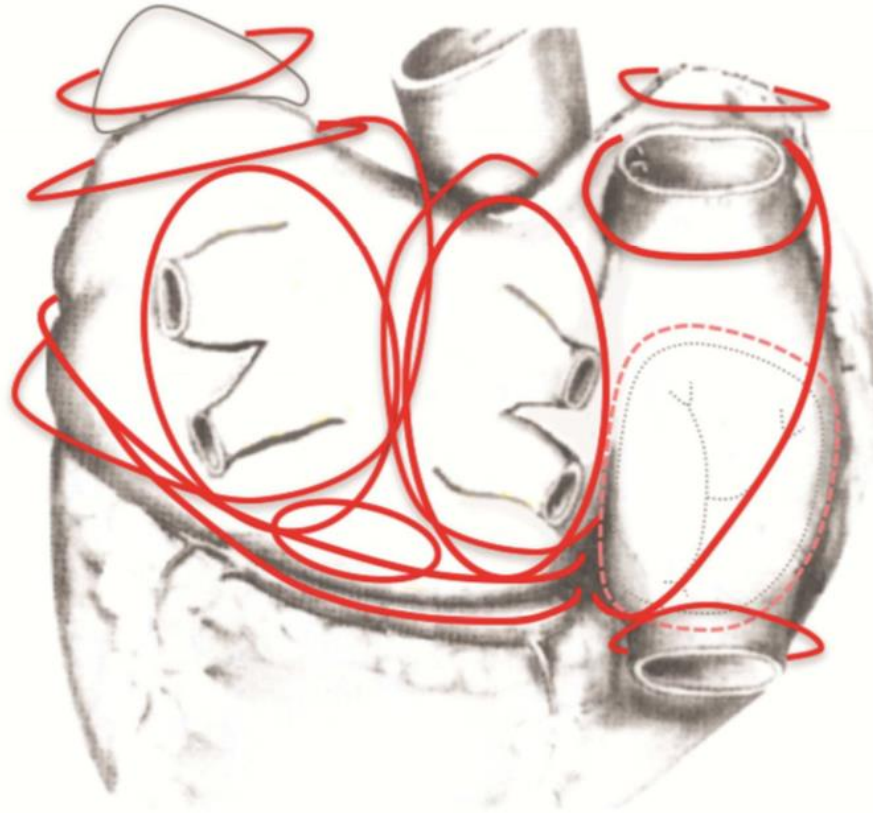
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Lessons from Surgical Ablation Cox Maze IV





Bi-Atrial Macro-Reentry in LSPAF



ACQUIRED CARDIOVASCULAR DISEASE: ARRHYTHMIAS

Late outcomes after the Cox maze IV procedure for atrial fibrillation

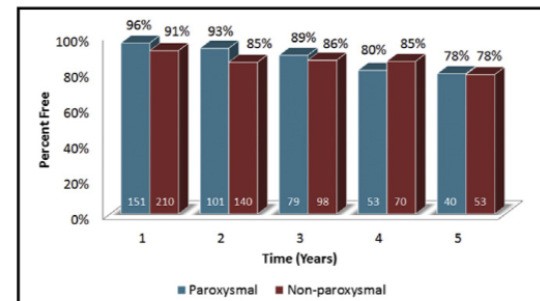
Matthew C. Henn, MD, Timothy S. Lancaster, MD, Jacob R. Miller, MD, Laurie A. Sinn, RN, BSN, Richard B. Schuessler, PhD, Marc R. Moon, MD, Spencer J. Melby, MD, Hersh S. Maniar, MD, and Ralph J. Damiano, Jr, MD

ABSTRACT

Objective: The Cox maze IV procedure (CMPIV) has been established as the gold standard for surgical ablation; however, late outcomes using current consensus definitions of treatment failure have not been well described. To compare to reported outcomes of catheter-based ablation, we report our institutional outcomes of patients who underwent a left-sided or biatrial CMPIV at 5 years of follow-up.

Methods: Between January 2002 and September 2014, data were collected prospectively on 576 patients with AF who underwent a CMPIV (n = 532) or left-sided CMPIV (n = 44). Perioperative variables and long-term freedom from AF, with and without AADs, were compared in multiple subgroups.

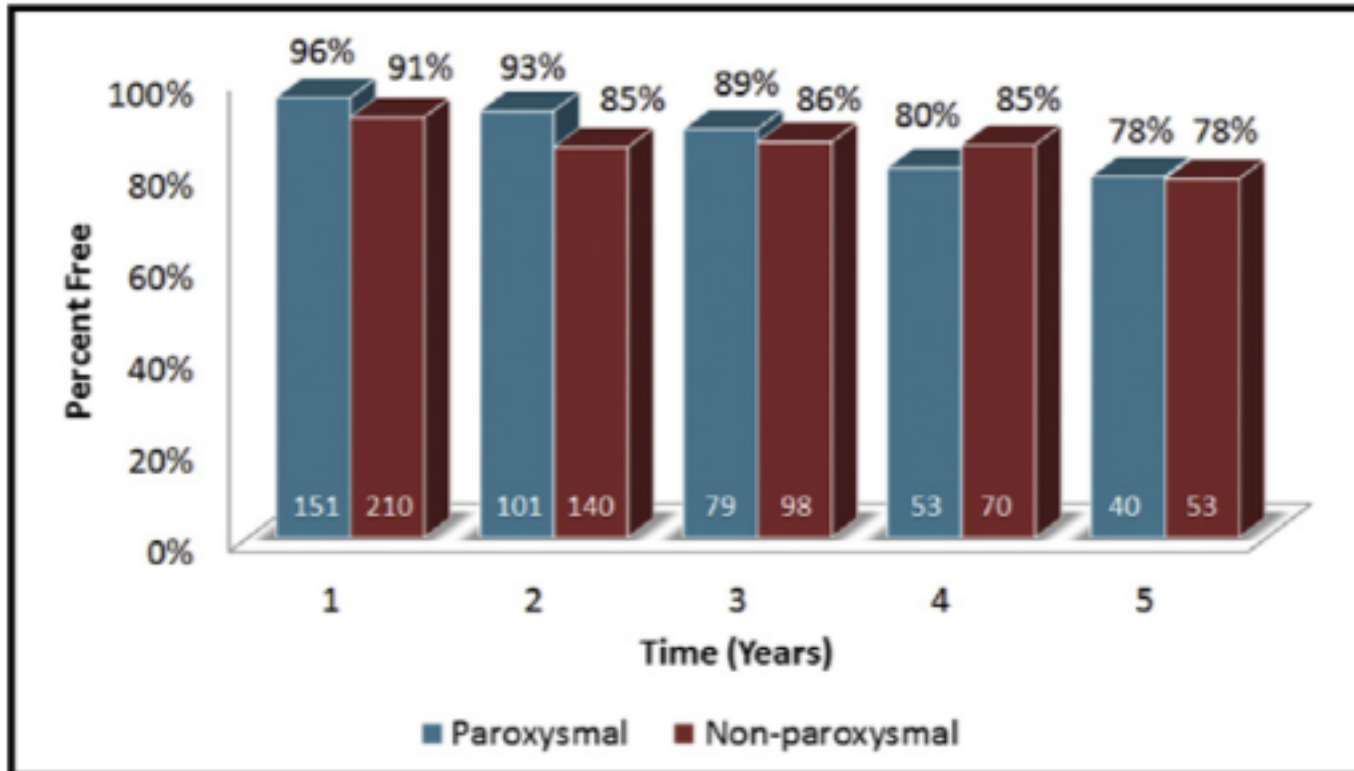
Results: Follow-up at any time point was 89%. At 5 years, overall freedom from



Freedom from atrial tachyarrhythmias was equivalent in those with paroxysmal versus nonparoxysmal atrial fibrillation.

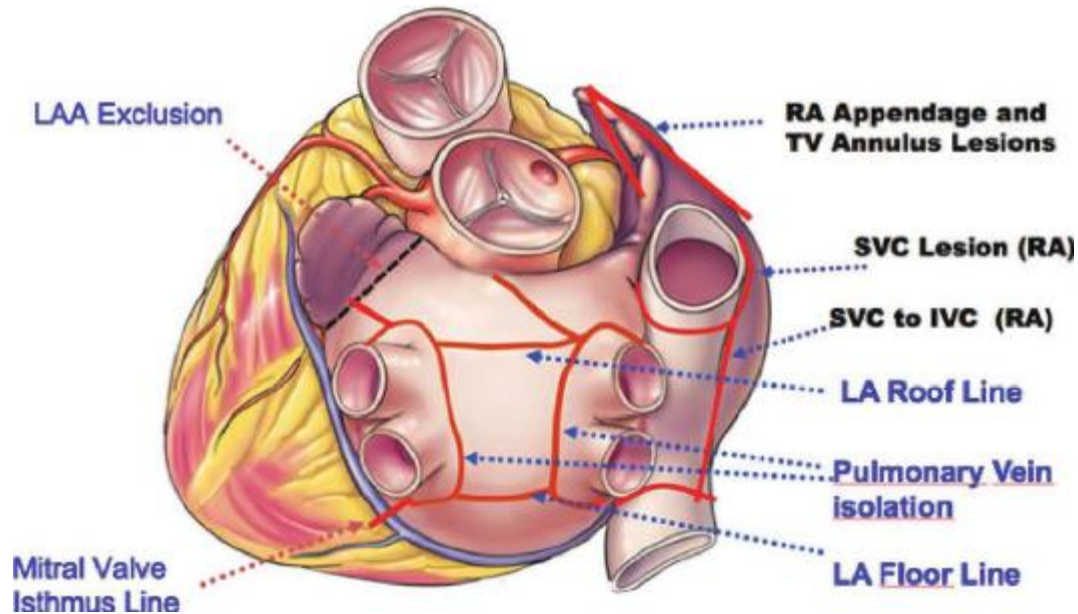
Central Message

At 5 years, sinus rhythm was restored in most



Freedom from atrial tachyarrhythmias was equivalent in those with paroxysmal versus nonparoxysmal atrial fibrillation.

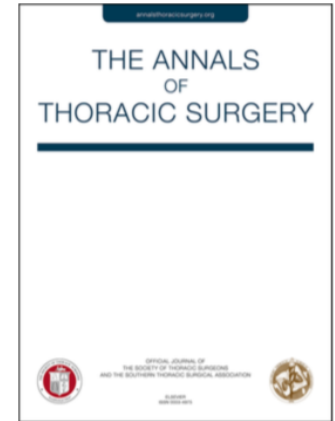
Lessons from Surgical Ablation Cox Maze IV



Accepted Manuscript

A Hybrid Maze Procedure for Long-Standing Persistent Atrial Fibrillation

James L. Cox, MD, Andrei Churyla, MD, S. Chris Malaisrie, MD, Duc Thinh Pham, MD, Jane Kruse, BSN, Olga N. Kislitsina, MD, PhD, Patrick M. McCarthy, MD



PII: S0003-4975(18)31131-7

DOI: [10.1016/j.athoracsur.2018.06.064](https://doi.org/10.1016/j.athoracsur.2018.06.064)

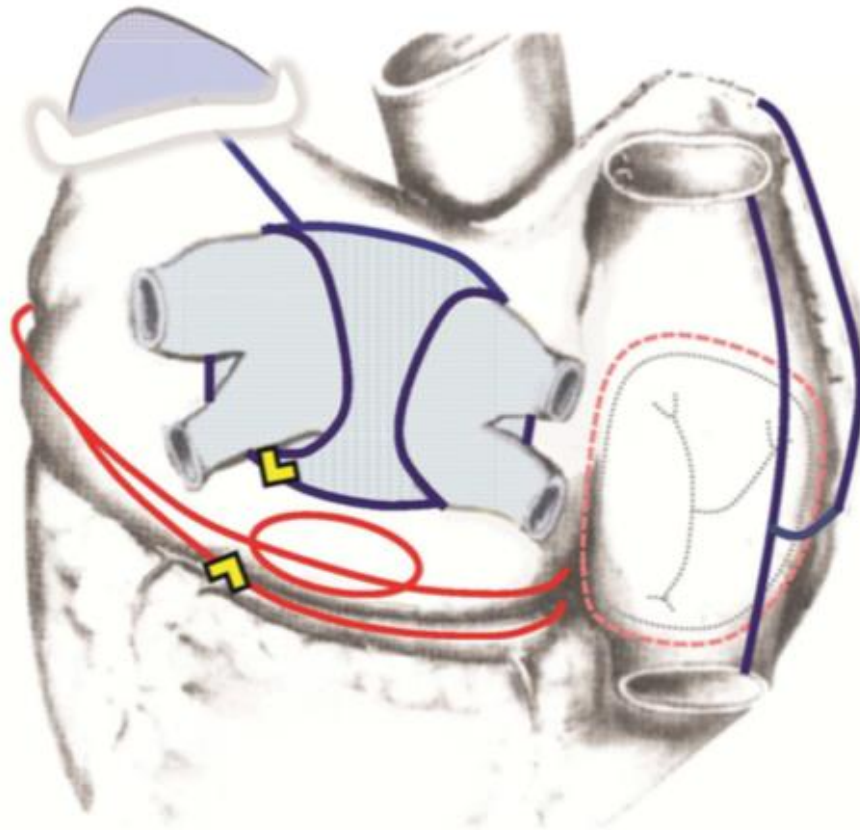
Reference: ATS 31825

To appear in: *The Annals of Thoracic Surgery*

Received Date: 23 May 2018

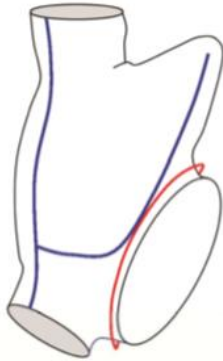
Accepted Date: 20 June 2018

Completed Thoracoscopic Lesions



A

Remaining Potential RA Macro-Reentry

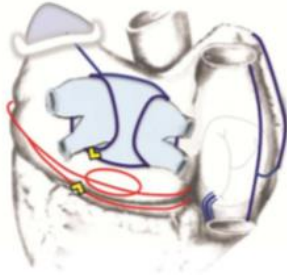


CTI "Flutter Lesion"



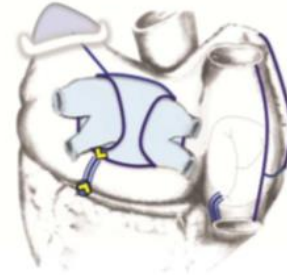
B

CTI "Flutter Lesion"



C

Mitral Line & CS Lesion

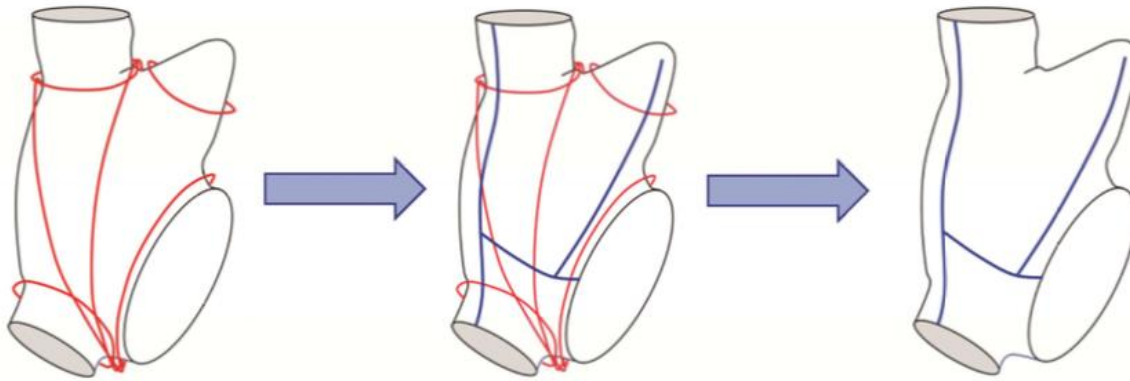


A

RA Macro-Reentry

RA Maze Lesions

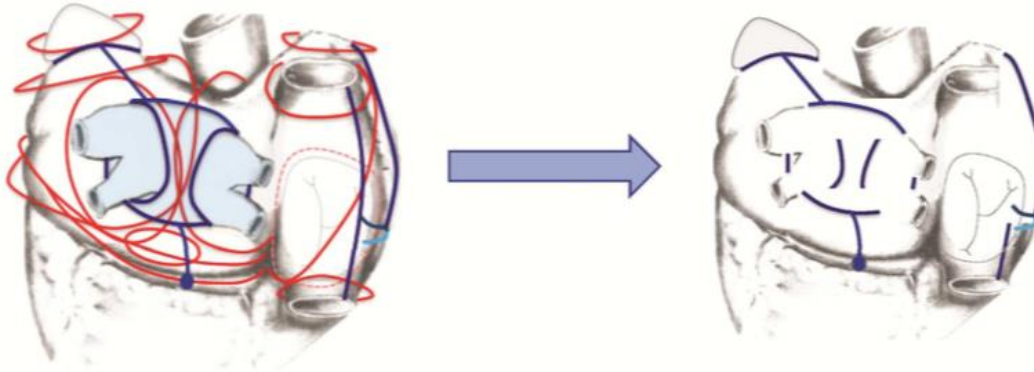
No RA Macro-Reentry



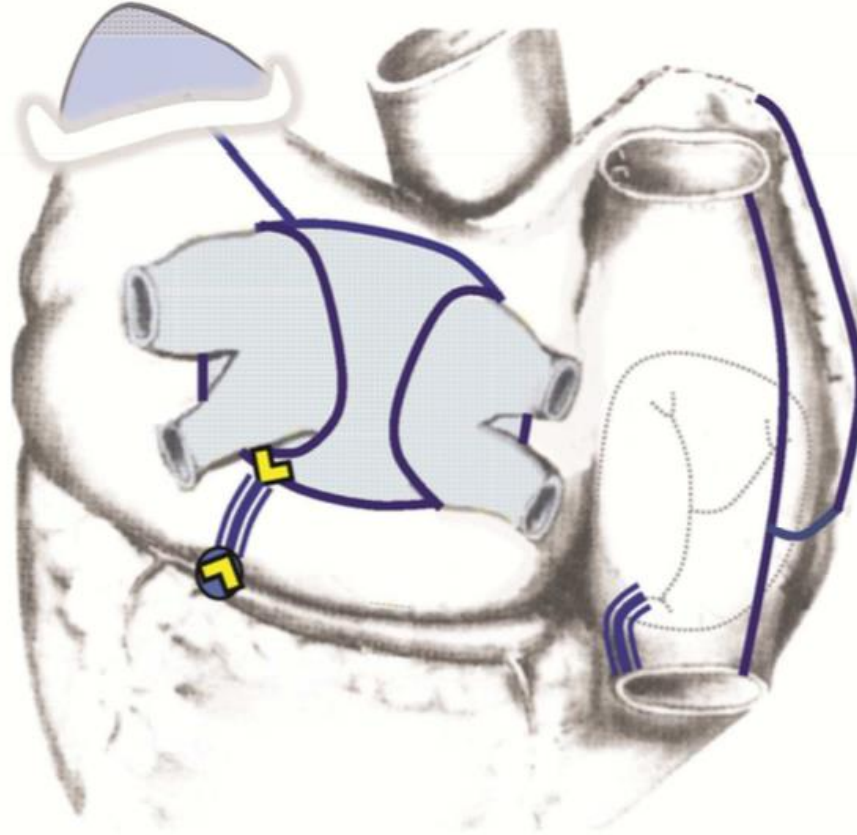
B

Bi-Atrial Maze Lesions

No Atrial Macro-Reentry



Hybrid Maze Procedure



Conclusions

- Persistent or Long standing persistent patients difficult to treat
- Beyond Pulmonary Vein triggers, persistent patients have fibrosis and re-entrant circuits
- Hybrid ablation techniques Significantly improve outcomes
 - Silencing the posterior left atrial wall
- Hybrid ablation is a safe minimally invasive method of silencing posterior wall and improving outcomes
- Hybrid Maze (bilateral thoracoscopic lesion set with trans-catheter mitral and tricuspid lines) re-creates the Cox-Maze IV lesion set
- Potential for true hybrid maze to improve outcomes even more.