



26

Heart Rhythm

Bringing the world of EP together.

April 23-26, 2026 • Chicago, IL

Robotics, Automation, and PFA:

Synergy to optimize the Future of Ablation

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Banner University of Arizona - Phoenix

April 24, 2026

10:00-11:30AM S406A

Traditional Ablation Biophysics

- Traditional ablation has been based on thermal destruction of target tissues:
 - Heating: RF, Laser
 - Freezing: Cryoablation
- Challenges in creating consistent high-quality lesions
 - Dependent on contact
 - Dependent on stability over the time needed to deliver energy
- Limitations due to risks: Can't Just Turn Up the Power
 - Perforation/tamponade: Especially with Contact Force Catheters
 - Esophageal Injury
 - Phrenic Injury

Catheter Contact Reality

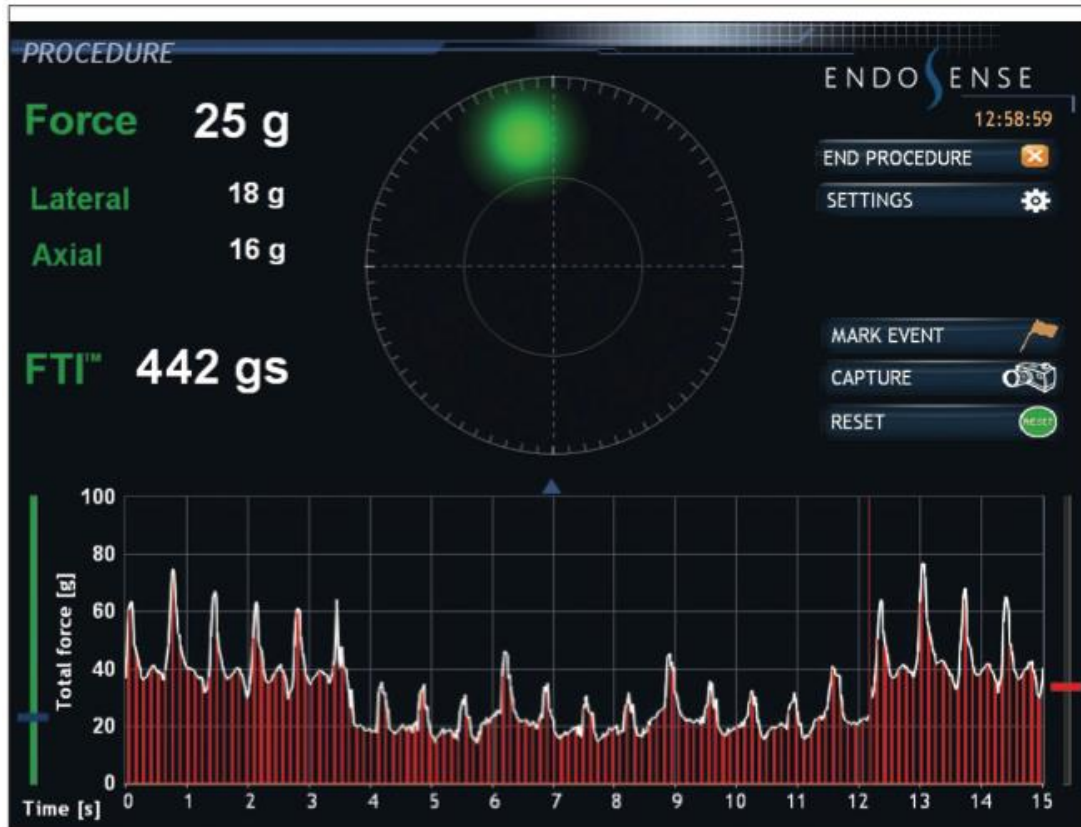
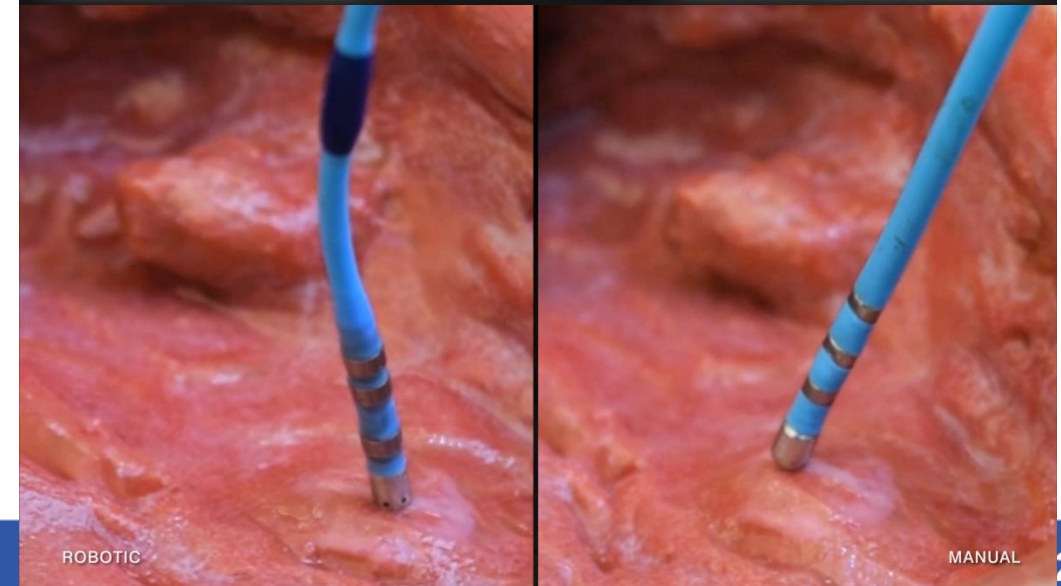


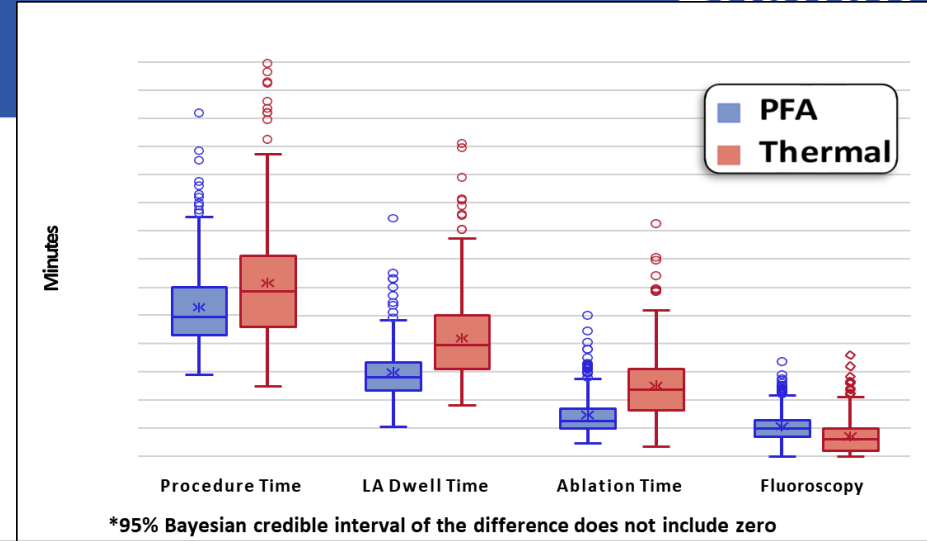
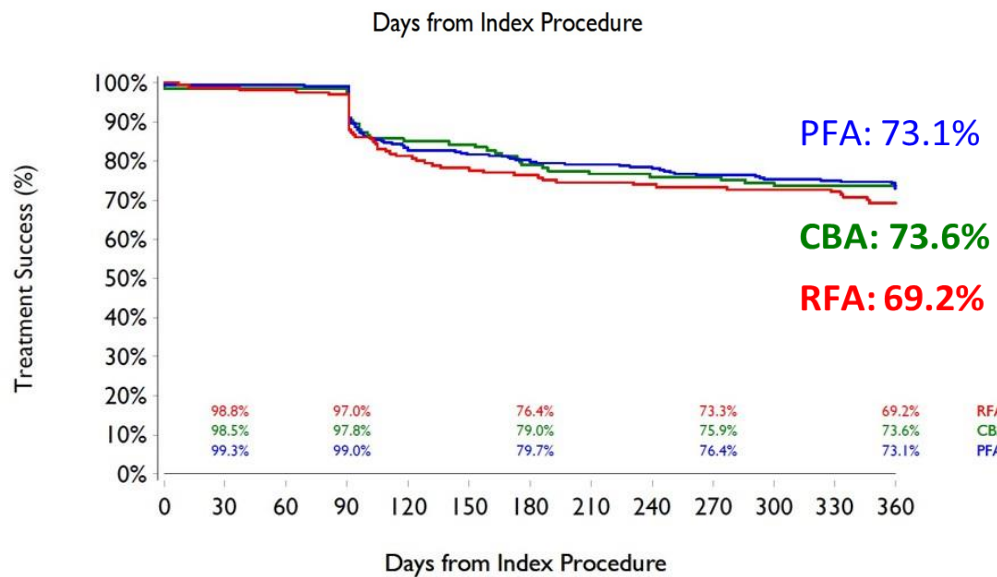
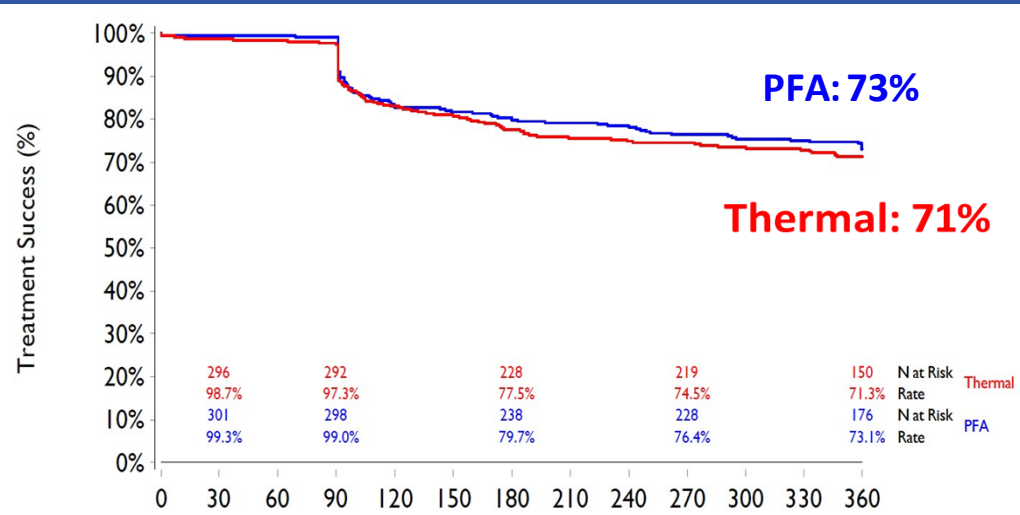
Figure 4: Display indicating the amplitude and direction of the contact force. The total forces are presented at the left side, indicating total force and lateral/axial force. FTI (force time integral) is displayed as well. Below is the curve indicating the total applied contact force over time.



Pulsed Field Ablation Advantages

- Non-thermal Ablation
- Rapid lesion delivery
- Tissue selectivity: Potentially improved safety
- Potentially more effective at creation of durable lesions?
- **May be less reliant on tissue contact force**
 - **But IS reliant on stable bioelectrical coupling**

Primary Results of the ADVENT Trial



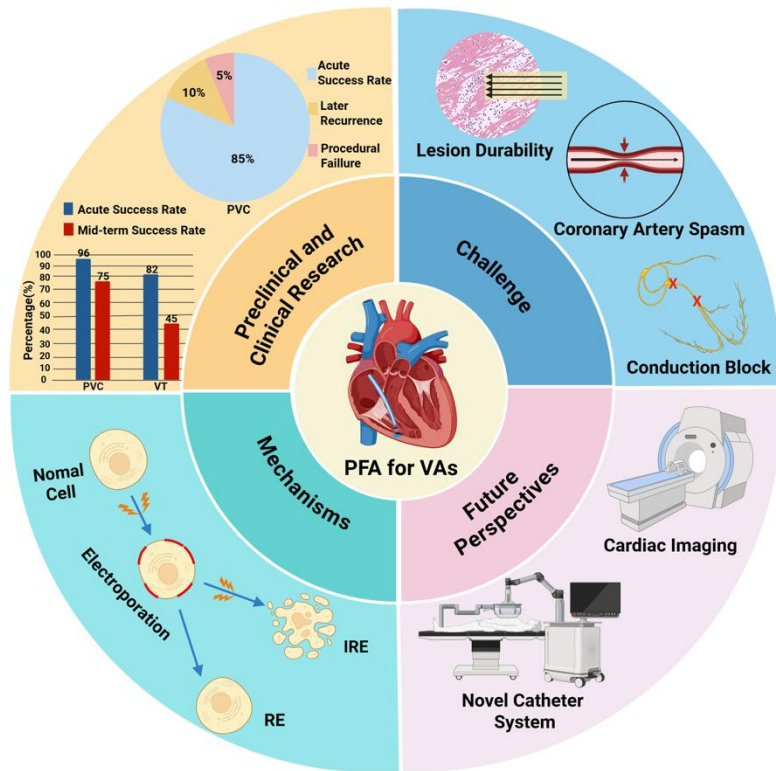
Change in PV cross-sectional area	Pulsed Field Group (n=305)	Thermal Group (n=302)	Difference (95% Credible Interval)	Posterior Probabilities—Superiority
Absolute difference, cm², mean (95% BCI)	-0.18 (-0.37, 0.00)	-1.18 (-1.39, -0.97)	1.00 (0.72, 1.28)	>0.999
Percent difference, mean (95% BCI)	-0.9% (-3.0, 1.1)	-12.0% (-14.2, -9.7)	11.0% (8.0, 14.1)	

	Pulsed Field Subjects no. / total no. (%)	Thermal Subjects no. / total no. (%)
Phrenic Nerve Injury (PNI)		
Intraprocedural PNI		
<i>Resolved during ablation procedure</i>	1/305 (0.3)	4/302 (1.3)
Resolved PNI		
<i>With documented resolution</i>	3/305 (1.0)	1/302 (0.3)
Persistent PNI		
<i>Without documented resolution</i>	0/305 (0)	2/302 (0.7)
Total with any PNI	4/305 (1.3)	7/302 (2.3)
Brain MRI Sub-Study: Silent Cerebral Lesions / Events (MRI within 48 hours)		
Center Adjudicated	6/34 (17.6)	4/37 (10.8)
Core Lab Adjudicated	3/33 (9.1)	0/37 (0)

Pulsed Field for Ventricular Ablation

TOPICS IN REVIEW

Pulsed field ablation for ventricular arrhythmias: From mechanistic foundations to clinical translation



Li H, Zhang H, Tian M et al. Pulsed field ablation for ventricular arrhythmias: From mechanistic foundations to clinical translation. Heart Rhythm O2, 2025; 7, 171-182

Table 2 Summary of clinical studies on PFA for ventricular arrhythmias (PVC/VT)

Author (y)	Patients (n)	Ablation Location	Catheter	Pulse Amplitude	Peak Current	PFA Application (mean)	Acute Success Rate	Follow-up (mean)	Mid-term Success Rate	Total Complications
Peichl et al ⁸ 2024	PVC:21	RVOT:33% LVOT:52% Non-outflow:15%	THERMOCOOL SMARTTOUCH	2000V	25A	7	81%	120 days	81%	3 transient conduction blocks
	VT:23	ICMP: N/A NICMP: N/A		2000V	25A	24	83%	116 days	52%	
Ruwald et al ⁹ 2025	PVC:24	RVOT:42% LVOT:17% Non-outflow:41%	Navistar SMARTTOUCH	2000V	22/25A	11	96%	293 days	75%	2 vascular Complications 2 transient conduction blocks 2 stroke
	VT:11	ICMP:55% NICMP:45%		2000V	22/25A	30	82%	230 days	45%	1 urinary tract bleeding
Rocca et al ²⁶ 2024	PVC:20	RVOT:40% LVOT:20% Non-outflow:40%	TactiCath Contact Force	2000V	N/A	8	85%	120 days	85%	2 transient conduction blocks 1 ST depression 1 pseudoaneurysm

Table 3 Comparative overview of emerging PFA catheter platforms for ventricular arrhythmia


Device	Manufacturer	Catheter Design	Diameter	Size	Catheter Deflection	Waveform Style	Electrode Configuration	PFA/RFC	Development Stage
AFFERA-Sphere-9	Medtronic	Focal	9 mm	8F	Bidirectional	Biphasic	Monopolar	Yes/Yes	Clinical trial
CENTAURI	Cardiofocus	Focal	3.5-4 mm	8F	Unidirectional/ Bidirectional	Biphasic	Monopolar	Yes/Yes	Clinical trial
FieldForce THERMOCOOL SMARTTOUCH SF and TRUPULSE	Field Medical Biosense Webster	Focal/ Ring	N/A 3.5 mm	N/A 8F	N/A Bidirectional	Biphasic Biphasic	Bipolar Monopolar	Yes/No Yes/Yes	Preclinical Preclinical

Table 4 Overview of clinical trials investigating ventricular arrhythmia ablation


NCT ID	Study Title	Device	Design	Estimated Enrollment	Study Start	Anticipated Completion Date
NCT06203262	Safety Assessment of Ventricular Catheter Ablation (VCAS)	FieldForce	NRCT, single-arm	60	April 2024	April 2025
NCT06747013	Treatment of Focal Ventricular Arrhythmias Using Novel Ablation Strategies (FOCUS-PFA)	Farapoint™	N/A, single-arm	30	January 2025	December 2025
NCT06816368	Combined Pulsed Field and Radiofrequency Ablation for Refractory Ventricular Tachycardia (DUAL-VT)	THERMOCOOL-SMARTTOUCH	N/A, single-arm	30	March 2025	June 2026
NCT06703489	Safety and Performance Evaluation of a Novel Multi-Electrode Ablation Catheter (Sphere-9 VT)	AFFERA-Sphere 9	N/A, single-arm	20	March 2025	June 2026

Safety considerations related to pulsed field ablation, both specific and non-specific for pulsed field ablation


More PFA-specific



Acute kidney injury



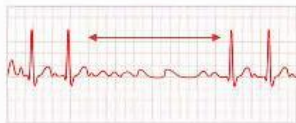
Vasospasm (late)




Platelet activation

Hemolysis
Hemolysis correlates with number of applications and catheter design. Acute kidney injury can be mitigated by fluid bolus 1.5-2 L, but other effects can not be mitigated.


Coronary spasm (early and late)
Coronary vasospasm occurs in proximity to coronaries (eg, tricuspid, mitral isthmus) and can be mitigated (not eliminated) by IV nitroglycerin 2-3 mg. Late spasm is different and may be related to hemolysis.




Vagal reaction
Occurs more frequently when starting with LSPV compared with RSPV. Can be attenuated with atropine 0.5-1.0 mg IV or glycopyrrolate 0.2-0.4 mg IV.



Phrenic injury
Complete paresis very uncommon, but transient stunning is about 0.3%, often with recovery within 24 hours.

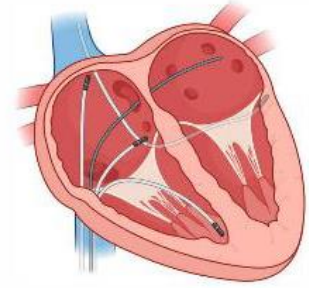


Device interactions
Devices should be checked and appropriately programmed pre- and post-ablation. Risk of device interaction is low.




Esophageal injury
None has occurred yet, but minor lesions are possible.

Pulsed field ablation




General ablation complications of particular concern with PFA


Vascular access
Large PFA catheters and their large sheaths increase risk of air embolism with exchange and risk of vascular injury. Use ultrasound access and meticulous flushing of sheaths.



Stroke
Excessive thermal profile can create clot. Air embolism (as above). Silent cerebral emboli (SCE) from microbubble formation. Overall risk about 0.5-1% with large PFA catheters. SCE about 10-15%, which is similar to thermal ablation.

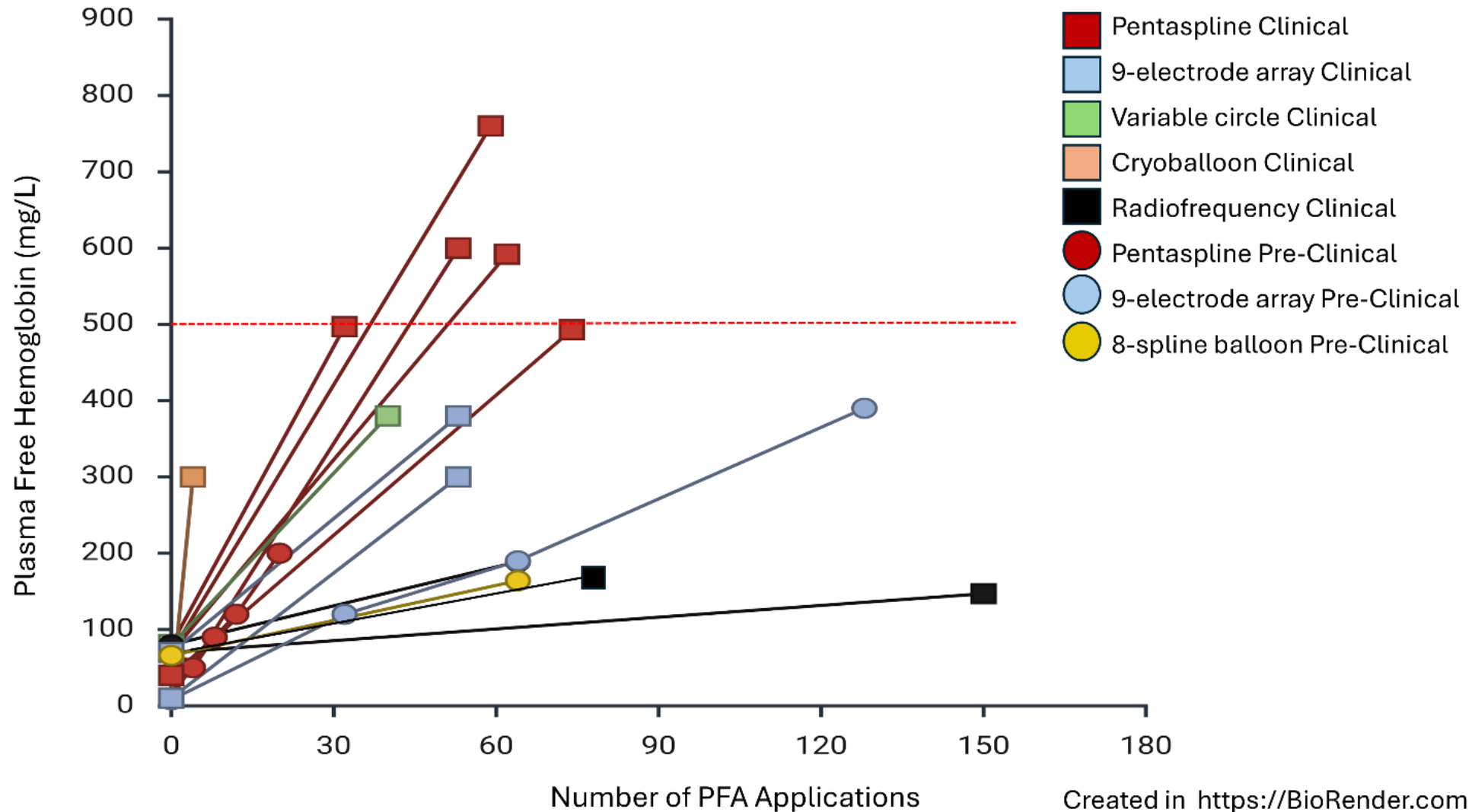


Left atrial function
Excessive ablation easy with PFA. Preserved extracellular matrix may preserve some elasticity.



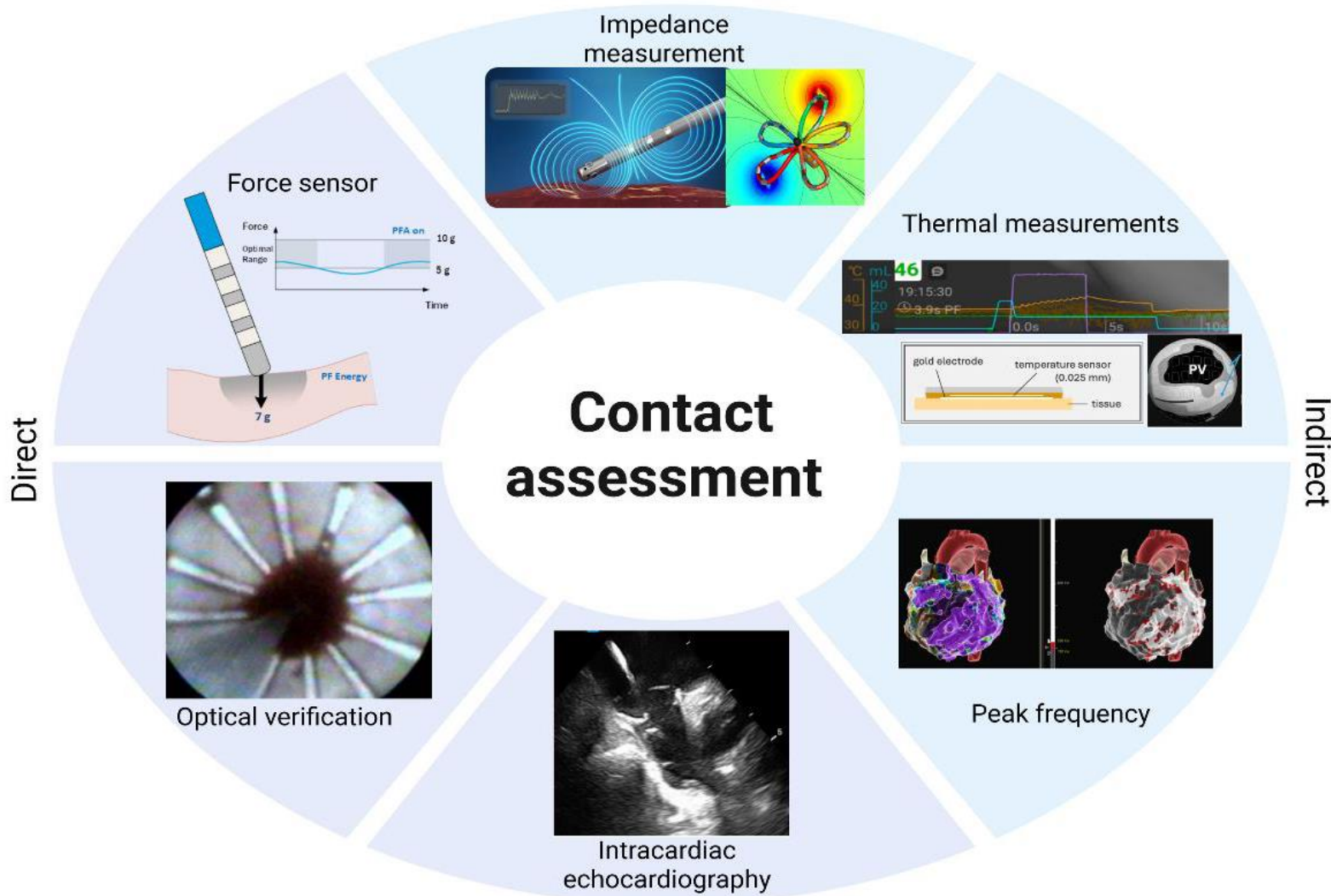
Created in BioRender. Verma, A. (2025) <https://BioRender.com/7fcrvb5>

Hemolysis profile for various pulsed field ablation devices



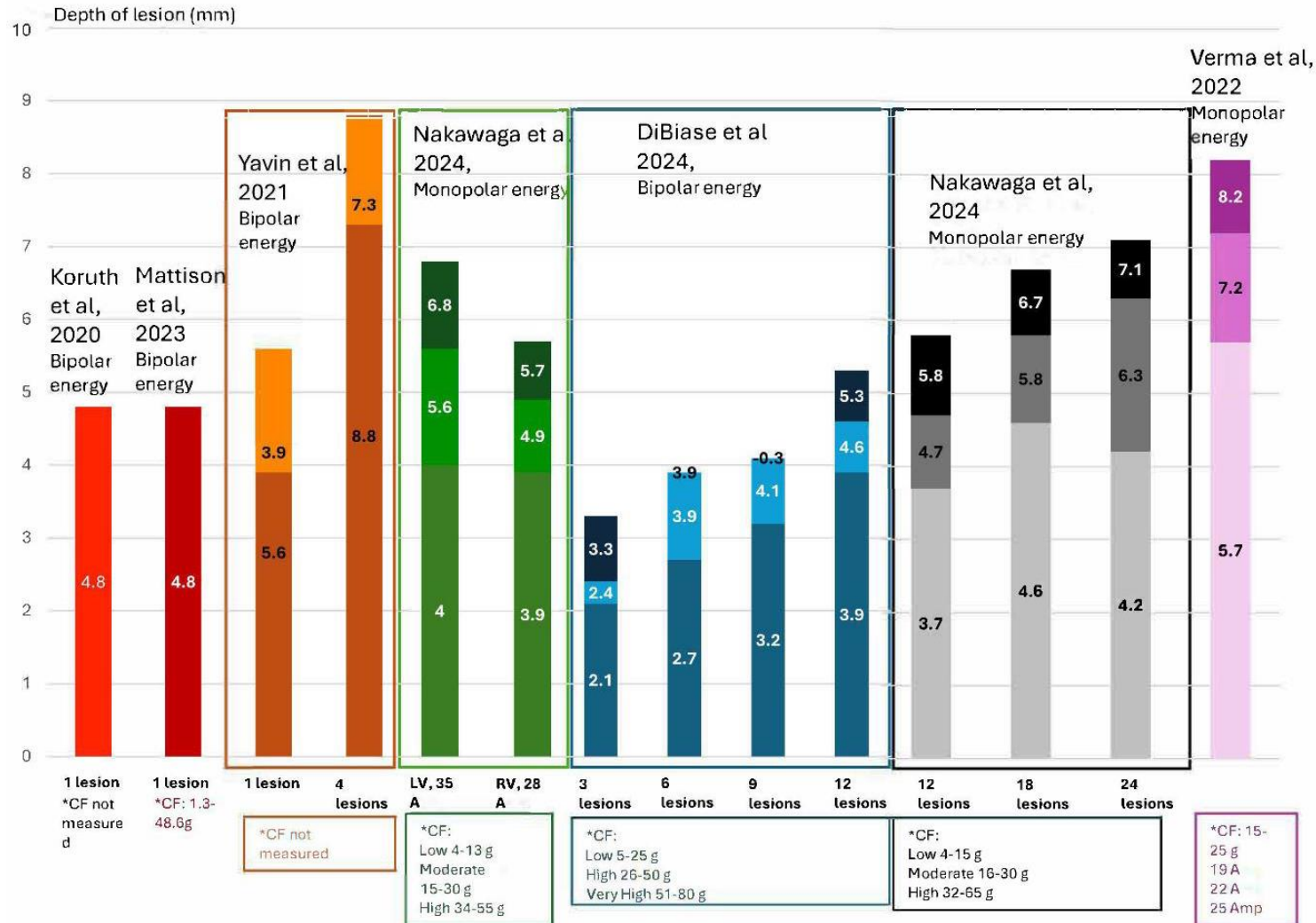
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Techniques to assess catheter-tissue contact for pulsed field ablation



Lesion Depths of Various PFA Platforms

Pre-clinical data in ventricle



Verma A, Hocini M, Andrade J, Gerstenfeld E, Kapa S, Lakkireddy D, et al. 2026 HRS/EHRA Scientific Statement on Pulsed Field Ablation for Cardiac Arrhythmias. Heart Rhythm. 2026 Feb 12:S1547-5271 (26)00124-4.

The Wide World of PFA Device Development

TABLE 3 – Characteristics of PFA catheters

Brand name	Catheter	Descriptive name	Ablation energy	Diameter (mm)/size (F)	Irrigation/flow (mL/min)	Number of applications recommended	Ablation mode/configuration	Nominal amplitude	Integration in mapping/mapping system	Waveform description	Vectoring/activation pattern	Pulse duration	Number of trains/application	Contact sensing/type
Faravave Boston Scientific		Pentaspine 20 electrodes (4 electrodes on each of 5 splines)	PFA	31 & 35 mm/12F	Saline drip	8 applications per vein (nominal)	Bipolar	1800-2000 V	Yes	Biphasic	Between spline pairs	Microseconds	5	Local impedance
OptShot Cardiofocus		Compliant PFA balloon	PFA	Up to 40 mm/12F	No	1 per position/1 per vein	Bipolar	Up to 2 kV	Not required	Biphasic	Simultaneous delivery to non-adjacent splines	Microseconds	Not provided	Direct visual confirmation
Farapoint Boston Scientific		Focal	PFA	8F	No	3-5 mm between lesions	Bipolar	1400-2000 V	Yes	Biphasic	Between electrode pairs	Microseconds	5	Local impedance (future)
PulsSelect Medtronic		Circular: 9 electrodes	PFA	25 mm/9F	Not irrigated	Minimum of 8 per vein	Bipolar	1500 V	Yes (compatible with all mapping systems)	Biphasic	Dual field: odd and even electrodes activated separately during pulse train	Microseconds	4	In development (irrigation or based)
Vartube Biosense Webster		Variable loop: 10 electrodes	PFA	25-35 variable/8.5F	Yes	>=12 per vein	Bipolar	1800 V	Yes	Biphasic	Between adjacent electrodes	Microseconds	Not provided	Impedance
Sphere-9 Medtronic		Large-tip focal	PFA & RFA	9 mm/8F	Yes/15 mL/min (PF); 30 mL/min (RF)	5-6 mm between lesions, user configurable	Monopolar	Up to 2000 V	Yes/Offers Prisma	Biphasic	Lattice to return patches	microseconds	12	Impedance and temperature change after starting ablation
Centaur Cardiofocus (Galaxy)		Focal	PFA	3.5-4 mm/8F	4 mL/min	4-5 mm between lesions	Monopolar	19 A, 22 A, 25 A, up to 3.5 kV	Yes	Biphasic	Unipolar to patch	Microseconds	Not provided	Contact force
Globe System Kardium		122 electrode spherical array	PFA RFA (investigational)	30 mm/16F	Yes/100 mL A (Yes/1.67 mL/min) Heparin coated	1 application per vein /target area	Bipolar	1700 V	Yes/Globe System	Biphasic	2 to 64 electrodes simultaneously	Microseconds	2 to 6	Thermal contact mapping
STSF dual energy Biosense Webster		Focal	PFA & RFA	3.5 mm/8F	Saline drip	Up to 24 applications, 25 s max, duration varies according to PF	Bipolar	1.0-1.5 kV	Yes	Biphasic	Unipolar to patch	Microseconds	Not provided	Contact force with direction vector
OMNY pulse Biosense Webster		Large-tip focal	PFA	12 mm/7.5F	Saline drip	Up to 12 applications, 14.5 s max, duration varies according to PF	Bipolar	1.0-1.5 kV	Yes	Biphasic	Bipolar 3 splines vs 3 splines	Microseconds	Not provided	Contact force with direction vector
Abbott Volt		Balloon in splined basket	PFA	28 mm/12.5F	None	Nominal waveform: minimum 2, average of 4 Low waveform: minimum of 3	Bipolar	Nominal: 1700 V Low: 1345 V	Yes	Biphasic	Spline to neighboring spline in sequence around the 8 splines	Microseconds	10	Yes: complex impedance (LivePoint)
Abbott Tacitflex Duo		Focal	PFA & RFA	4 mm tip/8F	2 mL/min baseline 13 mL/min on PF and RF	1 application per location for atrial locations	Monopolar	Nominal: 2332 V Low: 1950 V	Yes	Biphasic	Unipolar to patch	Microseconds	Nominal: 5 trains Low: 10 trains	Yes: Light-interferometry contact force
Sphere-360		Very large array	PFA	34 mm/8F	Not irrigated	3-4 per vein	Monopolar	Not provided	Yes/Offers Prisma	Biphasic	6 panels activated individually to return patch	Microseconds	Not provided	Impedance
mPFA, PulseBiosences		Very large array	PFA	30 mm/11F	No	1 ostial and 1 atrial application per vein	Bipolar	Not provided	Feasibility clinical integration with EnSite and CARTO	Monophasic	Between rings	Nanoseconds	Not provided	No
ElectroPulse, CathRx		Variable loop: 10 electrodes	PFA	2.33 mm/8F	No	1 per location	Bipolar	2800 V	Yes	Biphasic	Between adjacent electrodes	Microseconds	7	Yes
LotusPFA Inight Medtronic		Interconnected spline in spindle and lotus configurations	PFA	28 or 31 mm/11F	Saline drip	8 applications per vein	Bipolar	2100 V	No	Biphasic	Between adjacent electrodes	Nanoseconds	5 trains per site	No
Adagio		Very large array	PFA	20-25 mm/8.5F	Not irrigated	Not provided	Bipolar	1100 V	Feasibility with Ensite	Biphasic	Between adjacent electrodes	Not provided	1	Not provided
Faraflex Boston Scientific		Large focal	PFA	10 mm/8F	2 mL/min	5-6 mm between lesions	Monopolar/bipolar	2000 V	Yes	Biphasic	Monopolar: distal electrode-patch; bipolar: distal - proximal	Microseconds	5	Local impedance
QuickShot Cardiofocus		Map & ablate mini basket	PFA	10 mm/8.5F	2 mL/min	1 per position	Monopolar	33 A, 40 A up to 5 kV	Yes	Biphasic	Unipolar to patch	Microseconds	Not provided	Yes: impedance algorithm
Field Medical		Focal	PFA	8.5F	Irrigated	Not provided	Monopolar	>10 kV	Feasibility with CARTO	Monophasic	Not provided	Nanosecond	Not provided	Yes
Argo Medtronic SA		Circular, linear, focal	PFA	25 mm/7F	No	5-7 applications per PV	Bipolar, monopolar, and combination	2250-3250 V	No	Biphasic, coherent sine wave	Not provided	Microseconds	Not provided	Yes: impedance

Data were retrieved from public sources and compiled. The table was sent to companies to confirm, modify, and provide more information. Fields that are not populated indicate data that are either not available or were not disclosed by the companies. PFA = pulsed field ablation; PV = pulmonary vein; RFA = radiofrequency ablation. See an expanded version of the table in Supplemental Materials.

Biophysical Synergy Between RMN and PFA

- PFA

- Rapid, Effective, Safe
- High voltage energy delivered over milliseconds/nanoseconds
- Lesion effectiveness dependent upon catheter-tissue interface **at the moment of energy delivery**



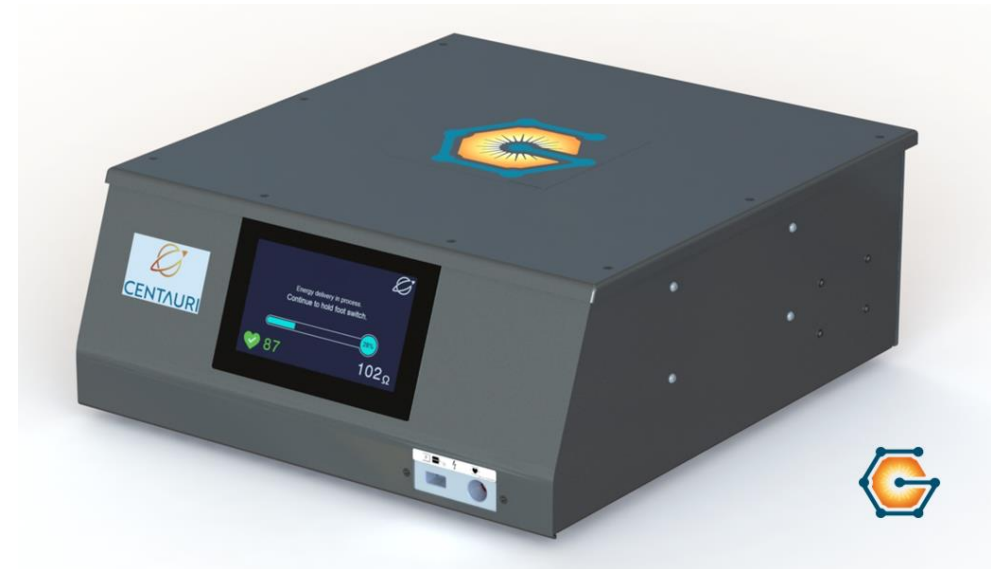
- Magnetic Navigation
 - Consistent focal contact
 - Open API
 - Automation
 - Telemedicine Capability

Pre-Clinical Proof of Concept

New Generation of Robotic Technology



Open Platform PFA Technology



The Galaxy Centauri system:

- Interoperable with some standard RF catheters and navigation/mapping systems

Proof of Concept

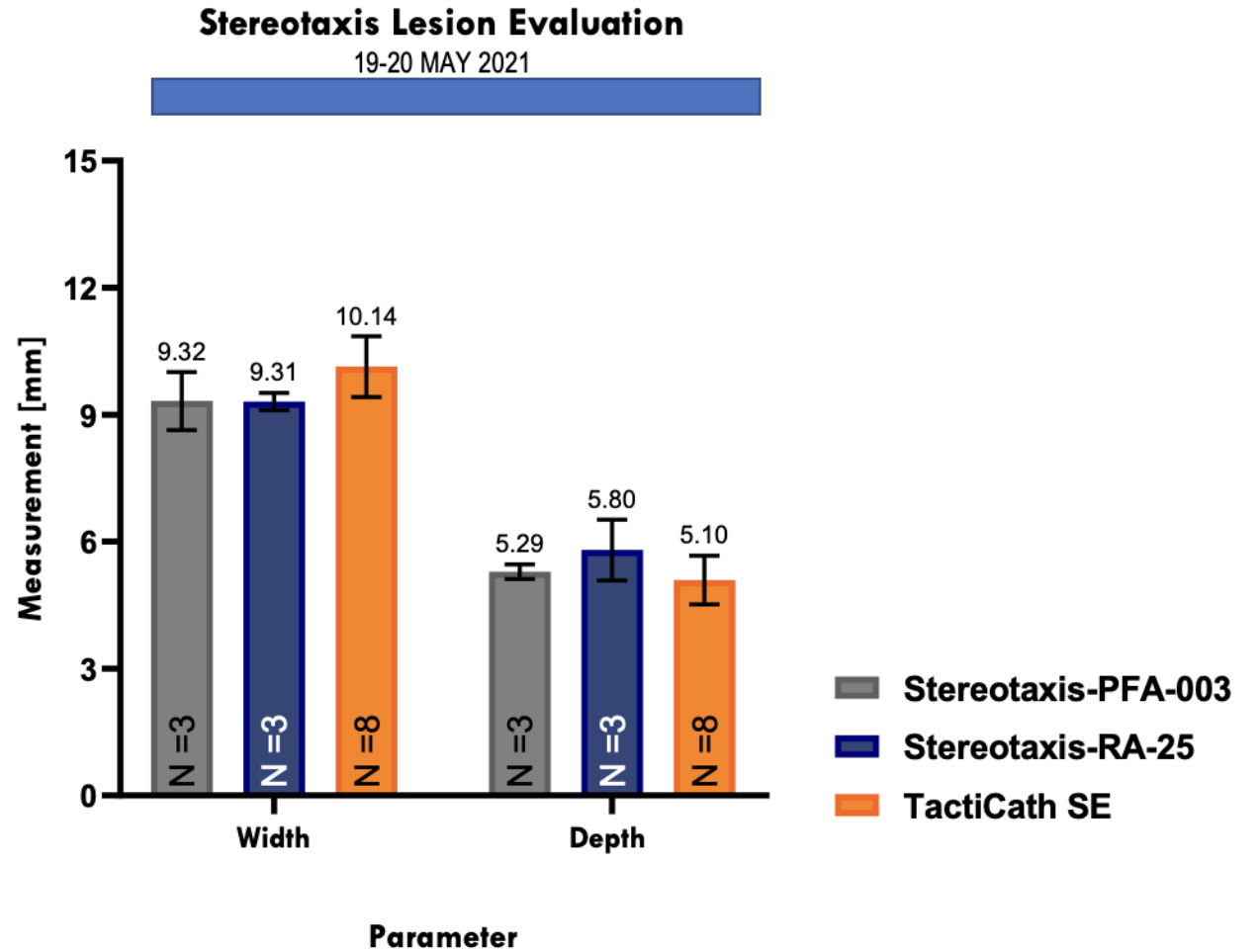
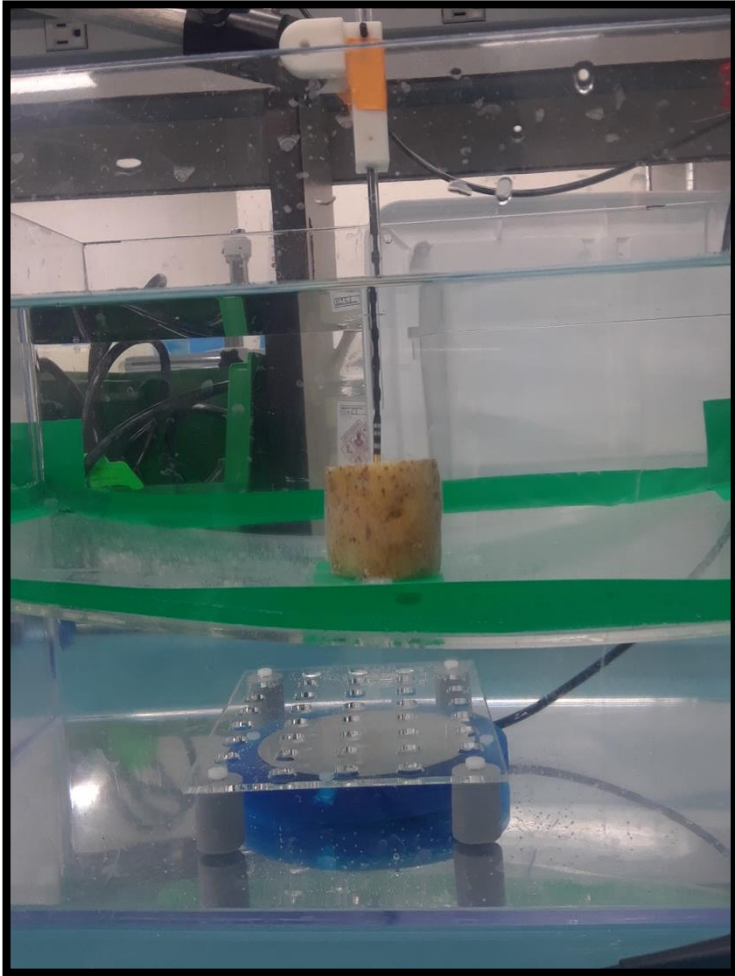
Benchtop

- Basic Compatibility: Potato Model
- Compare both current and upcoming RMN catheters with known standard: TactiCath™

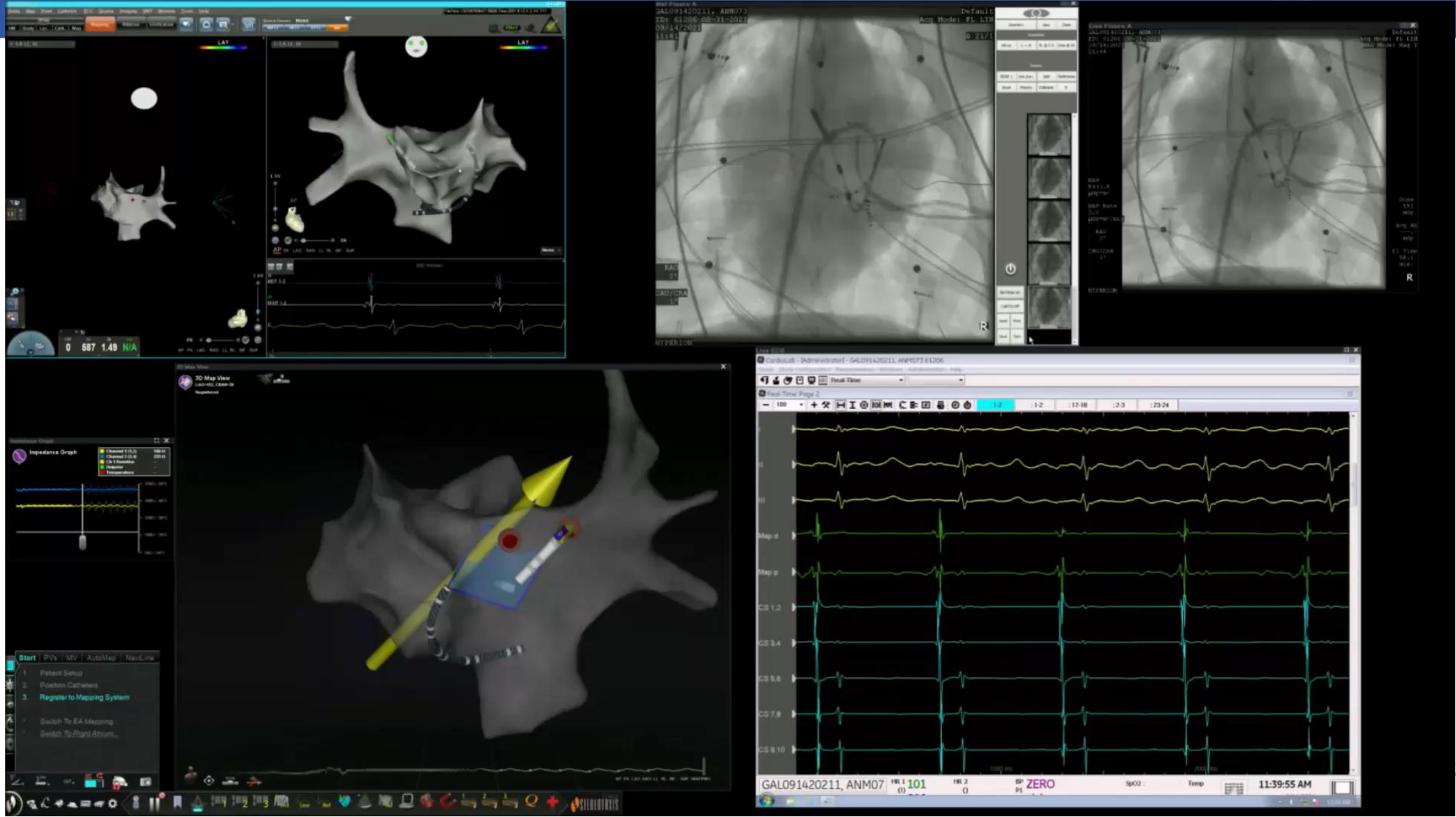
Animal Model

- Porcine Model
- Devices:
 - MAGIC Mapping and Ablation Catheter
 - Navistar RMT (4mm solid tip catheter)
 - Galaxy Medical CENTAURI™ PEF Generator
- Demonstrate two different mapping systems: CARTO and Acutus AcQmap
 - All 4 chambers
 - Remote Navigation
 - Acute Histology

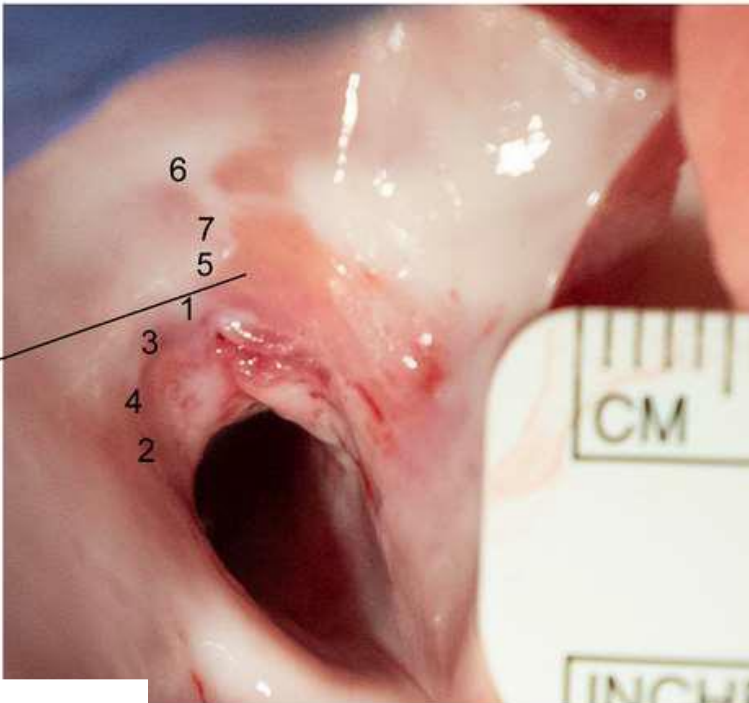
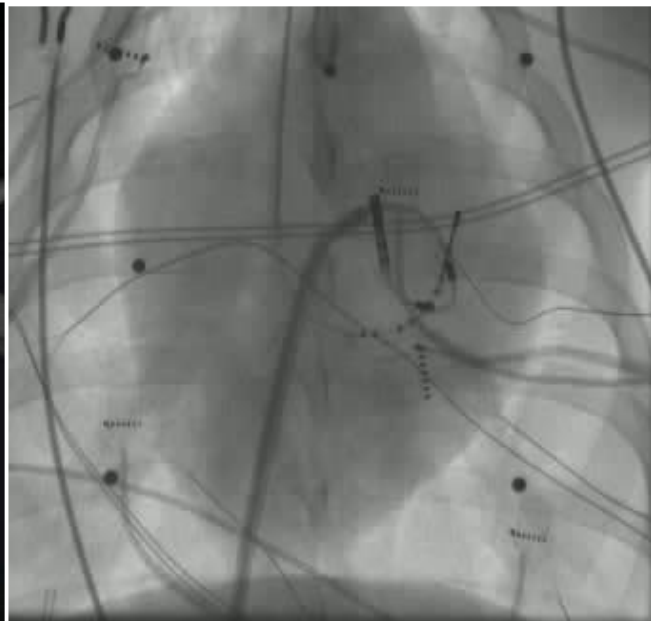
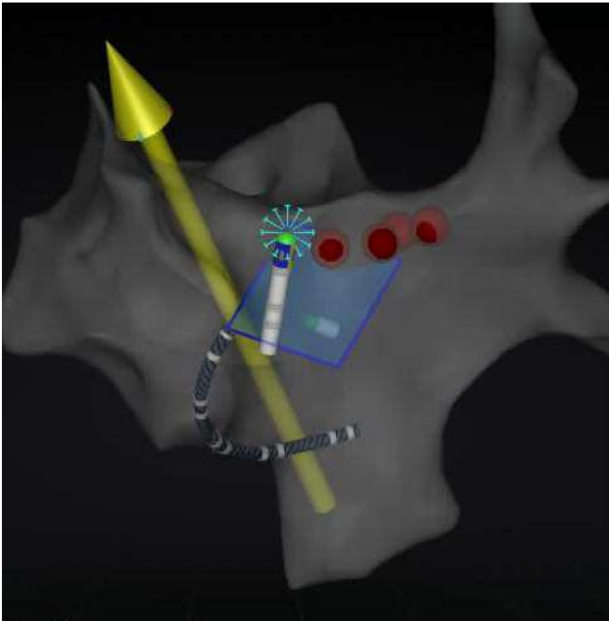
Benchttop Compatibility Testing



LA Ablation Animal Study



LA Ablation Animal Study



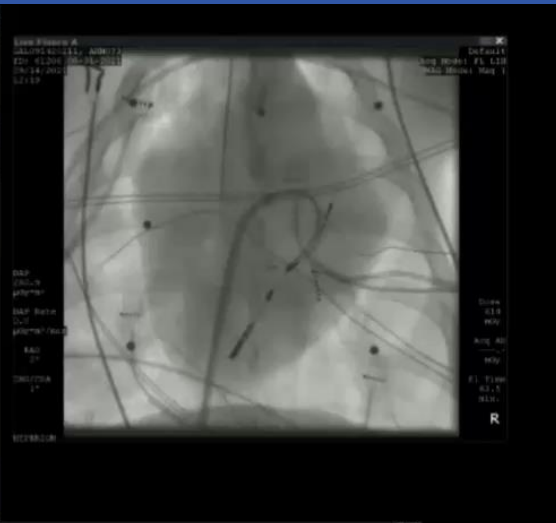
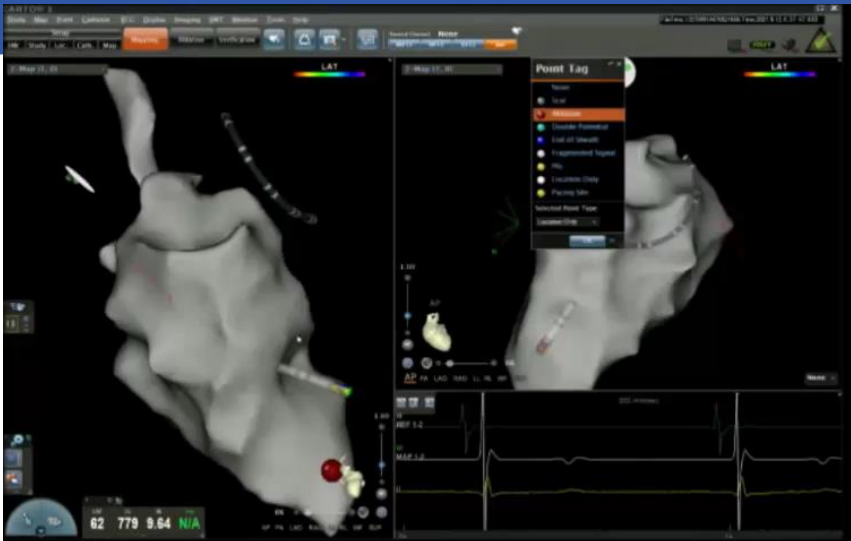
Before



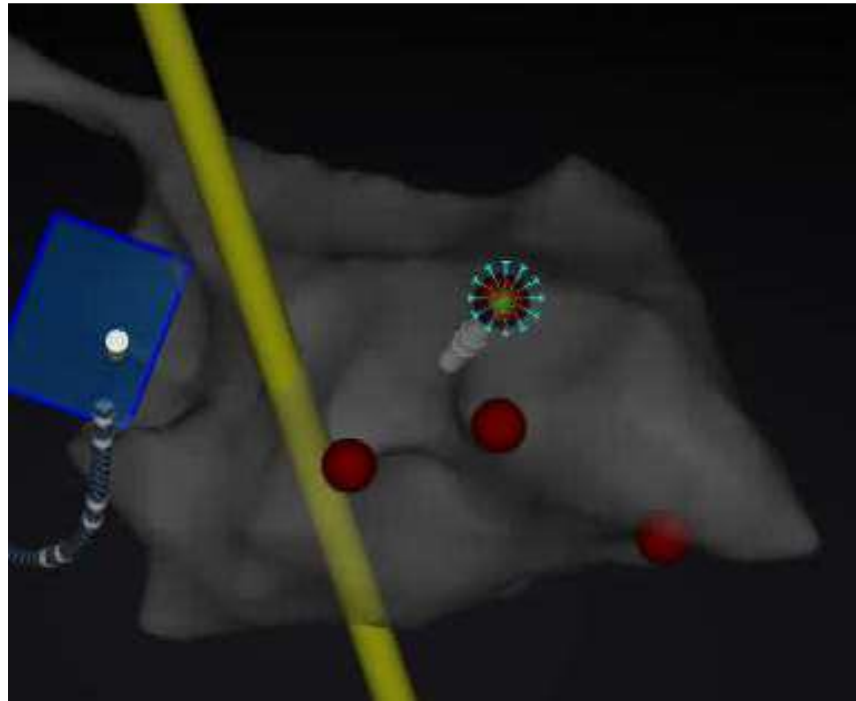
After



LV Ablation Animal Study



LV Ablation Animal Study



Before



After



Lesions were 7.2-11.1mm in diameter and 4-7mm in depth.

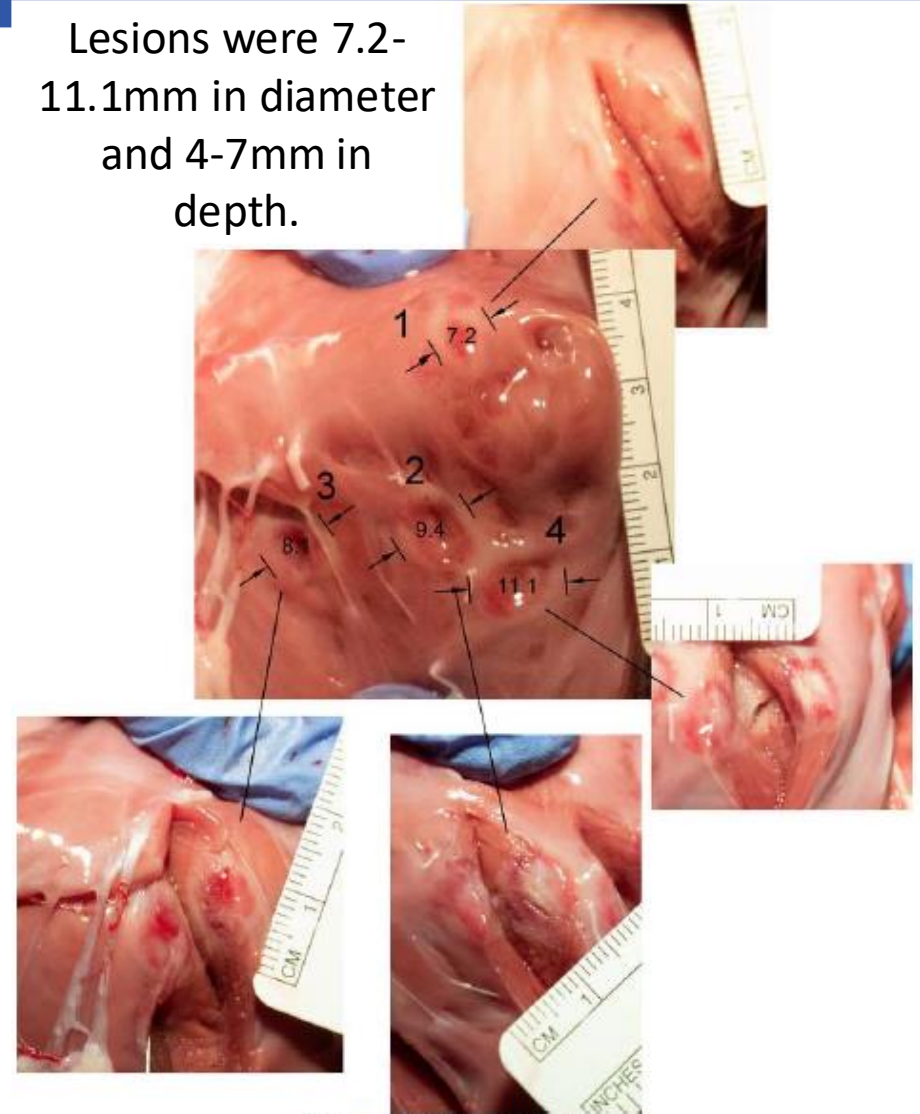


Figure 11 - Left Ventricular PEF Lesions

GLOBAL PRESENCE & IMPACT



15+ Years Clinical Experience

Hundreds of Physicians at 100+ Leading Global Hospitals have Treated 150,000+ Patients
>400 Publications



Efficacy and Safety of Atrial Fibrillation Ablation Using Remote Magnetic Navigation: Experience from 1,006 Procedures

- Mean procedural time and ablation time was 134 ± 35 minutes and $2,130 \pm 1,025$ seconds, respectively.
- The mean fluoroscopy time was 5.4 ± 3.7 minutes.
- Compared to PAF patients, procedural time and ablation time were significantly increased in patients with PerAF by 10% ($P < 0.001$) and 19% ($P < 0.001$), respectively. However, fluoroscopy time was not increased (5.3 ± 3.5 minutes, PAF vs. 5.6 ± 4.0 minutes, PerAF, $P = 0.17$).
- The overall complication rate was 0.6%

A Novel, Highly Efficient And Effective Minimally-Invasive Ablation Strategy for Remote Magnetic Navigation Guided Pulmonary Vein Isolation

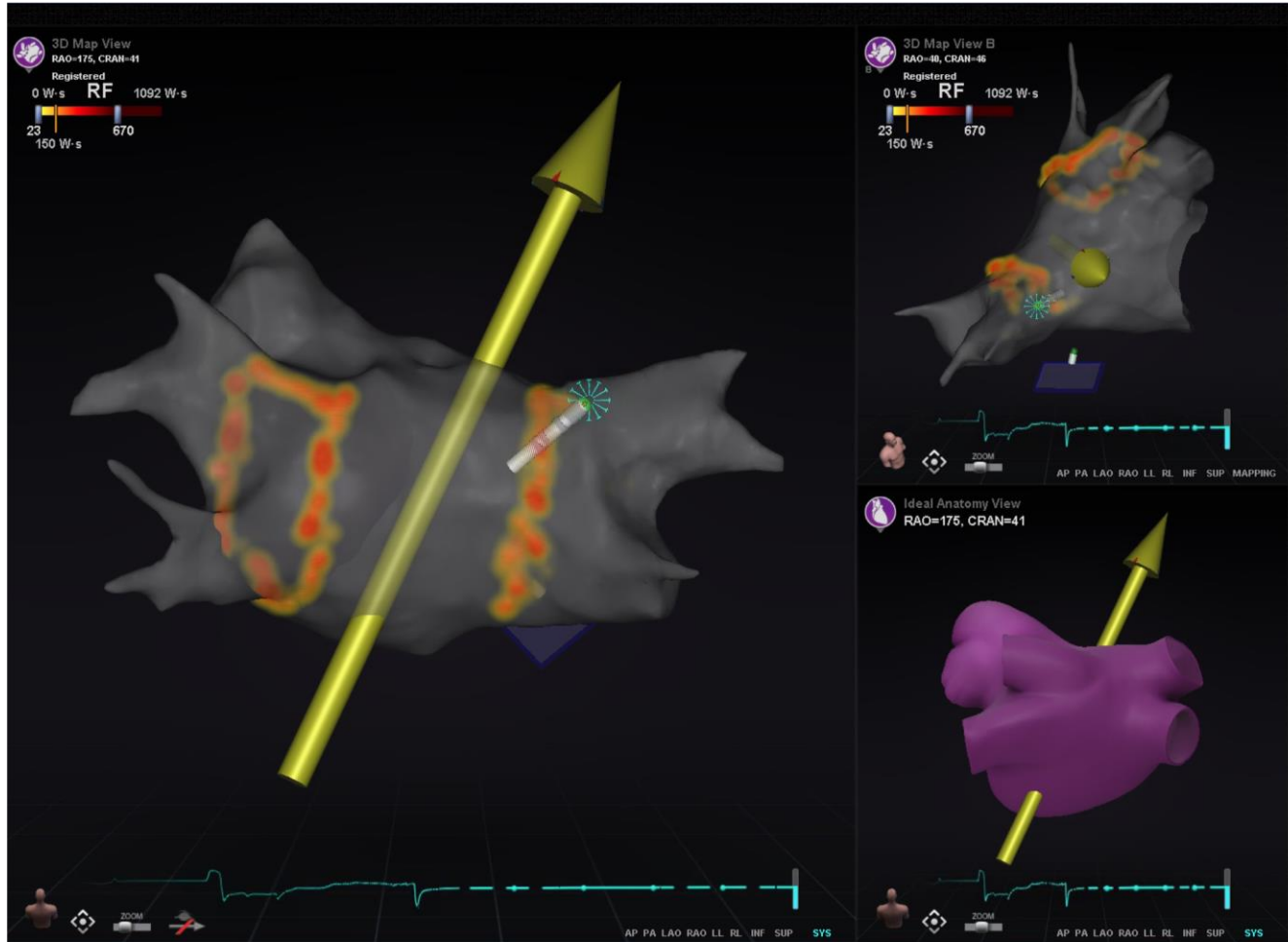


Table 2: Procedural Efficiency

All Patients (N = 14)

LA access time (min) 6.5 ± 1.9

Mapping time (min) 7.1 ± 1.4

Ablation time (min) 33.7 ± 9.1

Total procedure time (min) 63.1 ± 13.5

Fluoroscopy time (min) 12.0 ± 3.8

Fluoroscopy dose (mGy) 105.4 ± 33.6

DAP (mGy*cm²) 8565 ± 2215

Application duration (s) 1137 ± 186

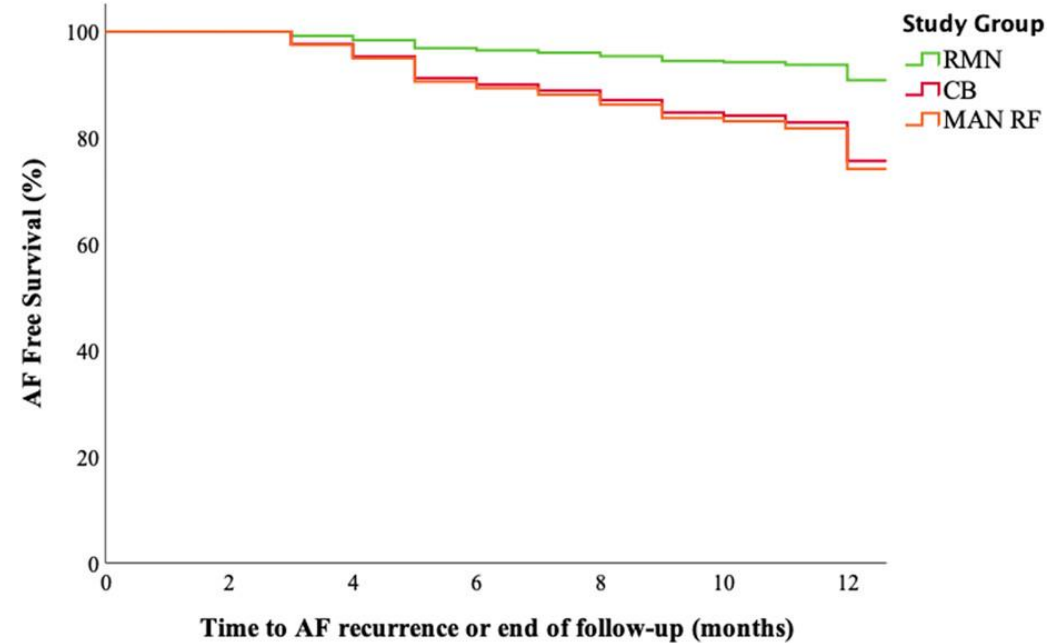
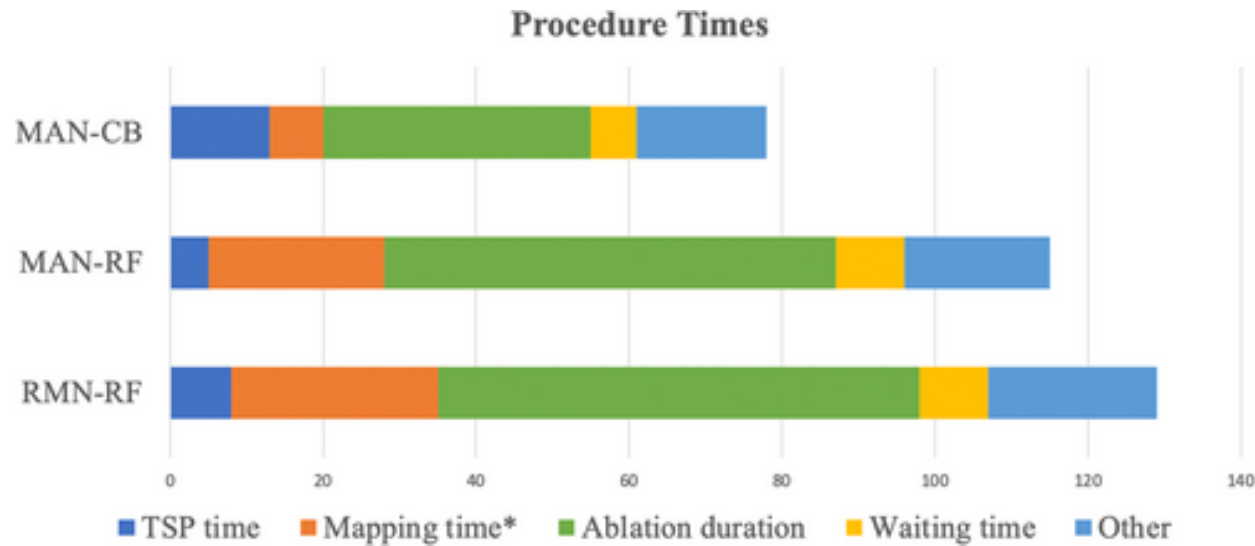
Application count 15 ± 5

ORIGINAL ARTICLES

Open Access

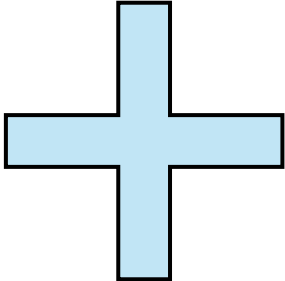


Robotic magnetic navigation-guided catheter ablation establishes highly effective pulmonary vein isolation in patients with paroxysmal atrial fibrillation when compared to conventional ablation techniques



	Nr at risk	80	79	77	74	71	68	51
MAN-CB	Nr at risk	80	79	77	74	71	68	51
	Cum Events	0	0	1	4	6	8	19
MAN-RF	Nr at risk	71	69	64	59	58	53	42
	Cum events	0	0	3	8	9	13	16
RMN-RF	Nr at risk	60	59	58	55	54	51	50
	Cum events	0	0	0	3	4	5	5

What is Next?

- Technology that is **Generally Attainable**
 - Technology that allows accurate and efficient navigation
 - Technology that allows us to create predictable, reproducible ablation lesions
 - Improved safety and effectiveness of catheter movement and ablation
- 
- **Advanced Integration with mapping and Imaging technologies**
 - **New Ablation Technologies: Pulsed Field Ablation options**
 - **Automation**
 - **Remote procedures?**
 - **Applications beyond EP?**

Genesis X Robotic System: Addressing Accessibility

Semi-mobile: can be set up in a cath lab over a weekend.

Just as easily as the system can be deployed, it can be removed with no lasting impact to the lab.

Ideal for the ASC environment with sale/lease option



Compatible with multiple Fluoro Systems

System components have all been miniaturized ensuring efficient space and operations.



Miniaturized Electronics



Downsized Cabinets

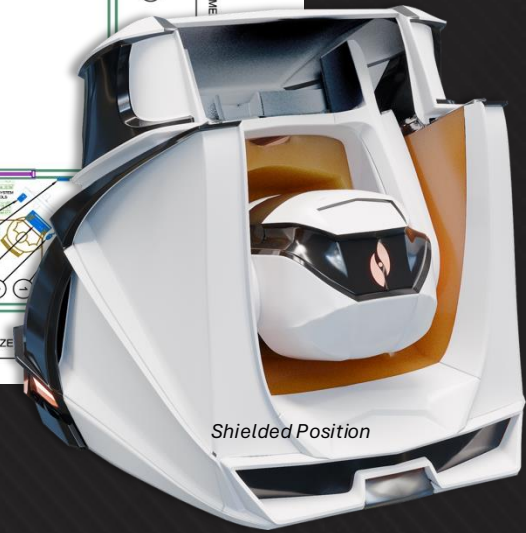
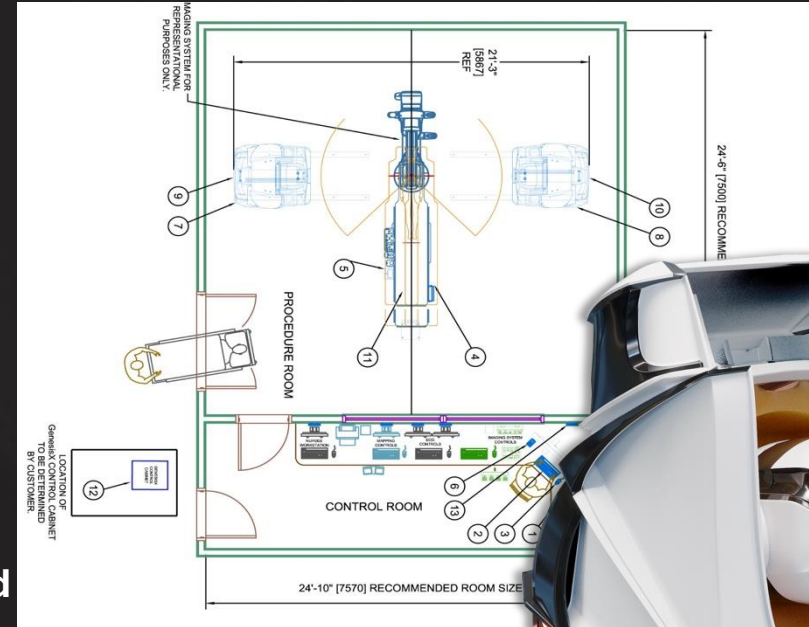


Traditional Outlets



Smaller Cables

Built-in magnetic shielding - allowing the room to be used without any restrictions or lab modifications.

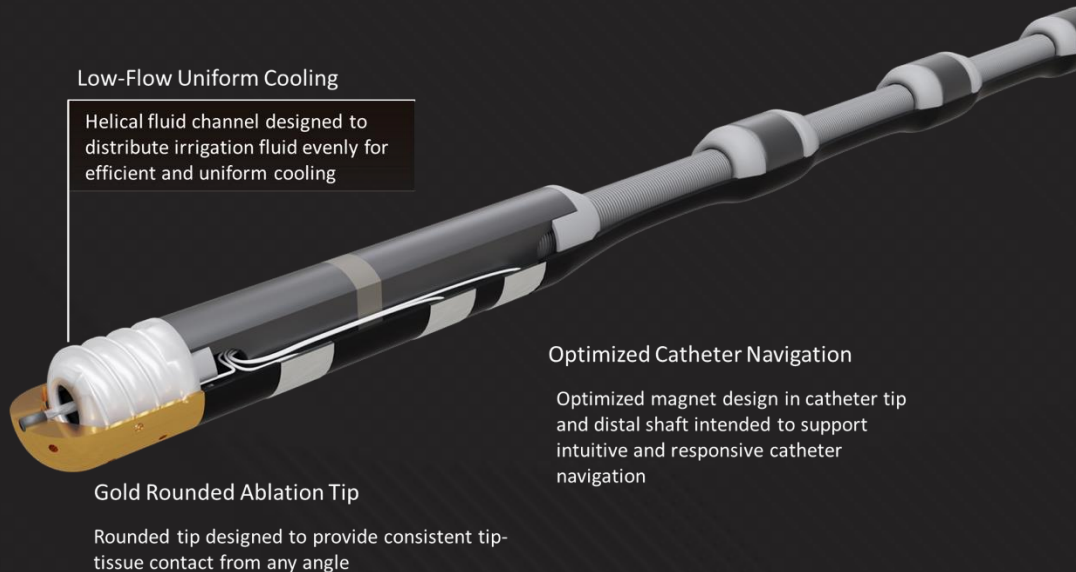
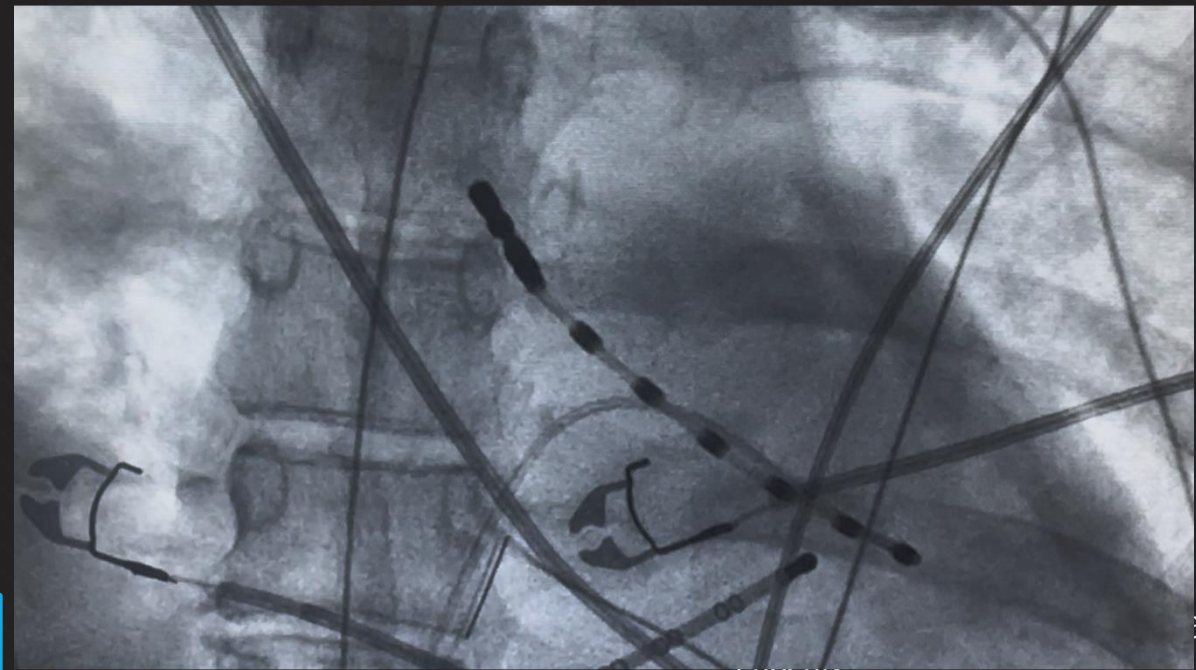


FDA 510(k) Cleared

MAGiC

Magnetic Interventional Ablation Catheter

- Developed free of strategic partnership/control
- Modular Platform: Mapping system compatibility
- e-Contact Module
- Gold tip with Surround Flow
- 8 navigation magnets in shaft
- Tip with more than double magnetic material



Low-Flow Uniform Cooling

Helical fluid channel designed to distribute irrigation fluid evenly for efficient and uniform cooling

Optimized Catheter Navigation

Optimized magnet design in catheter tip and distal shaft intended to support intuitive and responsive catheter navigation

Gold Rounded Ablation Tip

Rounded tip designed to provide consistent tip-tissue contact from any angle

FDA 510(k) Cleared

Advancing Robotic Pulsed Field Ablation

CARDIO*FOCUS



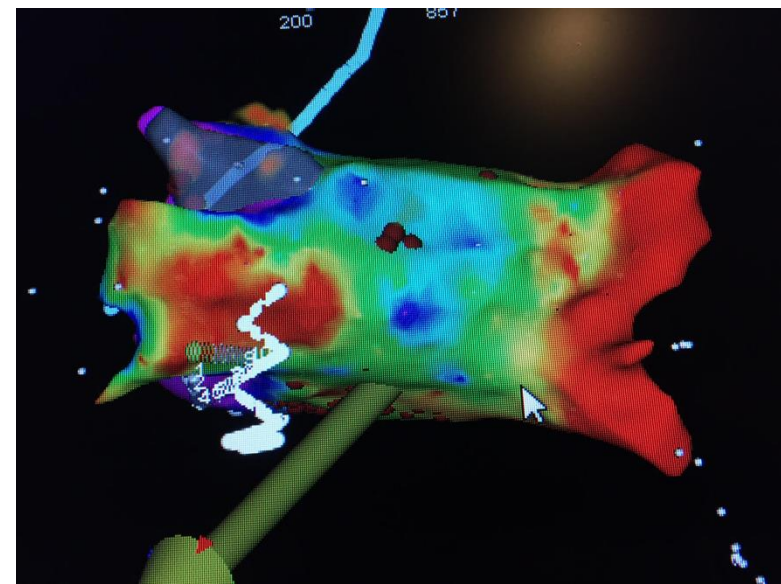
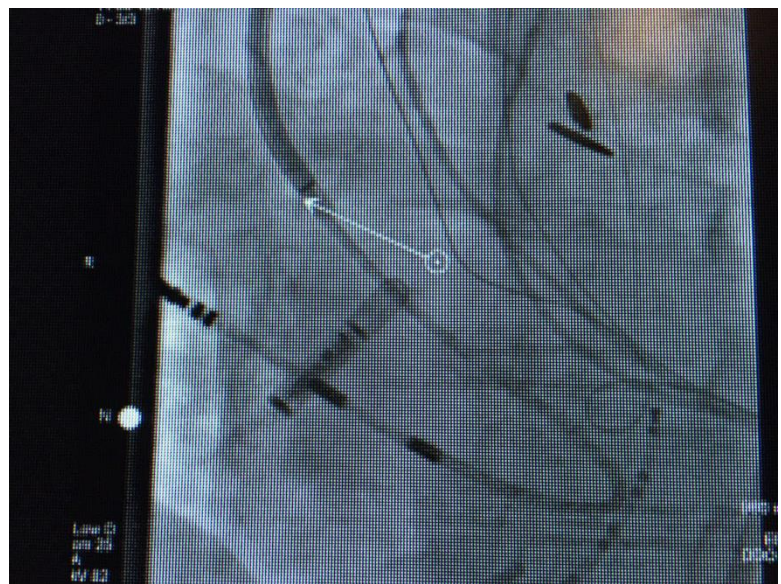
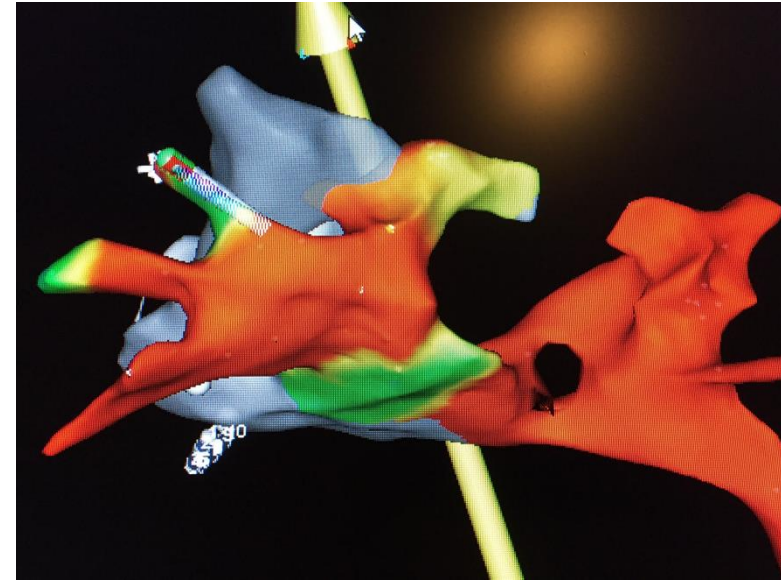
STEREOTAXIS

Stereotaxis & CardioFocus Collaborate to Advance Robotic Pulsed Field Ablation for Cardiac Arrhythmias

- The collaboration combines CardioFocus's Centauri™ PFA system with Stereotaxis' Robotic Magnetic Navigation and MAGiC® ablation catheter for stable, highly controlled catheter positioning.
- Preclinical studies demonstrated safe, efficient, and impressive lesion delivery including deep durable lesions in ventricular tissue.
- The Centauri system is CE-marked and has been used to treat 9,000+ European patients with clinical experience reported in over 40 publications. The integrated robotic PFA system is moving toward first-in-human use and clinical trials, expanding robotic options for complex EP procedures.

NOT Approved for use in the US

Unique Capabilities: Retrograde Aortic AF Ablation



Automation, Standardization



Updated Platform For Web Based Secure Connectivity



Broader than Robotics

All cath labs stand to benefit from improved workflow, connectivity, and collaboration.

SYNCHRONY

New Format Integrated Display

SYNX

Secure Mobile App

FDA 510(k) Cleared

A Revolution in Ablation?



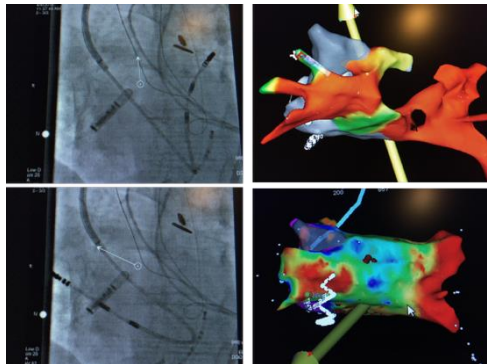
ASC



Radial Access



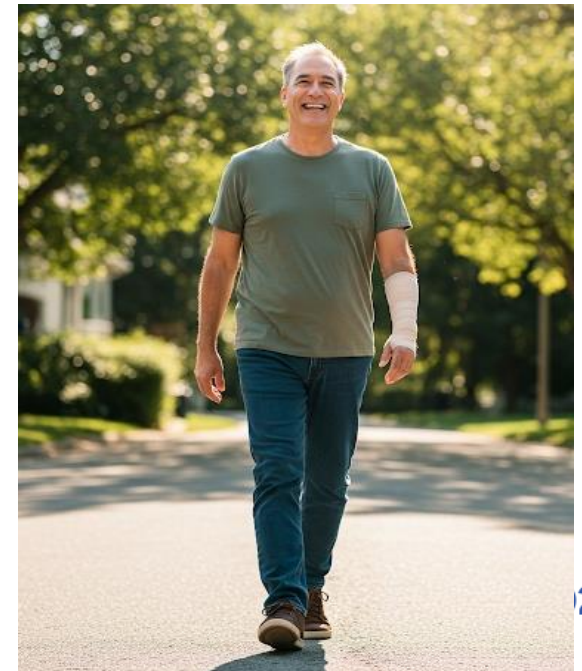
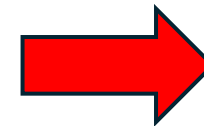
6F PFA Catheter



Retrograde Aortic



Automation and Connectivity



Slide may depict non-FDA approved devices



Banner Health



Thank You!

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