



Current Surgical Treatment for Atrial Fibrillation

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Introduction

- ❁ Detrimental sequelae of AF
 - Discomfort and anxiety
 - Compromise cardiac hemodynamics
 - Stasis of blood flow in the left atrium : vulnerability to thromboembolism



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Objectives of rhythm control in patients with AF

- ❁ Relieve of symptoms such as palpitation, fatigue, and dyspnea
- ❁ Prevention of tachycardia-induced myocardial remodeling and HF
- ❁ Prevention of thromboembolism



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Goals of Curative Procedure for AF

- ✿ Restore sinus rhythm
Without drugs, if possible
- ✿ Restore atrial transport function
Synchronized contraction
- ✿ Reduce the risk of thromboembolism
Remove areas of clot formation
- ✿ Safe and efficacious



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Merits: Surgical AF ablation

- ✿ Left atrium auricle manipulation
- ✿ LA size reduction
- ✿ Transmural lesions
- ✿ Operation for associated lesion



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Essentials of AF ablation

❁ Clinical

- *Long, linear lesions*
- *Various shape lesions*
- *Continuous lesions*
- *Transmural lesions*

❁ Surgical

- *Off-Pump*
- *Minimally invasive*
- *Directed Lesions*
- *Short, Stand-Alone procedure*



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Lesion set of AF surgery

✿ To simplify and less complications

- Less ischemic time
- Less bleeding chance
- Minimize adjacent organ damage
- Easy to apply



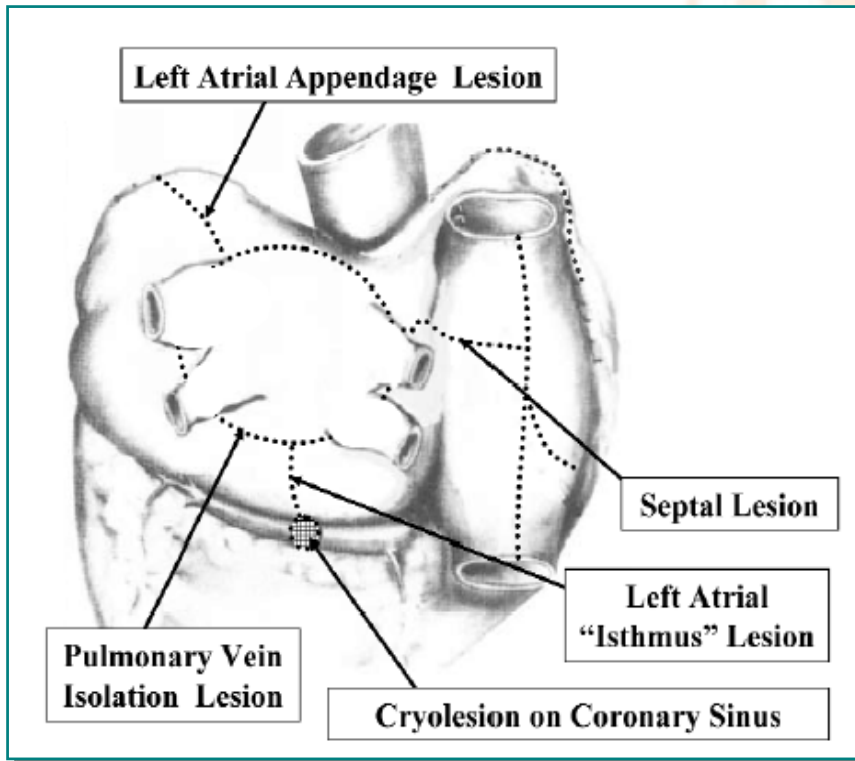
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Lesion set of AF surgery

Cox Maze III

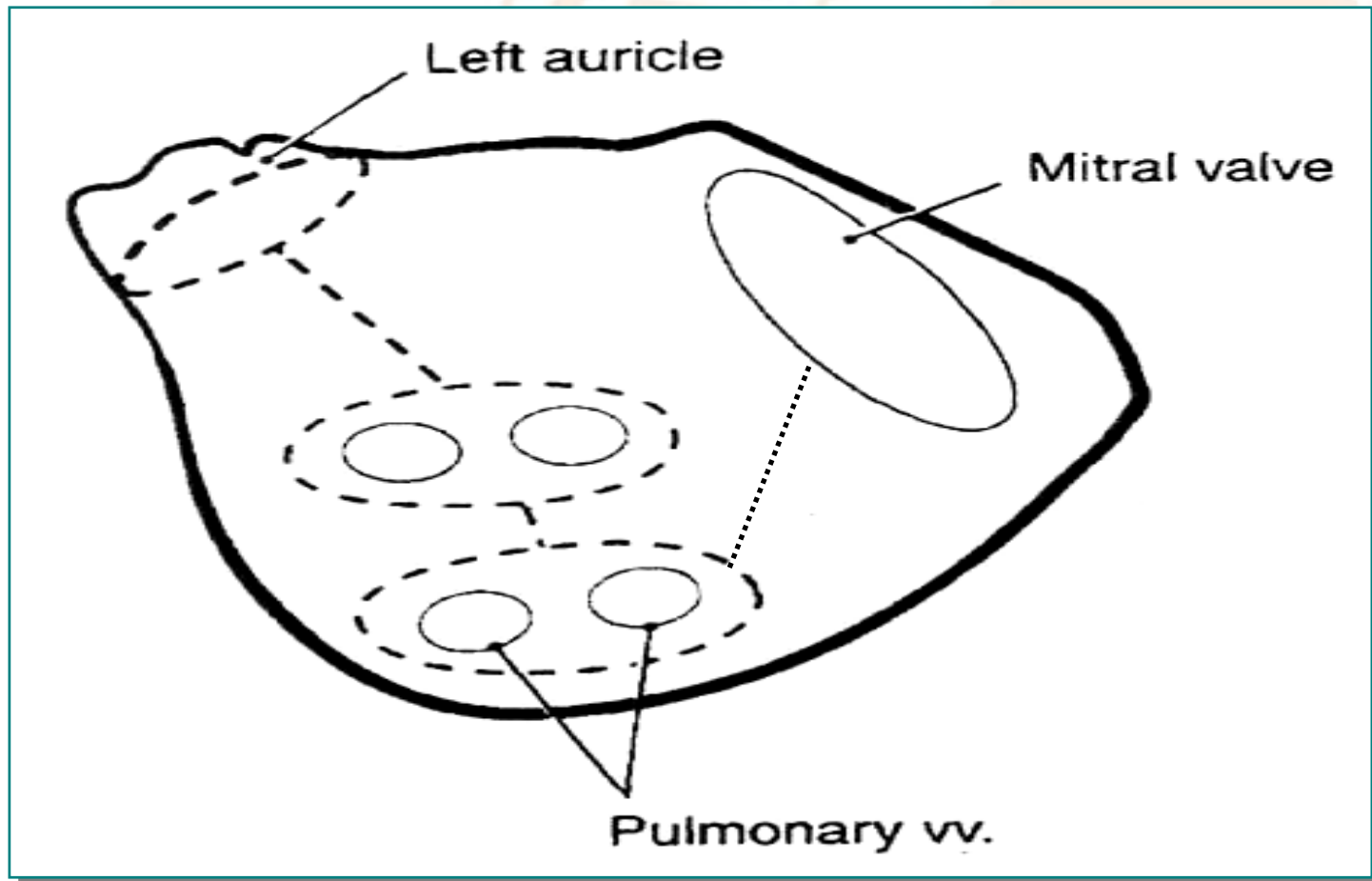


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Common Left Atrial Lesion Set



Energy Sources for Surgical AF Ablation

Energy type	Endo	Epi	Flexible	TM	No Char	Rapid
RF	+	+	+	+	-	+
MW	+	+	+	-	+	+
Cryo	+	+	-	-	+	-
Surgi-Frost	+	+	+	+	+	+

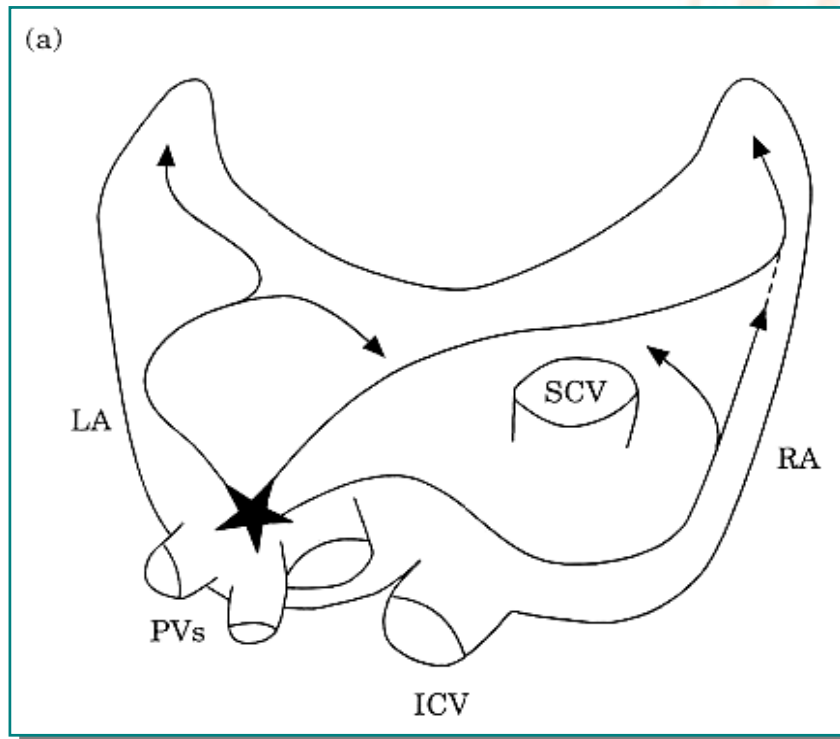


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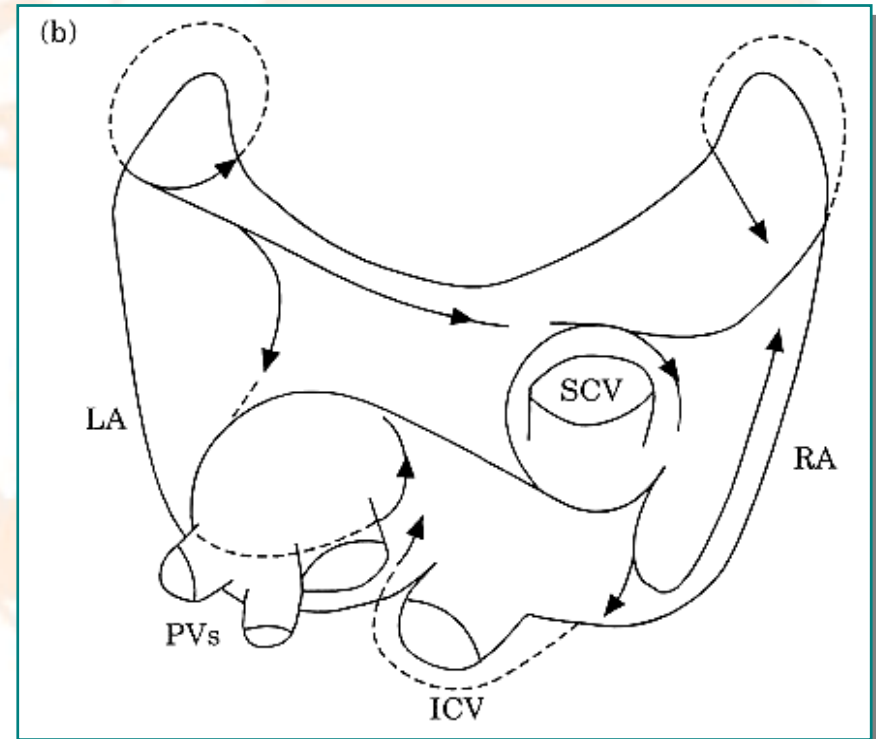


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Principal electrophysiological mechanisms of AF



Focal activation



Multi-wavelet reentry



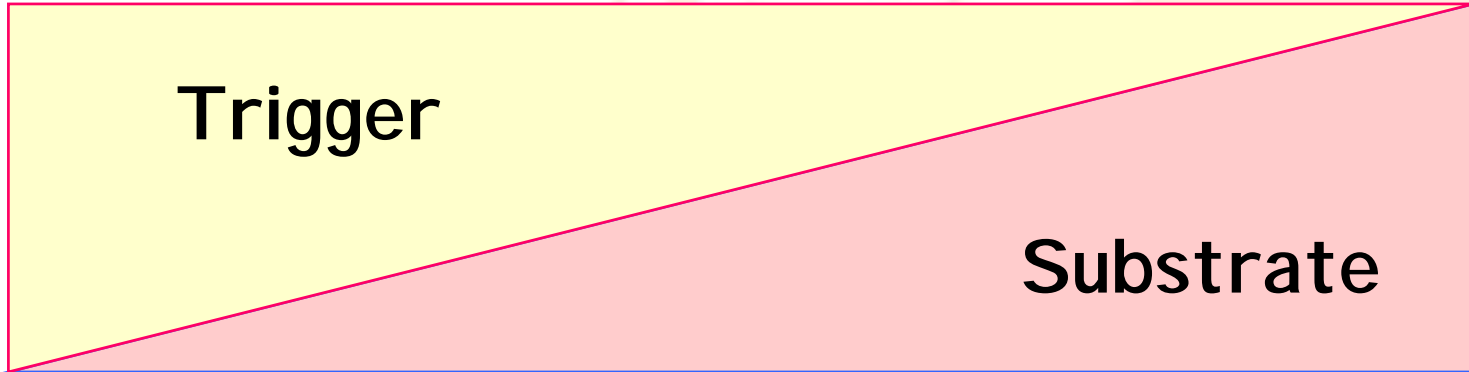
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Paroxysmal AF

Chronic AF



Lesion set of AF surgery

✿ Pulmonary vein isolation

- *Left atrium act as electrical driving chamber for chronic atrial fibrillation* ; Harada, 2000, Ann Thorac Surg
- *Pulmonary vein orifice isolation was effective in treatment of chronic atrial fibrillation* ; Sueda, 2001, Ann Thorac Surg



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The Ideal AF Procedure

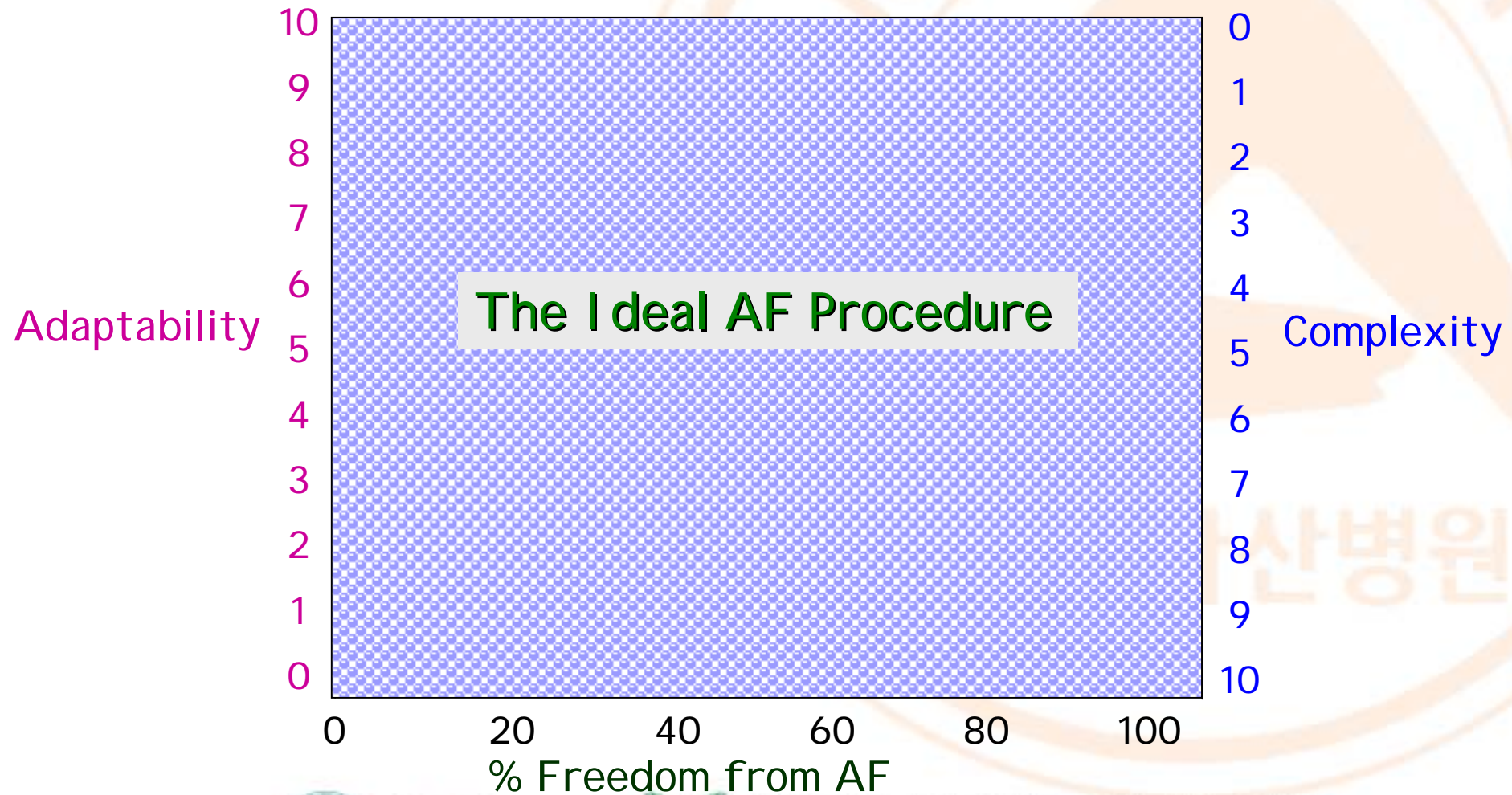


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The Ideal AF Procedure

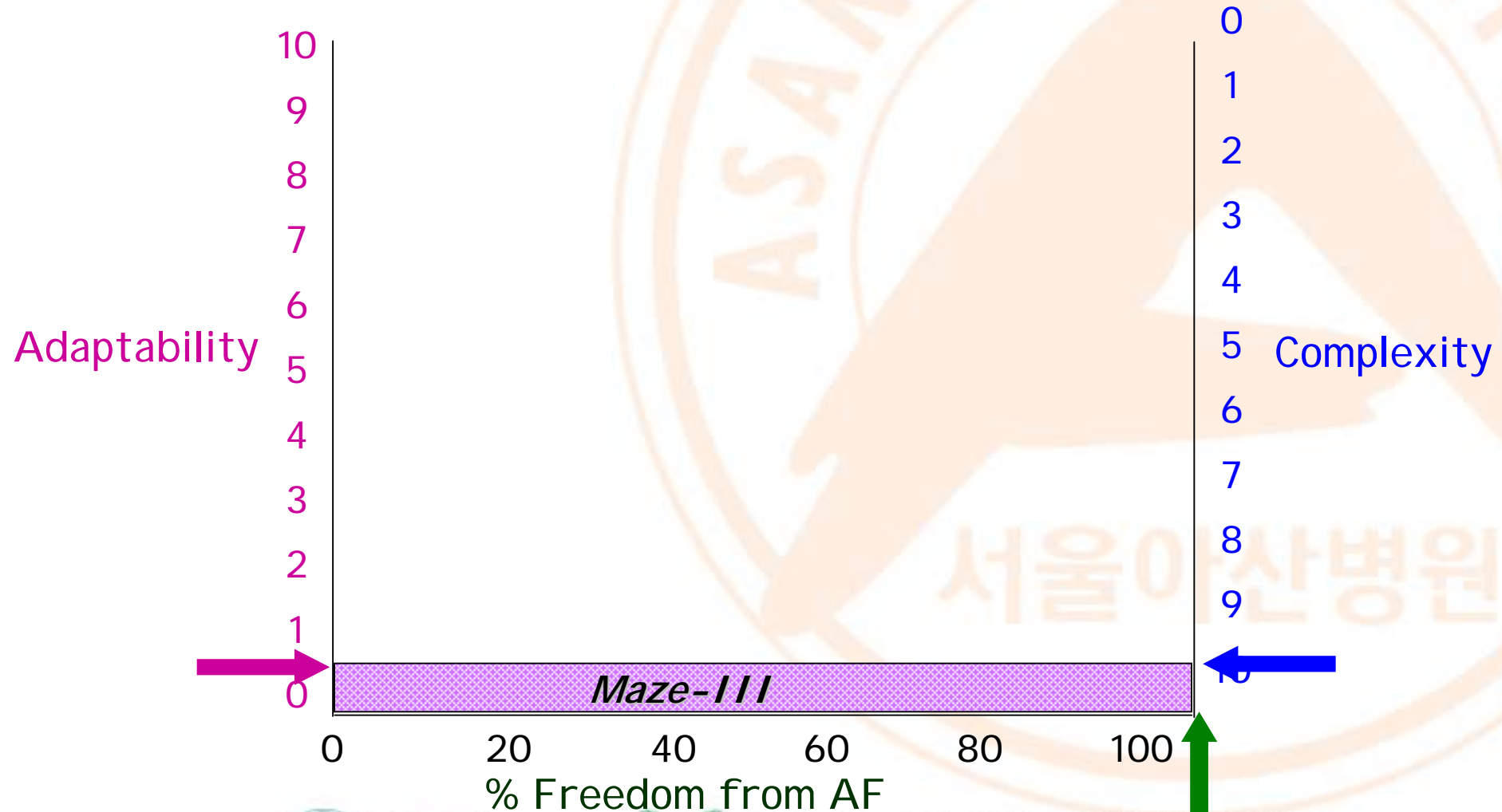


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The Surgical Maze-III Procedure

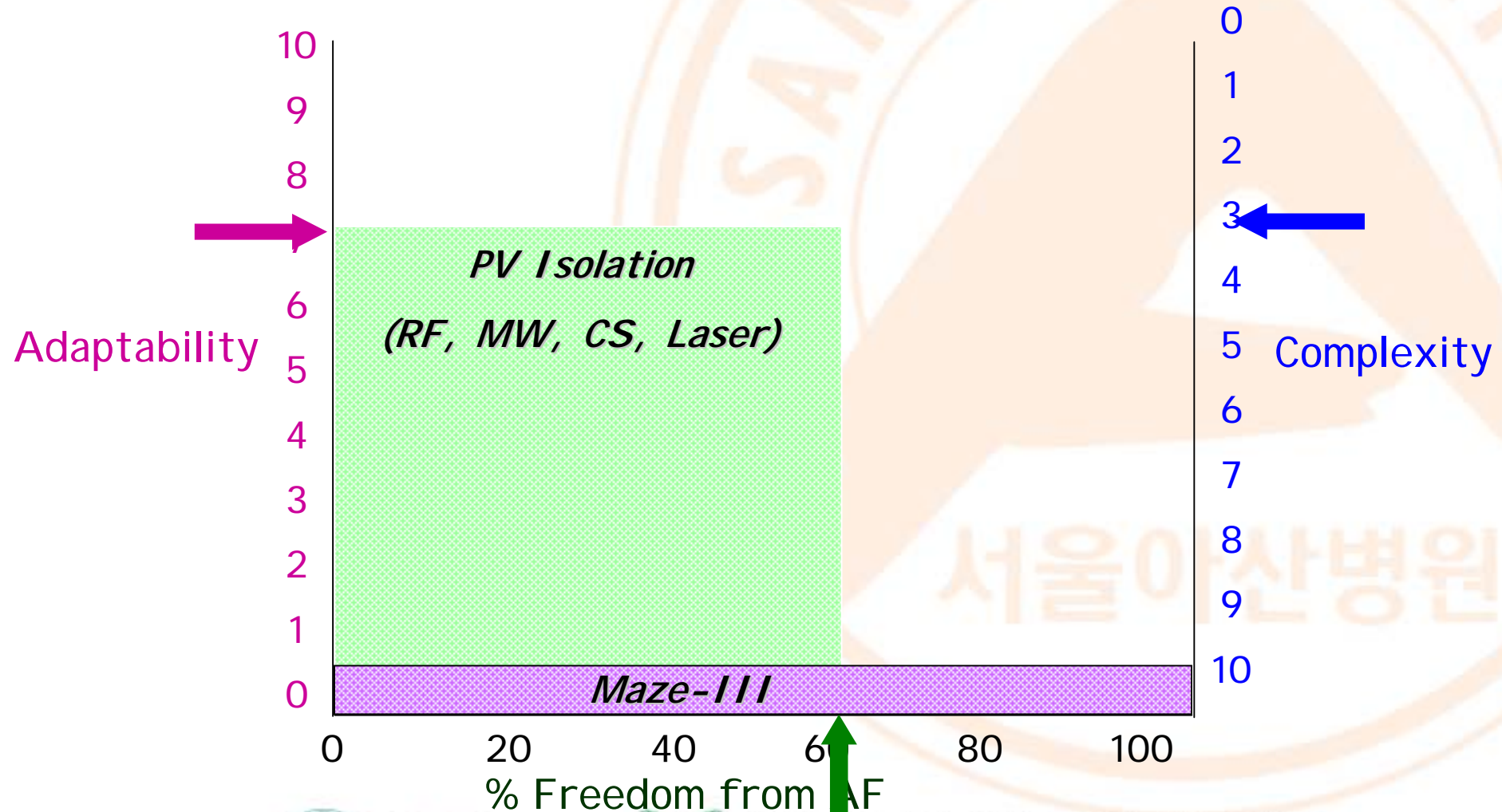


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Pulmonary Vein Isolation

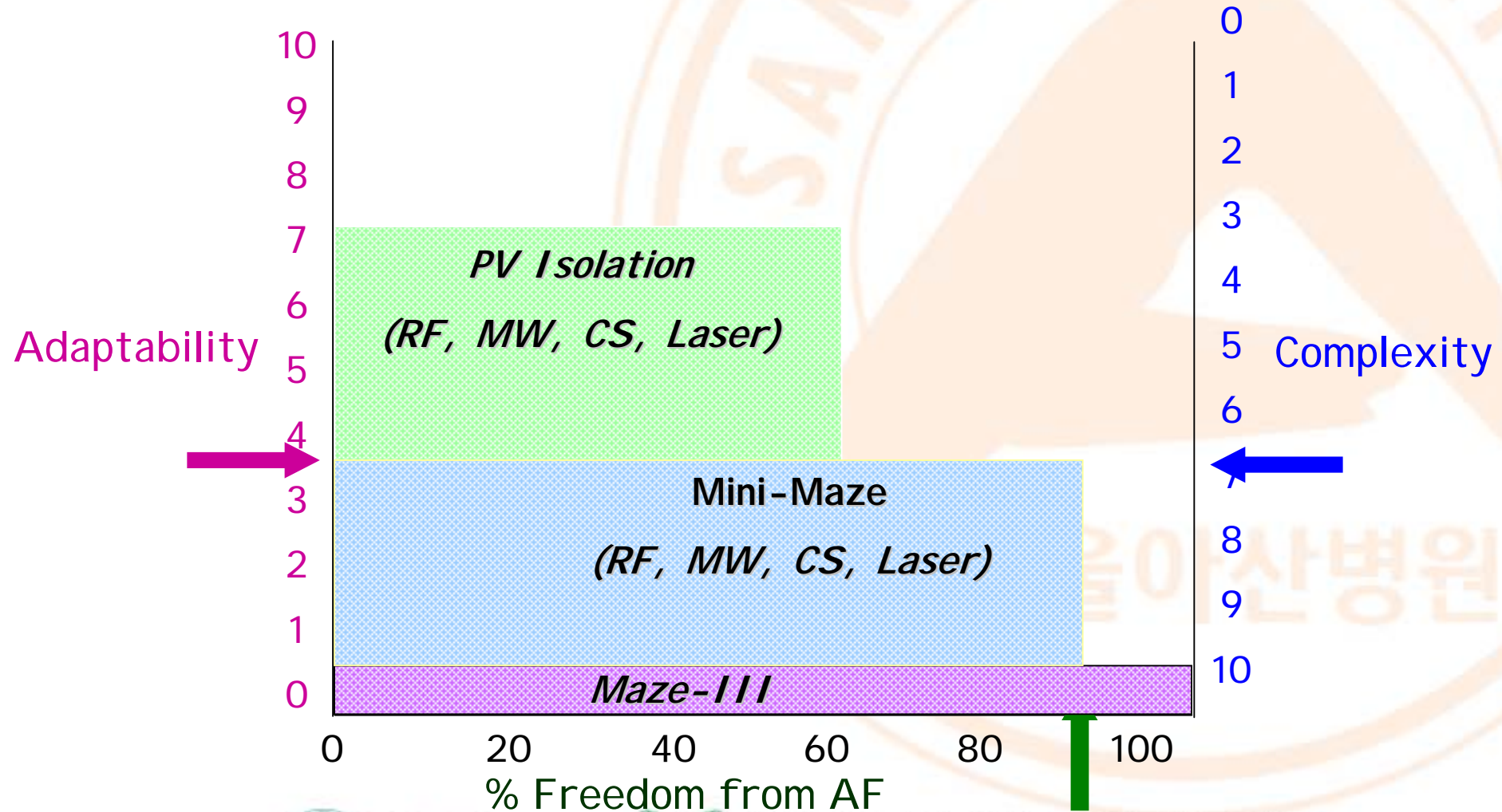


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The Mini-Maze Procedure

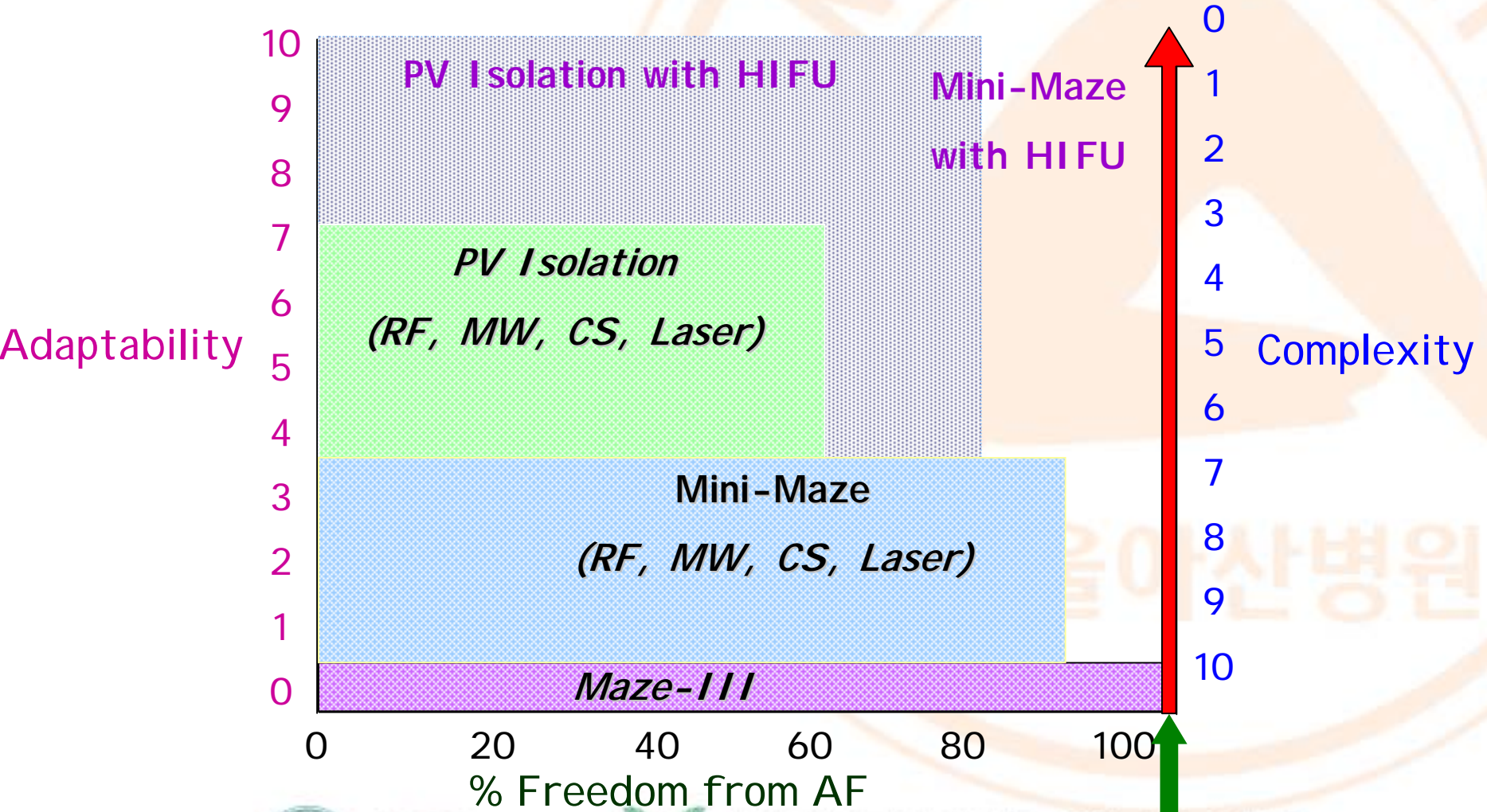


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Mini-Maze Procedure with HIFU



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Methods used to conduction block

- ✿ Surgical Incisions
- ✿ Cryolesions
- ✿ Radiofrequency Lesions
- ✿ Microwave Lesions
- ✿ Laser Lesions
- ✿ High-Intensity Focused Ultrasound



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Surgical 'Maze' operation

- ✿ Cox-Maze III operation : gold standard for surgical treatment of AF
- ✿ Cut and Sew
- ✿ Best initial overall results
- ✿ Technical difficulty and complexity
- ✿ Cure rate: more than 96% at 10 years

Washington university, Damiano

✿ *Problem*

- *Postoperative pacemaker insertion*
- *Reduced LA contraction*



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Alternative Energy Sources

- ❁ *“ The object of these new technology is to replace the surgical incision with the lines of transmural ablation to creat conduction block”*

Damiano, *Ann Thorac Surg*, 2003



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Energy Sources

- ✿ Safety and effective
- ✿ *TRULY* less invasive
 - minimal invasive surgery
 - epicardial ablation



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Energy Sources

✿ Transmurality

- Production of histological transmural line
- Thickness of atrial wall may vary tenfold in one ablation line
- Fat tissue and Trabeculation
: inter or intraindividual variability



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Cryoablation

- ❁ Inexpensive, reasonable results
- ❁ N₂O-based Frigitronics cryoprobe
- ❁ Lateral diffusion damage
- ❁ Successful ablation of AF
- ❁ 2min, -60
- ❁ Bulky, sometimes unreliable cooling



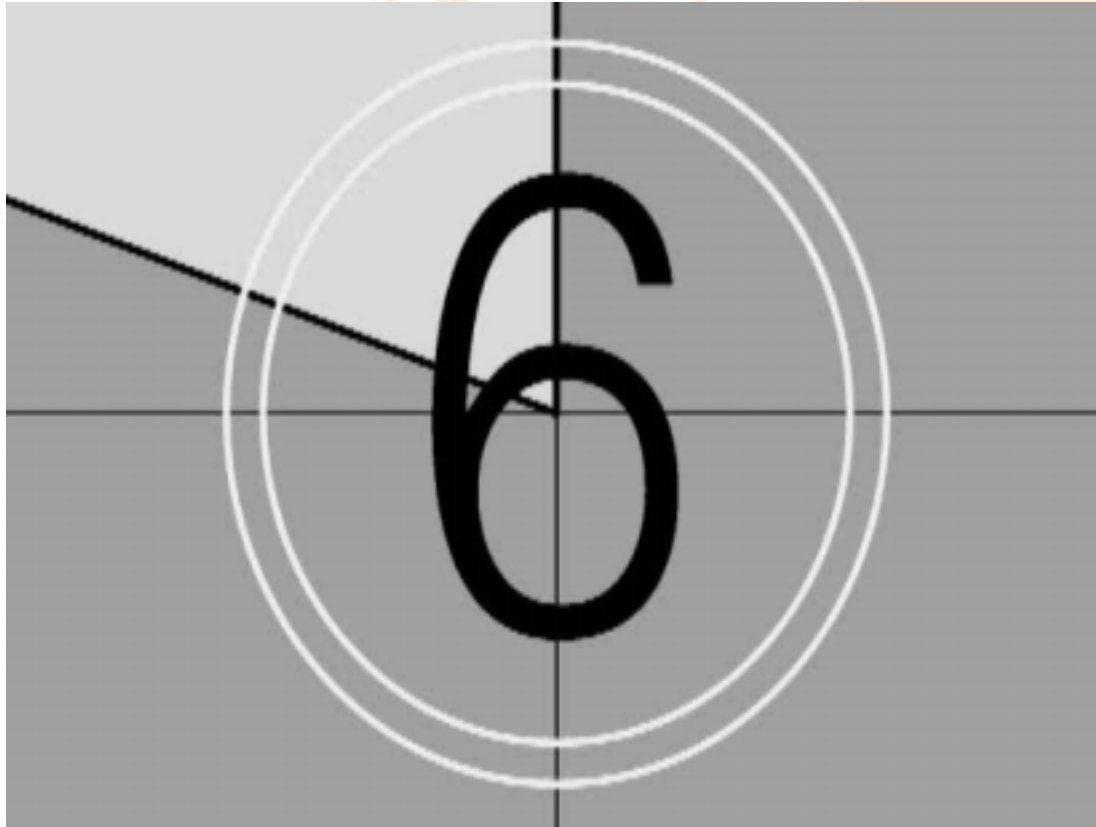
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Cryoablation

Transmural set : 2min at -60



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SurgiFrost

- ❁ - 160
- ❁ Tailoring ablation lines : flexible
- ❁ Rapid, efficient transmuralty
- ❁ Off-pump, epicardial ablation



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Radiofrequency

- ✿ More incisive than cryotherapy
- ✿ Current of 350 kHz to 1MHz
- ✿ Adjacent tissue injuries
- ✿ Saline irrigation
- ✿ Successful AF ablation



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Radiofrequency

❁ Bipolar probe

- Atricure ,Cardioblate
- Transmurality
- Epicardial/endocardial ablation



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Microwave

- ❁ High-frequency electromagnetic radiation
 - ➔ Oscillation of water molecules in tissue
 - ➔ Converting electromagnetic energy into kinetic energy(heat)
- ❁ Minimal invasive
 - ➔ Epicardial/ Endocardial approach
 - ➔ On/Off-pump ablation



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Epicardial Beating Heart Ablation

✿ Lesion set

- Single encircling lesion around PVs
- Line from PV circle to LA appendage
- LA appendage amputated or stapled off
- Line from SVC to IVS (crista terminalis)
- Line from CT to RA appendage

✿ FLEX 4 Microwave Ablation Probe

✿ Ablation times and power

- Epicardial: 65 watts @ 90 sec



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Microwave



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AMC results

- ✿ Period : Jul. 1997 ~ Sep. 2005
- ✿ Prospective cohort study of 422 patients
- ✿ Echocardiogram follow up
immediate postop, 3, 6, 12, 18, 24, 36 and 48 Mo



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AMC results

✿ Sex (M/F) : 184/238 (43.6:56.4)

✿ Age(yrs) : 51.2 ± 12.7 (11~80)

✿ Mean follow up(months)
 32.1 ± 23.1 (0.1~89.3)



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Mortality

	N(%)
✿ Early mortality	3 (1.2)
✿ Late mortality	2 (0.8)



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Morbidity

Minor stroke

2 (0.8)

N(%)

PPM

3 (1.2)

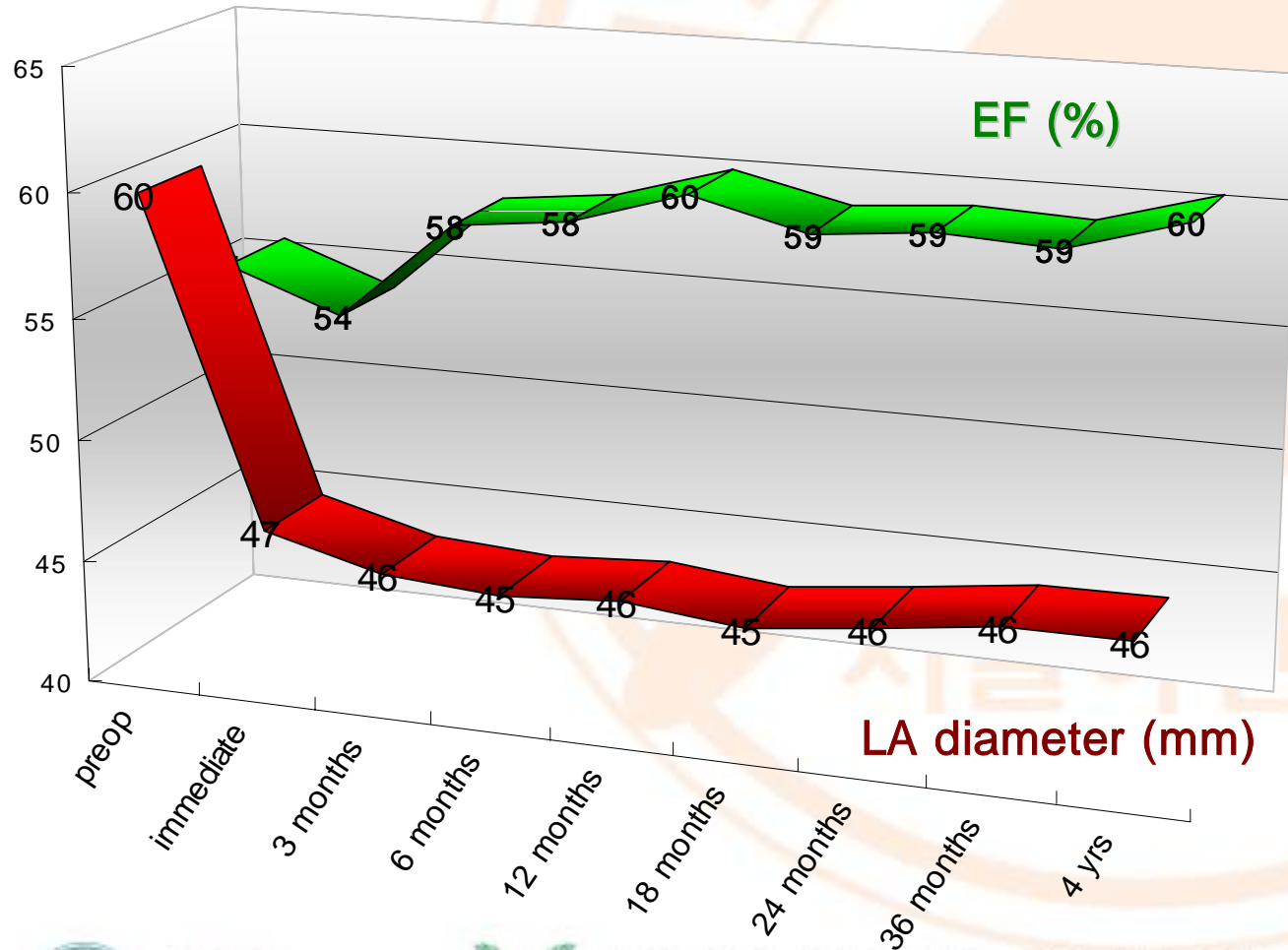


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LA diameter & EF

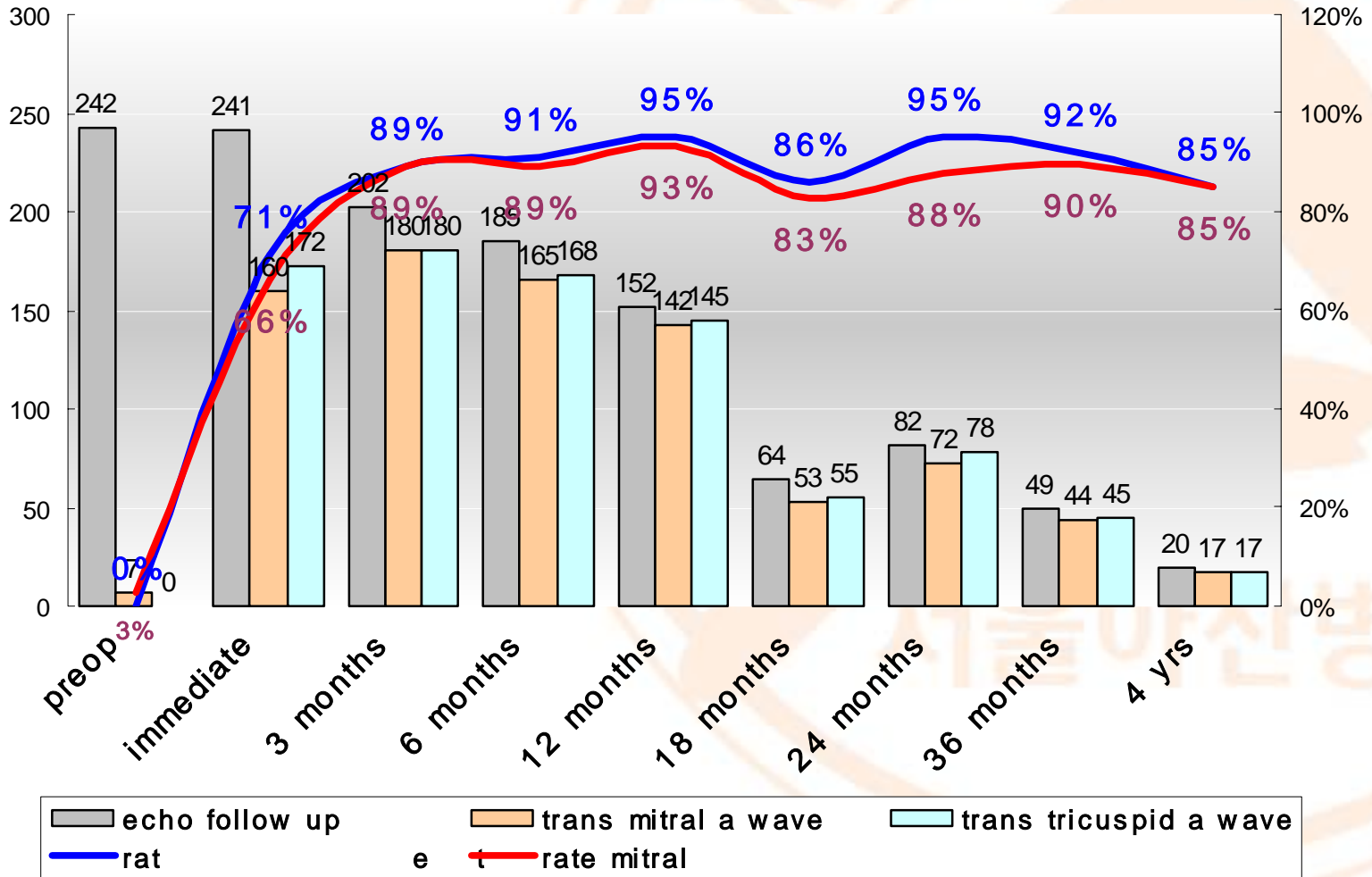


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A wave



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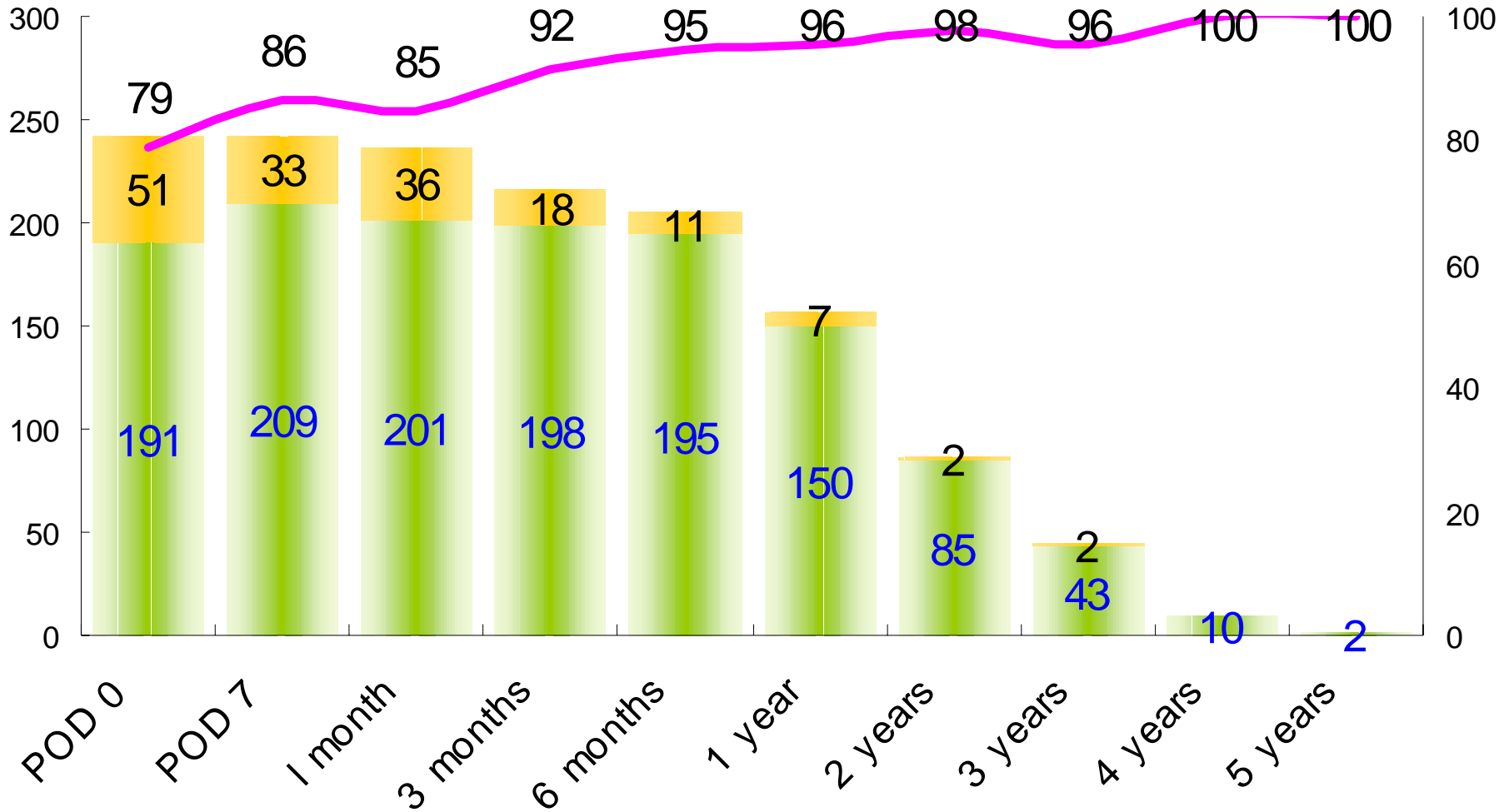


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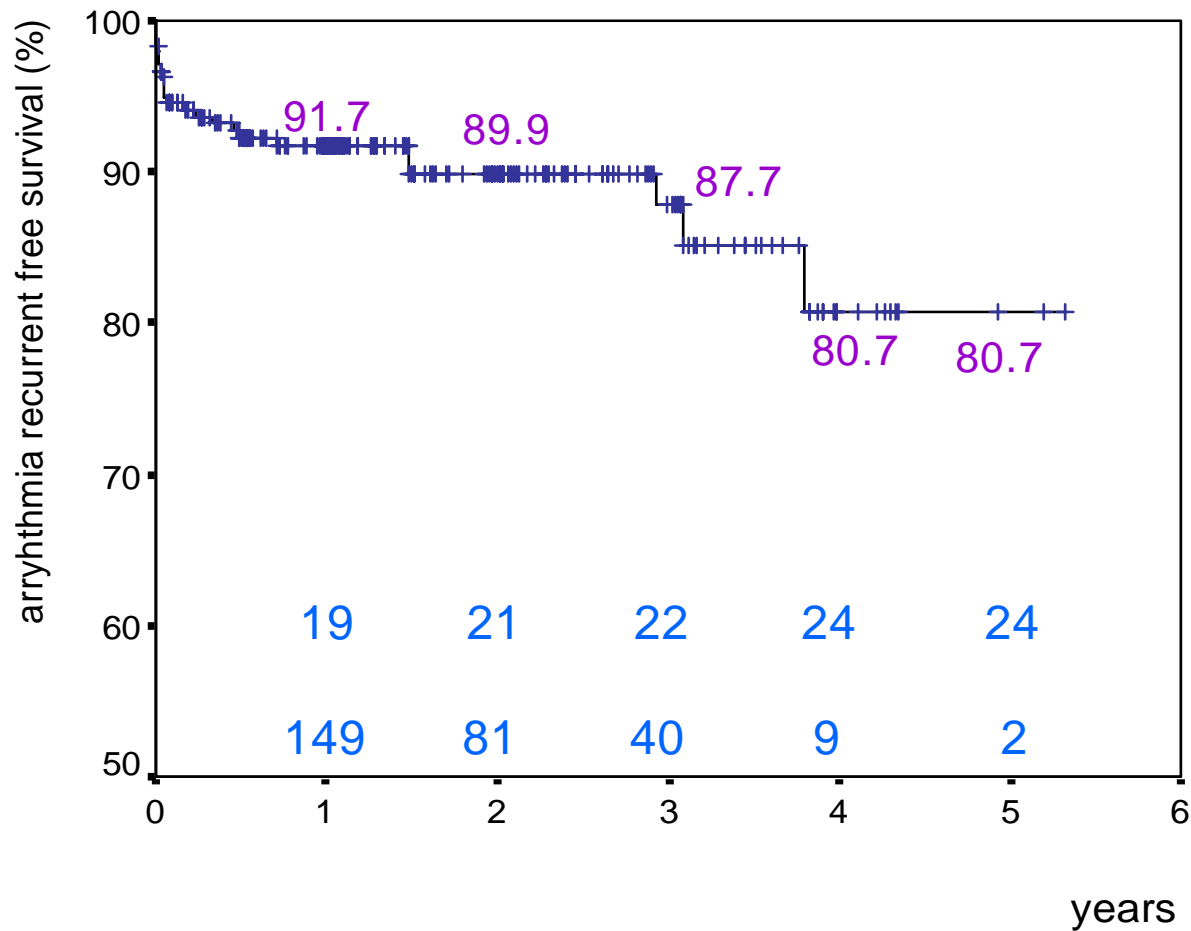
Sinus Rate

counts

%



AF recurrence free rate

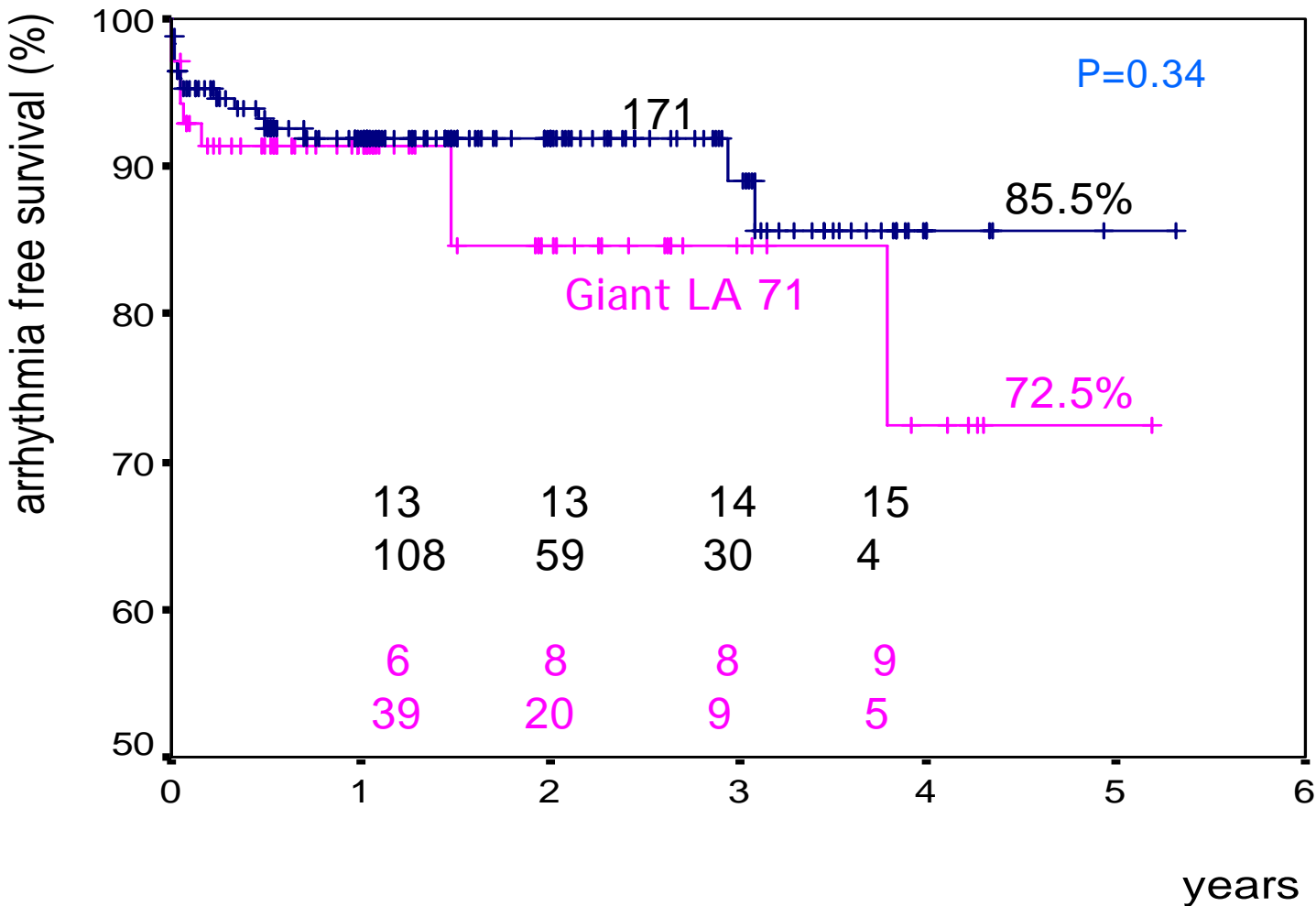


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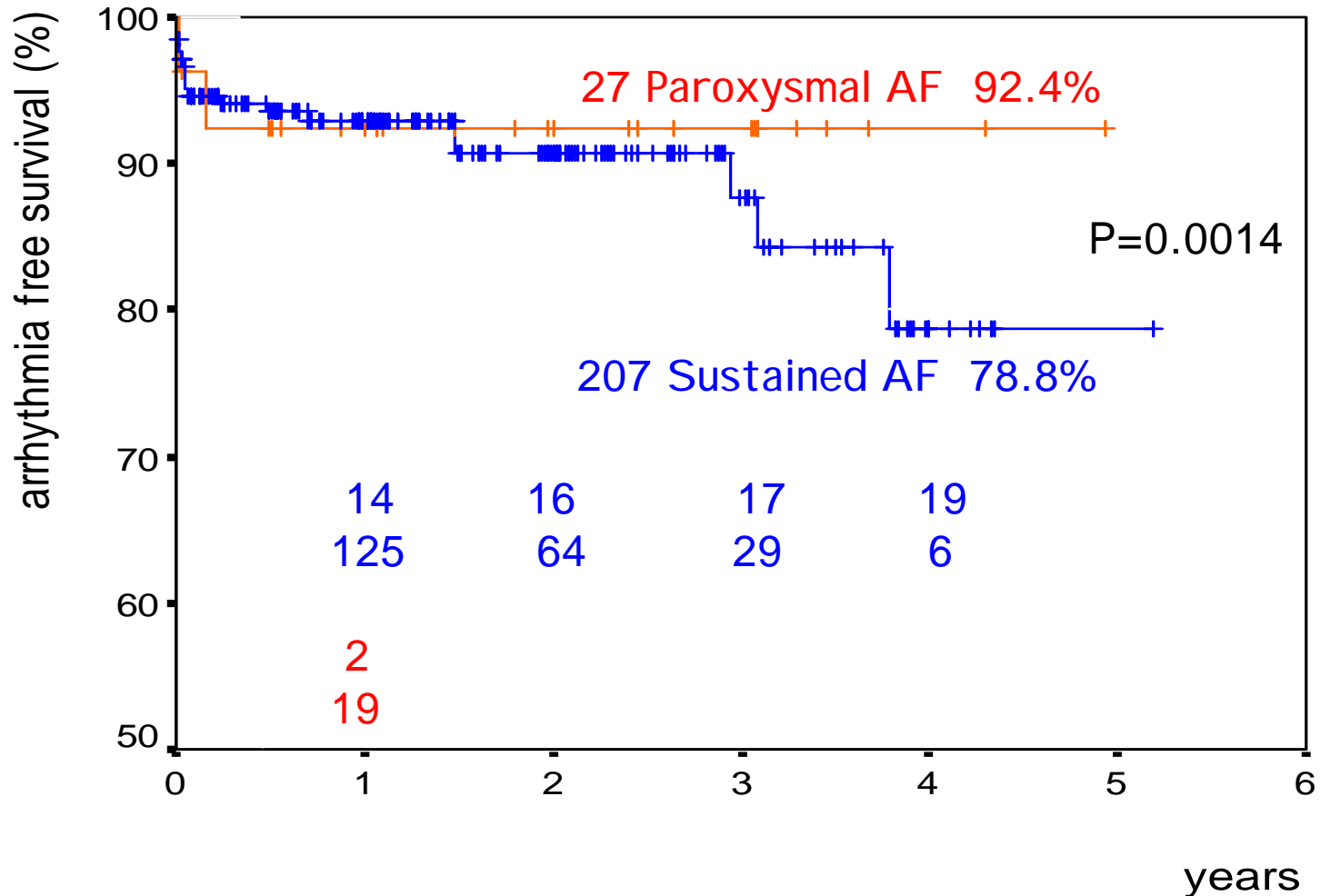


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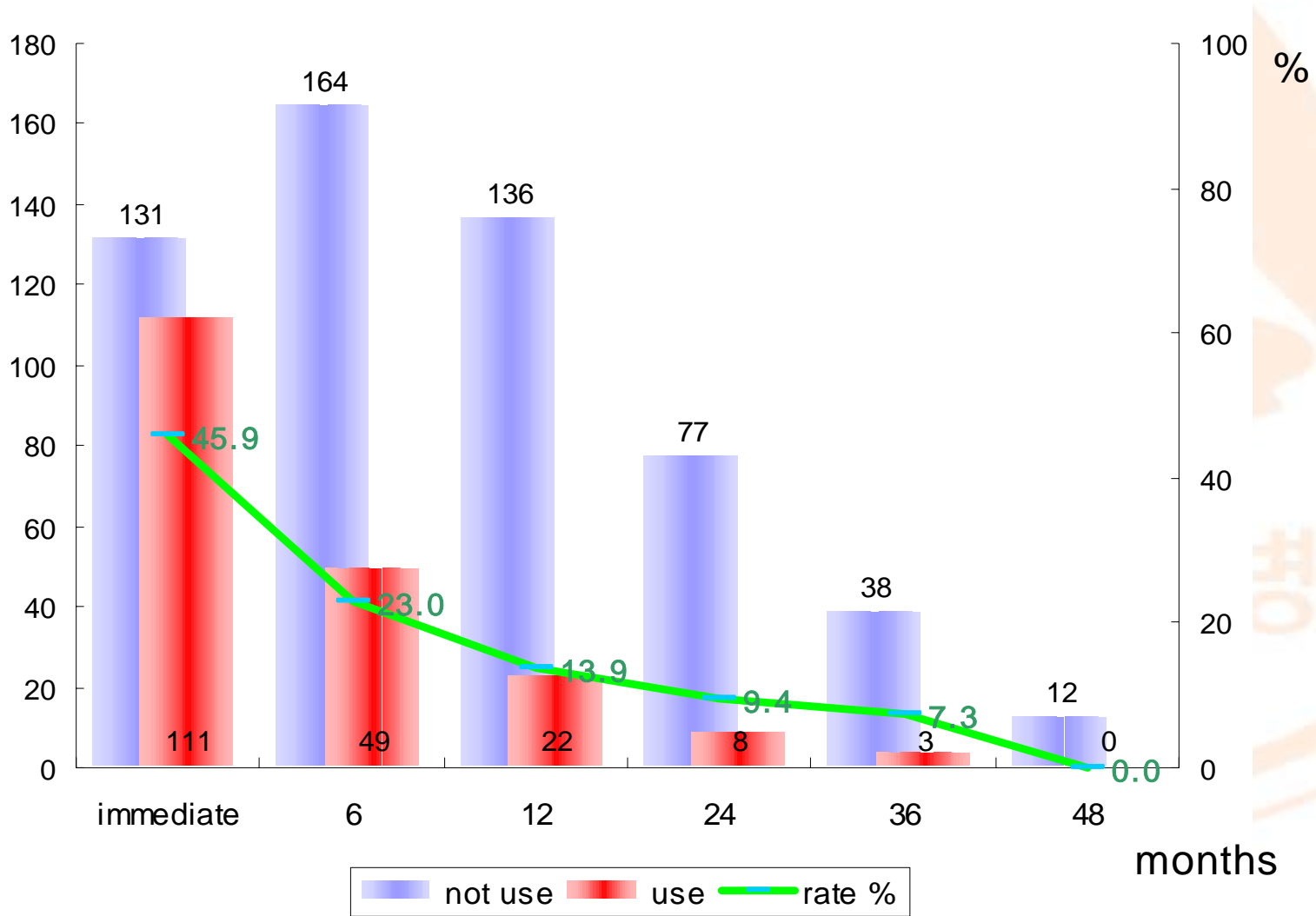
AF recurrence free rate; Giant LA



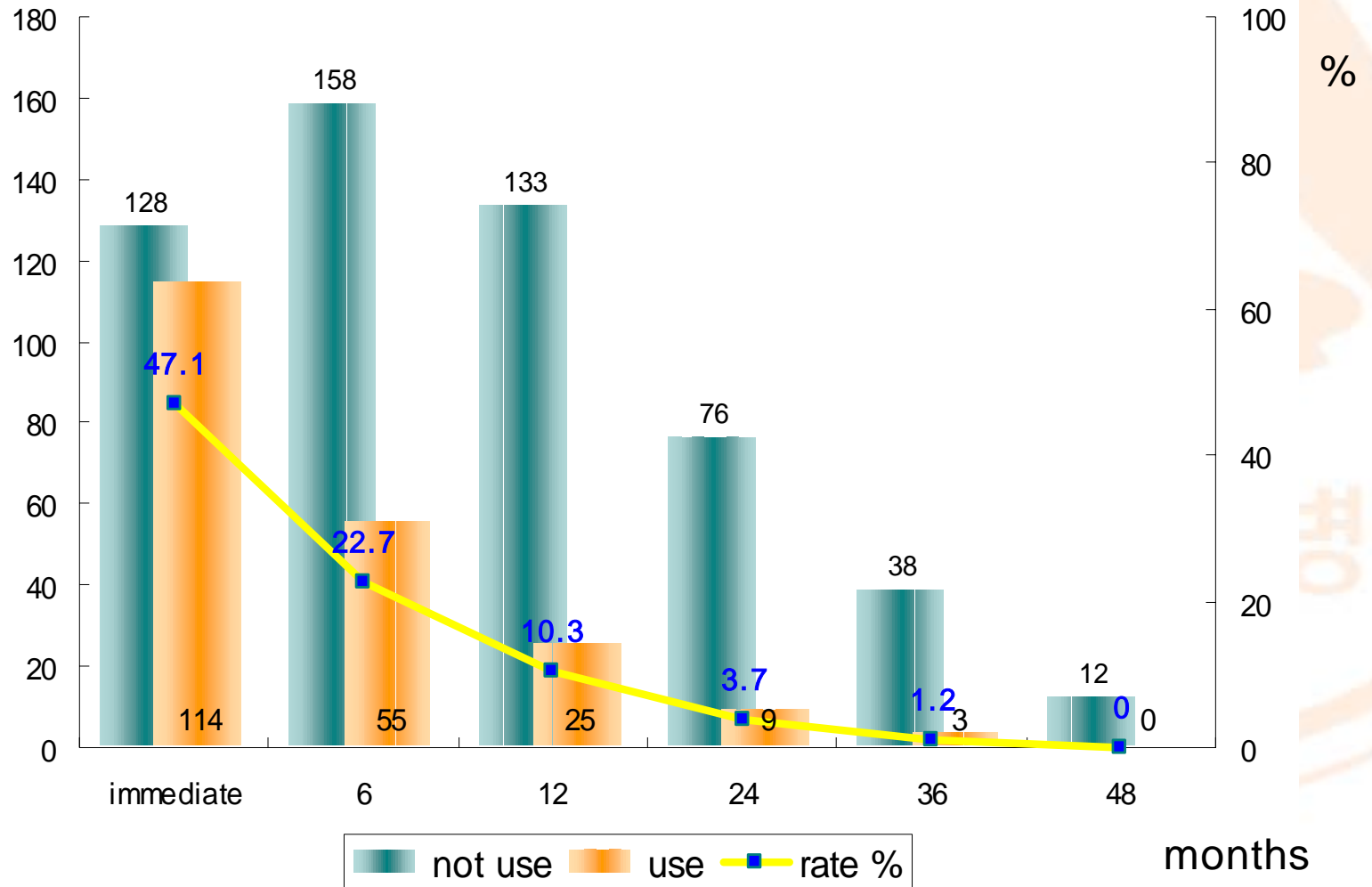
AF recurrence free rate; Sustained AF vs. Paroxysmal AF



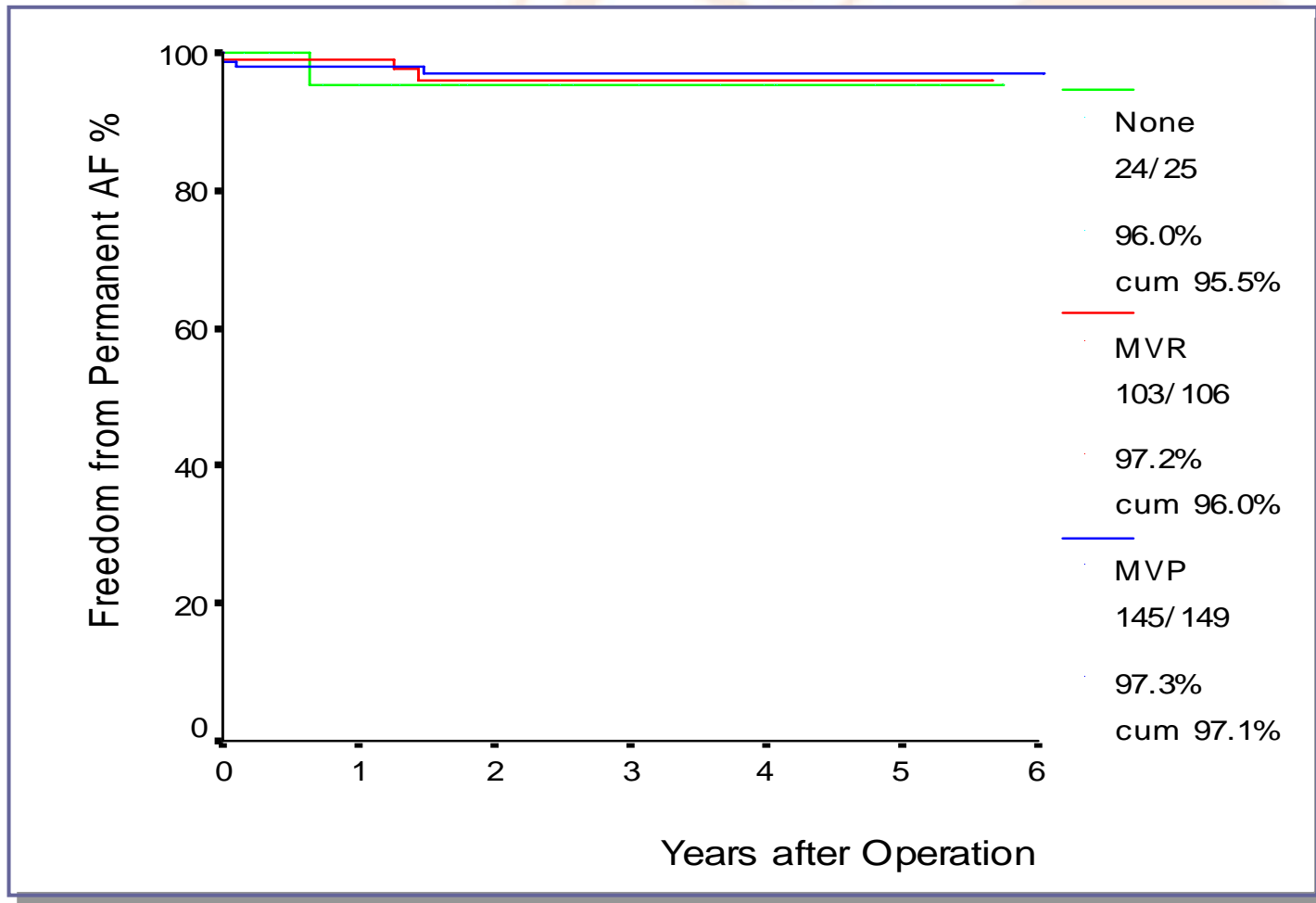
Warfarin; arrhythmia related use



Amiodarone



Freedom from AF : MVR vs MVP

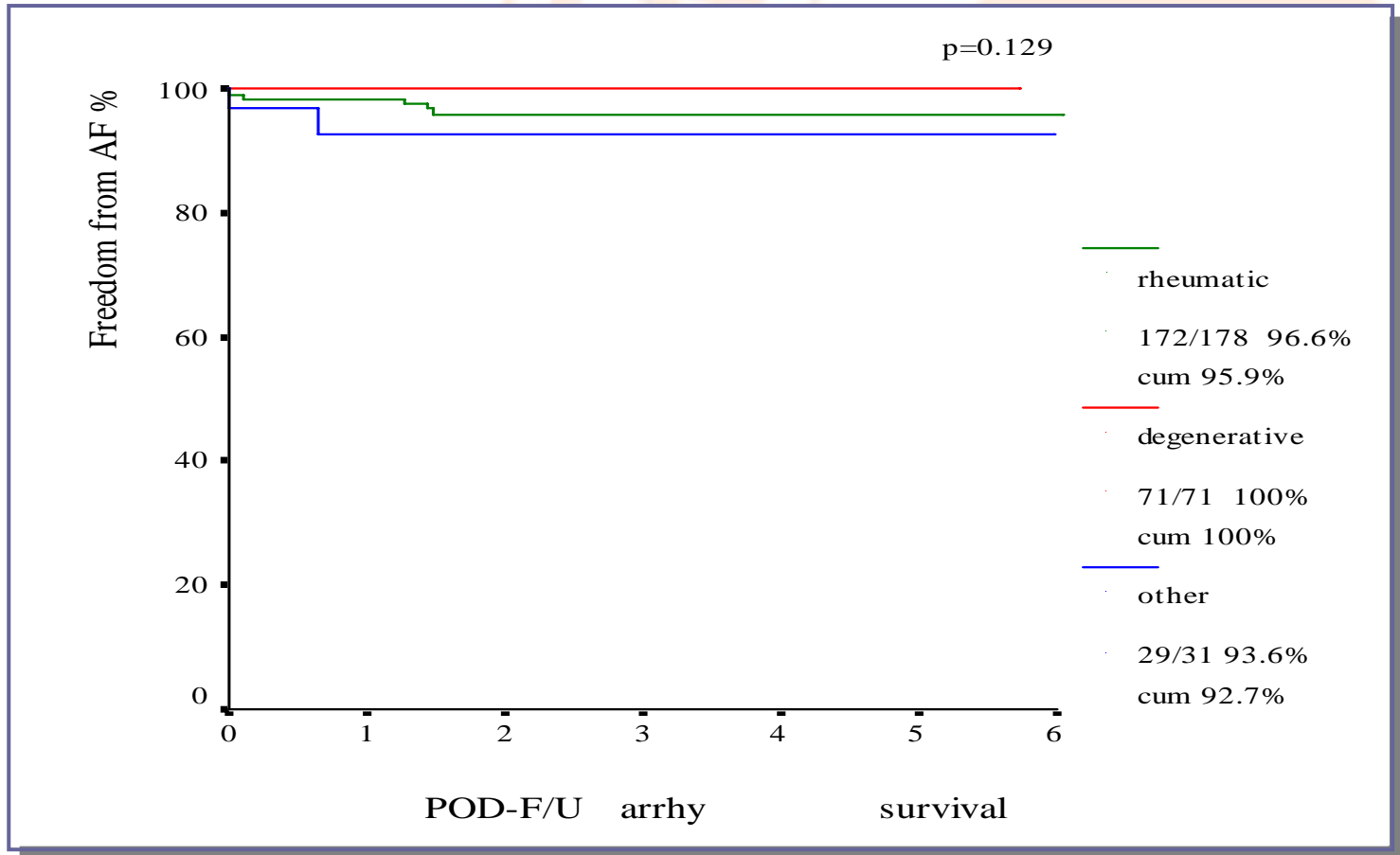


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Freedom from AF : Rheumatic vs Degenerative



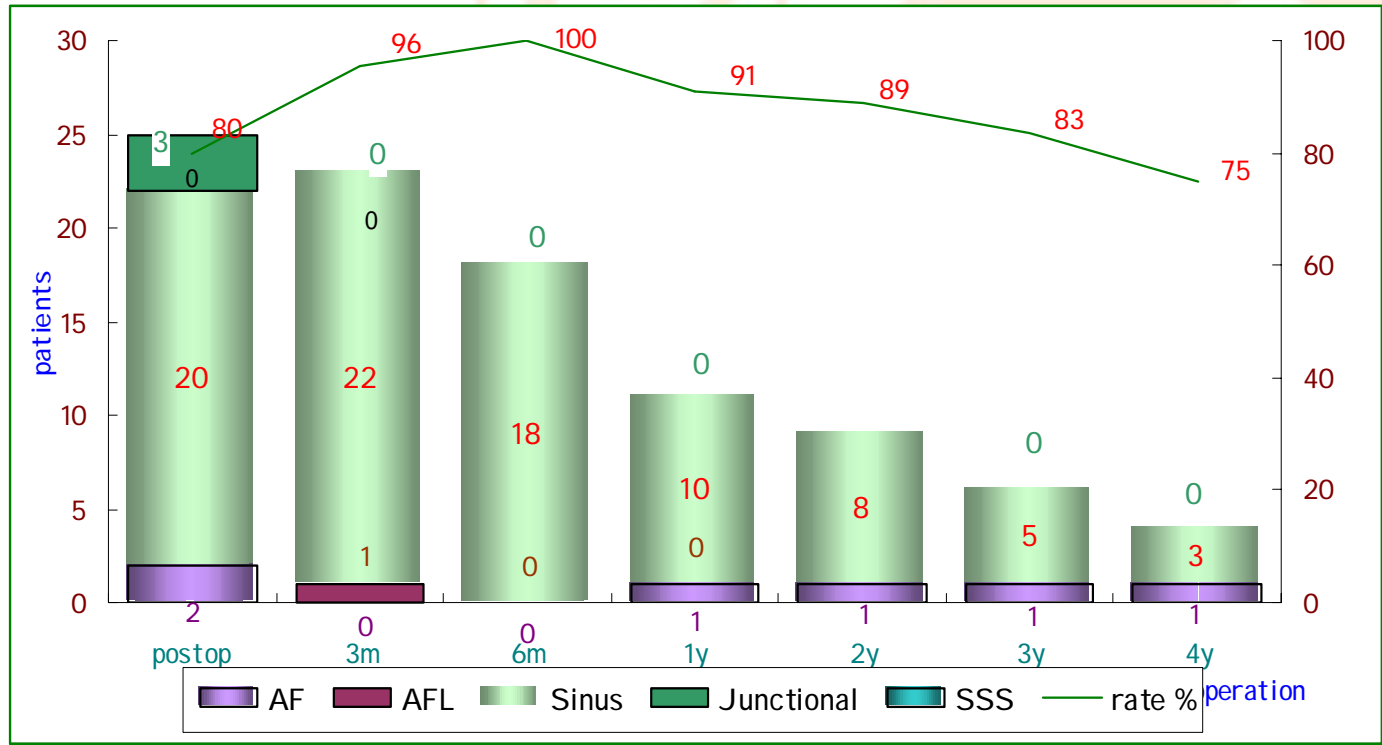
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AMC results

AF without mitral valve disease
(on-pump beating, epicardial MW)



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Summary

- ✿ Modified Maze is a safe procedure, Mx 1.2%
- ✿ Sinus: 79% in OR, 86% on discharge,
and > 95% up to 5 yrs
- ✿ Atrial transport (a wave): 71% on discharge,
> 90% after 6 mos
- ✿ Minimal use of warfarin and amiodarone in the
long-term
- ✿ No differences in giant LA, rheumatic MV
- ✿ Good result in lone AF with MI CS approach



Surgical Conclusion

The long-term results of Maze operation
are stable up to 5 years
without increased need for medications



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Recurrence of AF/AFL

- ❁ Postoperative supraventricular tachycardias (mostly AFL)
 - : 3% to 11%
- ❁ Mechanism of atrial tachyarrhythmias
 - predominantly left-sided origin
- ❁ Need for EPS for recurred cases

Ann Thorac Surg 2005



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Conclusion

- ✿ Collaboration between surgery and EPS
 - Postoperative AF/AFL → EPS
 - AF/AFL surgical ablation after EPS failure



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