Under Pressure:

Optimal Post-Dilation Strategy

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(Optimal) PCI Procedure

Pre-Lesion Modification

Stent Implantation

Post-Dilatation

- Stent Balloon
- High Pressure Balloon
- IVUS Guidance

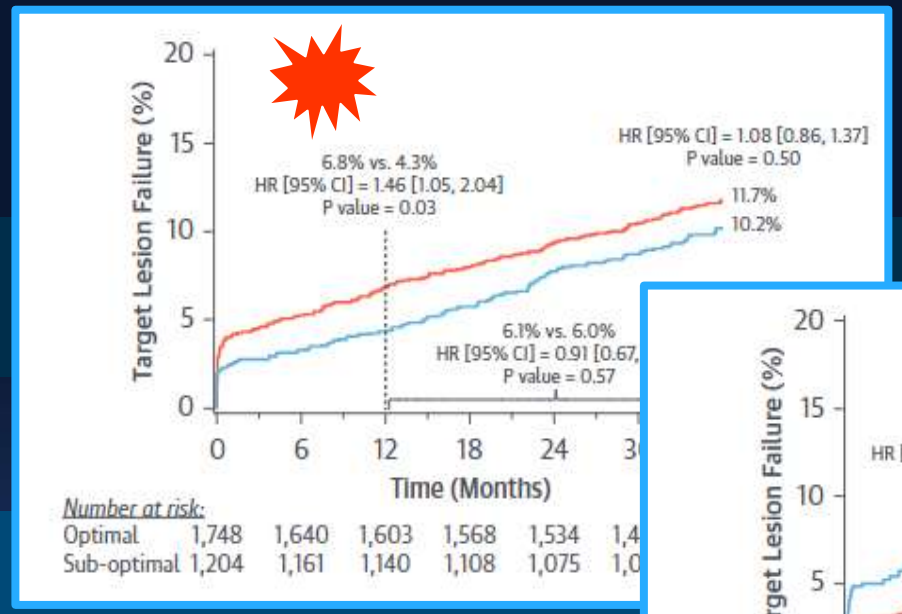
BRS Experience From the ABSORB Trials

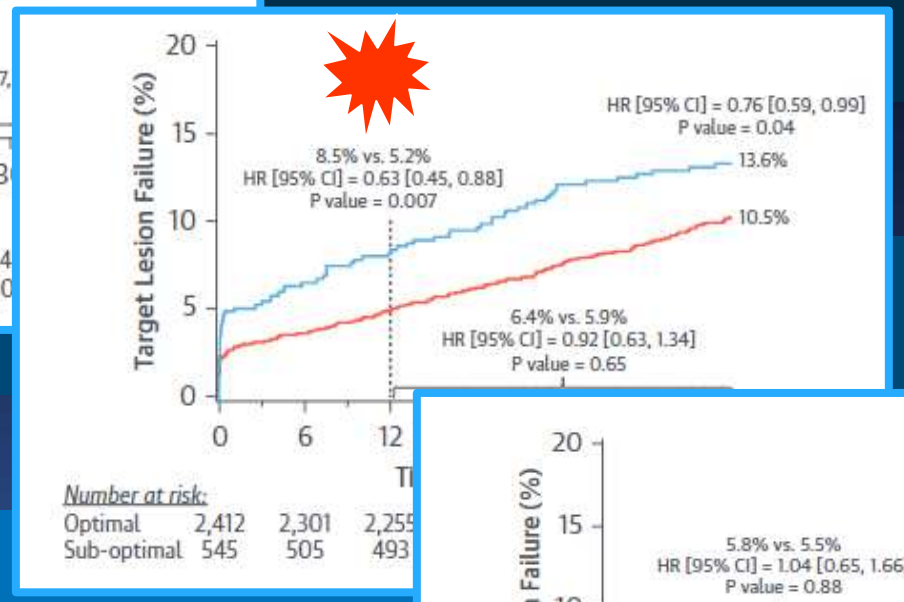
Optimal
Suboptimal

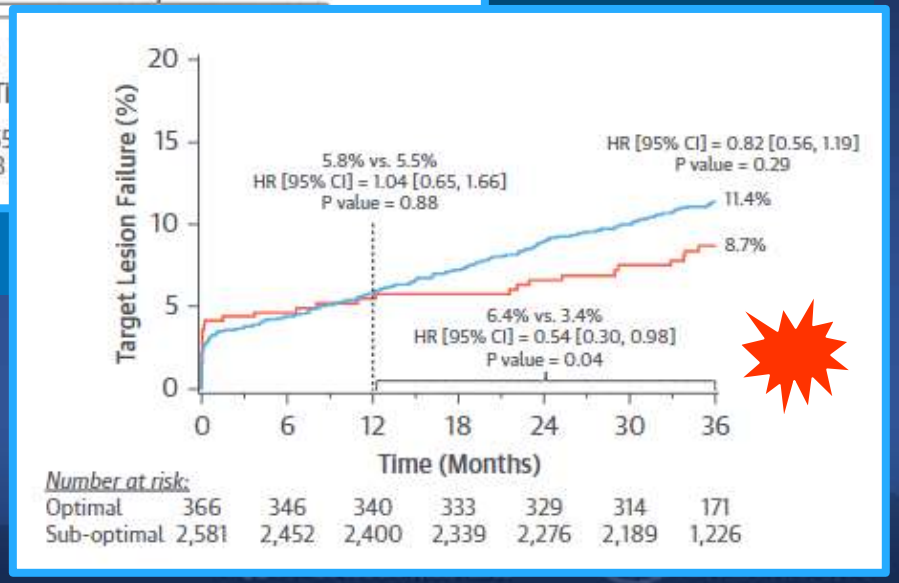
P *Pre-Dilation*

S *Sizing*

P *Post-Dilation*







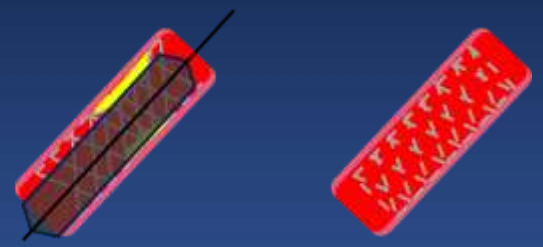
- **Only 5% of Patients Achieved Optimal PSP**

Gregg W. Stone et al. JACC 2017;70:2863-74

Imaging Guided PSP From IRIS FFR Registry (N=9525)

Under the Intracoronary Imaging Guidance

Inspection of lesion characteristic by IVUS	Selection of stent size and length by IVUS	Surveillance of stent outcomes
Calcification Plaque burden and configuration Opening of side branch	Stent landing zone configuration Lesion length Reference vessel size	Stent apposition Stent area Procedural complications
P Pre-dilation	**S** Stent Sizing	**P** Post-dilation



Pre-dilation	Stent Sizing	Post-dilation
Lesion pre-modification for stent delivery and expansion: High pressure balloon Cutting or scoring balloon Rota-ablation	Full lesion coverage Adequate stent size	Complete stent apposition Sufficient stent area No geographic miss No procedural complications

Park HB, Ahn JM, Park SJ et al. 2020 Jun 22;13(12):1403-1413

Imaging Guided PSP for Complex CAD (N=9525)

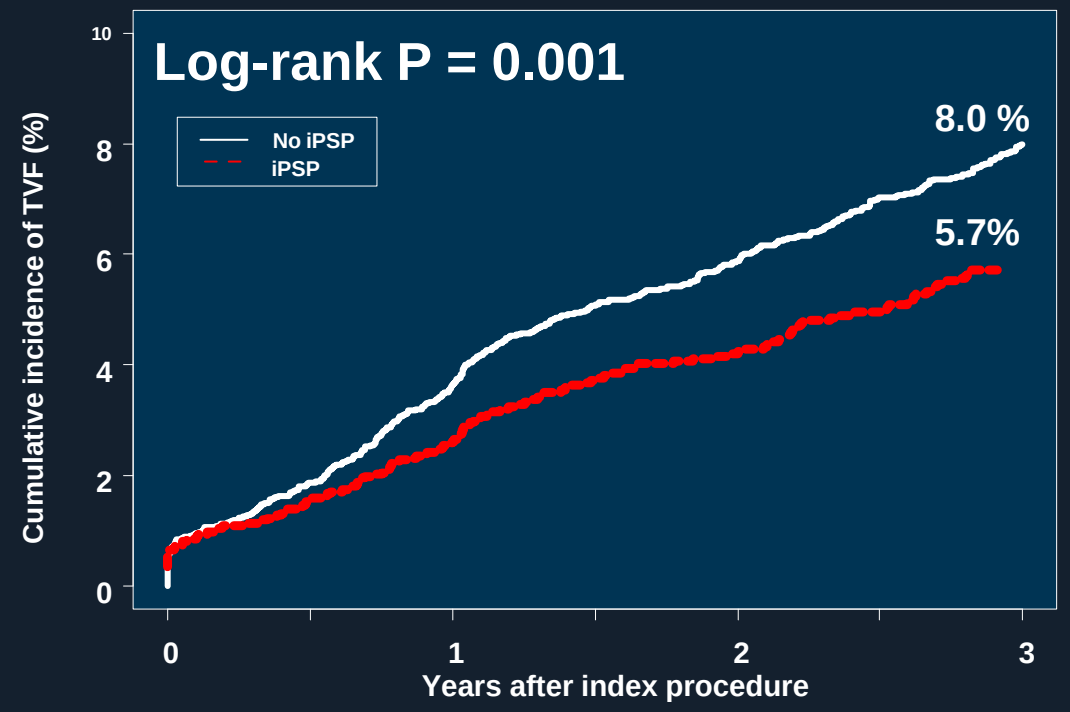
P	*Pre-Dilation*	*8522 patients (89.5%)*
S	*Sizing by IVUS*	*5141 patients (54.0%)*
P	*Post-Dilation*	*5531 patients (58.1%)*

→ *3,374 patients (35.4%)*

Park HB, Ahn JM, Park SJ et al. 2020 Jun 22;13(12):1403-1413

Unadjusted Kaplan-Meier Curves

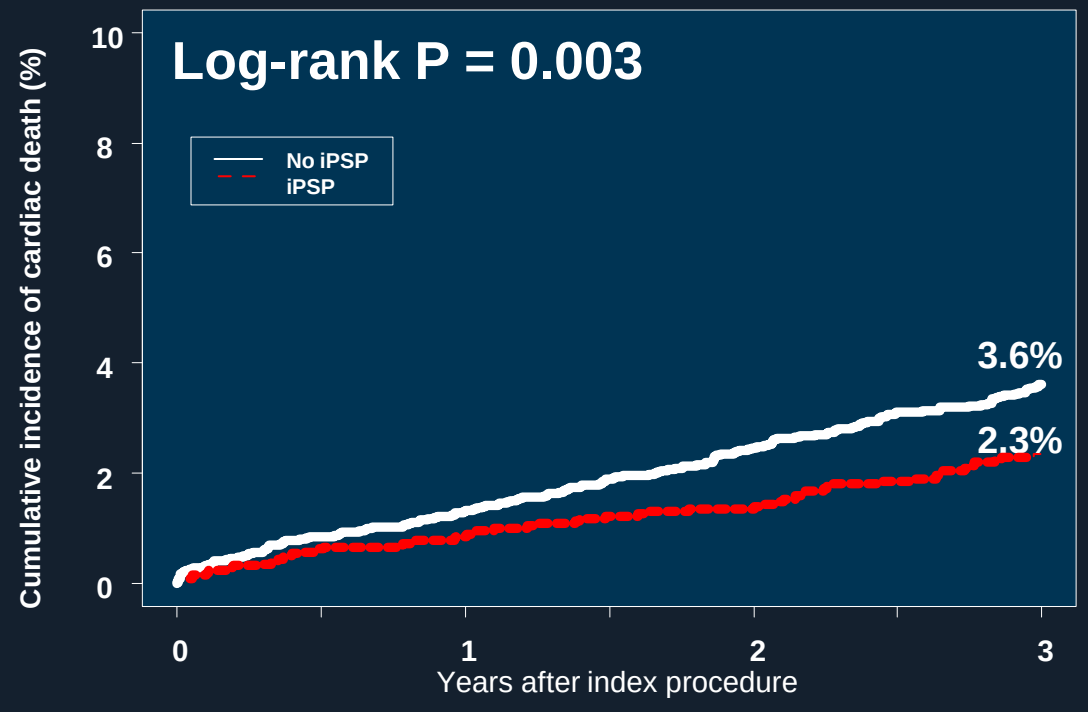
Primary Outcome



No. of at risk

No iPSP	6151	4928	3993	3324
iPSP	3374	2733	2147	1897

Cardiac Death



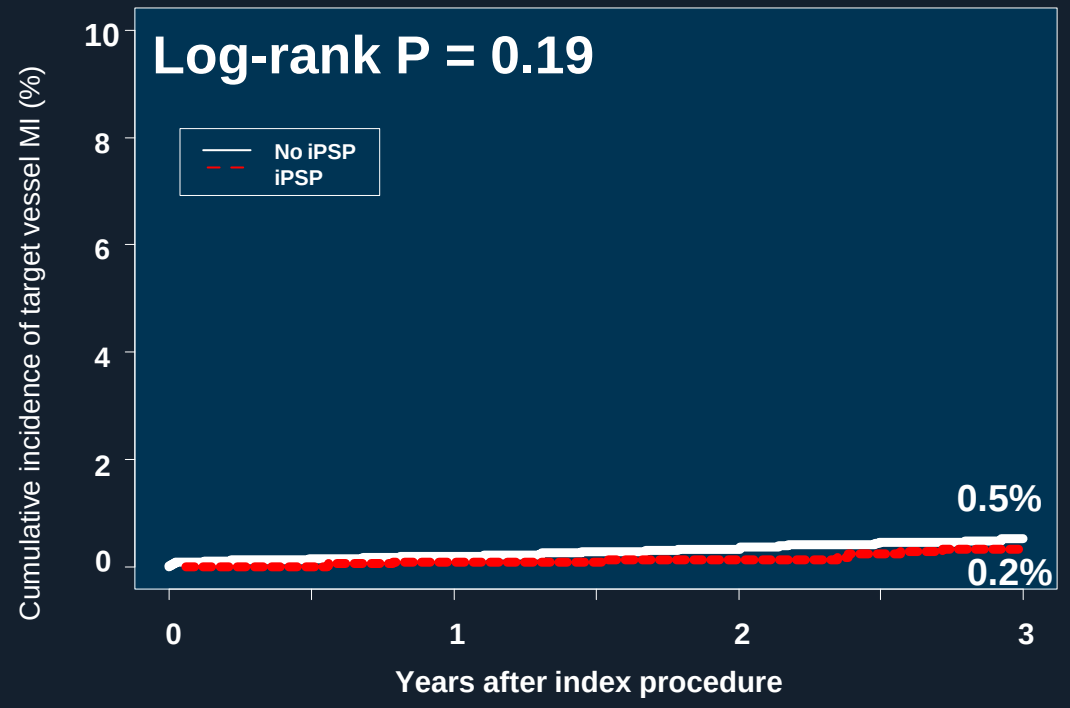
No. of at risk

No iPSP	6151	5039	4140	3538
iPSP	3374	2886	2206	1794

Park HB, Ahn JM, Park SJ et al. JACC: Cardiovascular Interventions Volume 13, Issue 12, June 2020

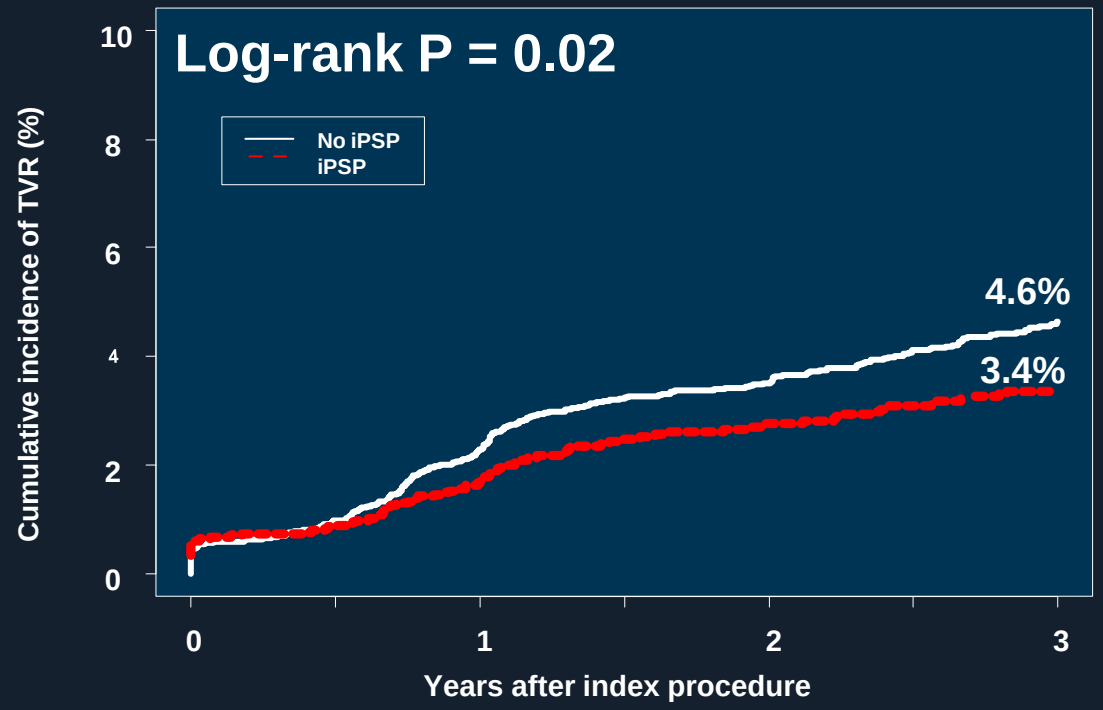
Unadjusted Kaplan-Meier Curves

Target Vessel MI



No. of at risk				
No iPSP	6151	5633	4231	3682
iPSP	3374	3111	2273	2062

Target Vessel Revascularization



No. of at risk				
No iPSP	6151	4957	4018	3347
iPSP	3374	2736	2163	1921

Park HB, Ahn JM, Park SJ et al. JACC: Cardiovascular Interventions Volume 13, Issue 12, June 2020

Adjusted Hazard Ratios for Primary Outcomes According to Components of iPSP

	Univariate analysis		Multivariate analysis*	
	HR (95% CI)	P value	HR (95% CI)	P value
Pre-dilation	0.89 (0.69-1.15)	0.374	0.84 (0.64-1.11)	0.216
Stent-sizing	0.79 (0.67-0.93)	0.004	0.89 (0.74-1.07)	0.219
Post-dilation	0.79 (0.67-0.94)	0.006	0.80 (0.67-0.96)	0.016

* The multivariate analysis model included 18 clinical variables: age, sex, body mass index, hypertension, diabetes mellitus, prior history of MI, prior history of heart failure, prior history of stroke, hyperlipidemia, chronic kidney disease, peripheral artery disease, chronic lung disease, atrial fibrillation, acute coronary syndrome at presentation, left ventricular ejection fraction, disease extent of CAD (1-, 2-, or 3-vessel disease), involvement of LMCA, and angiographically severely calcified lesion. The primary outcome was defined as the composite of cardiac death, target vessel MI, or target vessel revascularization.

Park HB, Ahn JM, Park SJ et al. 2020 Jun 22;13(12):1403-1413

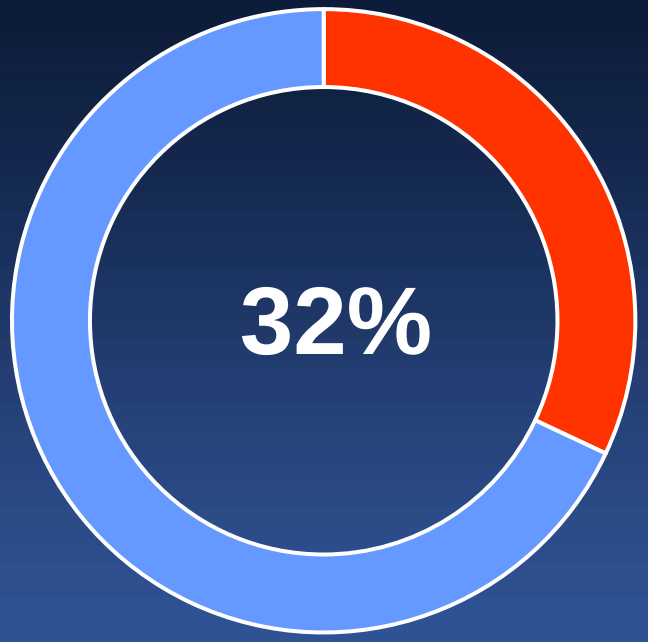
Procedures and Clinical Outcomes by iPSP Scenarios

Scenario	Pre-dilation	IVUS	Post-dilation	No. of patients (%)	Stent diameter (mm)	Post balloon size (mm)	Annualized event rate	Adjusted HR (95% CI)	P value
1	No	No	No	406 (4.3)	3.19 ± 0.46		3.94 %	Reference	
2	Yes	No	No	2130 (22.4)	3.06 ± 0.40		2.69 %	0.85 (0.57-1.26)	0.413
3	No	Yes	No	159 (1.7)	3.41 ± 0.45		2.03 %	0.71 (0.33-1.56)	0.394
4	**No**	**No**	**Yes**	129 (1.4)	3.04 ± 0.41	3.10 ± 0.81	3.04 %	0.81 (0.35-1.85)	0.613
					Δ +0.05 (P=0.550)				
5	Yes	Yes	No	1299 (13.6)	3.26 ± 0.85		2.90 %	0.91 (0.60-1.38)	0.663
6	**Yes**	**No**	**Yes**	1719 (18.0)	3.08 ± 0.38	3.12 ± 0.86	3.07 %	0.80 (0.53-1.21)	0.297
					Δ +0.04 (P=0.104)				
7	**No**	**Yes**	**Yes**	309 (3.2)	3.43 ± 0.41	3.79 ± 0.70	2.04%	0.72 (0.39-1.35)	0.306
					Δ +0.35 (P<0.001)				
8	**Yes**	**Yes**	**Yes**	3374 (35.4)	3.26 ± 0.39	3.58 ± 0.60	1.98%	0.63 (0.42-0.93)	0.022
					Δ +0.32 (P<0.001)				

Park HB, Ahn JM, Park SJ et al. JACC: Cardiovascular Interventions Volume 13, Issue 12, June 2020

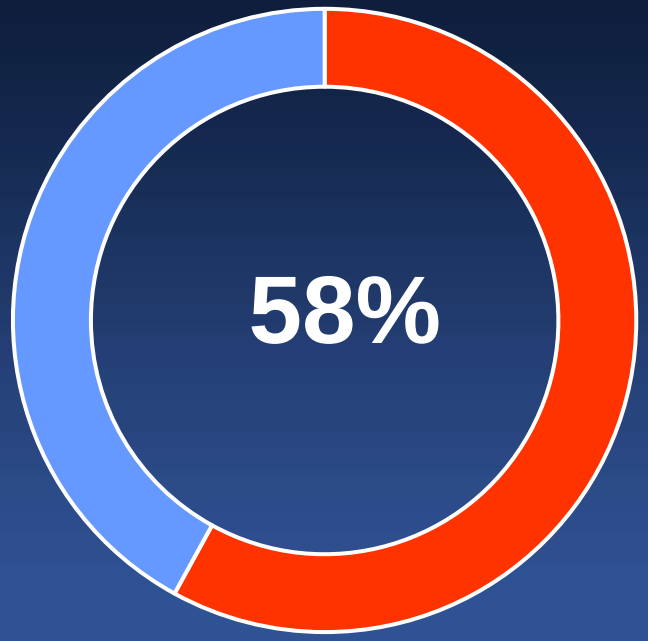
Post Dilatation

- SCAAR Registry (N=93,697)



Ole Frobert et al PLoS One 2013;8(2):e56348

- IRIS DES Registry (N=9,525)



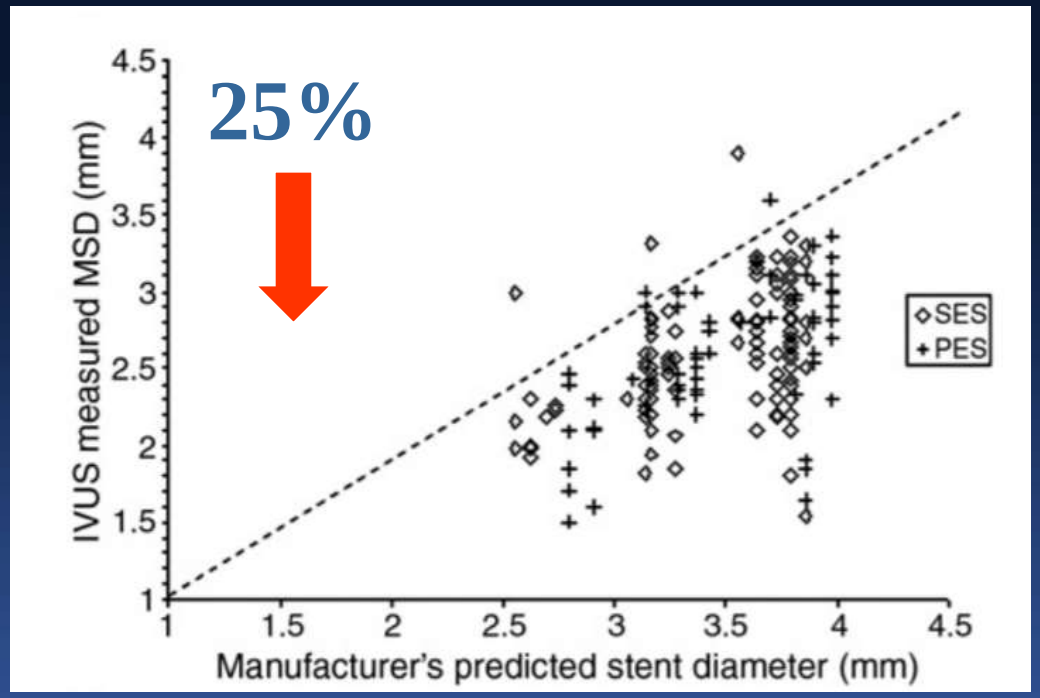
Park HB, Ahn JM, Park SJ et al. 2020 Jun 22;13(12):1403-1413

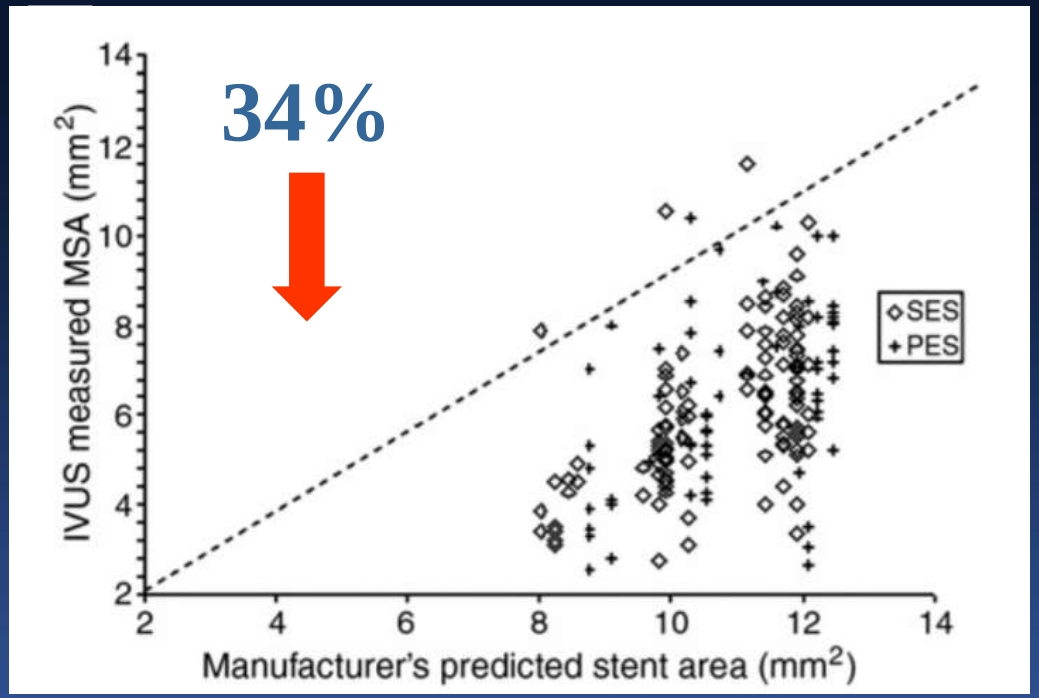
Post-Dilation Strategy

- Stent Balloon
- High Pressure Balloon
- What Pressure ?
- Imaging Guidance ?
- What is the target for post-dilation ?

Stent Balloon

The DES achieved only 75% of predicted MSD and 66% of predicted MSA



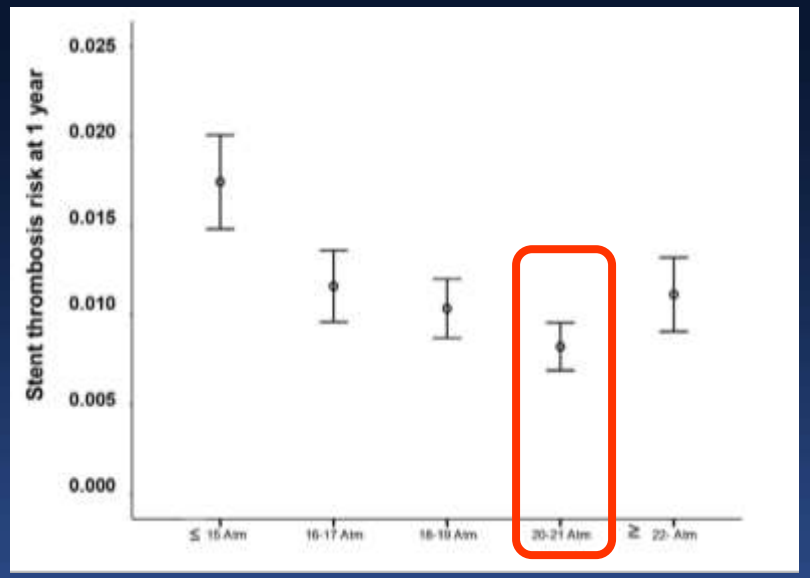


MSD **MSA**

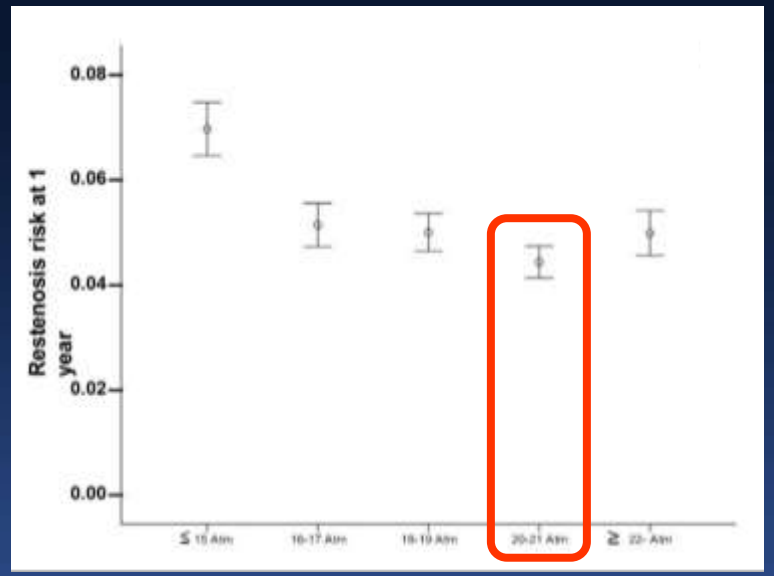
Am Heart J 2007;153:2972303

What Pressure ? SCAAR Registry

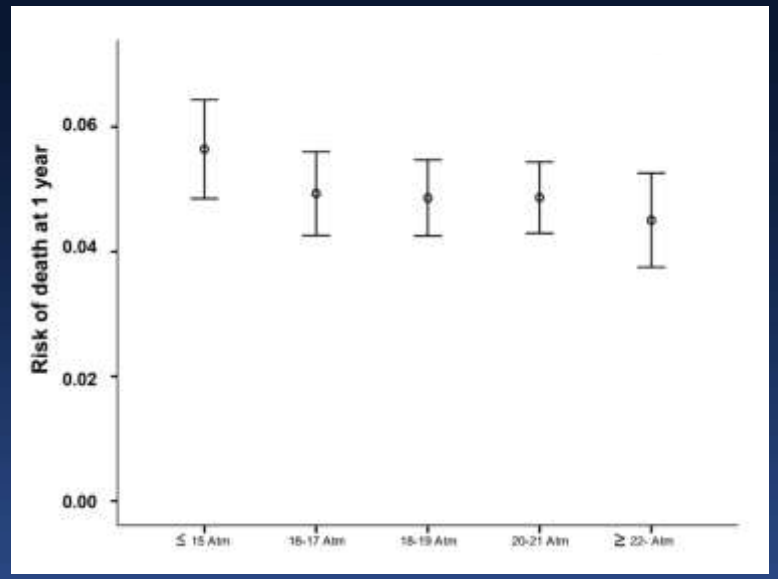
Stent Thrombosis



Restenosis



Death

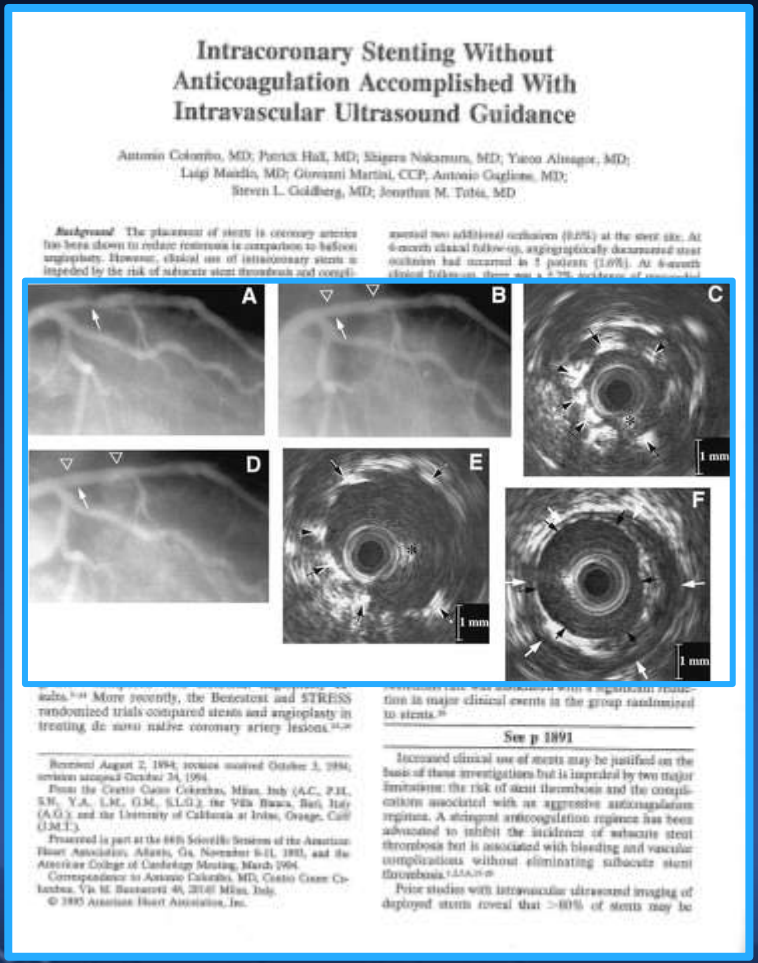


20-21 Atm

Ole Frobert et al PLoS One 2013;8(2):e56348

Intracoronary stenting without anticoagulation accomplished with *IVUS* guidance

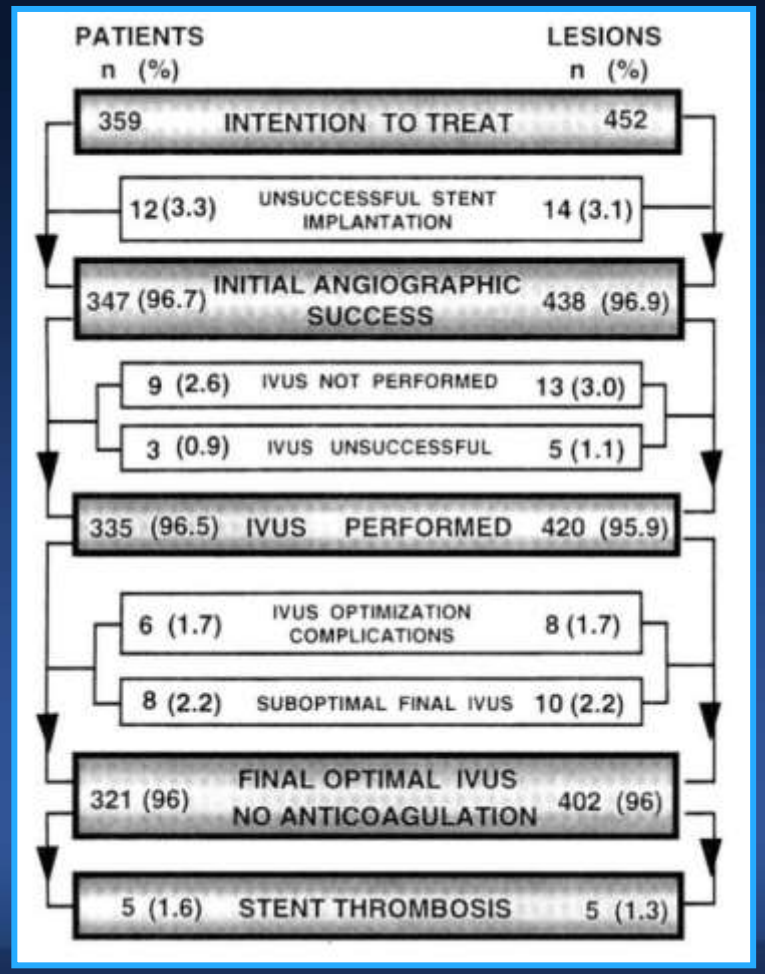
Antonio Colombo et al. Circulation. *1995 (26 years ago)*;91:1676–1688



Intracoronary Stenting Without Anticoagulation Accomplished With Intravascular Ultrasound Guidance

Antonio Colombo, MD; Patrick Hall, MD; Shigero Nakamura, MD; Yaron Almagor, MD; Luigi Maiello, MD; Giovanni Martini, CCP; Antonio Gaglione, MD; Steven L. Goldberg, MD; Jonathan M. Tobis, MD

See p 1891



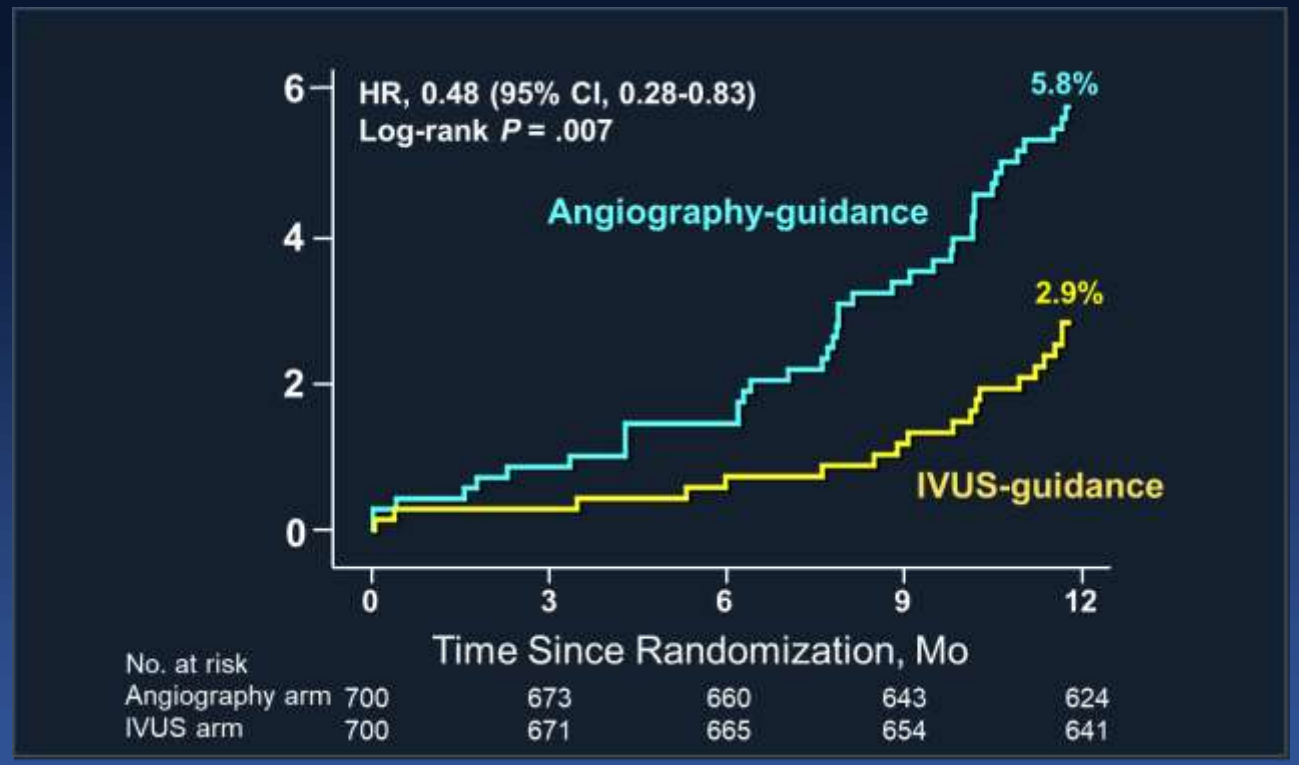
Stent Thrombosis

3-4%

1.6% at 6 months

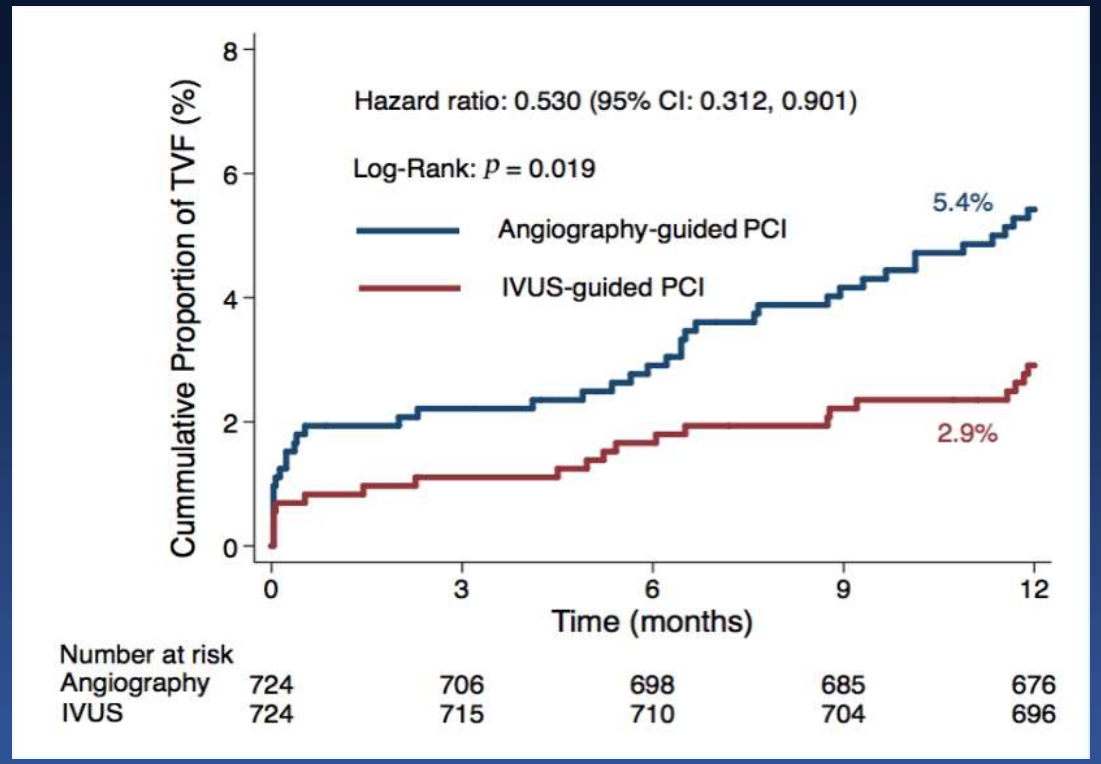
Randomized Trials

IVUS-XPL RCT



Hong SJ et al, *JAMA 2015*;314:2155-63

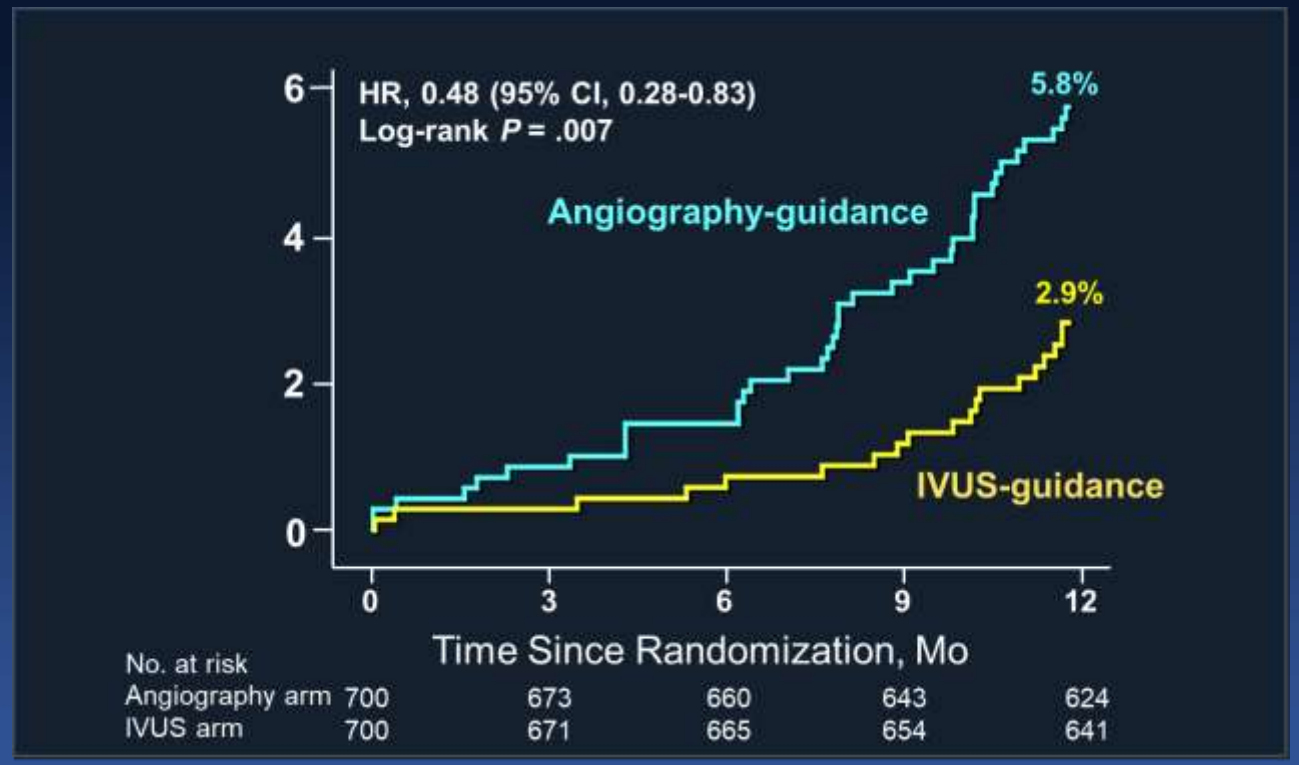
ULTIMATE RCT



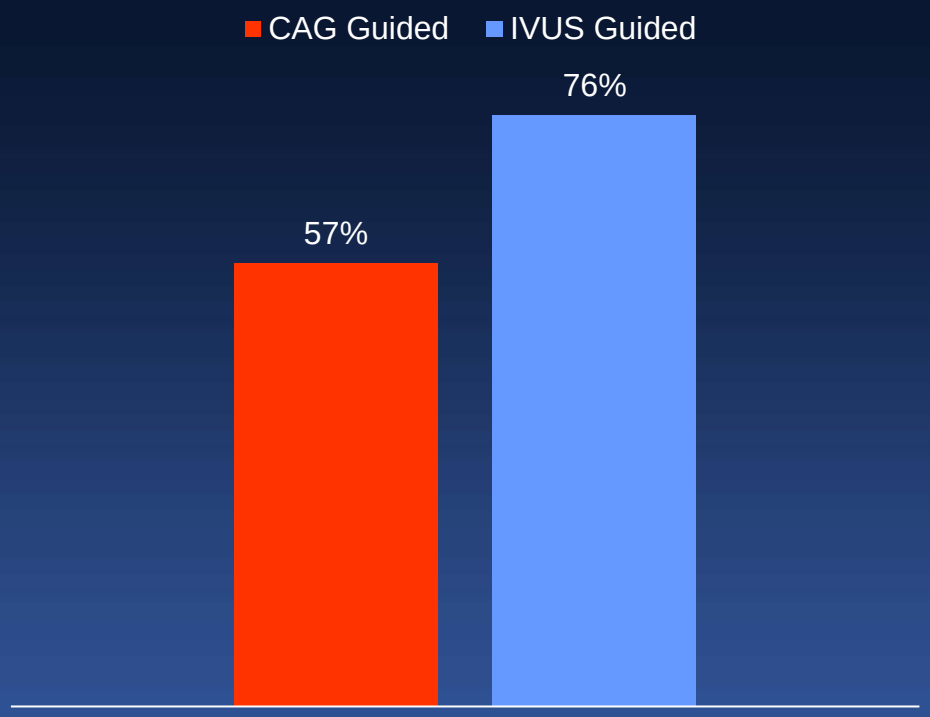
JACC. 2018 Sep 17. pii: S0735-1097(18)38433-X.

Randomized Trials

IVUS-XPL RCT



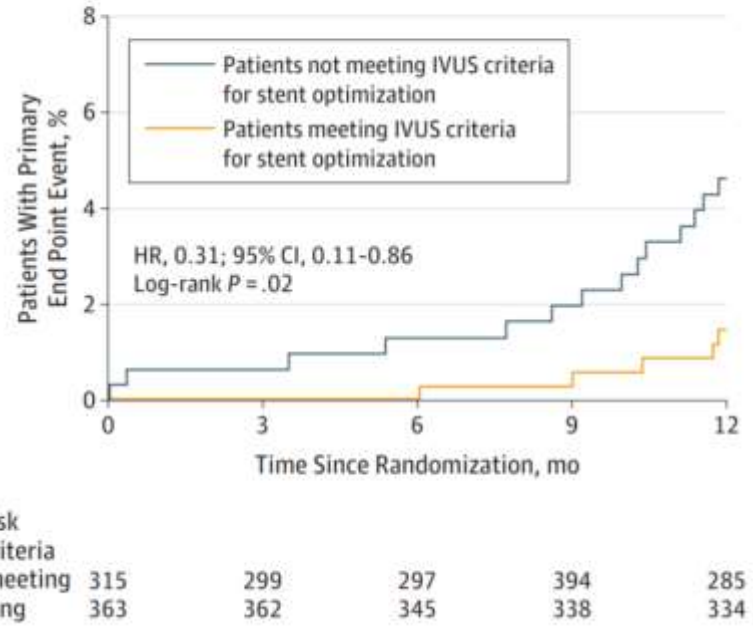
Post-Dilatation



Hong SJ et al, *JAMA 2015*;314:2155-63

IVUS XPL

IVUS Group



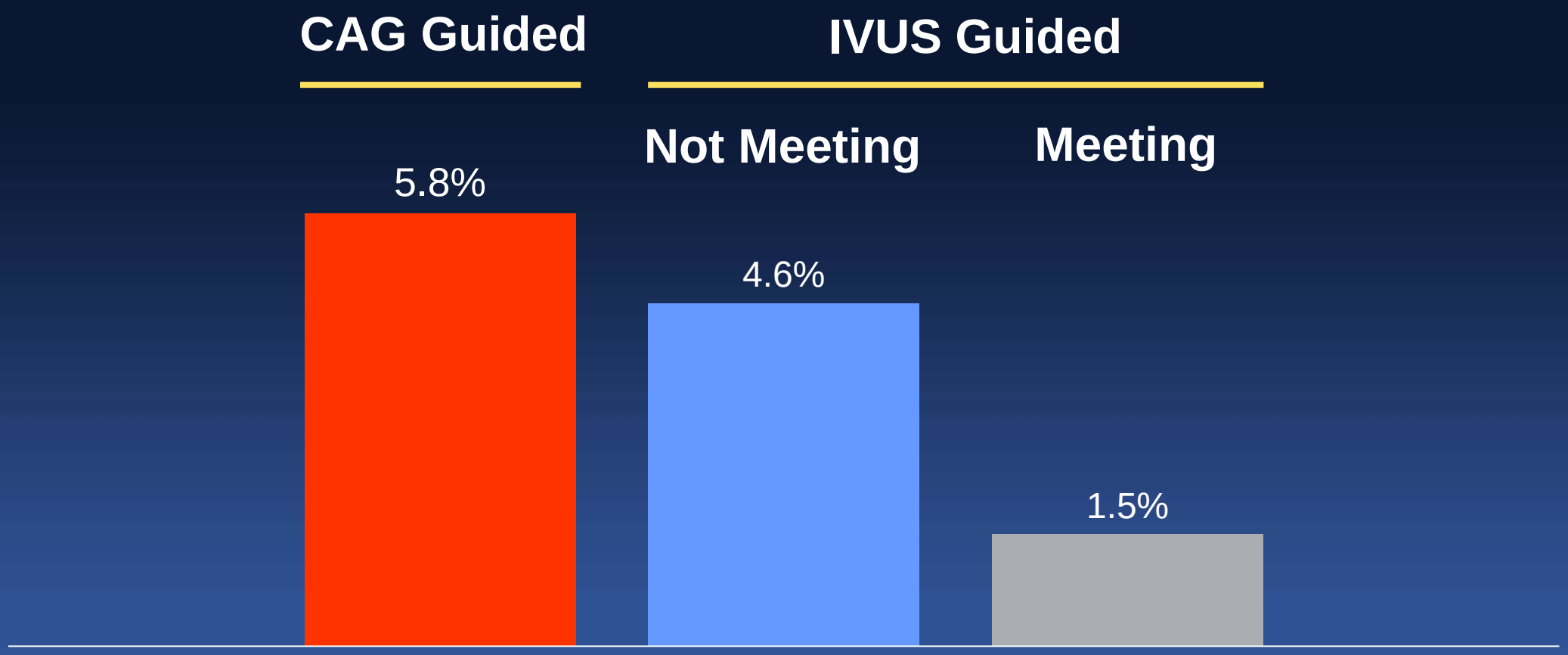
	Patients in the IVUS-Guided PCI Group Who Underwent IVUS-Guided Stent Implantation		
	Met Criteria[a]	Did Not Meet Criteria	*P* Value
No. (%) of patients[b]	363 (54)	315 (46)	
Adjunct postdilatation, No. (%)	282 (78)	237 (75)	.34
Final balloon size, mean (SD), mm	3.15 (0.45)	3.13 (0.42)	.52
Maximal inflation pressure, mean (SD), atm	16.5 (3.9)	16.4 (4.4)	.87
Proximal reference, mean (SD), mm^2			
External elastic membrane area	17.52 (5.34)	17.27 (5.04)	.56
Lumen area	9.02 (3.51)	8.86 (3.27)	.57
Minimal lumen area, mean (SD), mm^2	6.09 (1.91)	5.71 (1.71)	.008
Distal reference, mean (SD), mm^2			
External elastic membrane area	9.44 (3.98)	10.94 (3.83)	<.001
Lumen area	5.55 (1.82)	6.83 (1.68)	<.001

- IVUS criteria for stent optimization after PCI was defined as a minimal lumen cross-sectional area greater than the lumen cross-sectional area at the distal reference segments.

Hong SJ et al, *JAMA 2015*;314:2155-63

IVUS XPL

1 Year Primary Endpoint



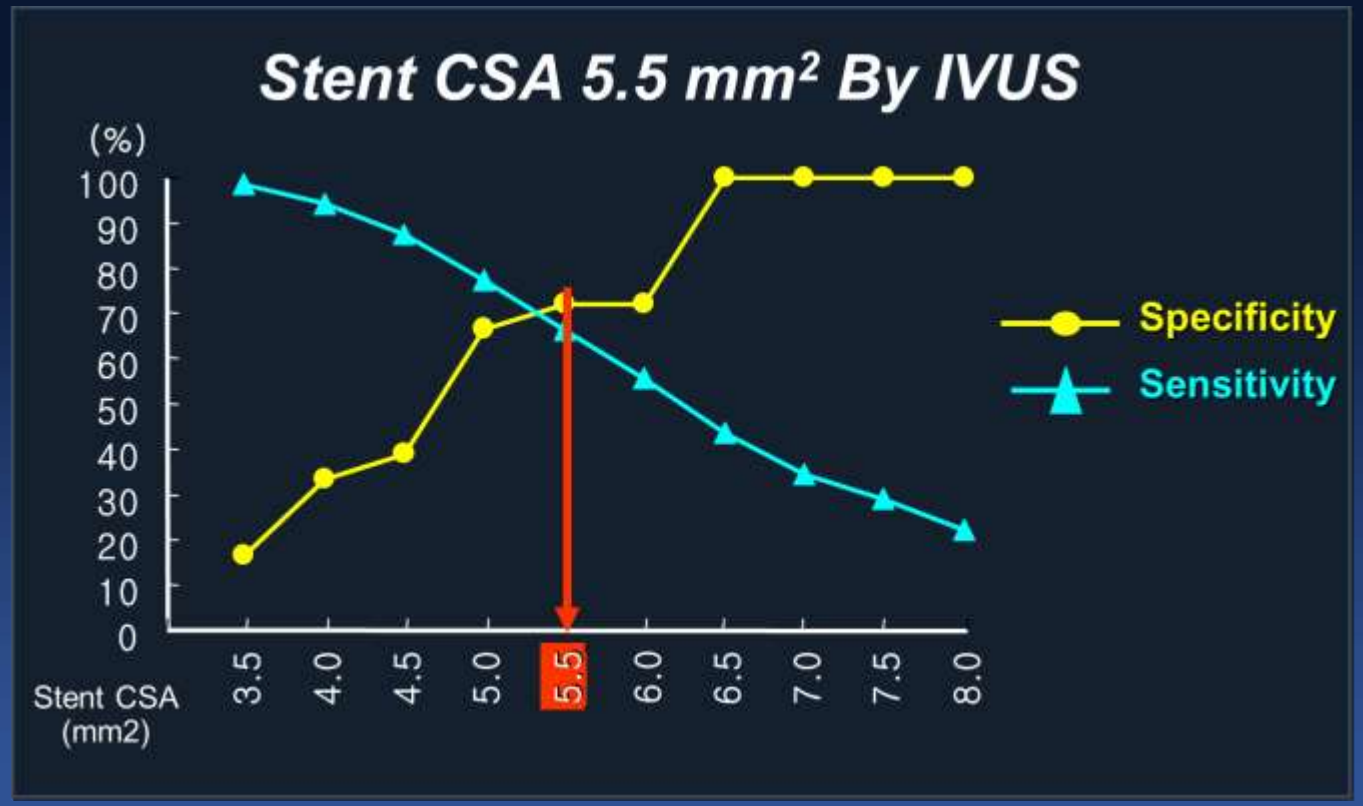
- IVUS criteria for stent optimization after PCI was defined as a minimal lumen cross-sectional area greater than the lumen cross-sectional area at the distal reference segments.

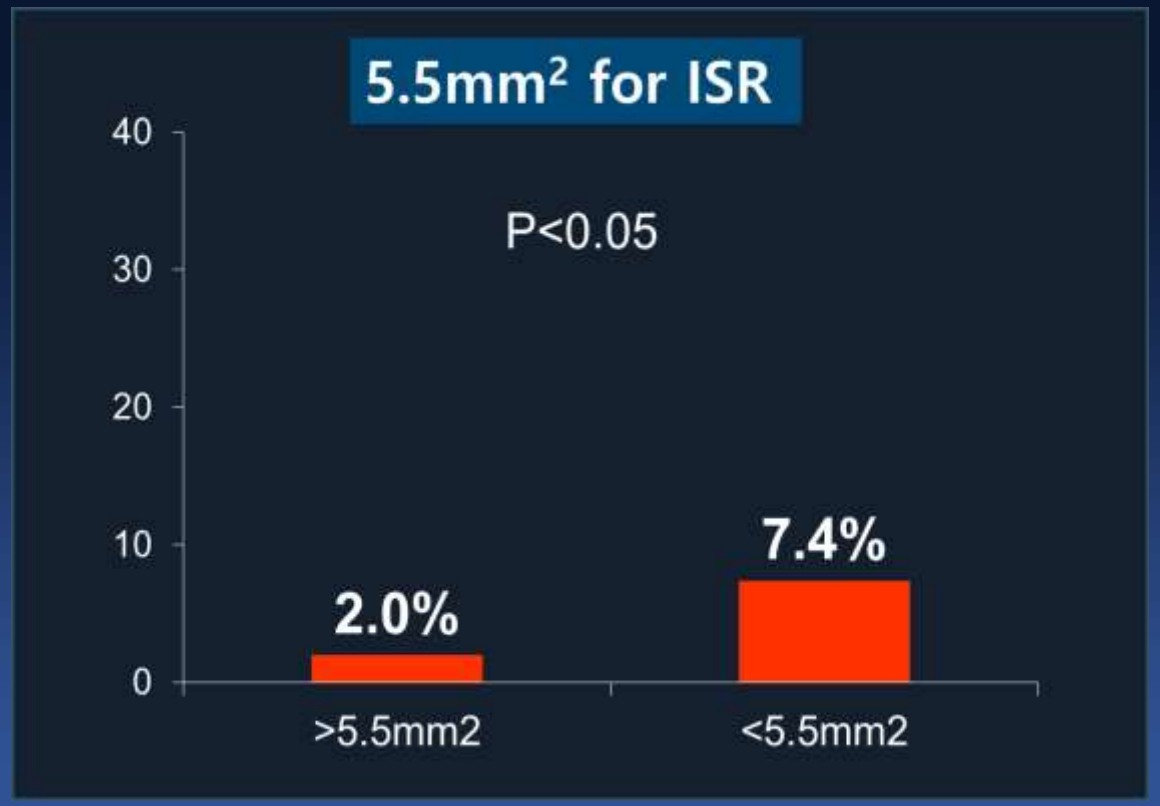
Knowing → Doing

IVUS → Post-Dilation

To Achieve Sufficient MSA Without Complication

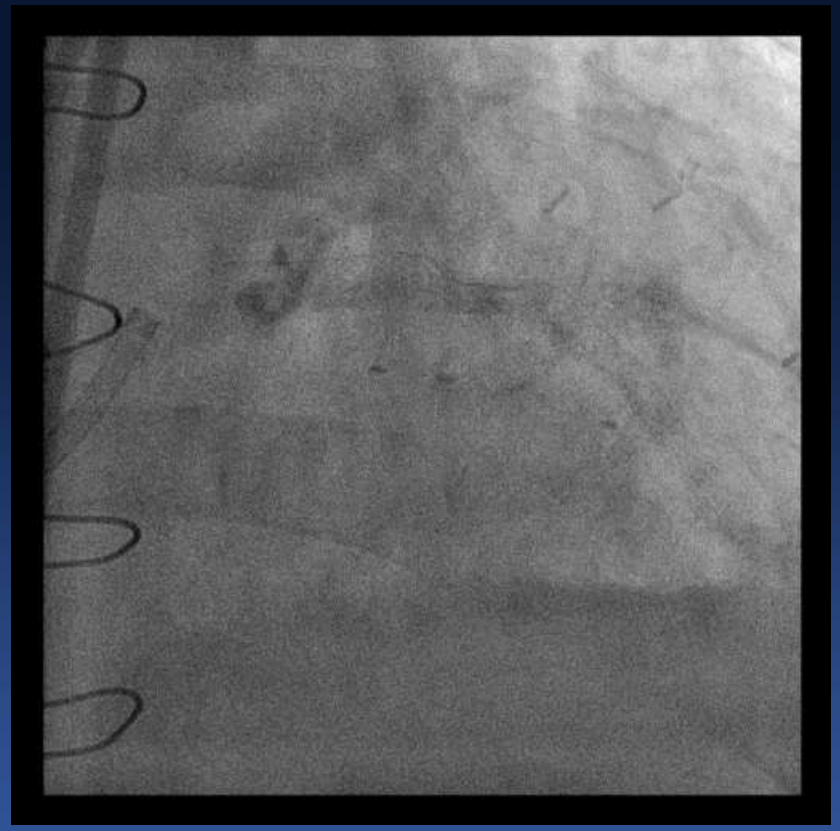
Minimal Stent Area

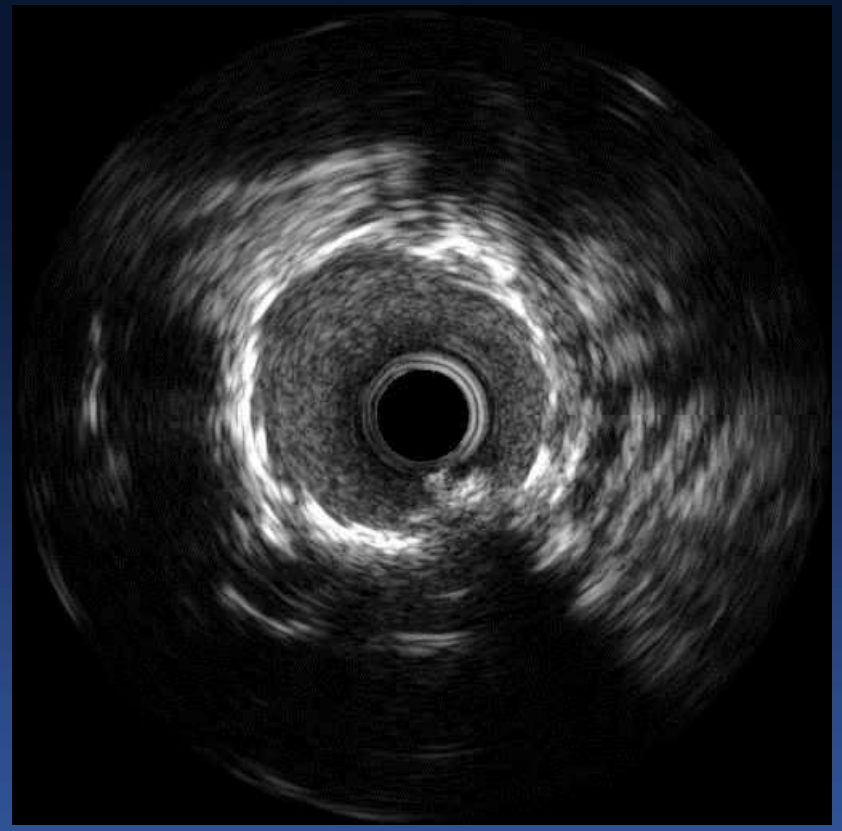




Hong MK, Park SJ, et al. Eur Heart J 2006 Jun;27(11):1305-10

Pre-Lesion Modification





What Is Optimal Post Dilation ?

- Optimal post dilation strategy can be defined as the imaging guided post-dilation strategy to achieve the sufficient MSA (“any criteria”) regardless of balloon type and inflation pressure.

- For optimal post dilation, pre-lesion modification is the prerequisite.