

IVUS Use in Practice

Akiko Maehara, MD

Director of Intravascular Imaging & Physiology Core Laboratories

Associate Director of MRI/MDCT Core Laboratory

**Cardiovascular Research Foundation/Columbia
University Medical Center, New York**



CARDIOVASCULAR RESEARCH
FOUNDATION



COLUMBIA UNIVERSITY
MEDICAL CENTER



NewYork-Presbyterian

The University Hospital of Columbia and Cornell

IVUS Use in Practice

1. IVUS guided ? BMS and DES era
2. Cut-off values to predict restenosis vs non-restenosis
3. When can IVUS change the mortality? Stent Thrombosis, LM
4. Meaning of PROSPECT



IVUS Use in Practice

1. IVUS guided ? BMS and DES era
2. Cut-off values to predict restenosis vs non-restenosis
3. When can IVUS change the mortality? Stent Thrombosis, LM
4. Meaning of PROSPECT

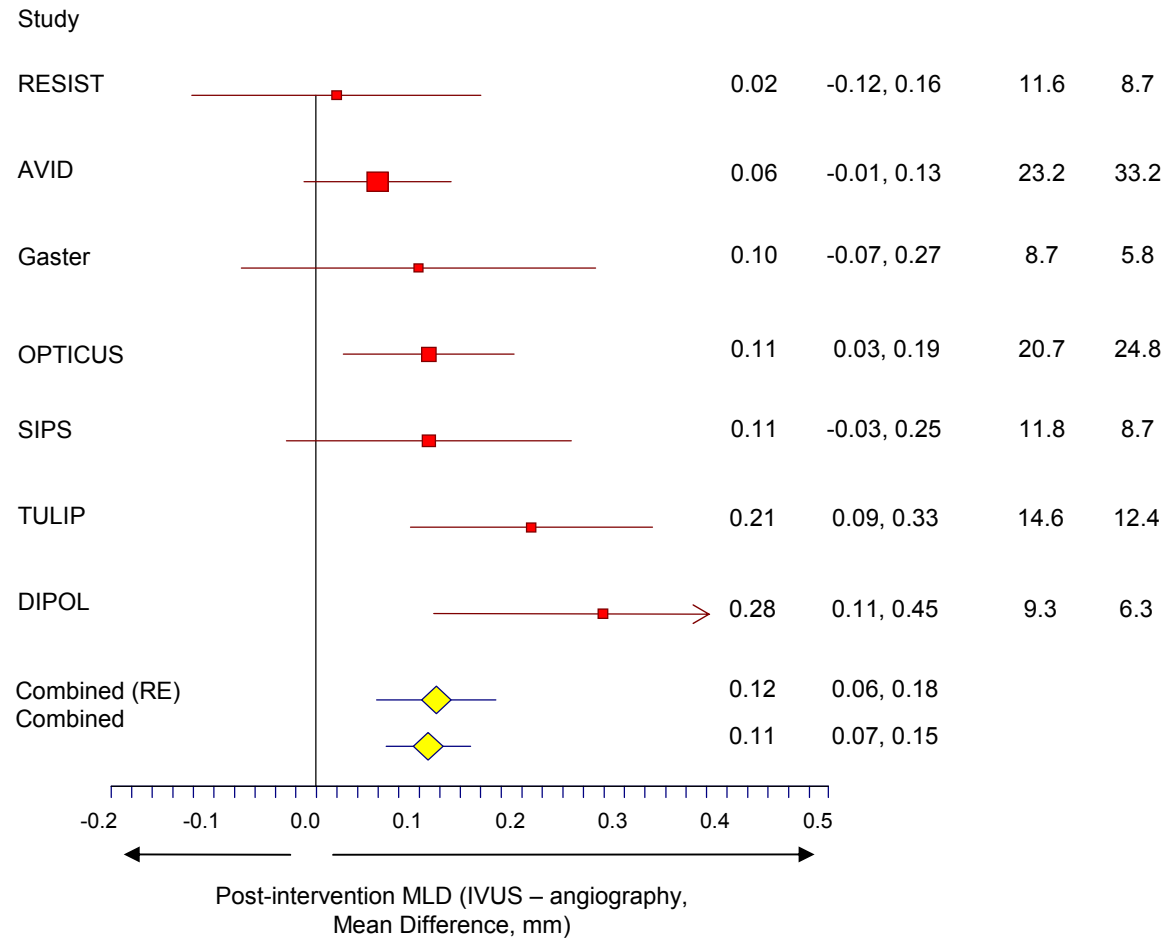


In BMS era, 10/12 studies supported IVUS-guided PCI

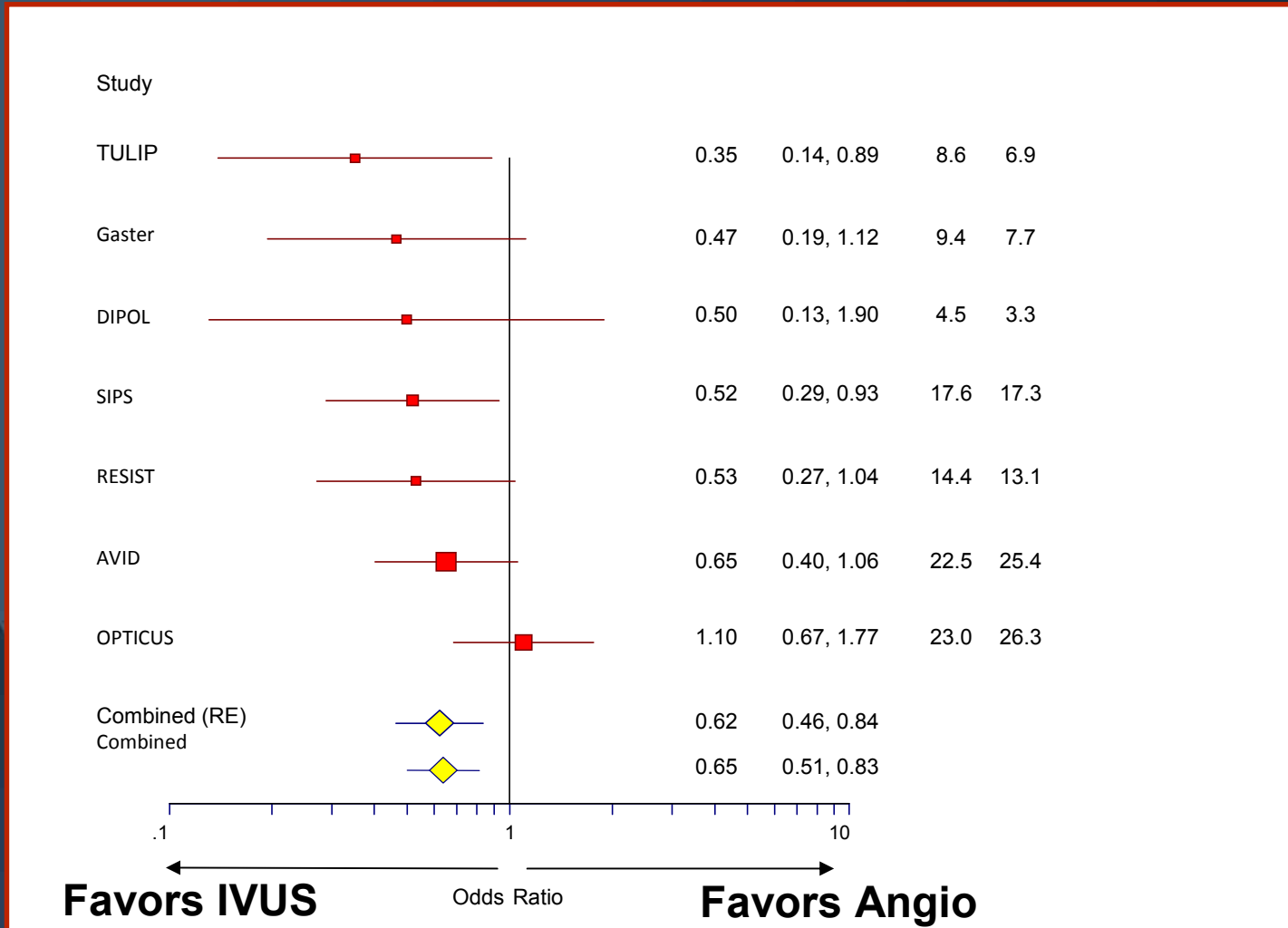
Study	Angio Better	IVUS Better	IVUS Also Cheaper
Choi et al (AHJ 2001;142:112-8)		X	
CENIC (JACC 2002;39:54A)		X	
CRUISE (Circulation 2000;102:523-30)		X	
SIPS (Circulation 2000;102:2497-502 and AJC 2003;91:143-7)		X	X
AVID (Circulation 1999;100:I-234)		X	
Gaster et al (Scan Cardiovasc J 2001;35:80-5 & Heart 2003;89:1043-9)		X	X
RESIST (JACC 1998;32:320-8 & Int J Cardiovasc Intervent 2000;3:207-13)		X	
TULIP (Circulation 2003;107:62-7)		X	
BEST (Circulation 2003;107:545-551)		X	
OPTICUS (Circulation. 2001;104:1343-9)	X		
PRESTO (Am Heart J. 2004;148:501-6)	X		
DIPOL (Am Heart J. 2007;154:669-75)		X	



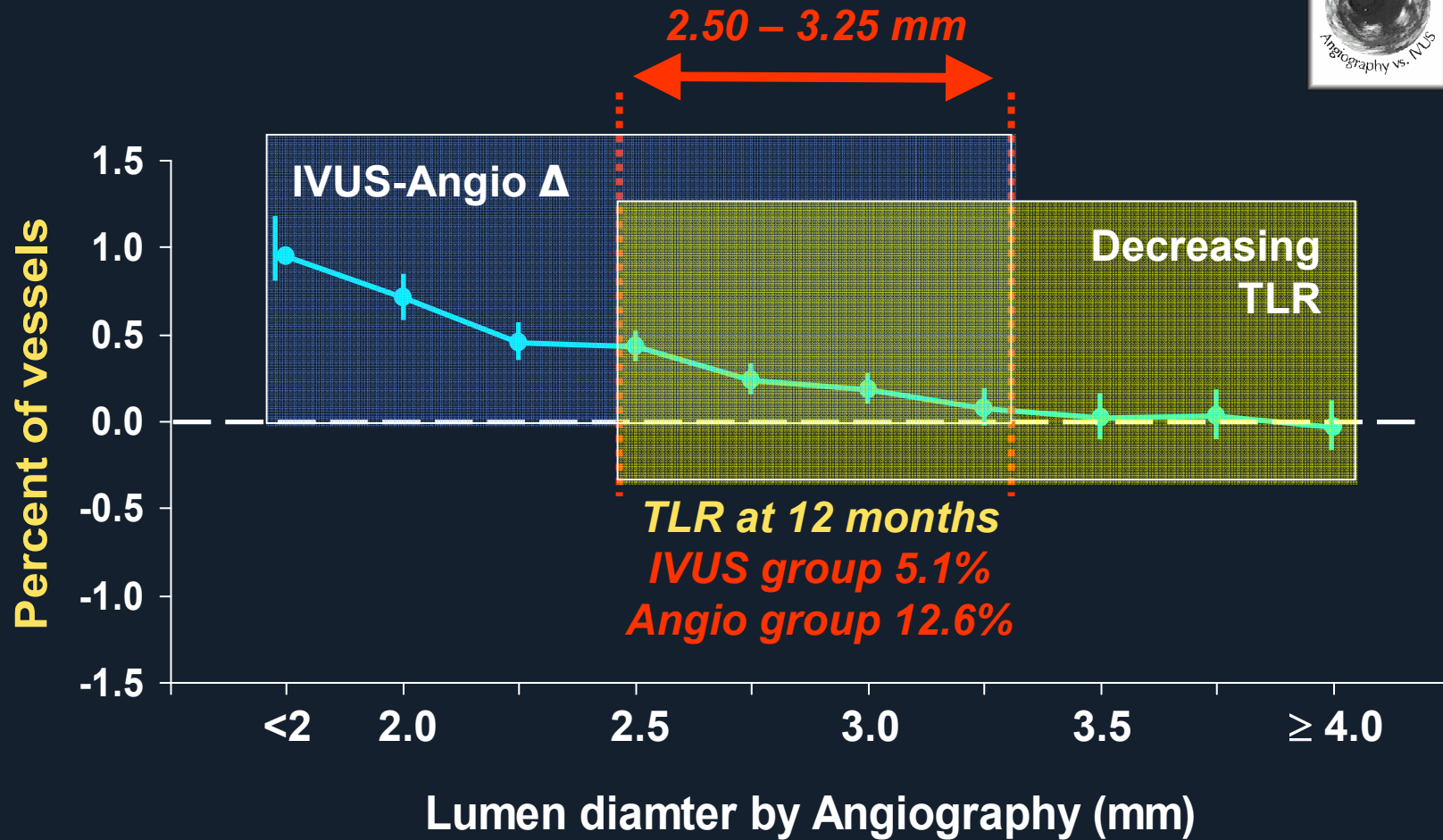
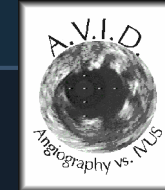
Post-Intervention MLD



Revascularization



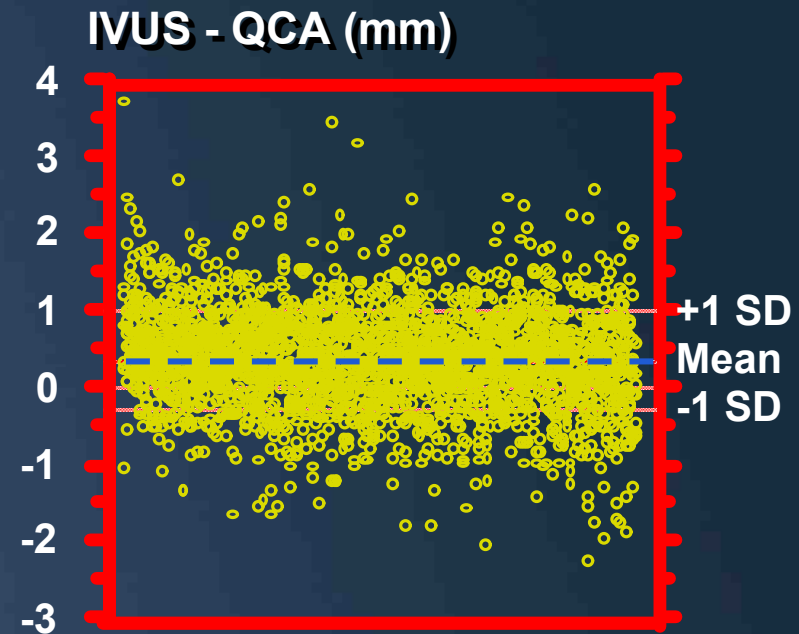
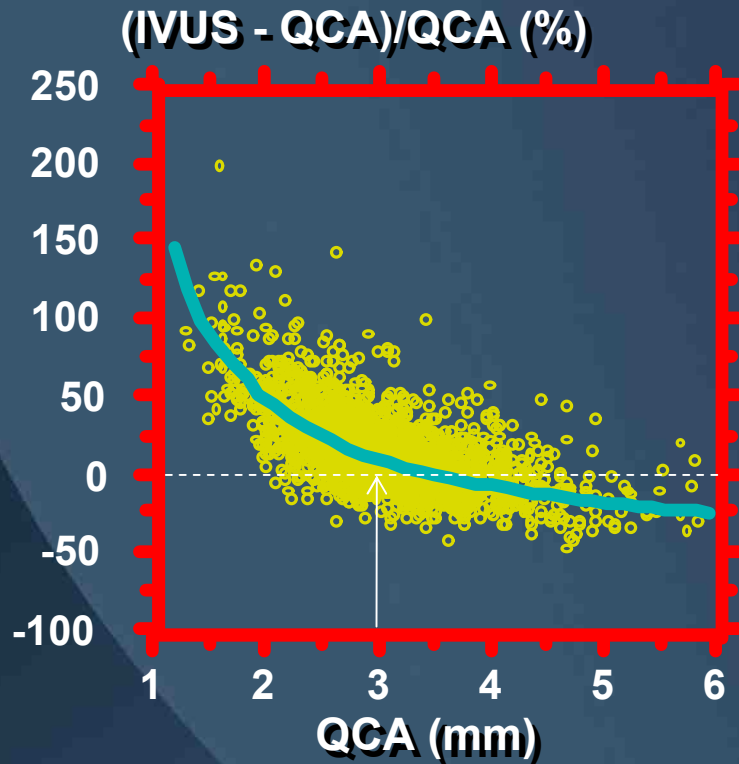
AVID



Vertical bars are 95% CI

IVUS is most effective in a lesion subset with maximal Angio-IVUS difference

IVUS vs QCA measurements of reference lumen dimensions (3311 nonostial lesions)



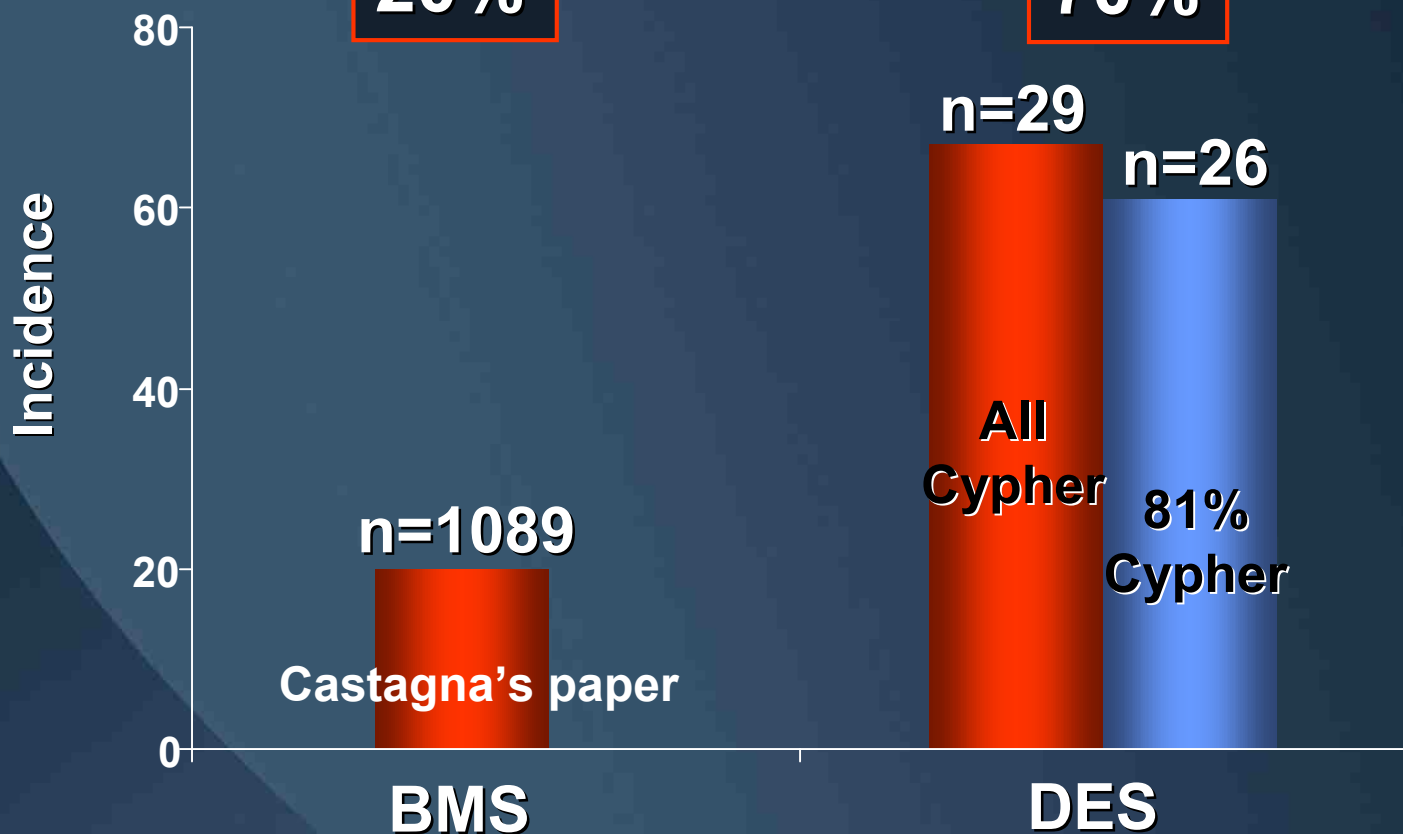
If RVD > 3mm by angio, lumen dimension should be similar with the real. If RVD < 3mm, I expect angio Diameter + 0.5mm.

Incidence of $MSA \leq 5mm^2$ in ISR

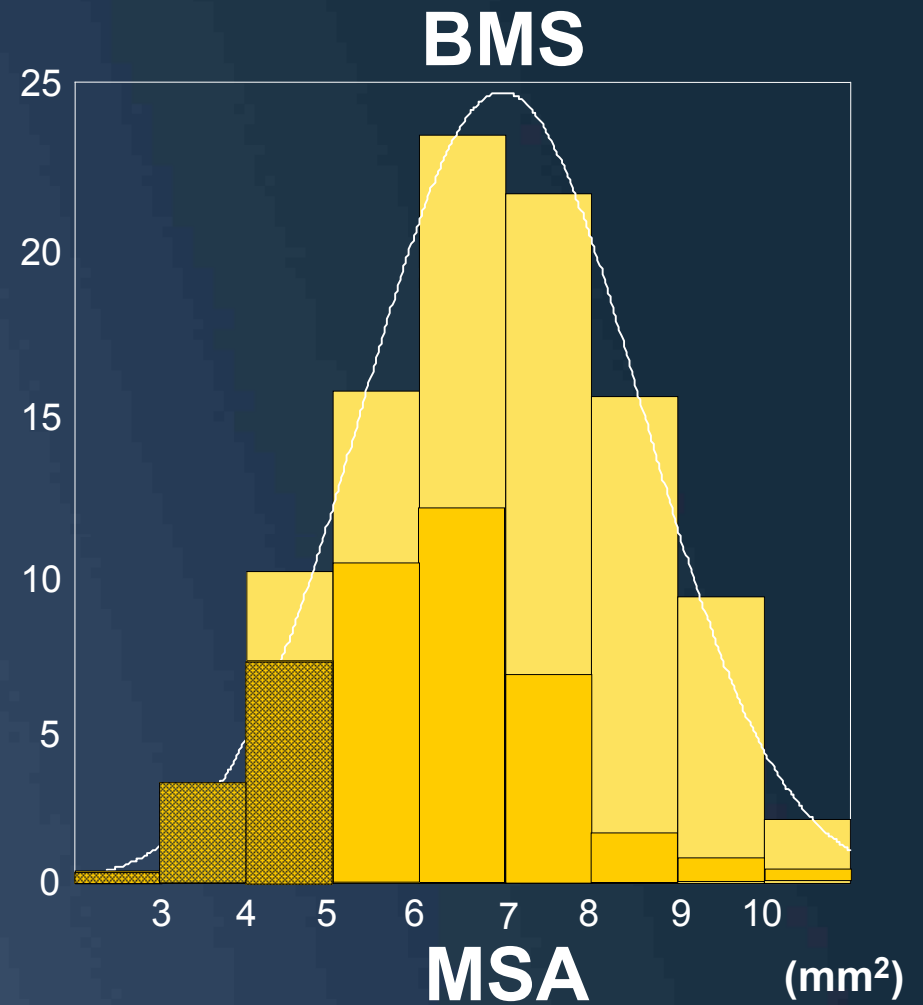
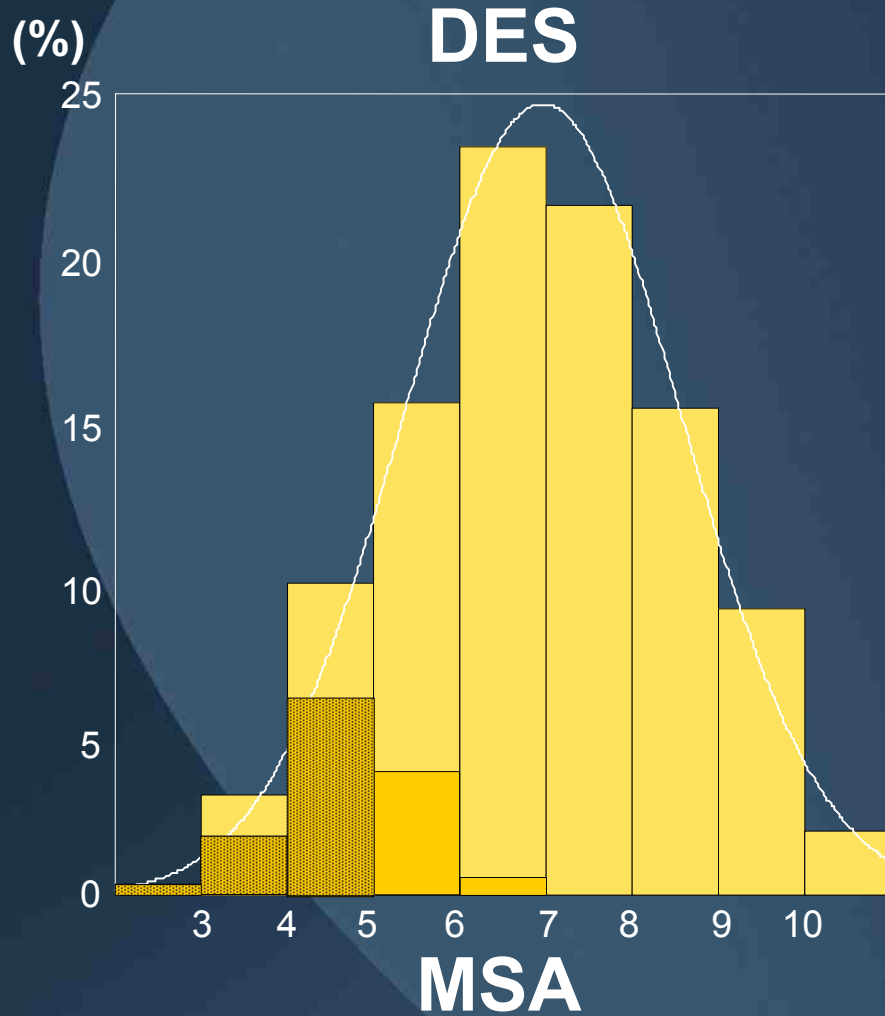
Stent Under expansion

20%

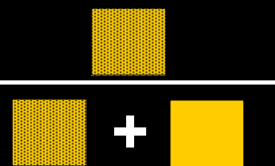
70%



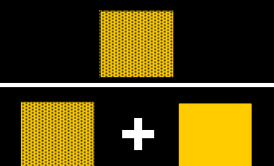
Impact of Underexpansion of DES



70% =



20% =

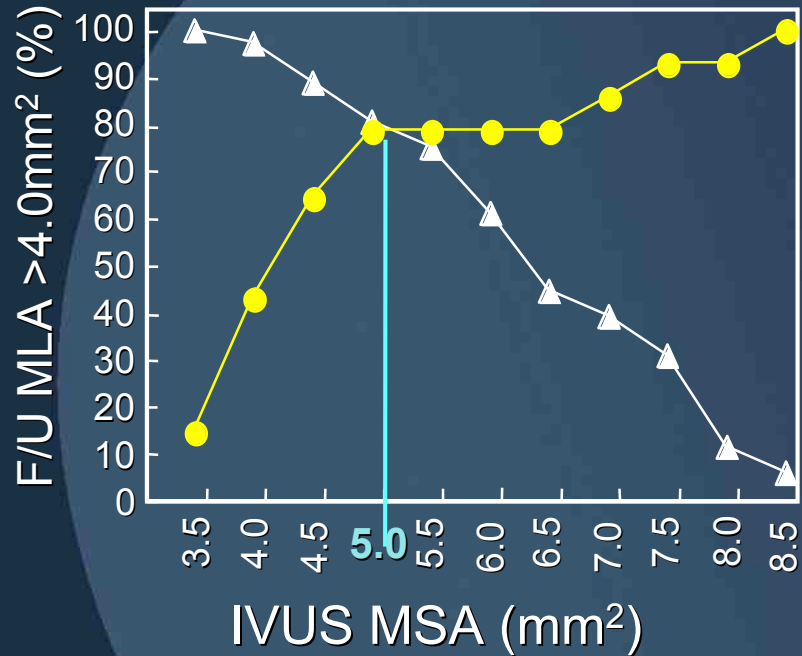


IVUS Use in Practice

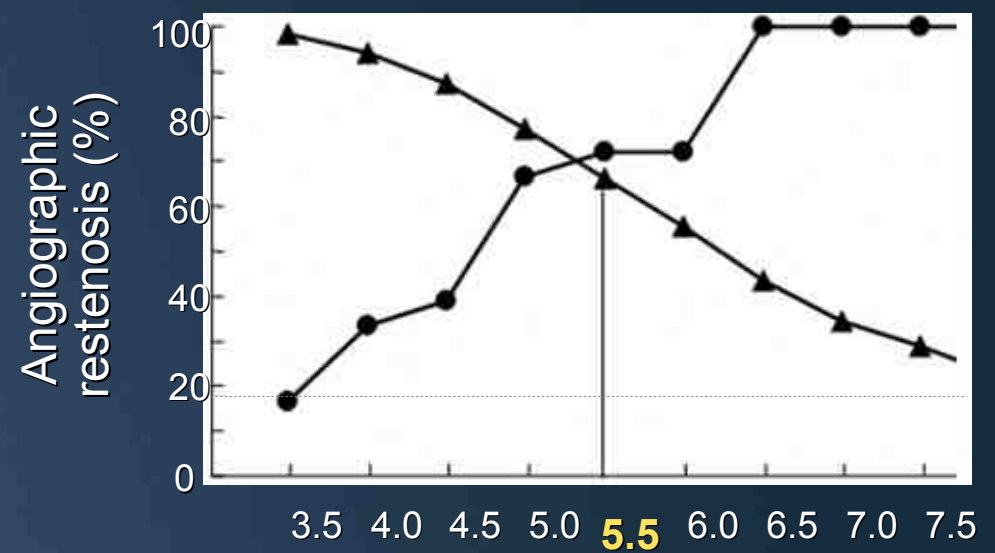
1. IVUS guided ? BMS and DES era
2. Cut-off values to predict restenosis vs non-restenosis
3. When can IVUS change the mortality? Stent Thrombosis, LM
4. Meaning of PROSPECT



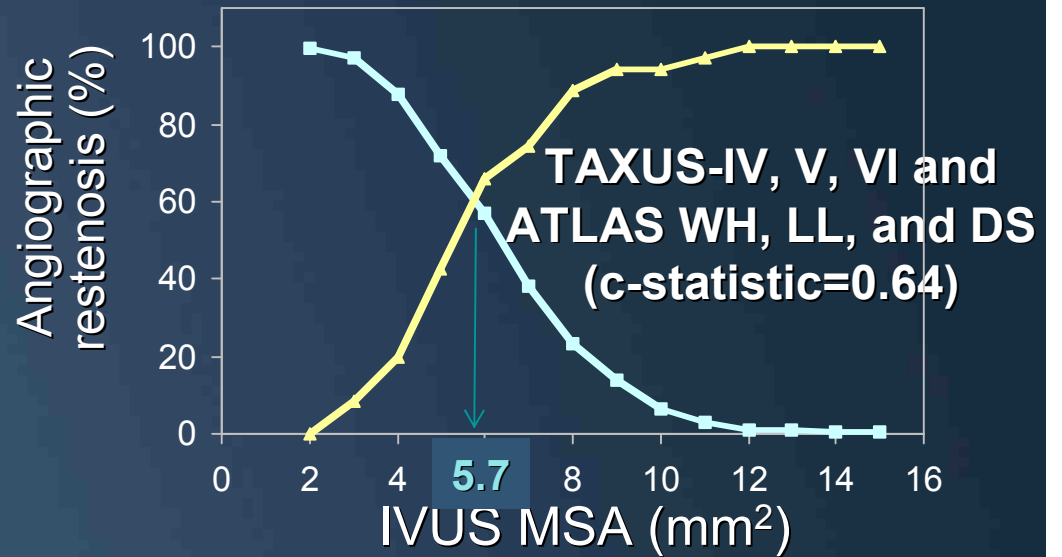
Cypher in SIRIUS*



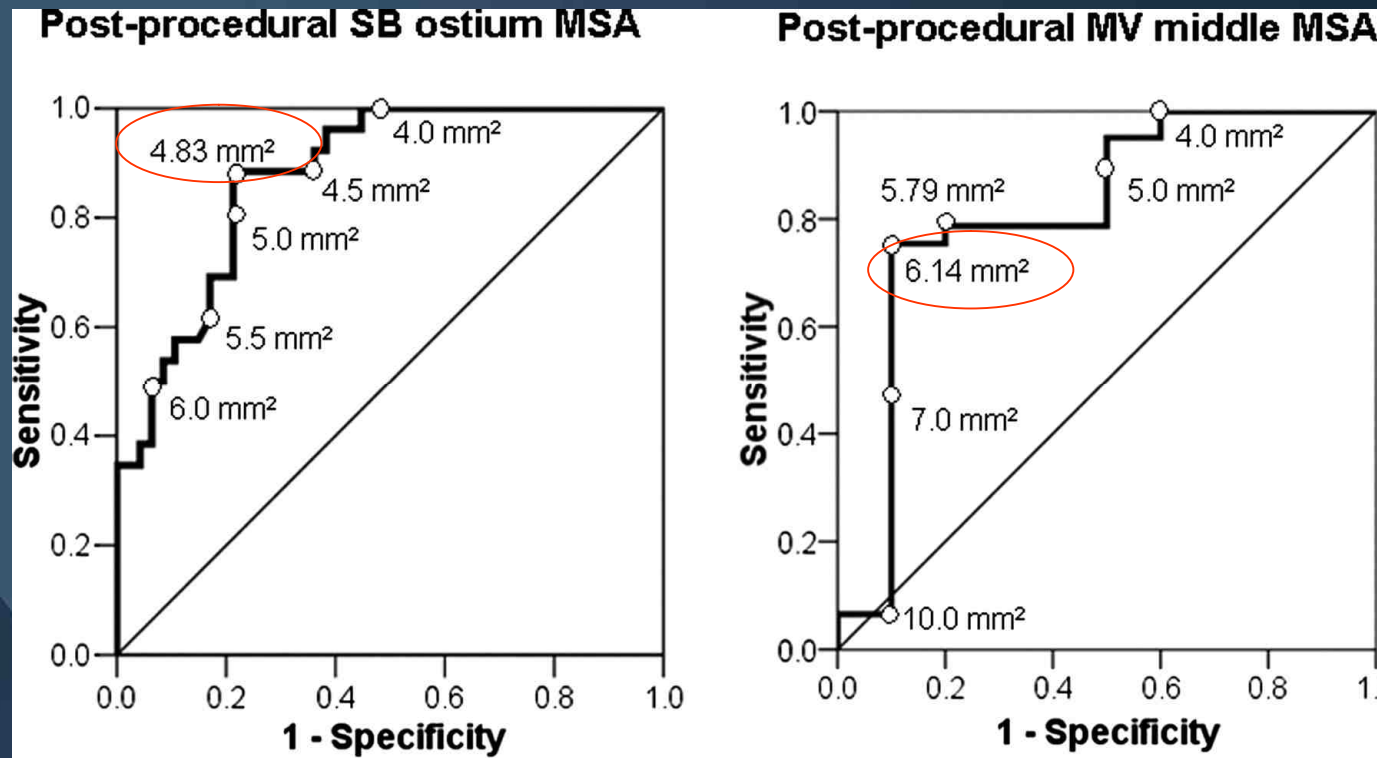
Cypher at AMC**



By definition, sensitivity/specificity curve analysis “must” identify a single MSA that best separates restenosis from no restenosis



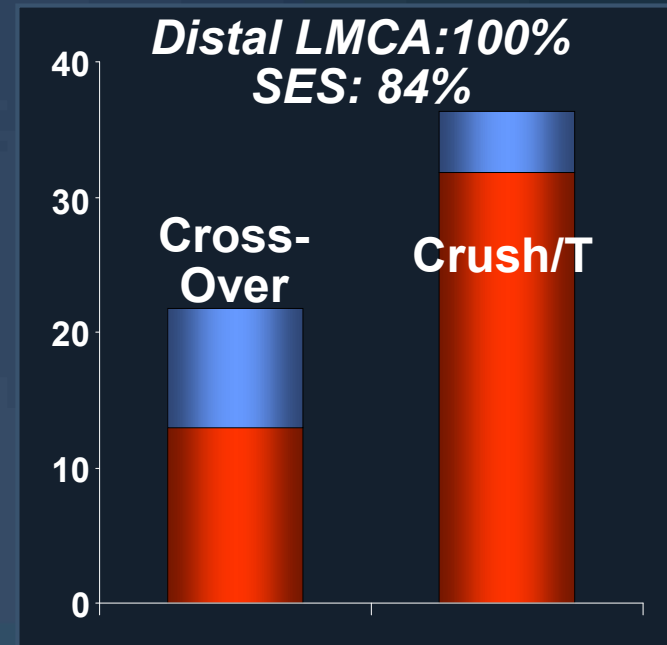
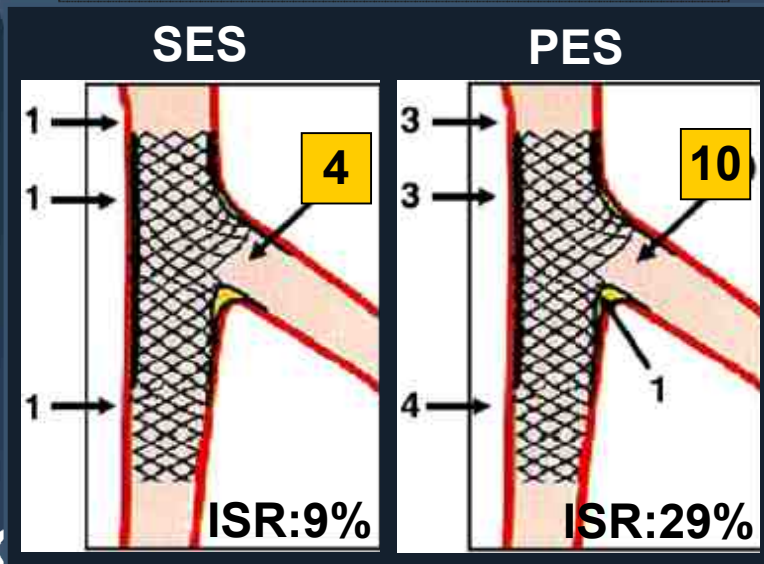
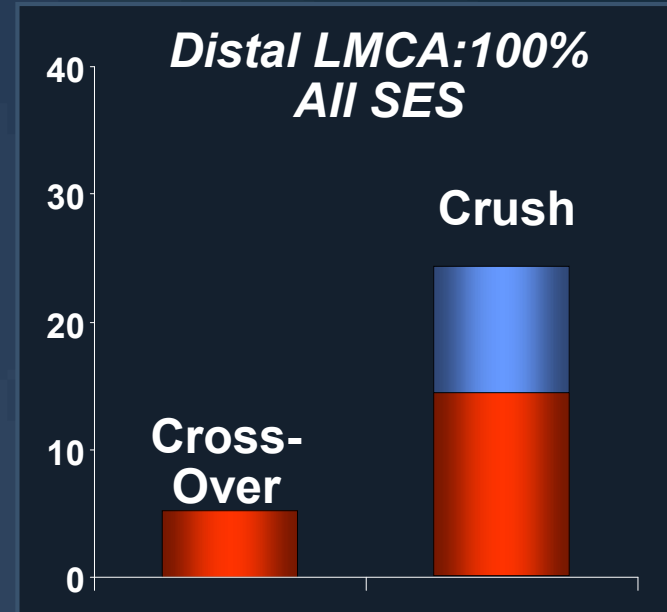
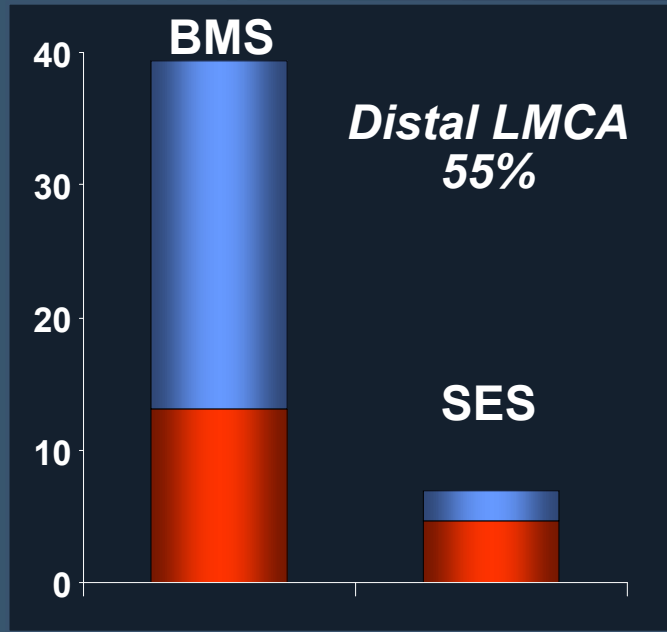
The Optimal Cutoff Value of Post-Procedural MSA to Predict a Follow-up MLA $\geq 4\text{mm}^2$ After Bifurcator T-Stenting



AUC=0.88
(95%CH=0.80-0.95)

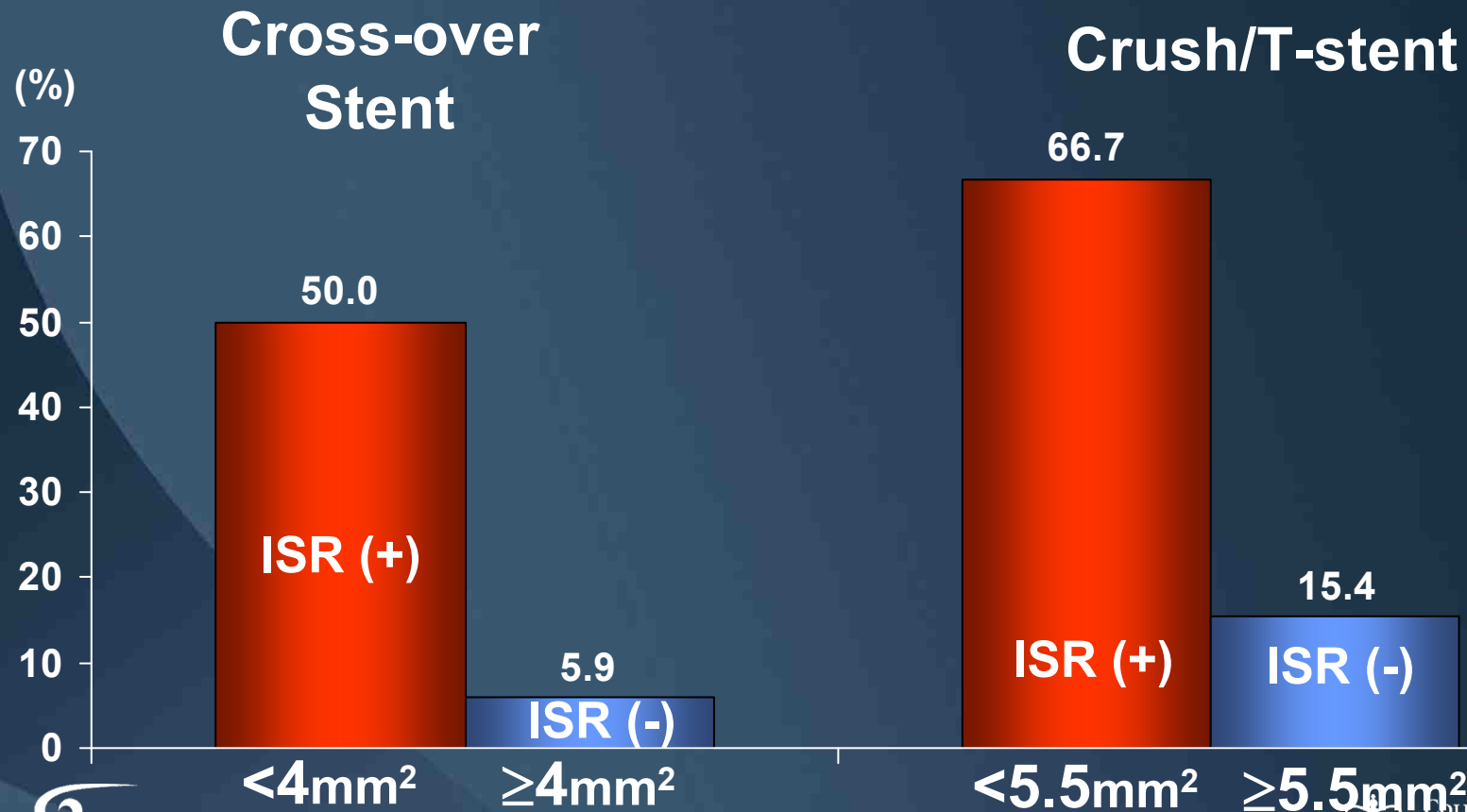
AUC=0.81
(95%CH=0.64-0.99)

Location of Restenosis after LMCA Stenting



Predictor of Restenosis in Ostial LCX with both LAD/LCX IVUS Evaluation (n=57)

Post LCX Ostial Lumen area



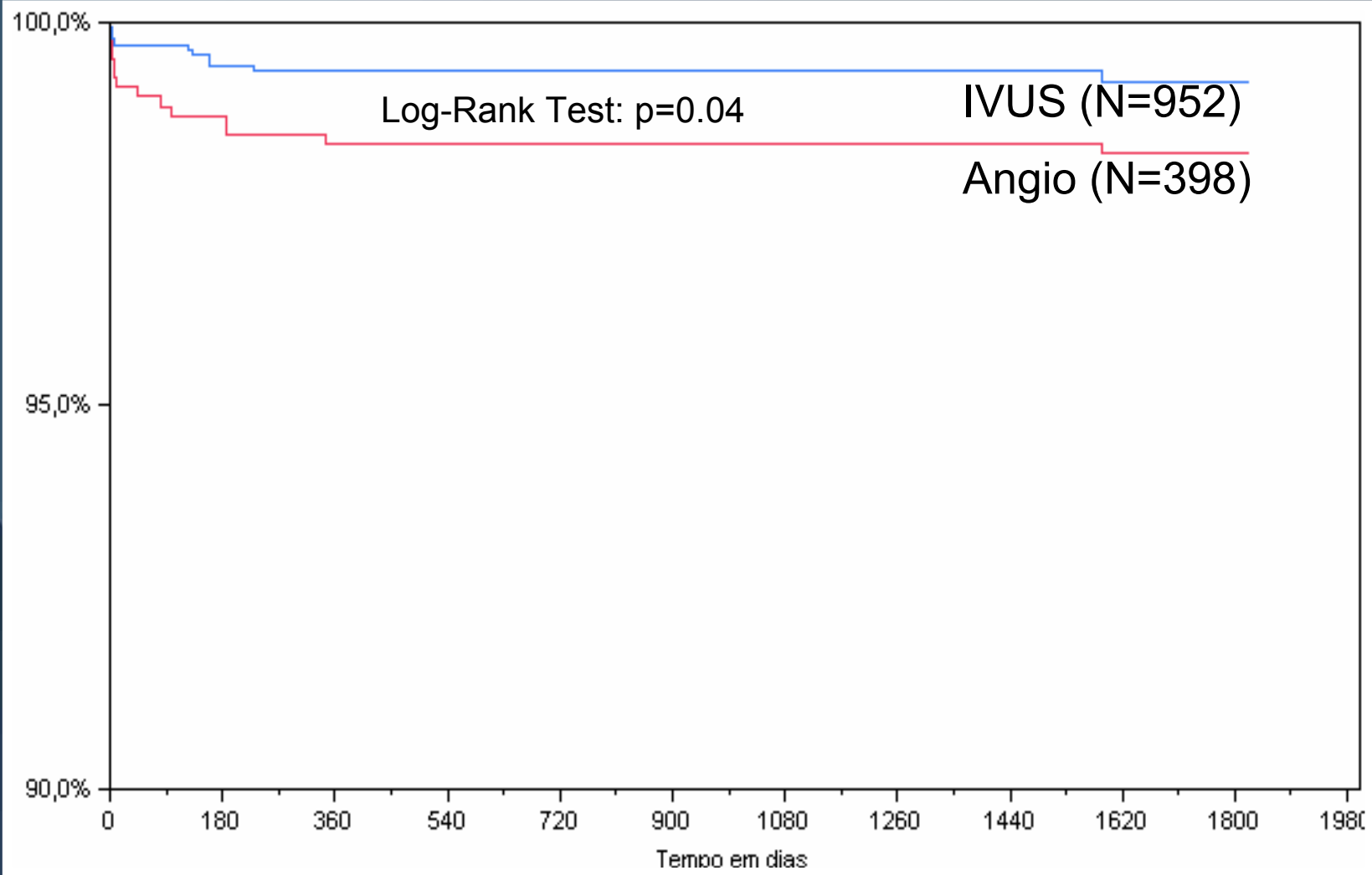
IVUS Use in Practice

1. IVUS guided ? BMS and DES era
2. Cut-off values to predict restenosis vs non-restenosis
3. When can IVUS change the mortality? Stent Thrombosis, LM
4. Meaning of PROSPECT



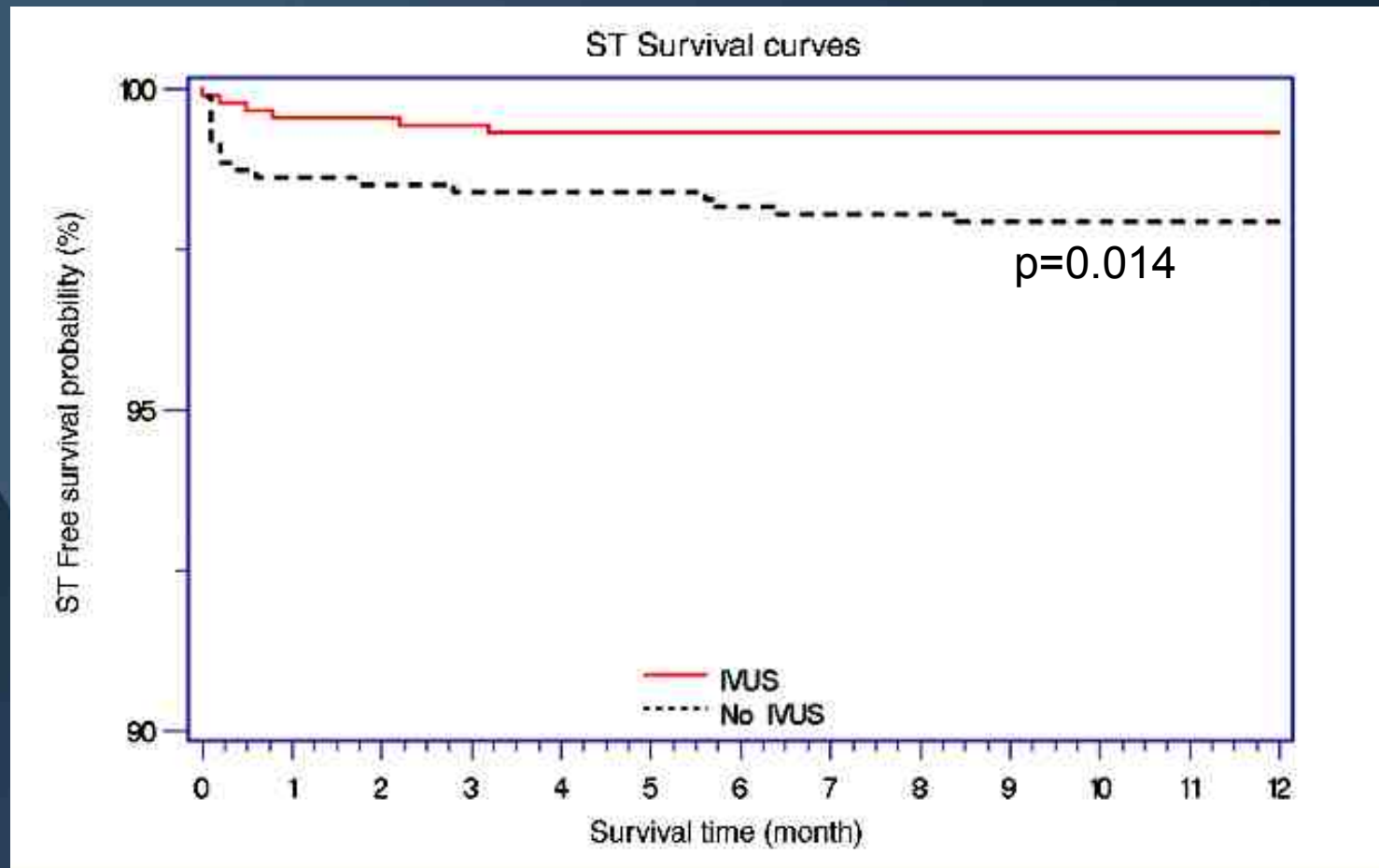
Stent thrombosis

Thrombosis Free-Survival, %



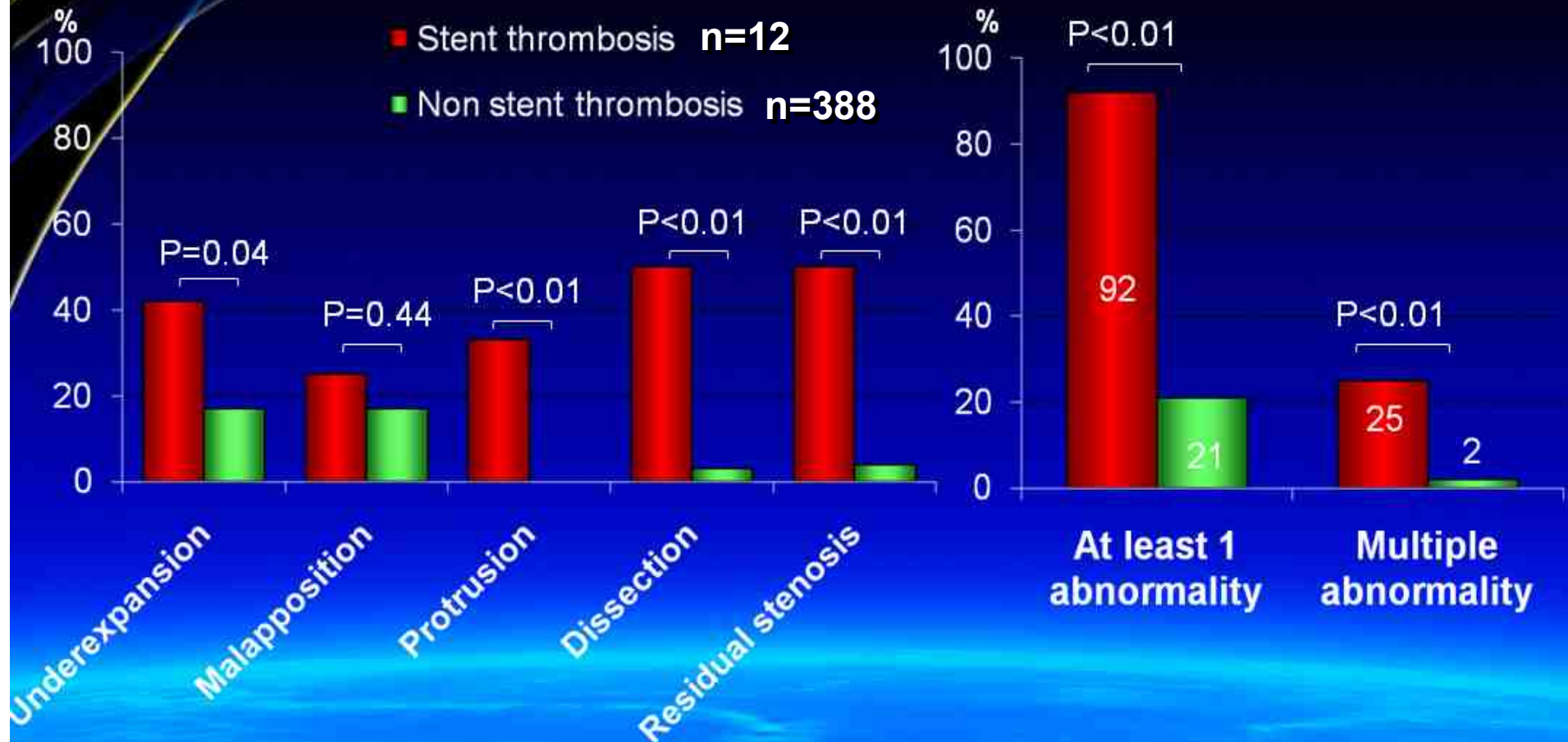
Freedom from Thrombosis: 12 mo

884 patients with IVUS-guidance propensity matched with angio-guided controls

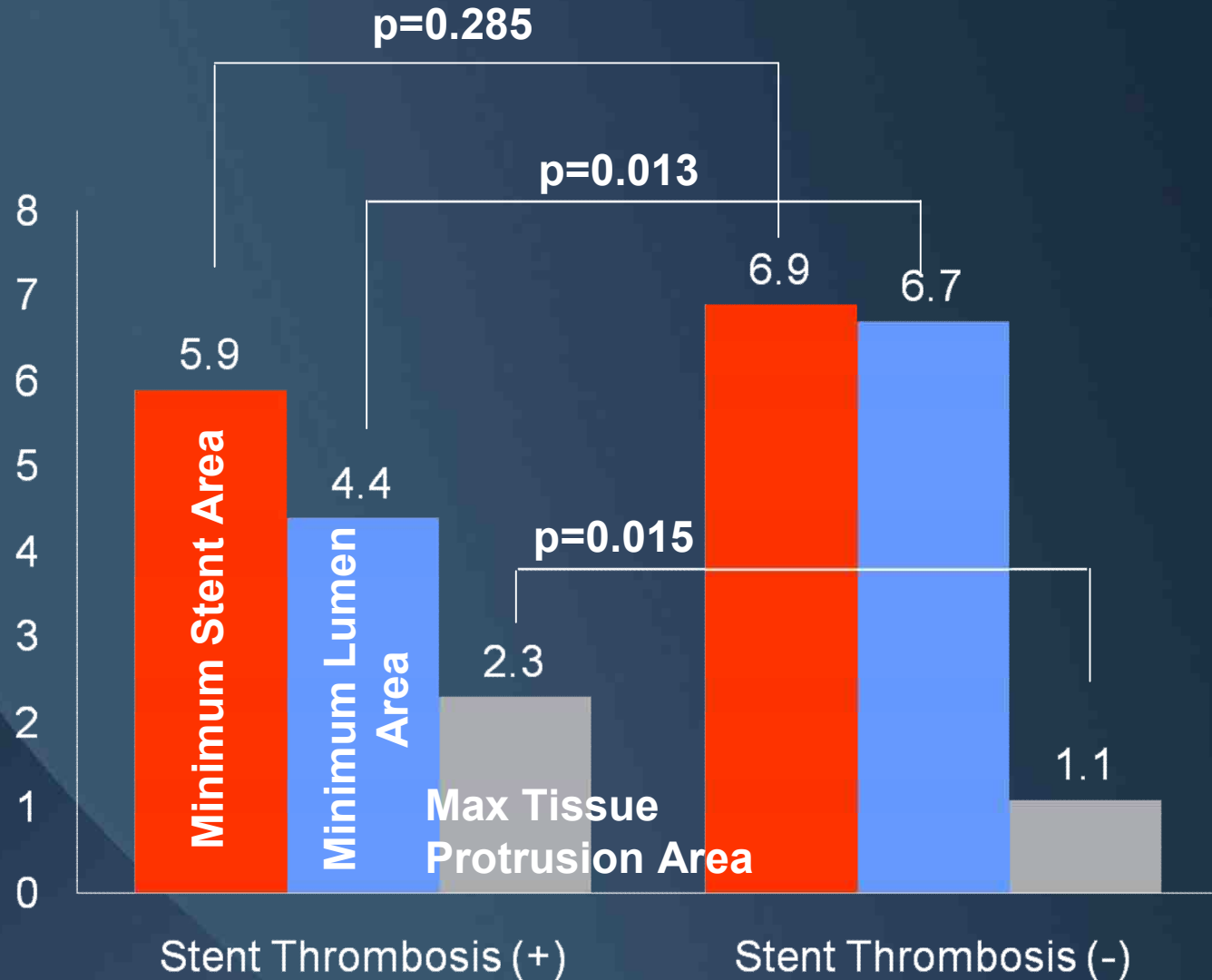


HORIZONS-AMI IVUS Sub-study Acute Stent Thrombosis

Significant Features



HORIZONS-AMI IVUS Sub-study Acute Stent Thrombosis



LITRO Study - multicenter, prospective observational study -

Population included

354 pts

$MLA \geq 6 \text{ mm}^2$
186 pts

$MLA < 6 \text{ mm}^2$
168 pts

7 revascularized

16 no revascularized

No Revascularization LM

179 pts

56% PCI in other lesions

$MLA=9.3\pm 3\text{mm}^2$

Plaque Burden $53\pm 12\%$

Revascularization LM

152 pts

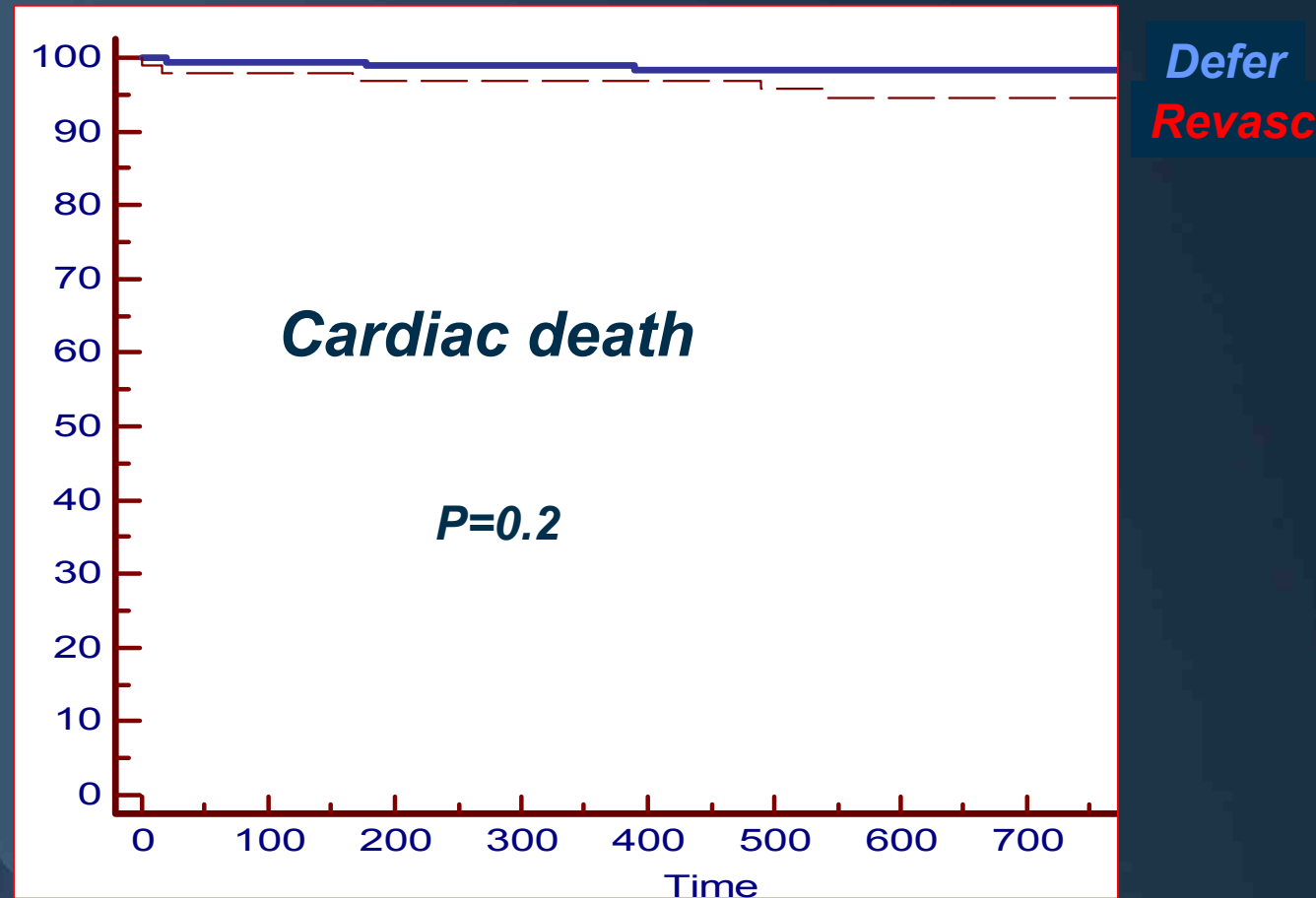
55% CABG

45% PCI of LMCA

(+ other lesions in 62%)



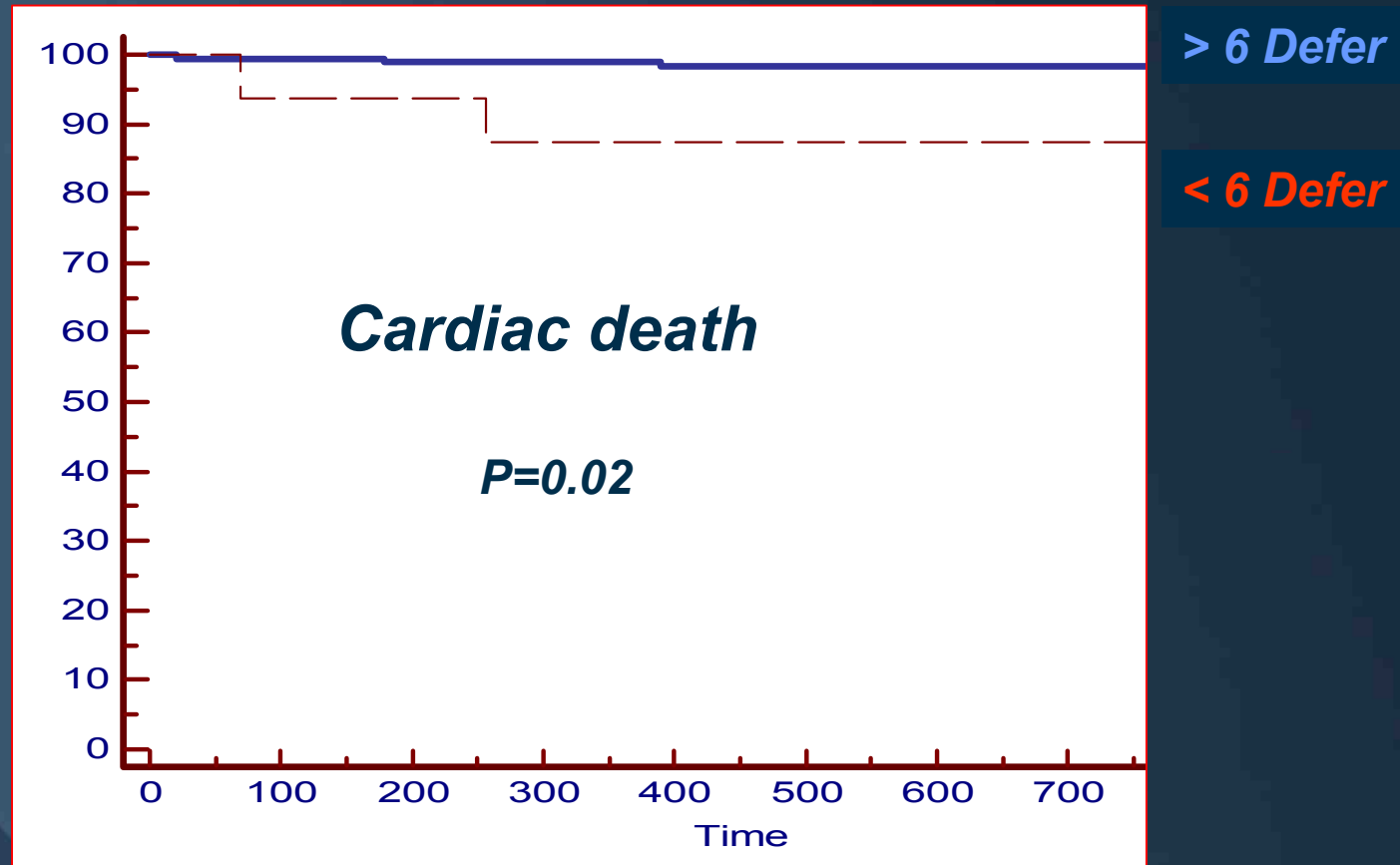
Compared clinical outcome in pts with and without LMCA revascularization



Pts at risk	1 year	2 years
Defer	179	152
Revasc	152	138



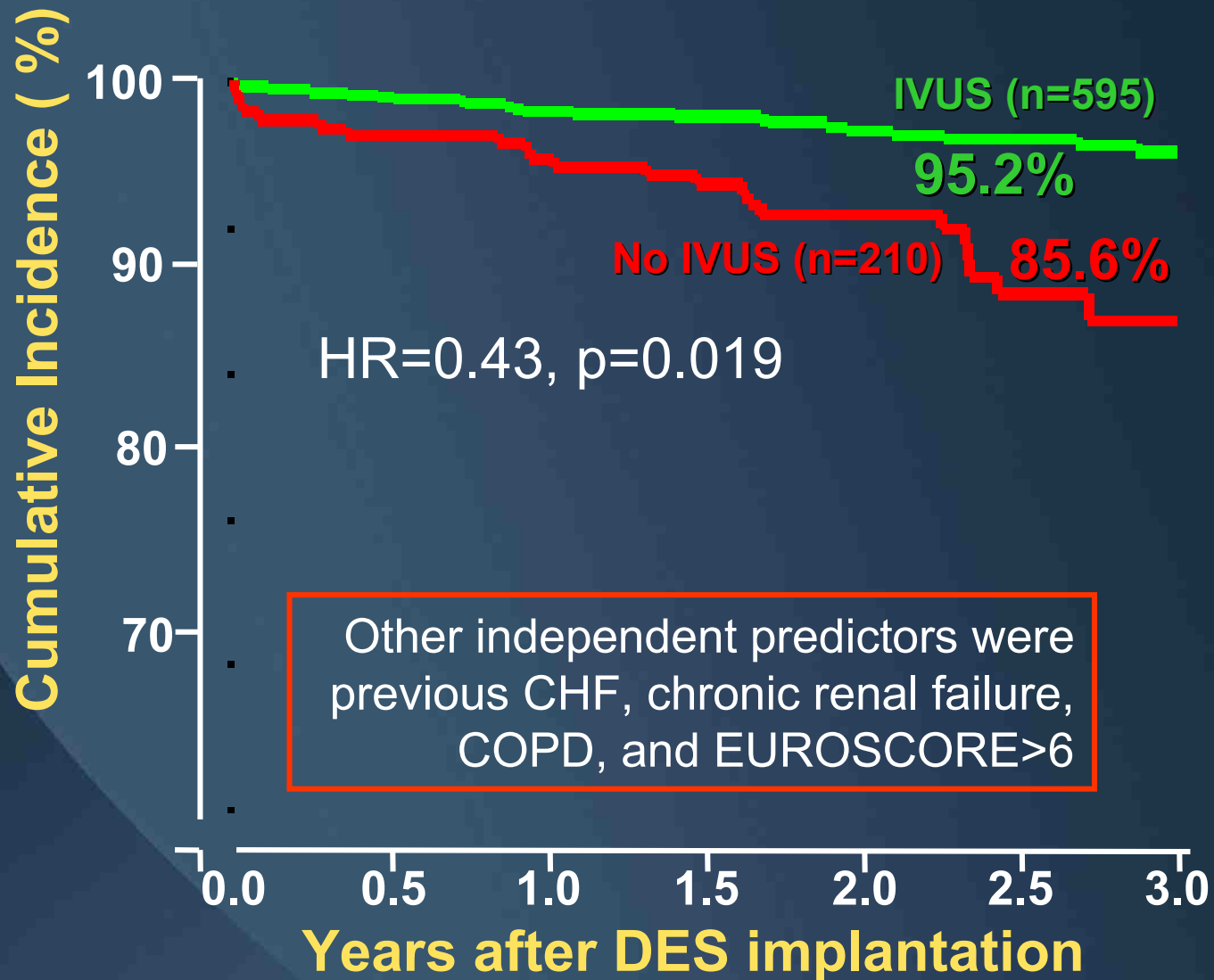
Compared clinical outcome in deferred pts with MLA > and < 6 mm²



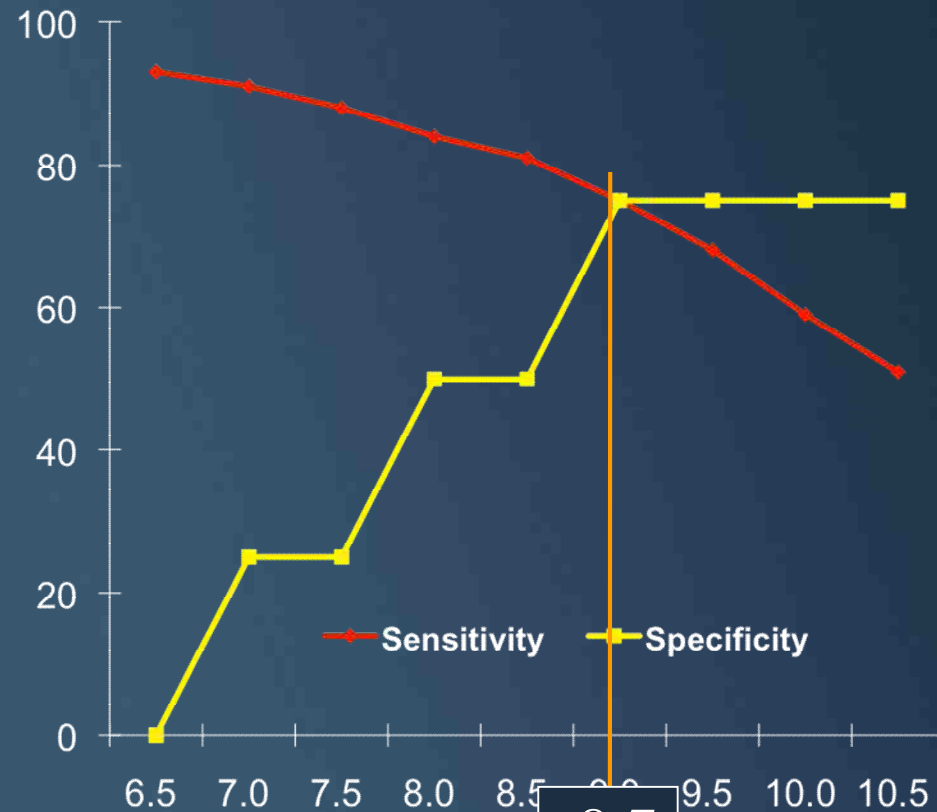
Pts at risk	1 year	2 years
Defer	179	152
No revasc	16	11



All-Cause Mortality After LMCA DES Implantation: Impact of IVUS Guidance



“Optimal” MSA and TLR after LMCA DES Implantation (n=595)



Minimum stent area (mm²)

IVUS Use in Practice

1. IVUS guided ? BMS and DES era
2. Cut-off values to predict restenosis vs non-restenosis
3. When can IVUS change the mortality? Stent Thrombosis, LM
4. Meaning of PROSPECT



The **PROSPECT** Trial

700 pts with ACS

UA (with ECGΔ) **or** NSTEMI **or** STEMI >24hrs
undergoing PCI of 1 or 2 major coronary arteries
at up to 40 sites in the U.S. and Europe



PCI of culprit lesion(s)

Successful and uncomplicated

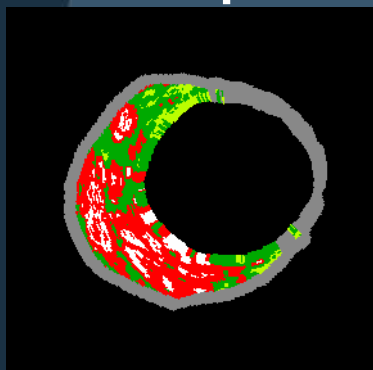


Formally enrolled

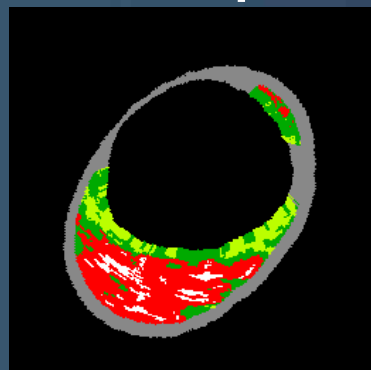


VH-IVUS Classification

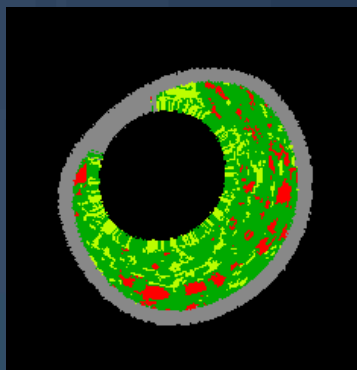
Thin-cap FA



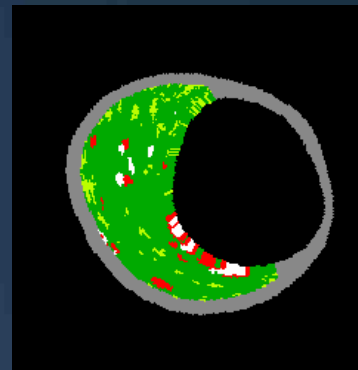
Thick-cap FA



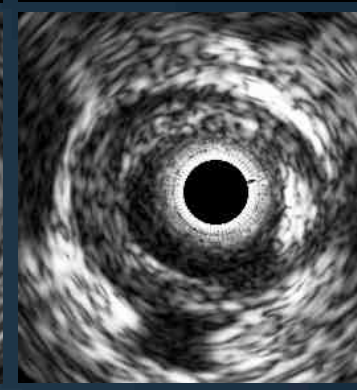
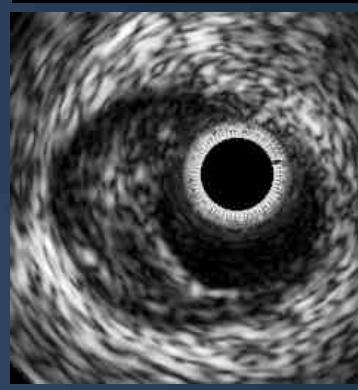
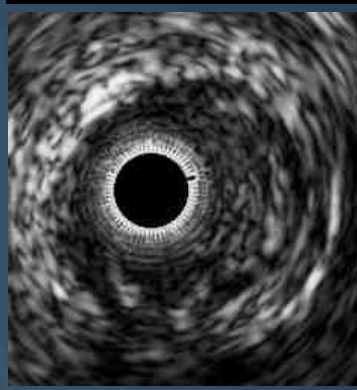
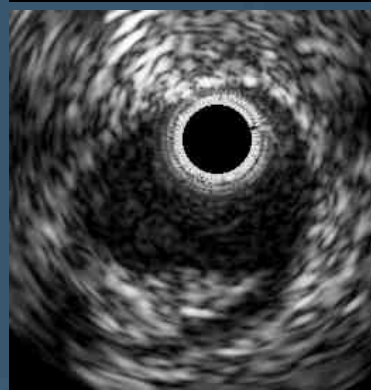
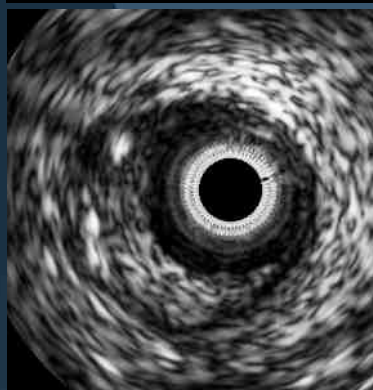
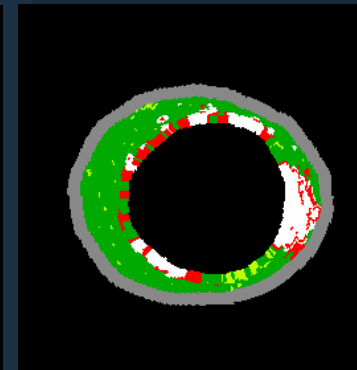
PIT



Fibrous



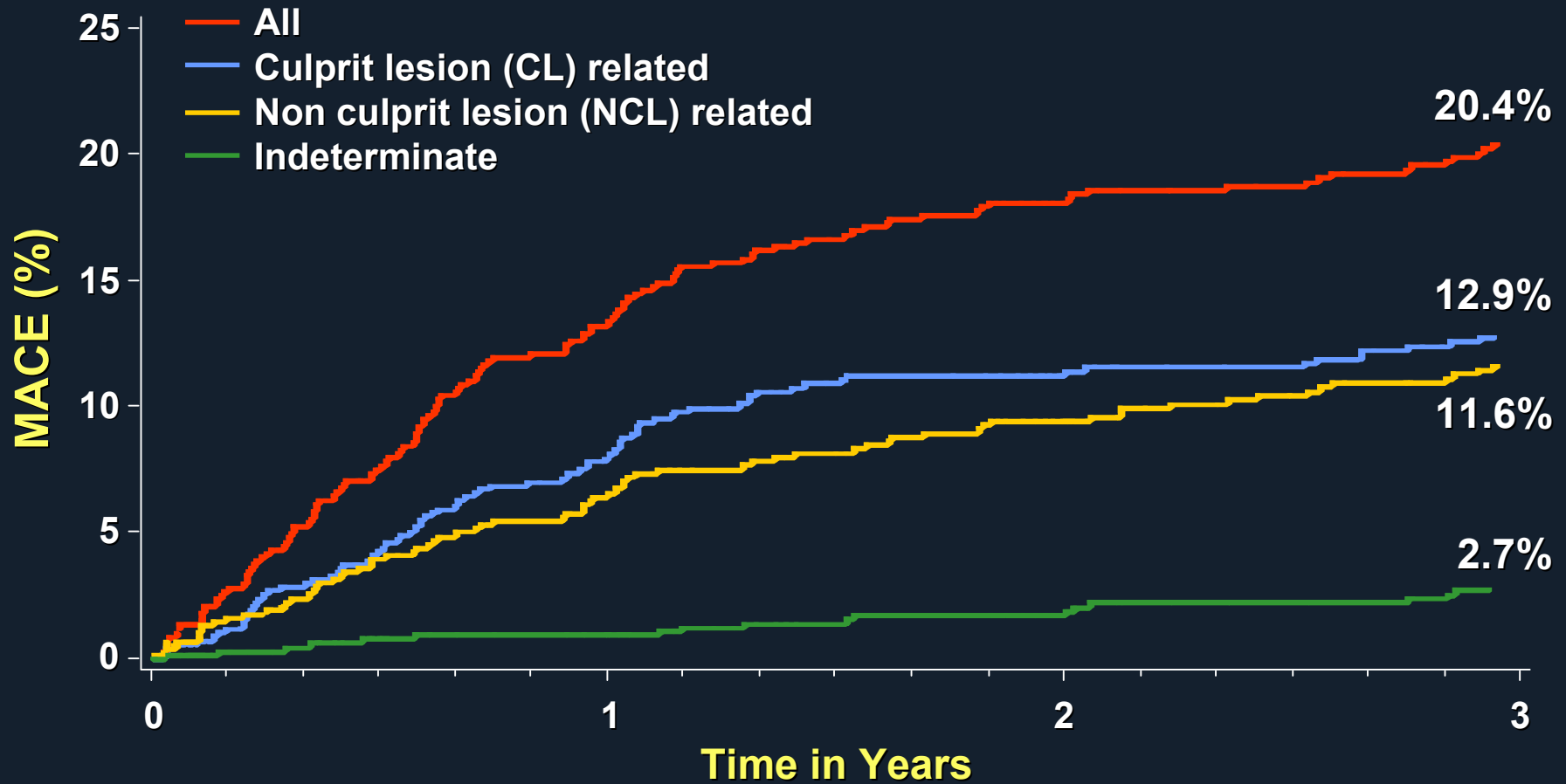
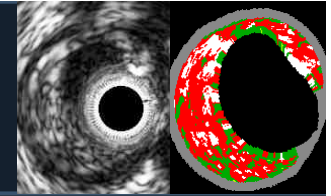
Fibrocalcific



**>10% Confluent
Necrotic Core**



PROSPECT: MACE



Number at risk

Category	0	1	2	3
ALL	697	557	506	480
CL related	697	590	543	518
NCL related	697	595	553	521
Indeterminate	697	634	604	583

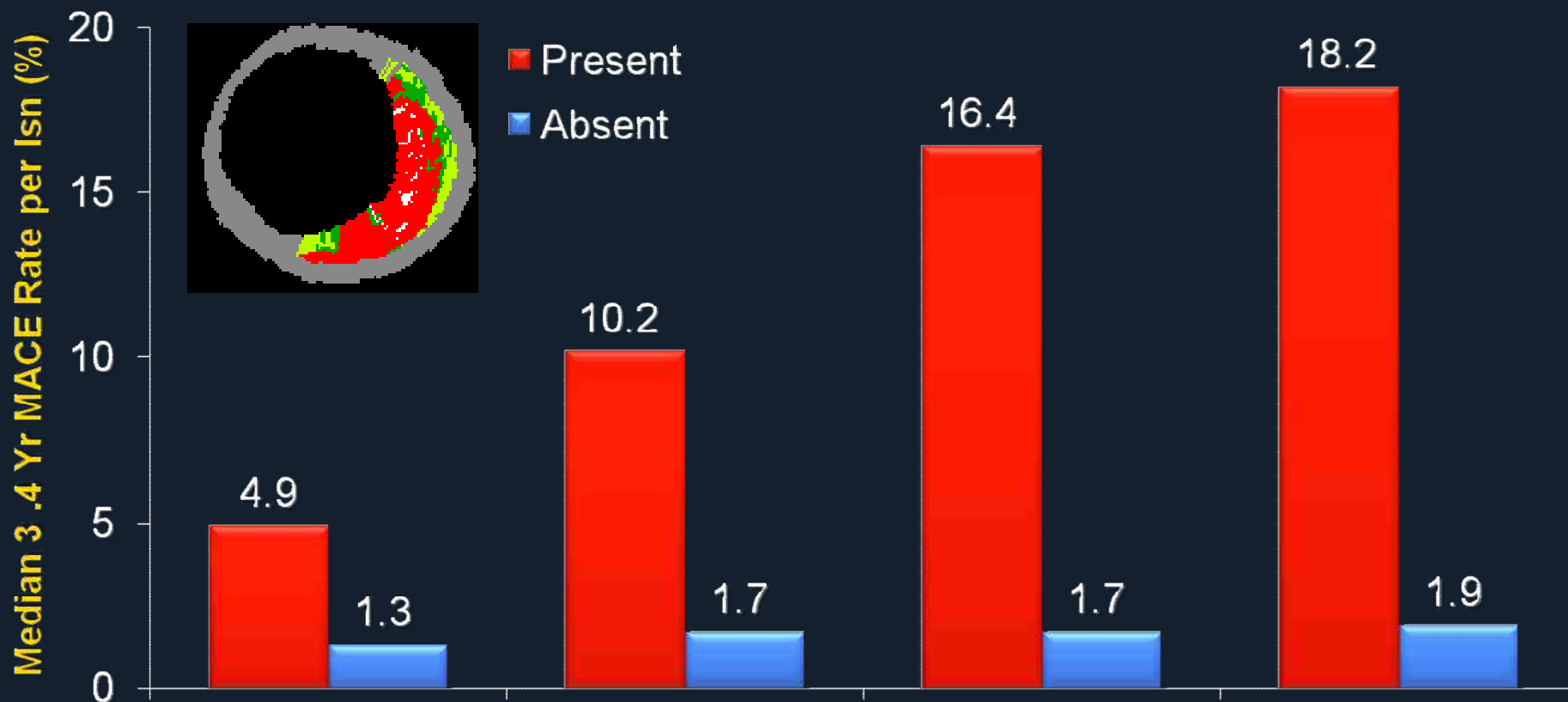
PROSPECT: MACE

3-year follow-up, non hierarchical

	All	Culprit lesion related	Non culprit lesion related	Indeterminate
Cardiac death	1.9% (12)	0.2% (1)	0% (0)	1.8% (11)
Cardiac arrest	0.5% (3)	0.3% (2)	0% (0)	0.2% (1)
MI (STEMI or NSTEMI)	3.3% (21)	2.0% (13)	1.0% (6)	0.3% (2)
Unstable angina	8.0% (51)	4.5% (29)	3.3% (21)	0.5% (3)
Increasing angina	14.5% (93)	9.2% (59)	8.5% (54)	0.3% (2)
Composite MACE	20.4% (132)	12.9% (83)	11.6% (74)	2.7% (17)
Cardiac death, arrest or MI	4.9% (31)	2.2% (14)	1.0% (6)	1.9% (12)

Rates are 3-yr Kaplan-Meier estimates (n of events)

PROSPECT: VH-TCFA and Non Culprit Lesion Related Events



	TCFA	TCFA + MLA $\leq 4.0\text{mm}^2$	TCFA + PB $\geq 70\%$	TCFA + PB $\geq 70\%$ + MLA $\leq 4.0\text{mm}^2$
Lesion HR	3.90 (2.25, 6.76)	6.55 (3.43, 12.51)	10.83 (5.55, 21.10)	11.05 (4.39, 27.82)
P value	<0.0001	<0.0001	<0.0001	<0.0001
Prevalence*	46.7%	15.9%	10.1%	4.2%

*Likelihood of one or more such lesions being present per patient. PB = plaque burden at the MLV. MLV The University Hospital of Columbia and Cornell

2 Year Survival Free of MACE

Angio Guided (n=496) FFR Guided (n=509)

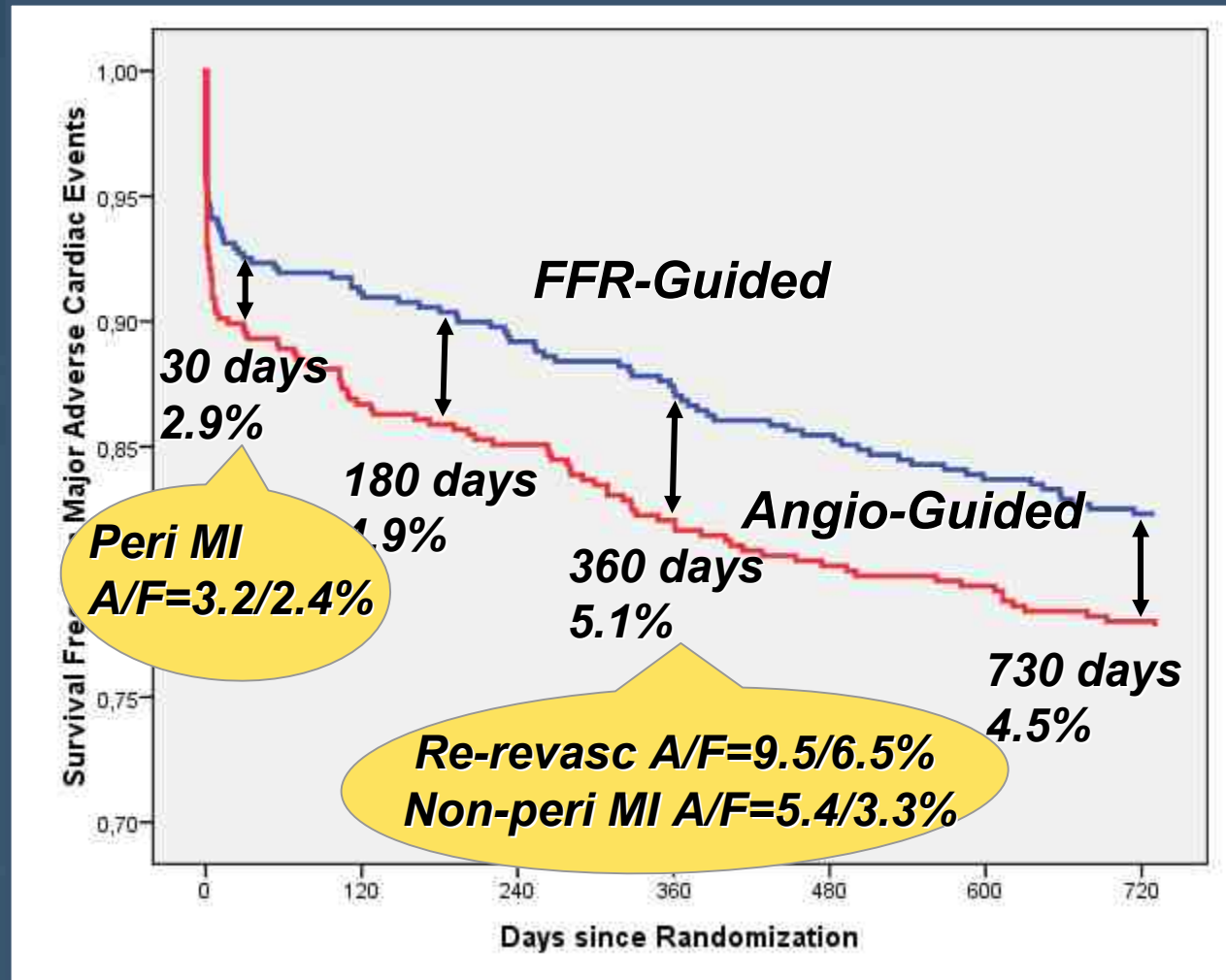
Angio Lesion 2.7 ± 0.9 2.8 ± 1.0

Stent # 2.7 ± 1.2 1.9 ± 1.3

FFR Deferred Lesions (n=513)



1 MI+10 revasc with clear progression (11/513=2.1%) in 2 yrs



MACE: Death, MI, Repeat Vascularization

Fearon W at TCT2009

COLUMBIA UNIVERSITY
MEDICAL CENTER

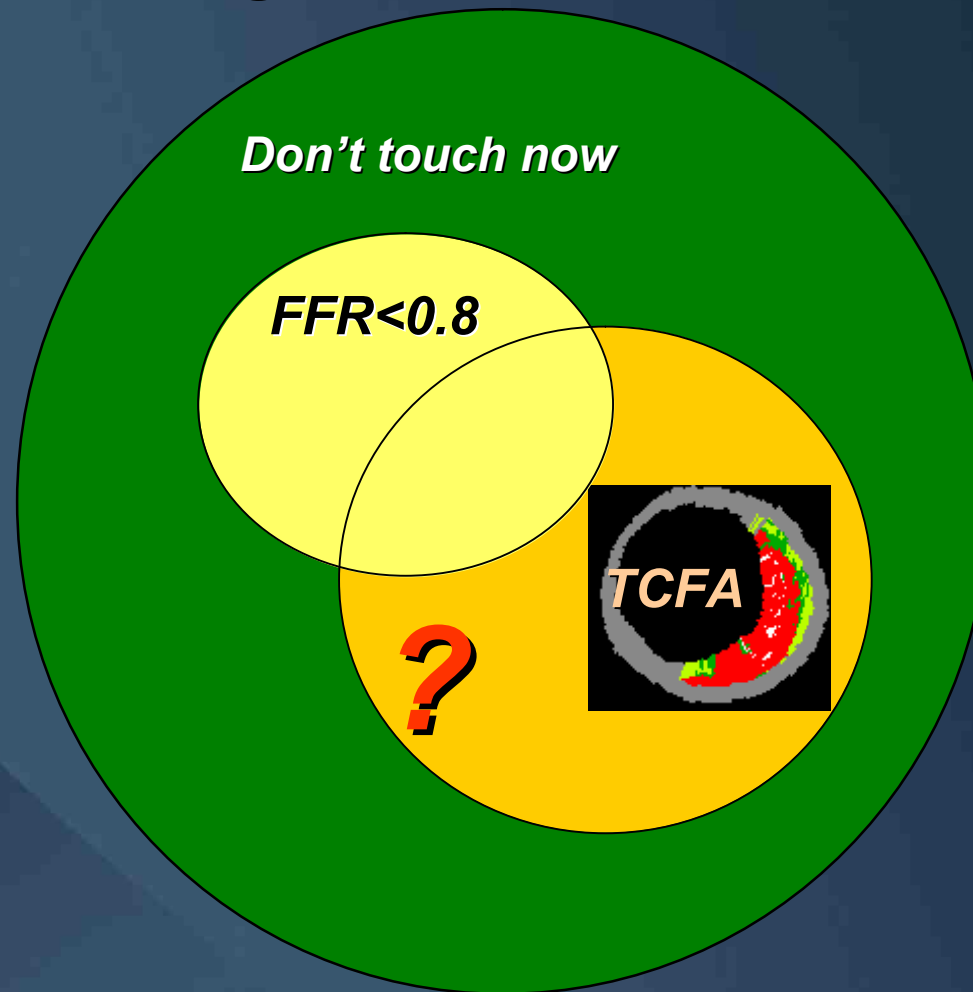
NewYork-Presbyterian

The University Hospital of Columbia and Cornell

1. PROSPECT; which lesions should we treat?

2. FAME; which lesions we should not touch now!

Angio/IVUS Lesions



Summary

- 1. IVUS guided PCI improves outcomes.**
- 2. Cut-off values discriminate restenosis vs non-restenosis, but they do not provide an optimal acute value.**
- 3. Non-significant stenosis with thin-cap fibroatheroma would be the next question to be answered...**

