

# **QCA guidance with selective use of IVUS is a reasonable approach in contemporary PCI**

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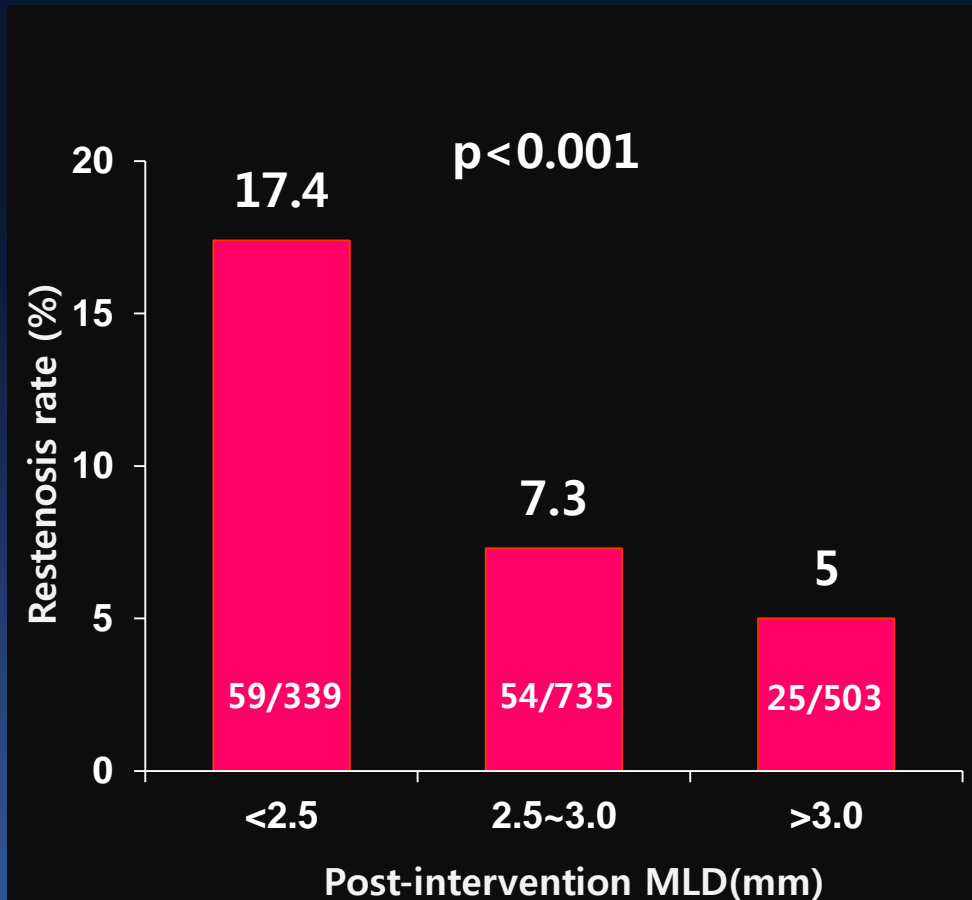
# IVUS in PCI Guidance

- **2011 ACC/AHA/SCAI Guideline**
  - may be considered for guidance of stent implantation, particularly in cases of left main coronary stenting (IIb)
  - to determine the mechanism of stent restenosis (IIa)
- **2014 ESC/EACTS Guideline**
  - selected patients to optimize stent implantation (IIaB)
  - to assess severity and optimize treatment of unprotected left main coronary artery disease (IIaB)

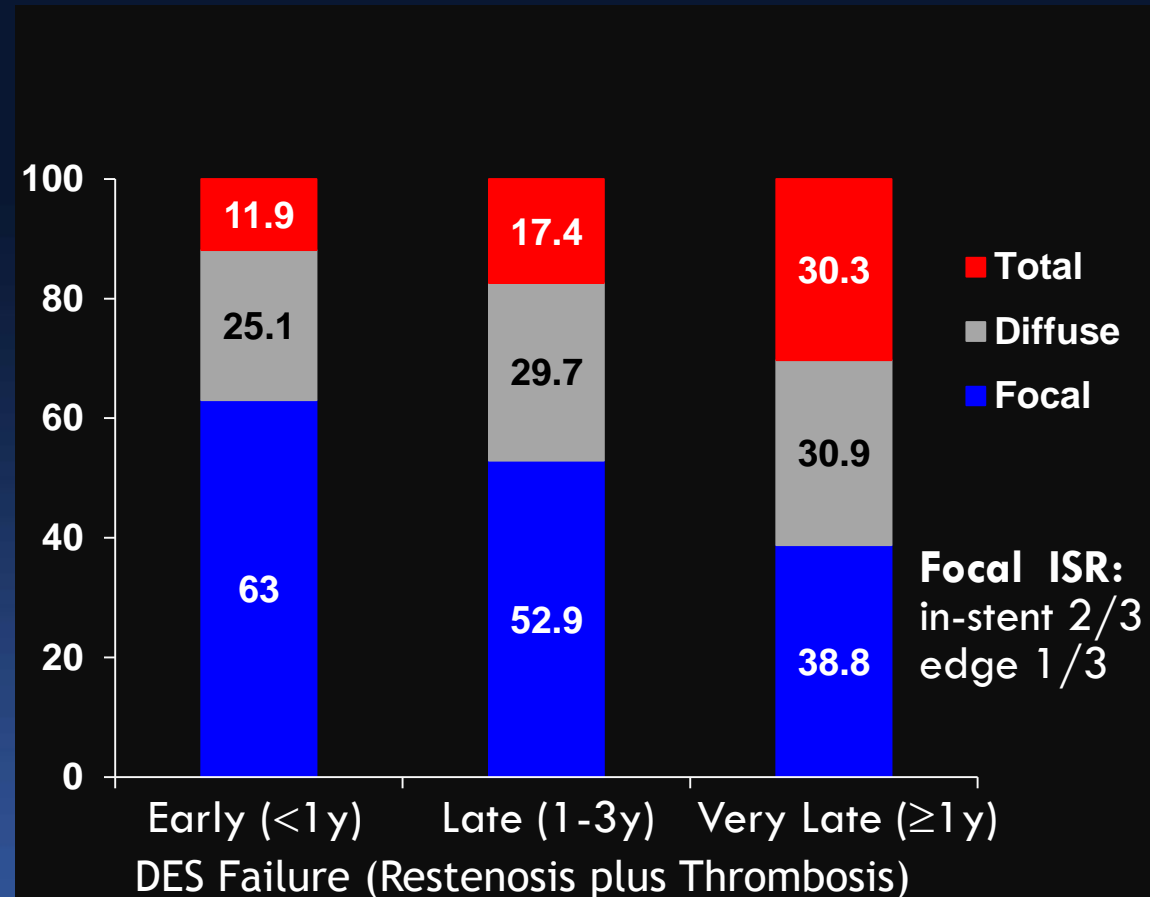
# Presentation

- **Why DES Failure ?**
- **Trials for PCI Guidance**
- **Issues & Solutions**

# Patterns & Predictors of ISR After DES Implantation

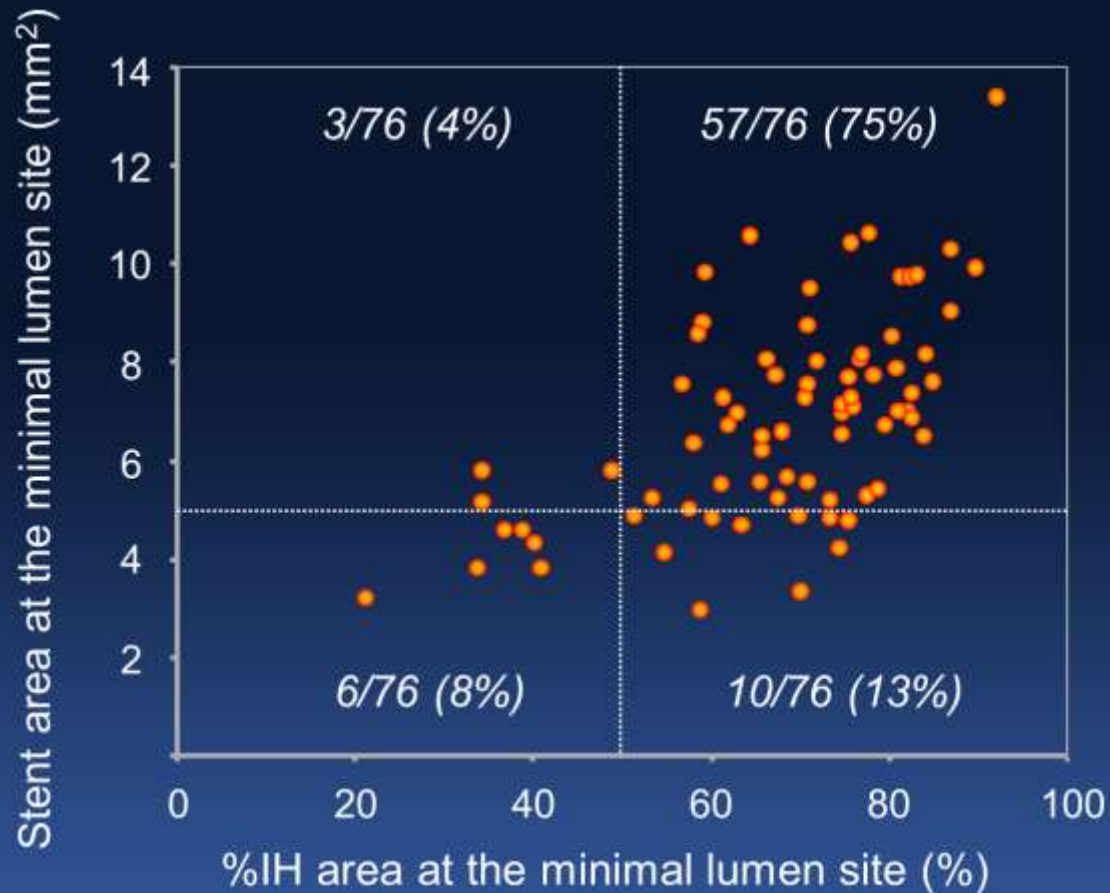


Lee CW, et al. Am J Cardiol 2006;97:506 –11



Lee CW et al, Catheter CI 2015;85:515-21

# Mechanism of DES Restenosis



MLA site was located at mid portion in 59%, within 5 mm from the proximal stent edge in 22%, and within 5 mm from the distal stent edge in 19%

Of the IVUS-defined ISR, 42% had stent under-expansion & 93% had IH area >50% of stent.

Because IH was not preventable, interventionists should focus on correction of stent under-expansion during the procedure.

Even bigger, even better:

The risk of target lesion failure decrease for every mm increases.

# Summary

- Post-intervention MLD & edge problems are key predictors of TLF after DES implantation.
- Achieving a greater stent area without edge problems may decrease the risk of TLF after DES implantation.

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# IVUS- vs. Angio-Guided PCI: 8 RCTS

Trials	Number	Lesions	Angio	Post-dil	1 <sup>o</sup> endpoint	Results	P-value
HOME <sub>DES IVUS</sub>	105/105	Complex	No	24/0	MACE	11/12%	NS
AVIO	142/142	Complex	Operator	88/68	Post-MLD	2.7/2.5mm	0.002
RESET	269/274	Long	Visual	55/45	MACE	HR 0.59	0.16
Tan et al	61/62	LM	No	23/9	MACE	13/21%	0.031
AIR-CTO	115/115	CTO	Visual	NA	Late loss	0.28/0.46	0.025
CTO-IVUS	201/201	CTO	No	51/41	C Death	—	0.16
IVUS-XPL	700/700	Long	Visual	76/57	TLF	HR 0.48	0.007
Zhang et al	42/42	Small	Visual	NA	Post-MLD	2.8/2.5mm	<0.001

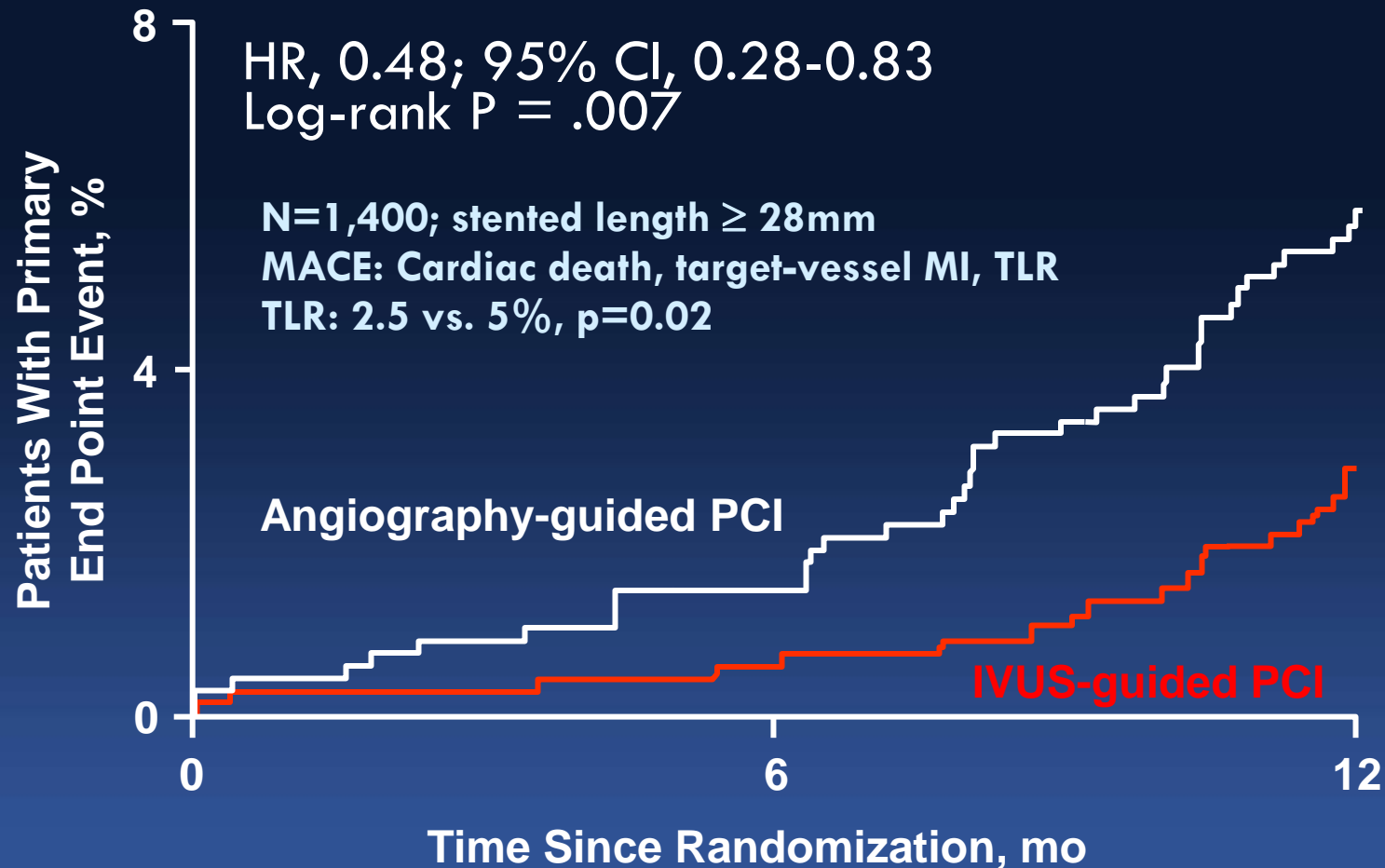
1) Catheter Cardiovasc Interv 2010;75:578-83. 2) Am Heart J 2013;165:65-72. 3) JACC Cardiovasc Interv 2013;6:369-76.

4) Saudi Med J 2015;36:549-53. 5) EuroIntervention 2015;10:1409-17. 6) Circ Cardiovasc Interv 2015;8:e002592.

7) JAMA 2015;314:2155-63. 8) J Clin Invasive Cardiol 2016;3:2-8.



# IVUS-XPL Randomized Clinical Trial



Among patients requiring long coronary stent implantation, the use of IVUS-guided everolimus-eluting stent implantation, compared with angiography-guided stent implantation, resulted in a significantly lower rate of MACE

# IVUS-XPL: What Makes the Difference?

Angiography-guided:

- stent size & length **by visual estimation**,
- post-dilation if residual DS  $\geq 30\%$  **by visual estimation**

IVUSU-guided: decisions according to IVUS findings

Differences in key parameters:

- adjunctive **post-dilation**: 76% vs. 57%,  $p < 0.001$
- final balloon size: 3.14 vs. 3.04mm,  $p < 0.001$
- **final MLD**: 2.64 vs. 2.56mm,  $p < 0.001$
- **residual diameter stenosis**: 12.79 vs. 13.74%,  $p = 0.04$

# Limitations of Previous Studies

The key determinant of the device failure is not imaging-guidance itself but suboptimal results.

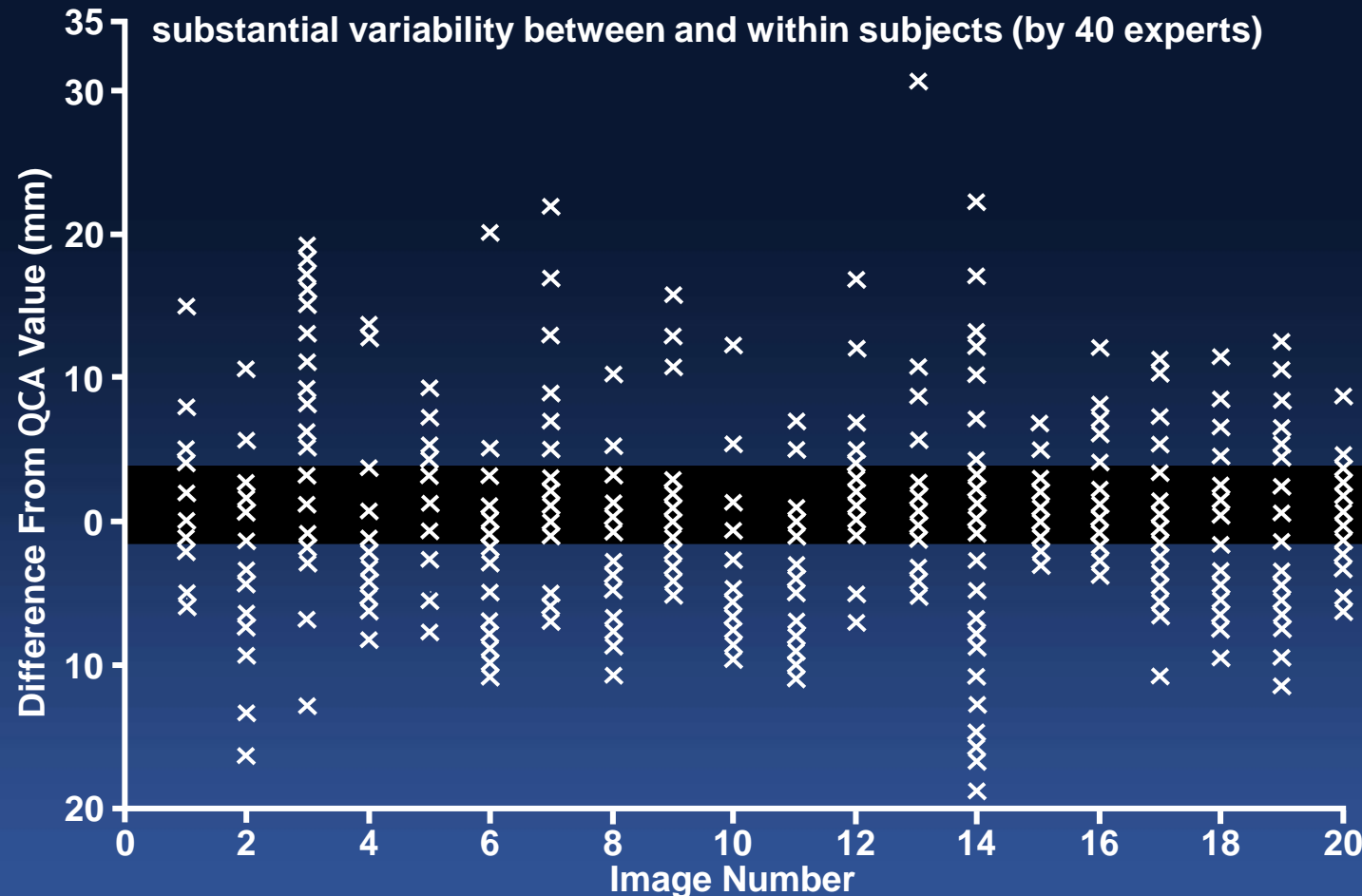
Looking at angiography guidance:

- Smaller stent: Angiography guidance was based on **visual estimation**, often leading to choose undersized stents.
- Stent underexpansion: High pressure **post-dilatation** was not routinely used, leading to inadequate stent expansion.

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# Visual Estimation



In clinical practice, PCI most commonly relies on visual estimation by physicians. Sizing by visual estimation, however, has well-known limitations with high variability & inaccuracy, which is affected by magnification, screen size, and etc.

# QCA Guidance for IVUS-Like Results

- **Design by angio** (shoulder to shoulder)  
creating harmony with reference vessels
- **Sizing by QCA** (fine edge-tuning)  
target size (adjusted QCA)=RVD + 5-10% of RVD
- **Finish by 3D** (dilate, dilate & one more dilate)  
minimal residual diameter stenosis <10% by QCA

# Design by Angiogram

Start with best angiograms

Take CAG after nitroglycerin (250-500 $\mu$ g) injection

## 1. Landing zone

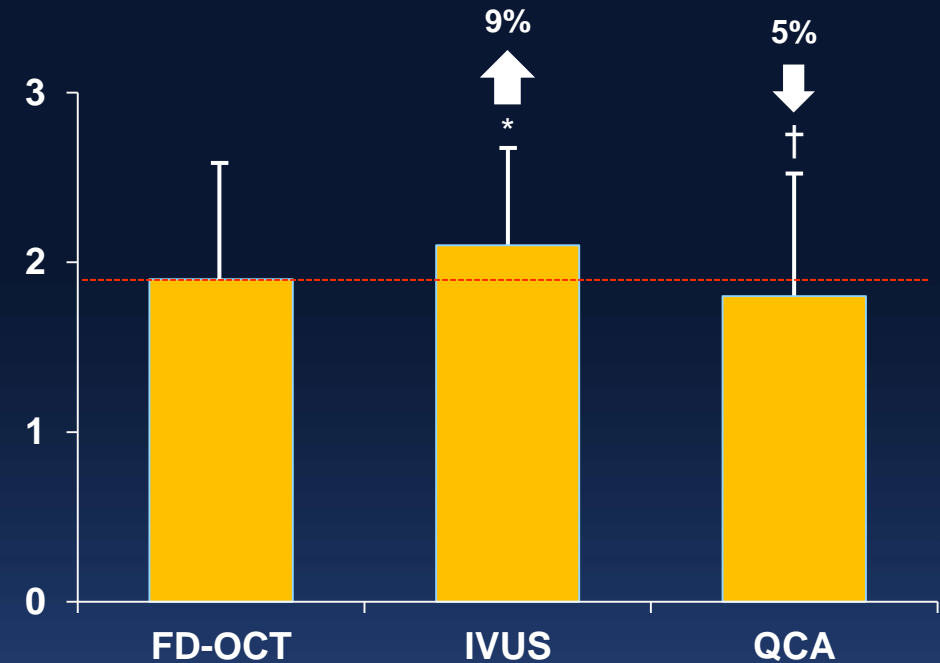
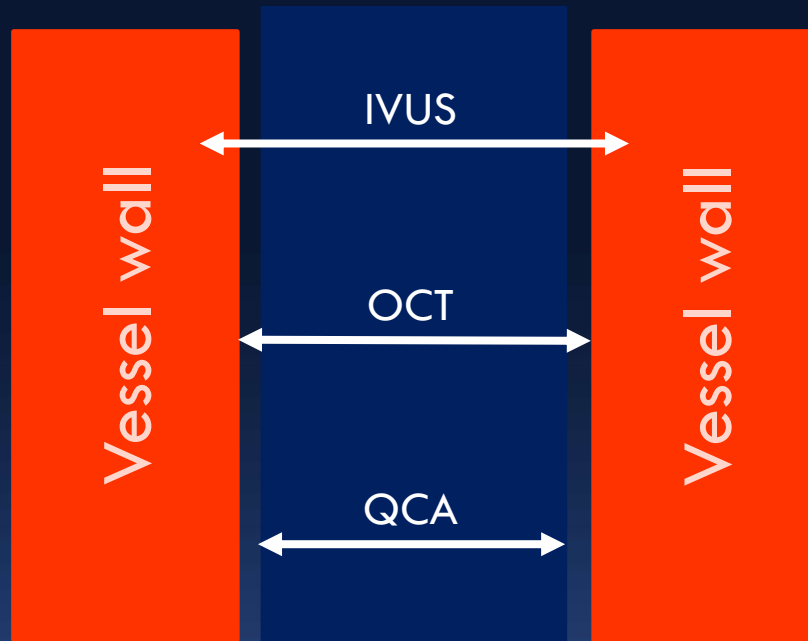
- shoulder to shoulder (normal or normal looking areas)
- poor zones: sharp turning points, bending or milking areas

## 2. Lesion length

- short lesions: by non-inflated balloon (15, or 20mm)
- long lesions: by radiopaque distal tip of the guide wire (30mm)

## 3. Reference vessel diameter by QCA

# Sizing by Dynamic QCA



**QCA underestimate the lumen dimension compared to OCT (real value), requiring oversize corrections.** Siemens on-line QCA by automatic calibration: error < 1.5%

1. get reference vessel diameter (RVD), by on-line QCA
2. stent selection & deployment, by balloon inflation up to target size
  - ≤3.5mm by QCA: target size = distal RVD + ~10% of distal RVD
  - 3.5-4.0 by QCA: target size = distal RVD + (5-10% of distal RVD)
  - ≥4.0 by QCA: target size = distal RVD + ~5% of distal RVD



# Finish by Post-dilation

The best time to invest: All patients begin to lose lumen area after achieving peak lumen area by post-dilation.

## 1. Edge tuning, up to target size ( $0 < \text{tapering index} < 10\%*$ )

A smooth tapered transition:

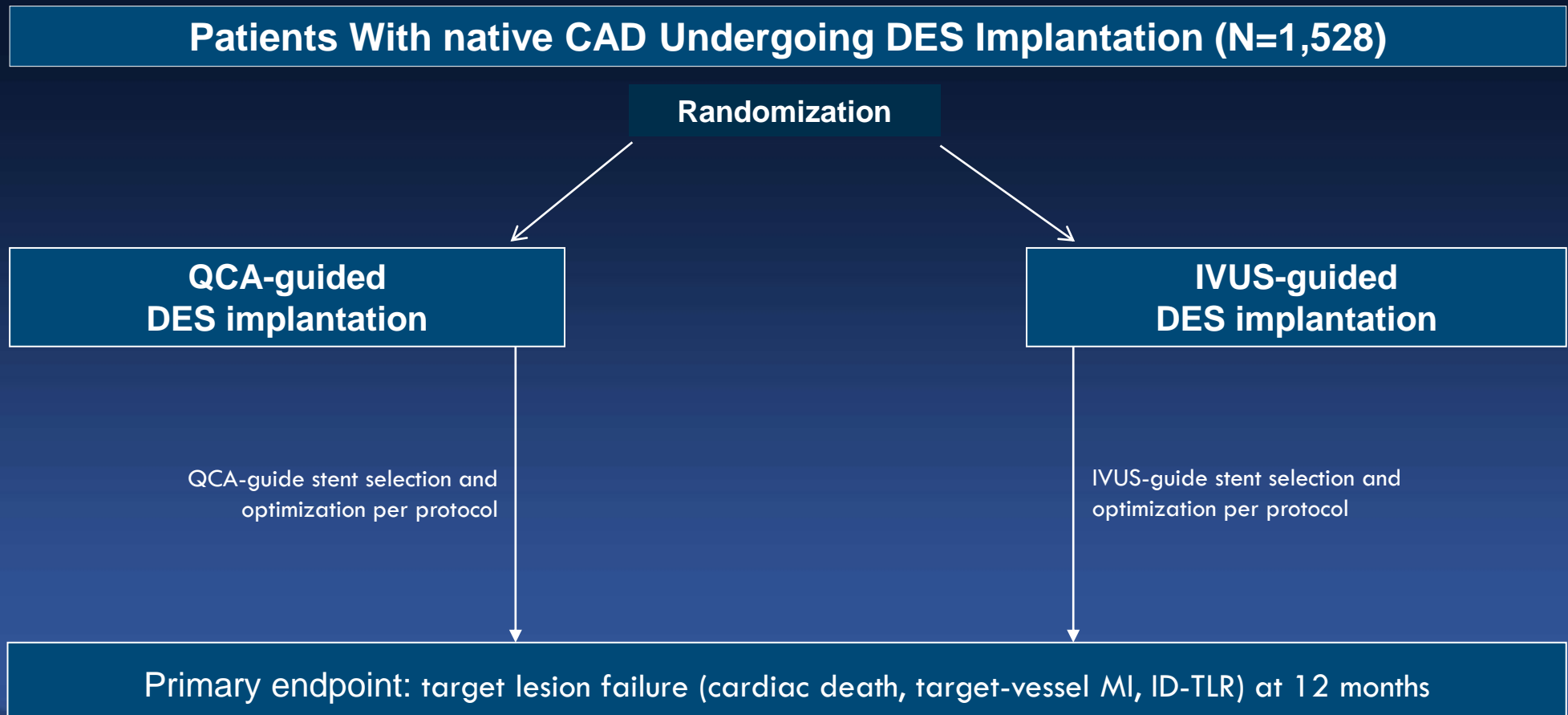
- golden ratio tapering =  $\sim 3\%$  by QCA or visual estimation
- Stent edge under-expansion: one more tuning up to target size +  $\sim 0.2\text{mm}$

## 2. In-stent tuning, up to (target size plus $\sim 0.2\text{mm}$ )

to minimize residual stenosis ( $0\%$  by visual estimation,  $< 10\%$  by QCA)

\*Tapering index =  $(\text{stent edge MLD} - \text{reference MLD}) / \text{stent edge MLD} \times 100$   
reference MLD: reference vessel size within 2.5mm from the stent margin

# Quantitative Coronary Angiography versus Intravascular Ultrasound *GUIDance* for *Drug-Eluting Stent* Implantation: *GUIDE-DES* trial



# Summary

## IVUSplasty vs. ANGIOplasty

### IVUS guidance\*:

- a limited impact on PCI outcome
- no reimbursement of IVUS worldwide, except Japan
- IVUS penetration: Japan 80%, Korea 23%, USA 15%, EU 5%, China 4%, India 1%

### QCA guidance:

- available at every catheterization laboratory
- quick and easy without additional cost
- a reliable time-honored method

\*Selective use of IVUS:

IVUS-guided wiring for CTO intervention, or evaluation of ambiguous lesions (haziness) and PCI complications (dissection, hematoma, thrombosis)