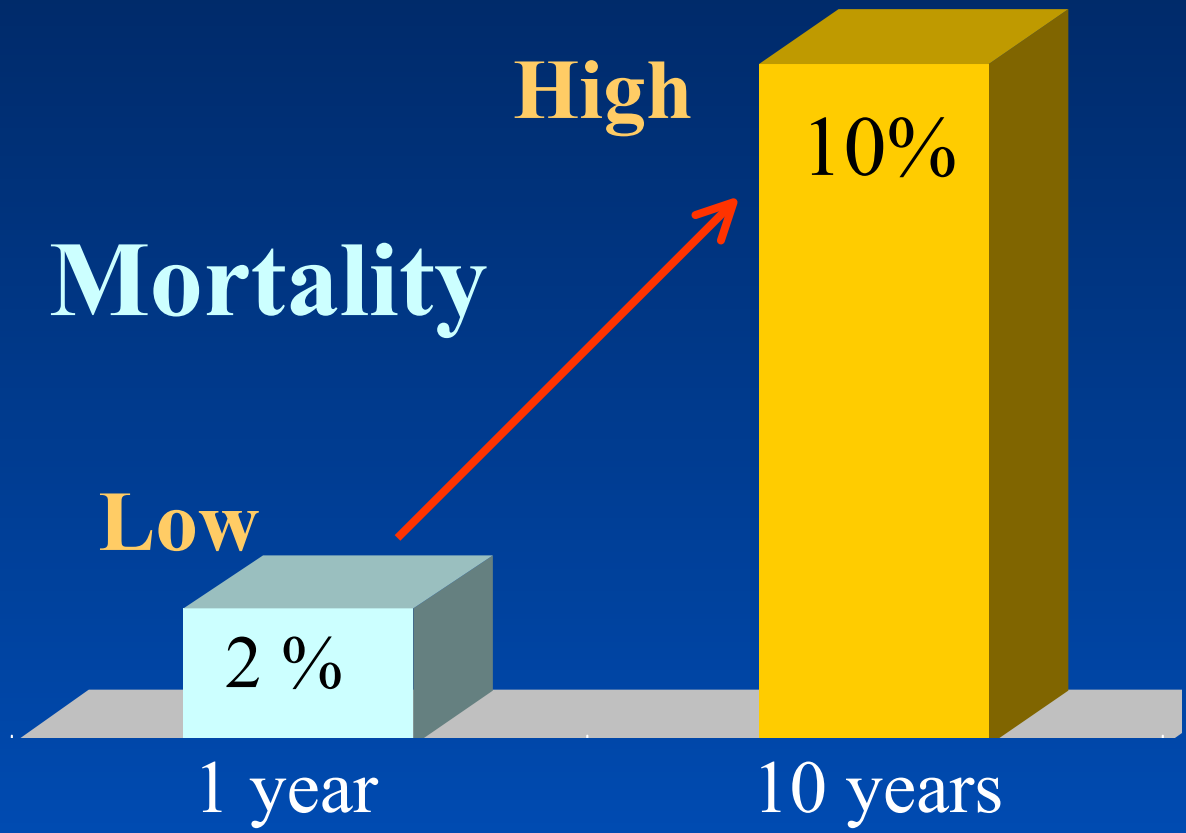
PCI for Chronic Total Occlusions

Chronic Total Occlusions

Why should we open ?

Medical Treatment

CTO in 891 pts over 24 years

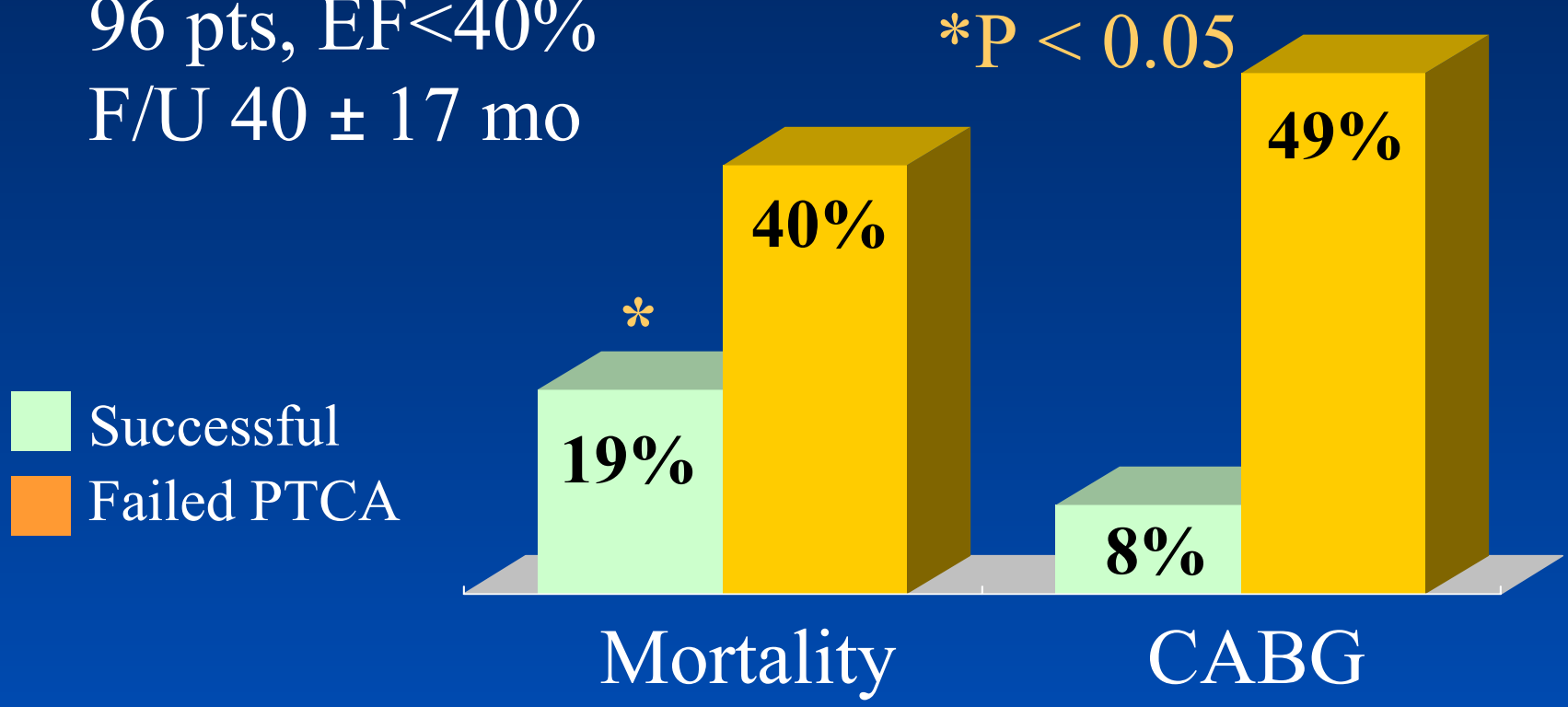


Puma JA, et al. JACC 1994;23:390A

Reopening of CTO

Improves Survival

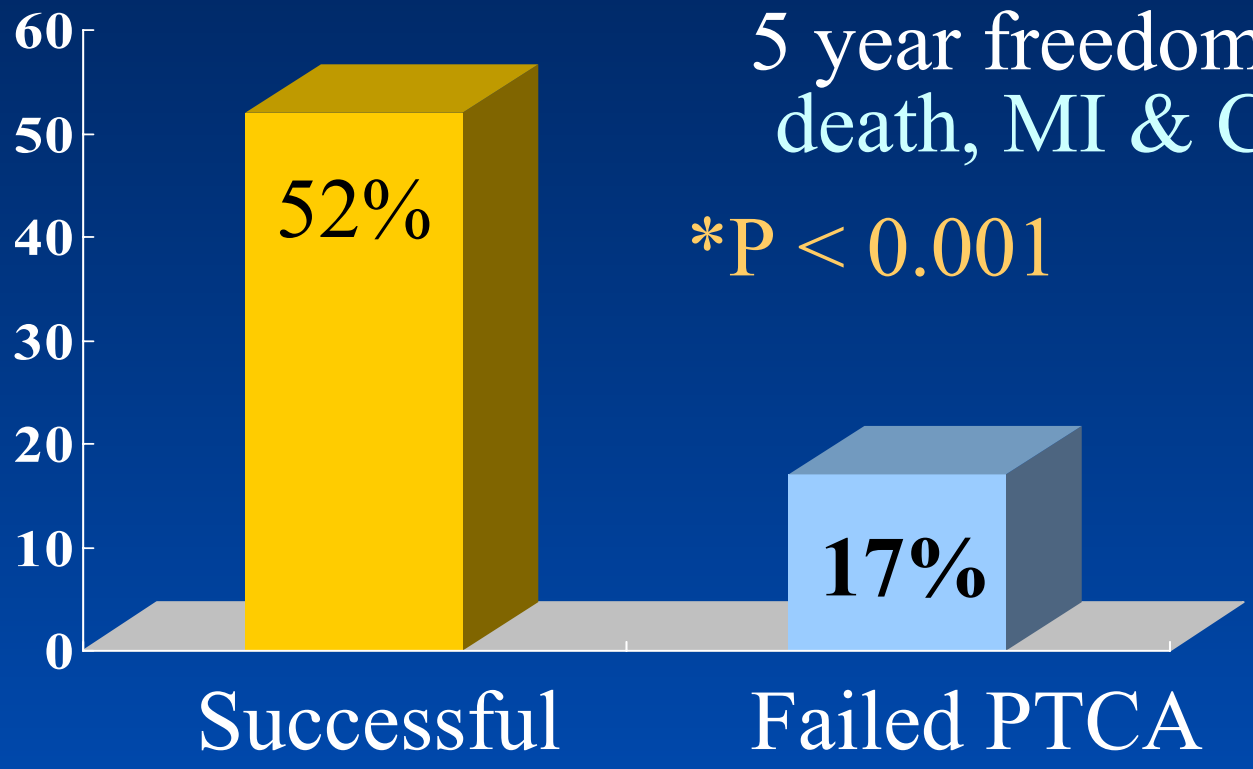
96 pts, EF<40%
F/U 40 ± 17 mo



Schultze C, et al. Am J Cardiol 2002;90:148H

Reopening of CTO

Decrease MACE



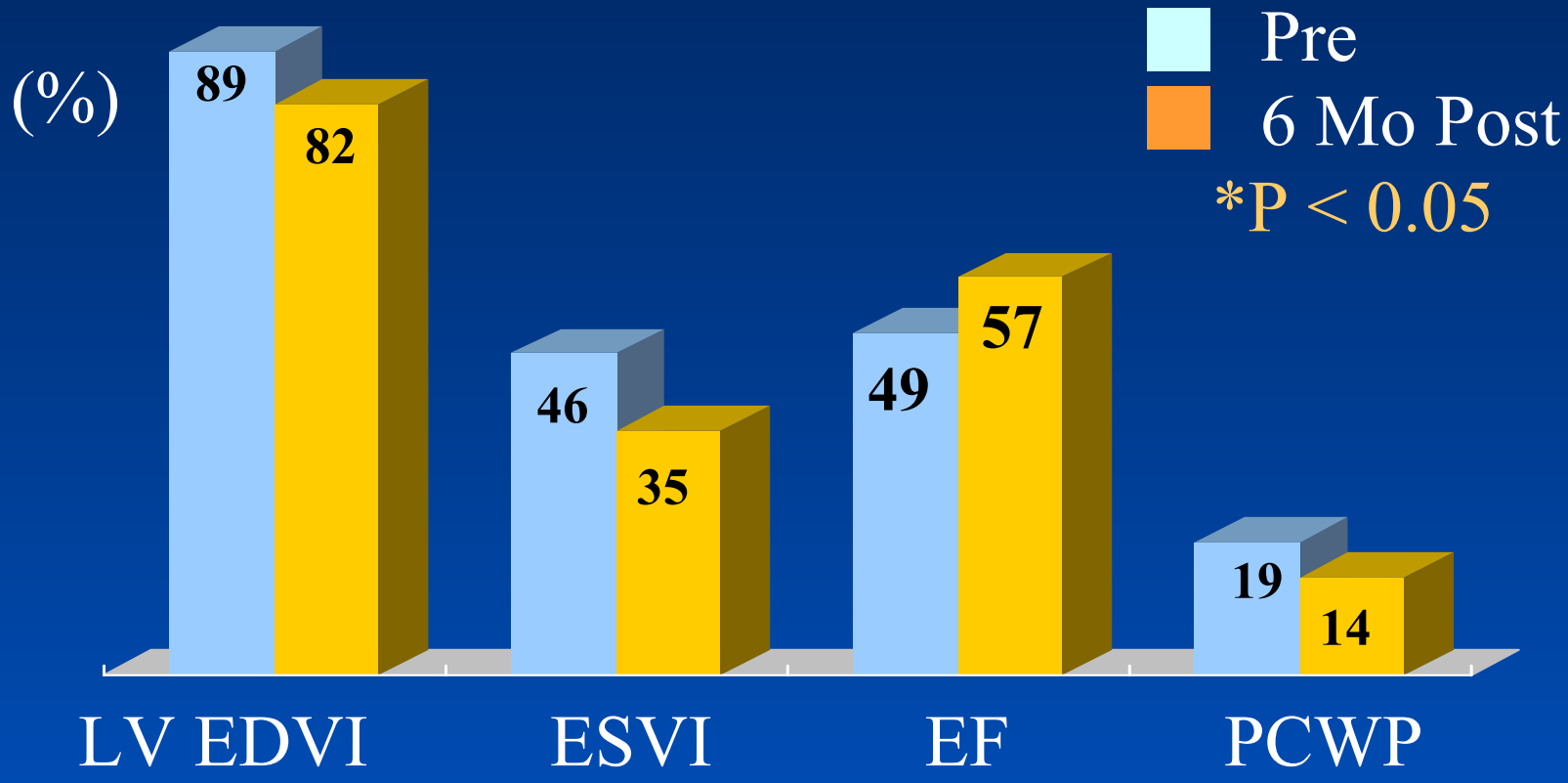
5 year freedom from death, MI & CABG

*P < 0.001

Bell MR, et al. Circ 1992;85:1033-11
Clin Investig 1994;72:442-7

Reopening of CTO

Improves LV Function



Van Belle E, et al. AJC 1997;80:1150-1154

Chronic Total Occlusion

Why PCI ?

- To relieve symptom itself
- To improve LV function
- To improve late outcomes

  Improved survival

  Freedom from subsequent CABG

Why challenging ?

CTO Intervention

- **Low Procedural Success**
- **High Restenosis Rate**

Procedural Success

Predictors

- Duration of occlusion
- Length of occluded lesion
- Absence of antegrade flow
- Absence of stump
- Presence of bridging collateral

Procedural Success

Favorable

Tapered stump

Functional occlusion

Pre or post occlusion

Bridging collateral (-)

Unfavorable

Stump absent

Total occlusion

Side branch(+)

Bridging collateral (+)

Procedural Failure

Multivariate analysis

Variables	*P* value	Odds ratio
Calcification	< 0.01	2.56
Multivessel disease	< 0.01	2.11
Lesion length >20mm	< 0.05	1.72
Duration of occlusion	0.96	1.21

Nouguchi et al, Cathet. Cardiovasc. Intervent 2000;49:258-64

Reopening of CTO

- Conventional Guidewires
- New Generation Guidewires
- New Devices for crossing lesion

  FrontRunner™ Catheter

  OCR SafeSteer™ System
  (Optical Coherence Reflectometry)

  Flow Cardia Crosser™ System

Reopening of CTO

Conventional Guidewire

vs.

New Generation

Conventional Wiring of CTO

- Success rate < 50%
- Age of occlusion is biggest determinant of failure

Ability to Cross CTO

Hydrophilic-coated Guidewire

	Conventional (n=46)	Crosswire (n=42)	*P*
1st GW success(%)	35	74	0.001
Crossover(%)	59	26	0.009
GW success after crossover(%)	37	0	<0.001
Total GW No.	1.7 ± 0.6	1.3 ± 0.5	<0.001
Procedure(min)	84 ± 33	42 ± 20	0.013

Lefevre et al, Am J Cardiol 2000;85:1144-7

Ability to Cross CTO

Laser Guidewire

Procedural Success	**50-59 %**
Coronary Perforation	**1-21 %**
Restenosis at 18 weeks	**20-31 %**
Improved Angina Status	**66%**
Death / MI / CABG	**0%**

Hamburger JN, et al. AJC 1997;80:1419-1423
Hamburger, et al. JACC 1997;30:649-656
Schofer et al. JACC 1997;30:1722-1728

Guidewire in CTO PCI

New generation guidewires may be effective in the treatment of CTO in case refractory to conventional guidewires.

New Devices for CTO

Crossing Lesion

- FrontRunner™ Catheter
- OCR SafeSteer™ System

  (Optical Coherence Reflectometry)
- Flow Cardia Crosser System

FrontRunner Catheter

Intraluminal MicroDissection

- Blunt controlled passage through occlusion
- Uses elastic properties of adventitia
  vs. inelastic fibrocalcific plaque

FrontRunner Catheter

Advantages

- Torqueable
- Guide support
- Directable/Steerable
- Hydrophilic coating
- Blunt tip to avoid perforation
- Avoids side branches

Disadvantages

- Difficult anatomy: tortuosity, small vessel, heavy calcium
- Expensive
- 8 Fr guiding for curved jaw
- Failure Modes

FrontRunner Technique

- 6 or 8 Fr guiding catheter
- Collateral visualization
- Tip shapeable and steerable
- Engagement in CTO & Jaw opening
- Torque and advance / retract
- Intraluminal vs subintimal
- Replace with guidewire
- Dilate and stent

FrontRunner Catheter

Milan Experiences

50 pts with 50 CTO, Refractory to guidewire
Mean occlusion length 38.3 ± 22 mm

- **Overall Device Success** **50 % (25)**
- **Coronary perforation** **17.3 % (9)**
- **Adverse events @ 30 days** **15.7 % (8)**

7 non-Q wave MI, 1 sudden death

Relatively high risk of perforation !

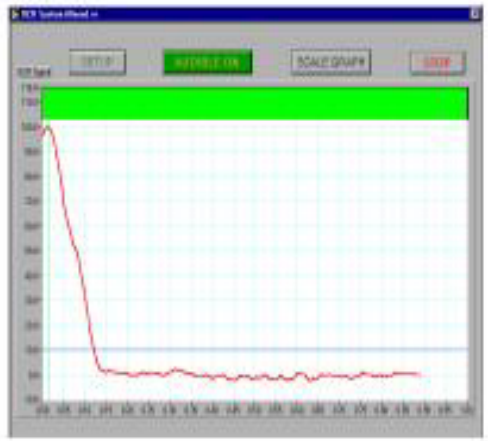
A Colombo et al, ACC 2004

OCR SafeSteer System

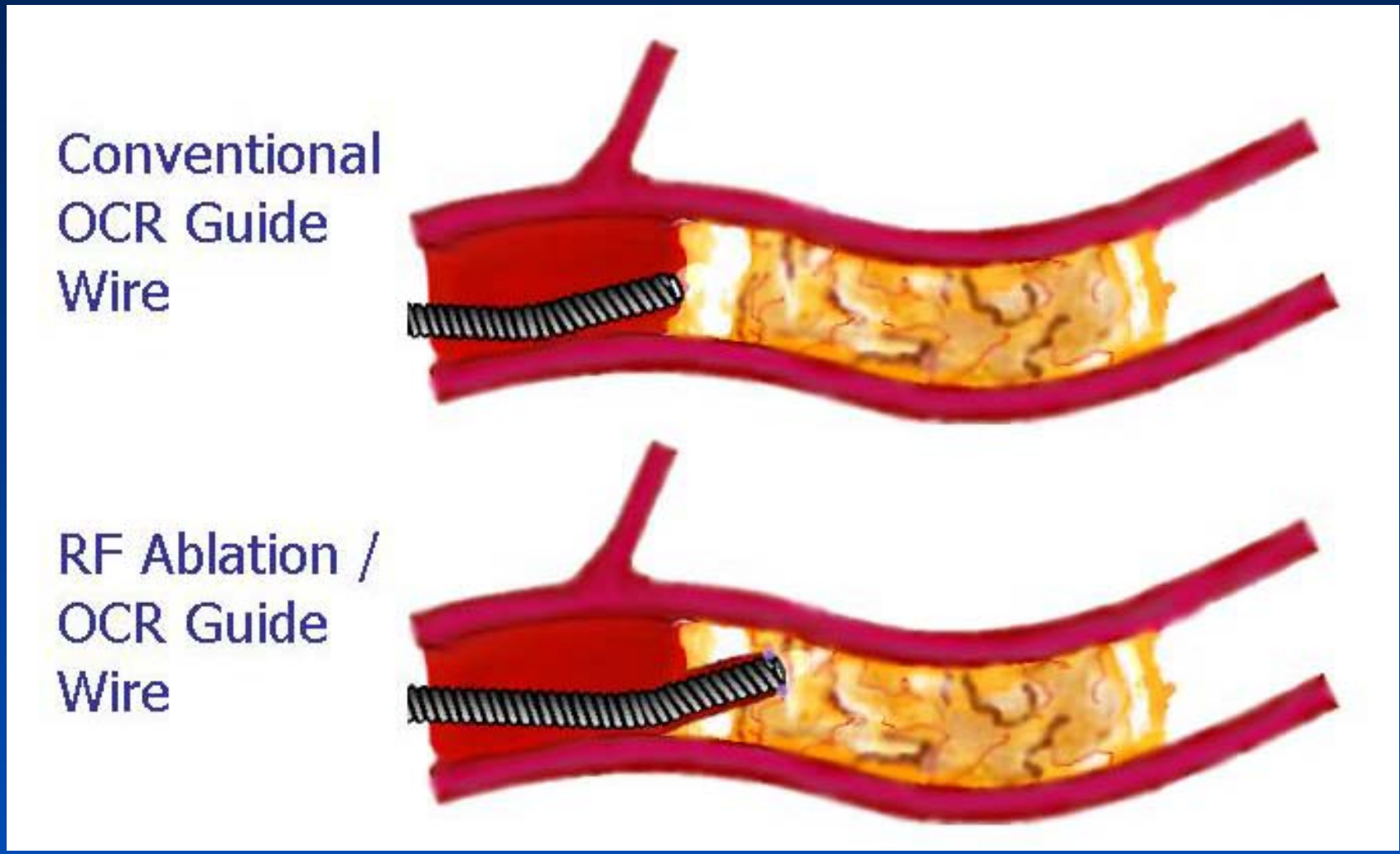
- Forward looking guidance system, using OCR to determine tissue types (plaque vs arterial wall).
- Designed to navigate through total occlusion.

OCR SafeSteer System

OCR Wavefore Displays



OCR SafeSteer System



OCR SafeSteer System

Pilot Study

	Safe-Cross (n=13)	Conventional wire (n=13)
Age (years)	70	60
Male	92 %	85 %
Occlusion length	40.2 mm	12 mm
Occlusion age	3.4 years	5 years
Success crossing	11 (85 %)	8 (62 %)

Heuser RR et al, TCT 2002

The Crosser™ System

New Devices for CTO

- **Generator**
  converts line power into high frequency current
- **Transducer**
  converts electric current into mechanical vibration
- **The Crosser catheter**

The Crosser™ System

Pilot Study

54 pts with 56 CTO, Refractory to guidewire
Mean occlusion length 27 mm (8~46 mm)

- Average time spent 2:43 min
- MACE (2 NQMI) 3.6 % (2/56)
- Clinical perforation 0 %

High frequency mechanical recanalization is a promising technology.

G. Sutsch et al, JIM 2004

Role of New Devices

- FrontRunner™ Catheter
- OCR SafeSteer™ System
- The Safe Crosser™ System

May be useful for specific CTO cases refractory to conventional system.

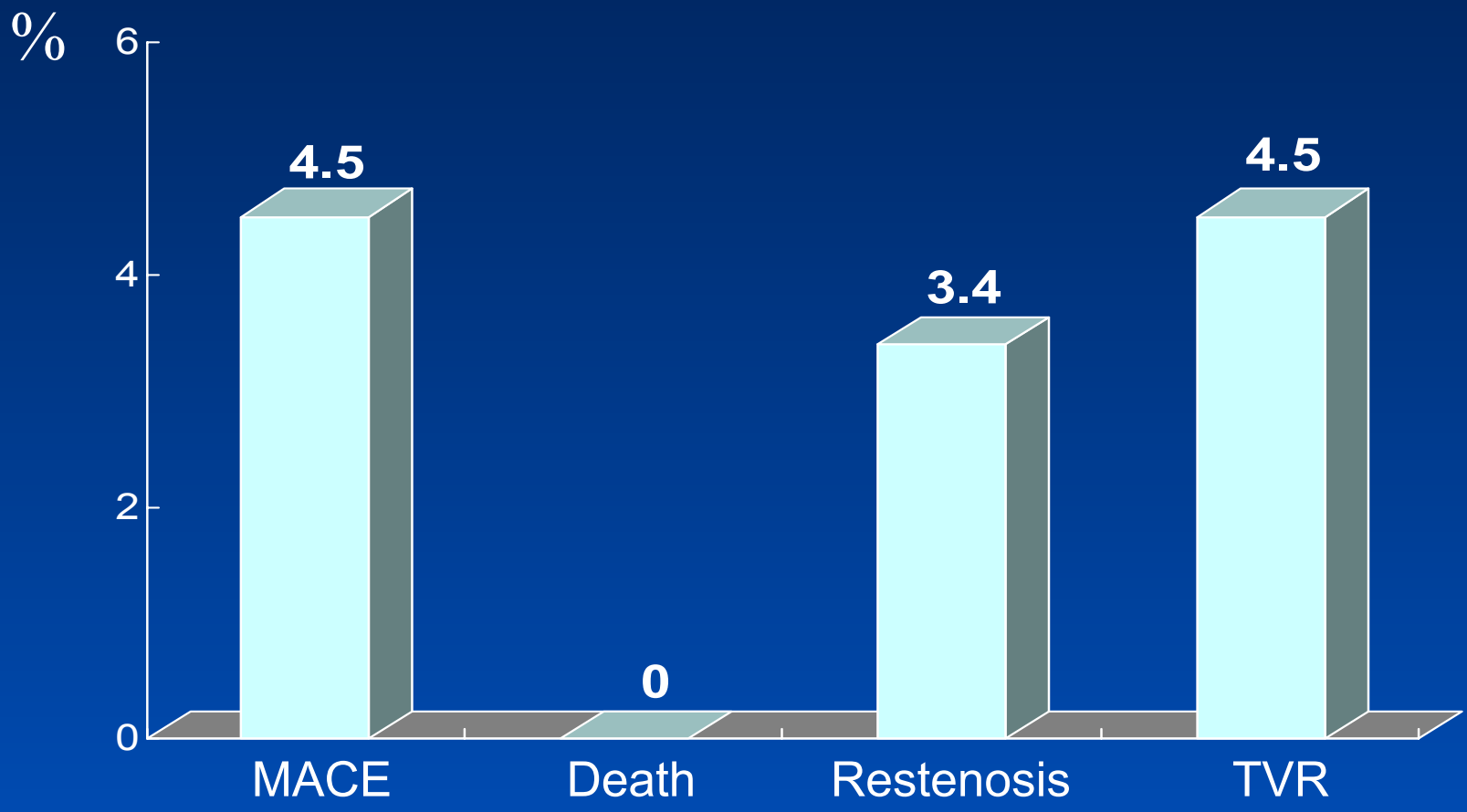
High Restenosis Rate of CTO

Is not high anymore with the introduction of DES !

Impact of DES on CTO Intervention

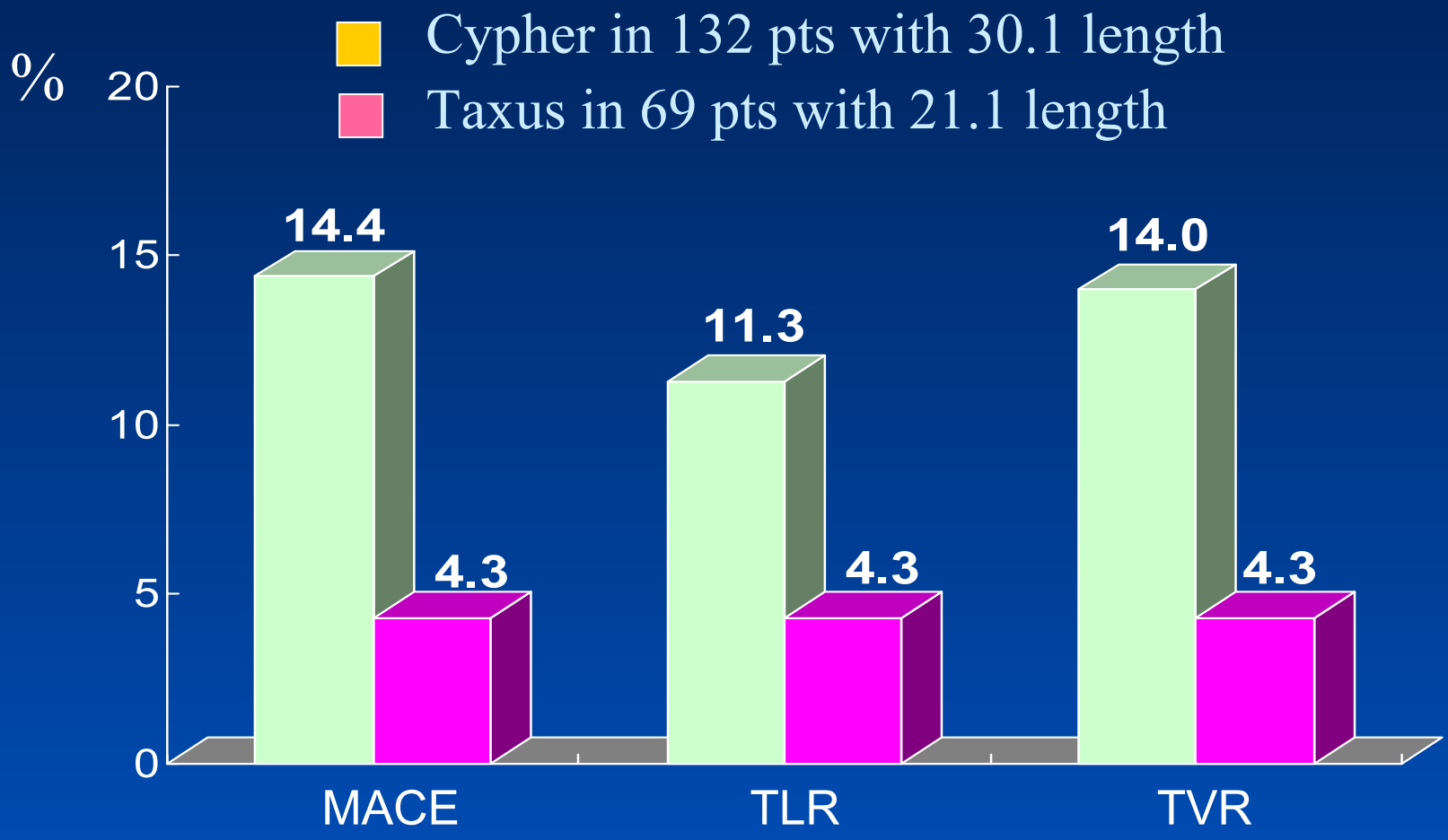
CTO in 5 Asian Center

Total 88 pts with 102 CTOs treated with Cypher



Nakamura et al, ACC 2004

CTO in Milan



Colombo et al, ACC 2004

CTO from RESEARCH Registry

CTO (>1 Mo), stented length 45 mm

- Restenosis @ 6 month 9 %
- 12 month Follow-up
  - Death 0 %
  - AMI 0 %
  - TLR 6.1 %
  - MACE free survival 96.4 %

Serruys et al, ACC 2004

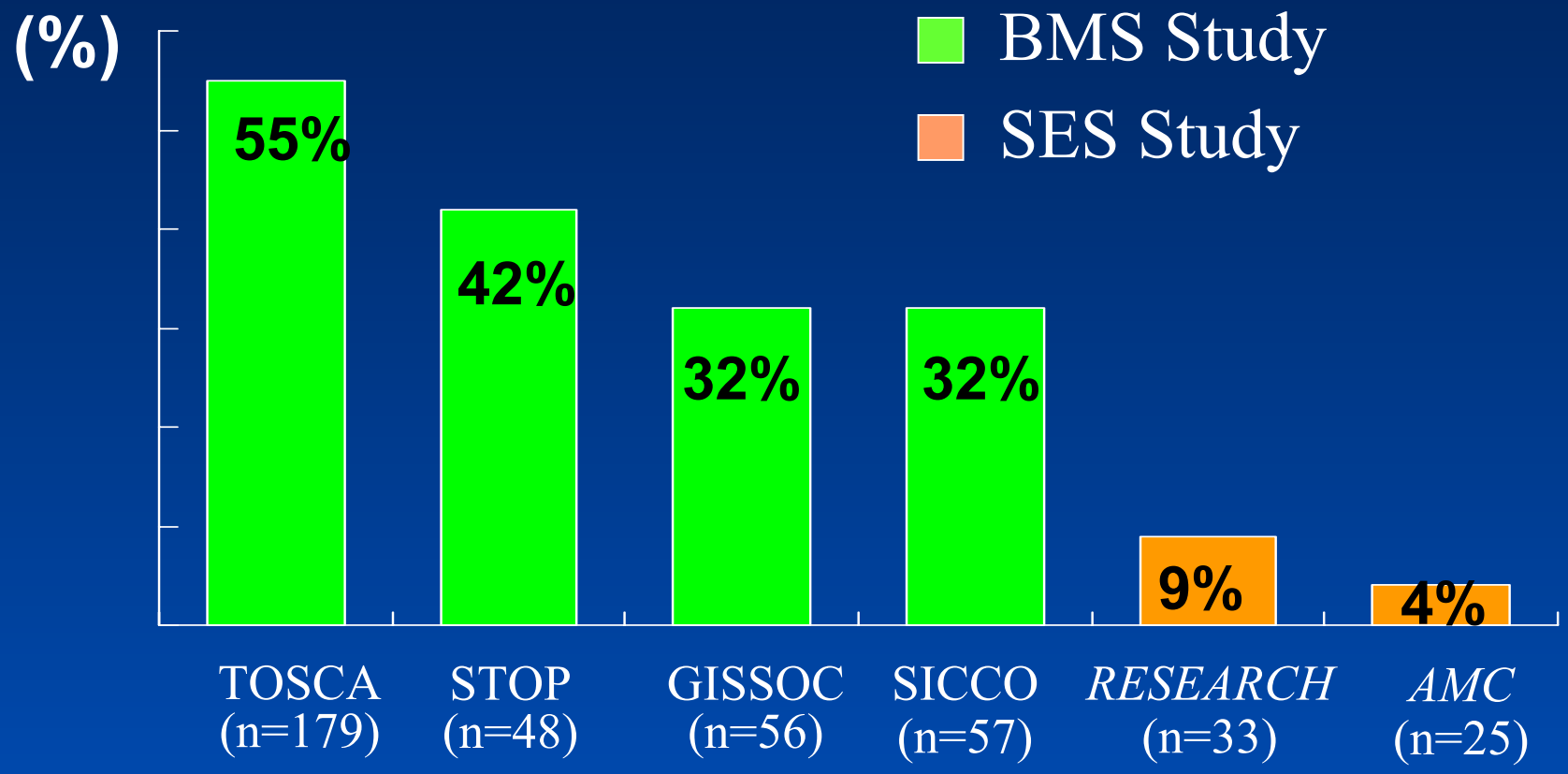
CTO in AMC

6-Month QCA Analysis from 57 lesions with Cypher implantation

6-month follow-up	25 / 32 eligible lesions (78%)
Reference vessel (mm)	2.95 ± 0.57
MLD (mm)	2.58 ± 0.79
Late loss (mm)	0.30 ± 0.69
Diameter stenosis (%)	12.2 ± 23.0
Binary restenosis (%)	1 (4%)

Historical Comparison

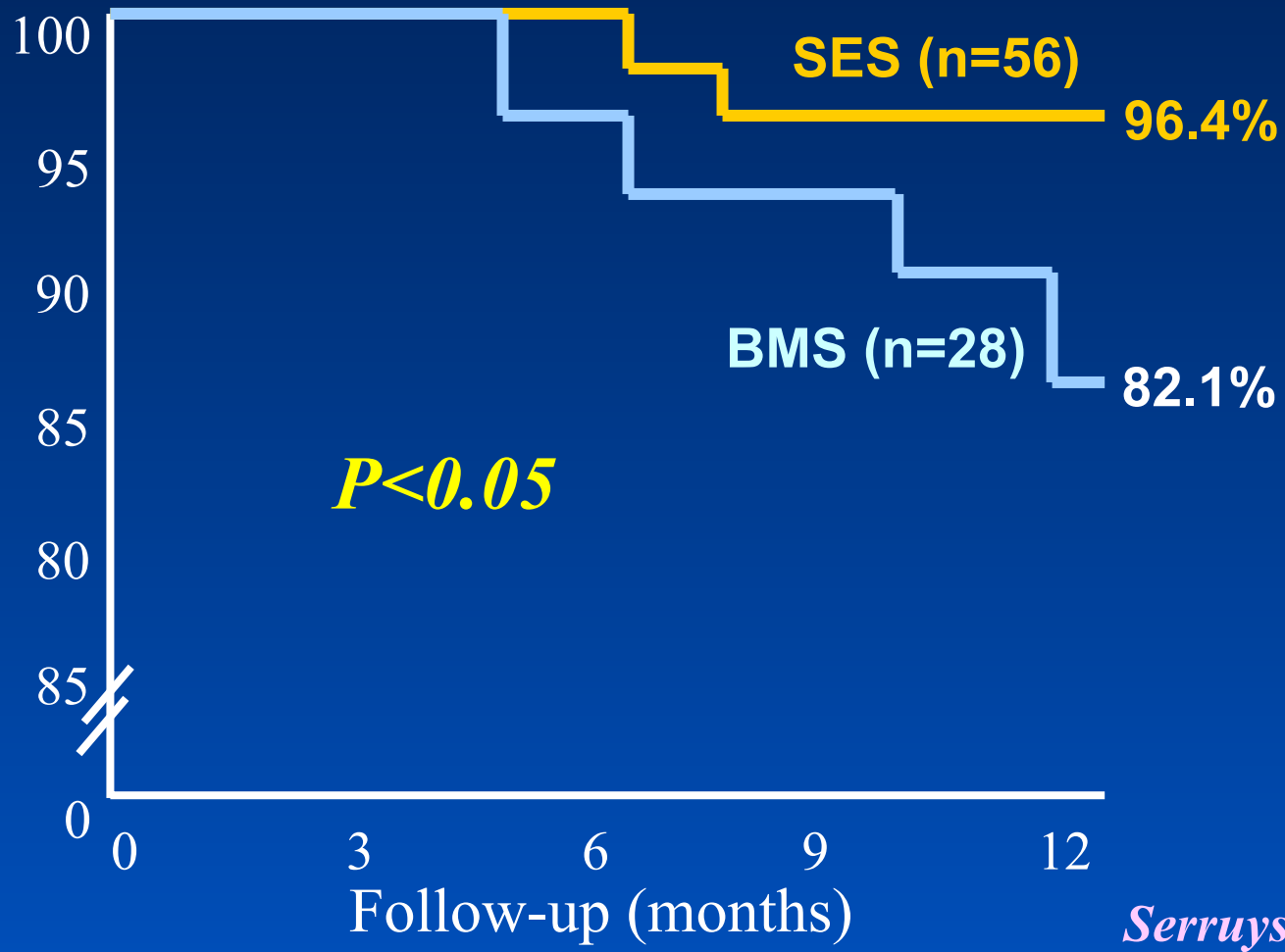
6 Month Restenosis Rate



Serruys et al, ACC 2004

MACE Free Survival

RESEARCH Registry



Serruys, ACC 2004

CTO Intervention

- Reopening of total occlusion remains a challenging problem.
- New CTO device may be helpful to reopen the total occlusion.
- The efficacy of DES may be extended to the CTO lesion.