

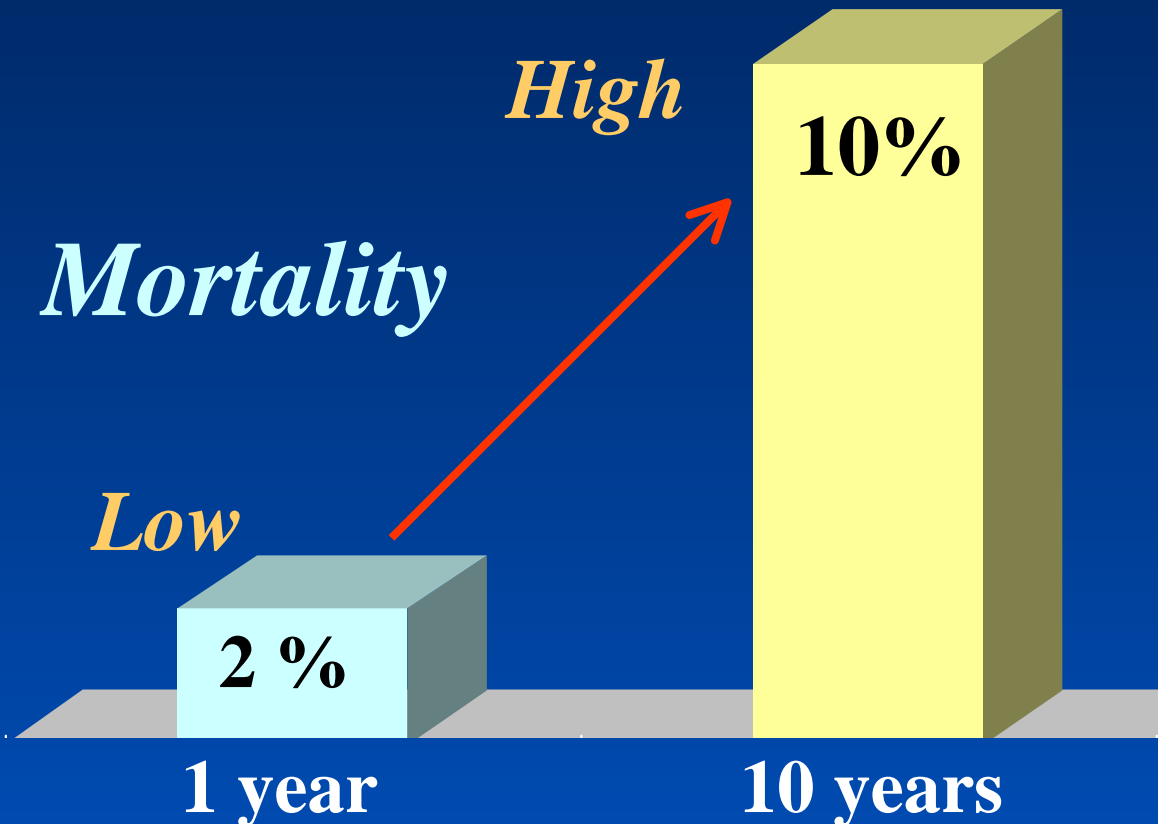
PCI for Chronic Total Occlusions

Chronic Total Occlusions

*Why not Medical
Treatment ?*

Medical Treatment

CTO in 891 pts over 24 years



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

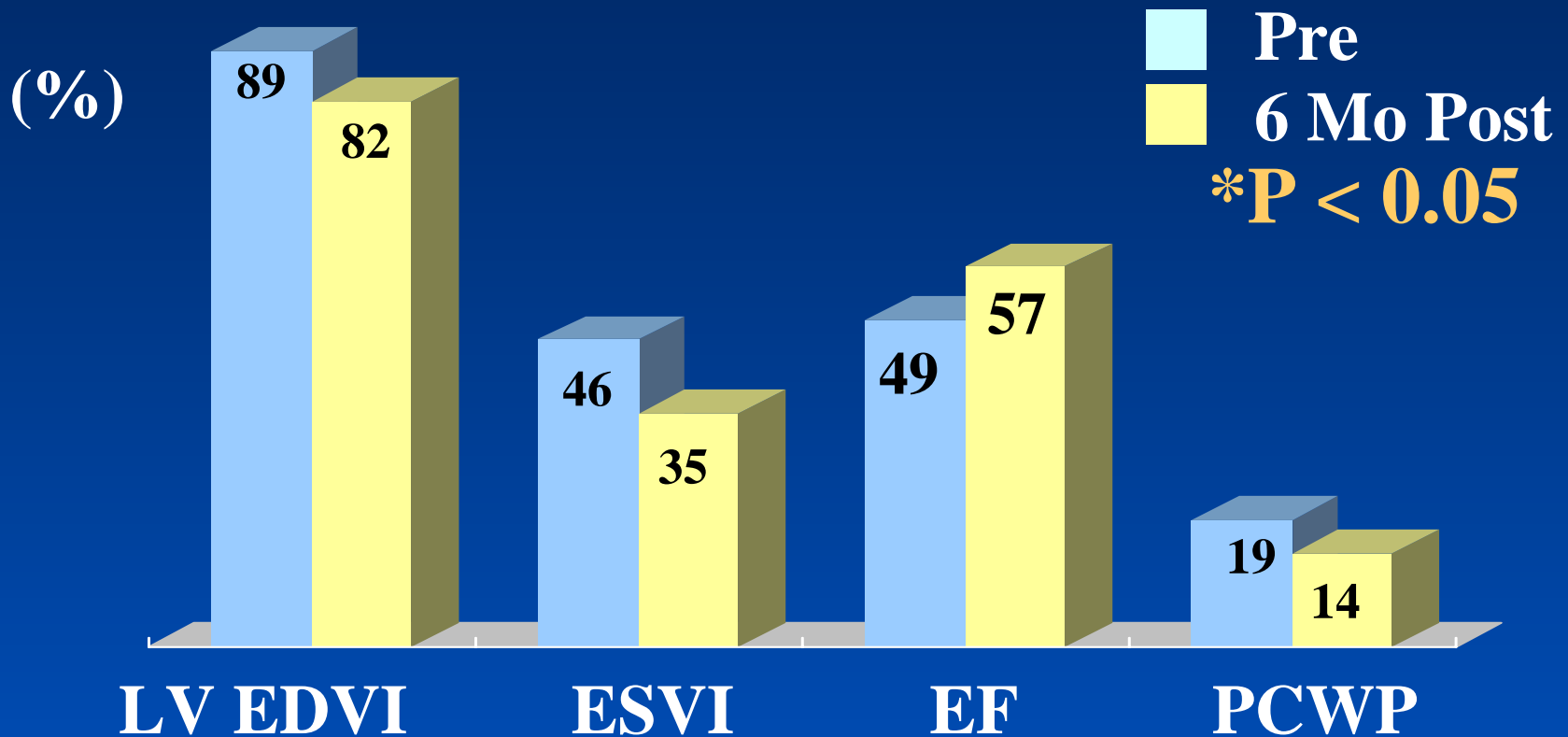
Chronic Total Occlusions

20-40% of patients with CAD

Why should we open ?

Effect on LV function

PCI in CTO improves LV function



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

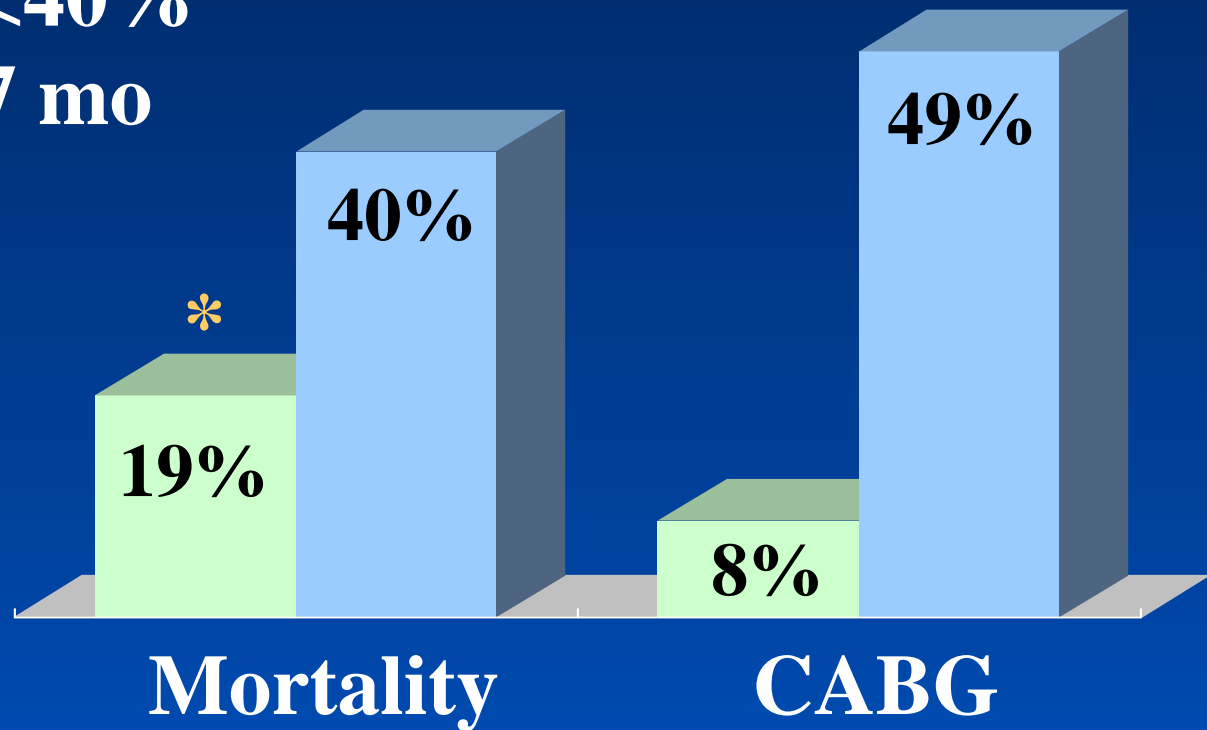
Reopening of CTO

Improves Survival

96 pts, EF < 40%
F/U 40 ± 17 mo

*P < 0.05

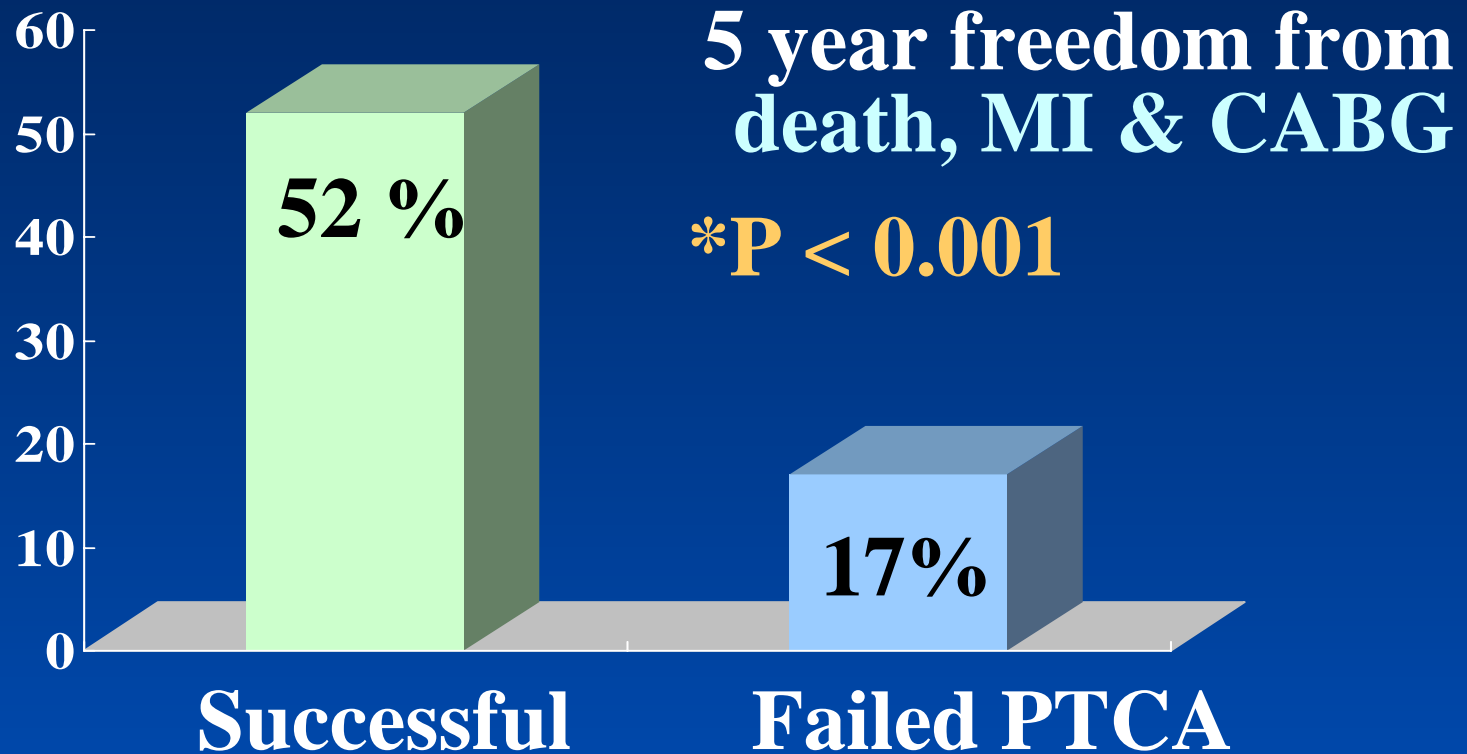
Successful
Failed PTCA



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

Survival Outcomes

Successful vs Failed PTCA



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

Chronic Total Occlusion

Rationale for Invasive Treatment

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

Improved mortality

Freedom from subsequent CABG

What are the problems in reopening of CTO ?

- **Low Procedural Success**
- **High Clinical and Angiographic Restenosis**

Procedural Success

Predictors

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

Procedural Success

Favorable

Unfavorable



Tapered stump



Stump absent



Functional occlusion



Total occlusion



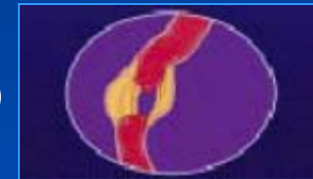
Pre or post occlusion



Side branch(+)



Bridging collateral (-)



Bridging collateral (+)

Procedural Failure

Multivariate analysis

Variables	<i>P</i> 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

Failure of PCI in CTO

Why ?

Crossing Failure of Guidewire

Reopening of CTO

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

FrontRunnerTM Catheter

OCR SafeSteerTM System

(Optical Coherence Reflectometry)

Wiring in 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)	<i>P</i>
1 st 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 are an effective in the treatment of CTO refractory to conventional guidewires.

New Devices for CTO

Crossing Lesion

- **FrontRunner™ Catheter**
- **OCR SafeSteer™ System
(Optical Coherence Reflectometry)**

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

Clinical Experiences

- 107 patients (mean 62 years)
- Refractory to guidewire
- Mean lesion length 21 ± 8 mm

Overall Success 60 %

Complication Rate 5 %

Mehtew Selmon et al, ACC 2002

OCR SafeSteer System

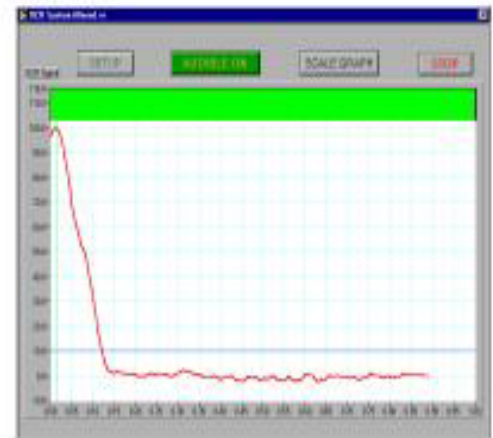
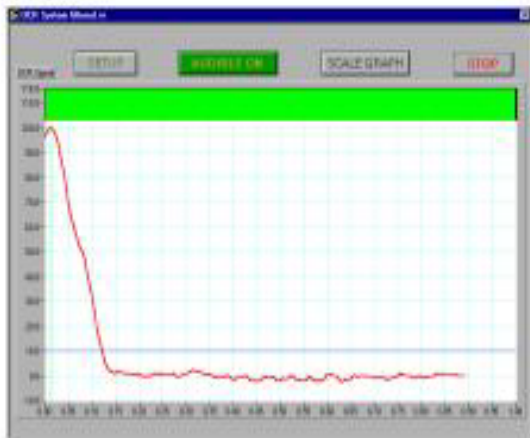
New Devices for CTO

- *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

Conventional
OCR Guide
Wire



RF Ablation /
OCR Guide
Wire



OCR SafeSteer System

Clinical Experiences

	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

New Devices

- *FrontRunner™ Catheter*
- *OCR SafeSteer™ System*

*may be advantages
for specific CTO
refractory to
conventional system.*

To Achieve and Sustain Patency in CTO

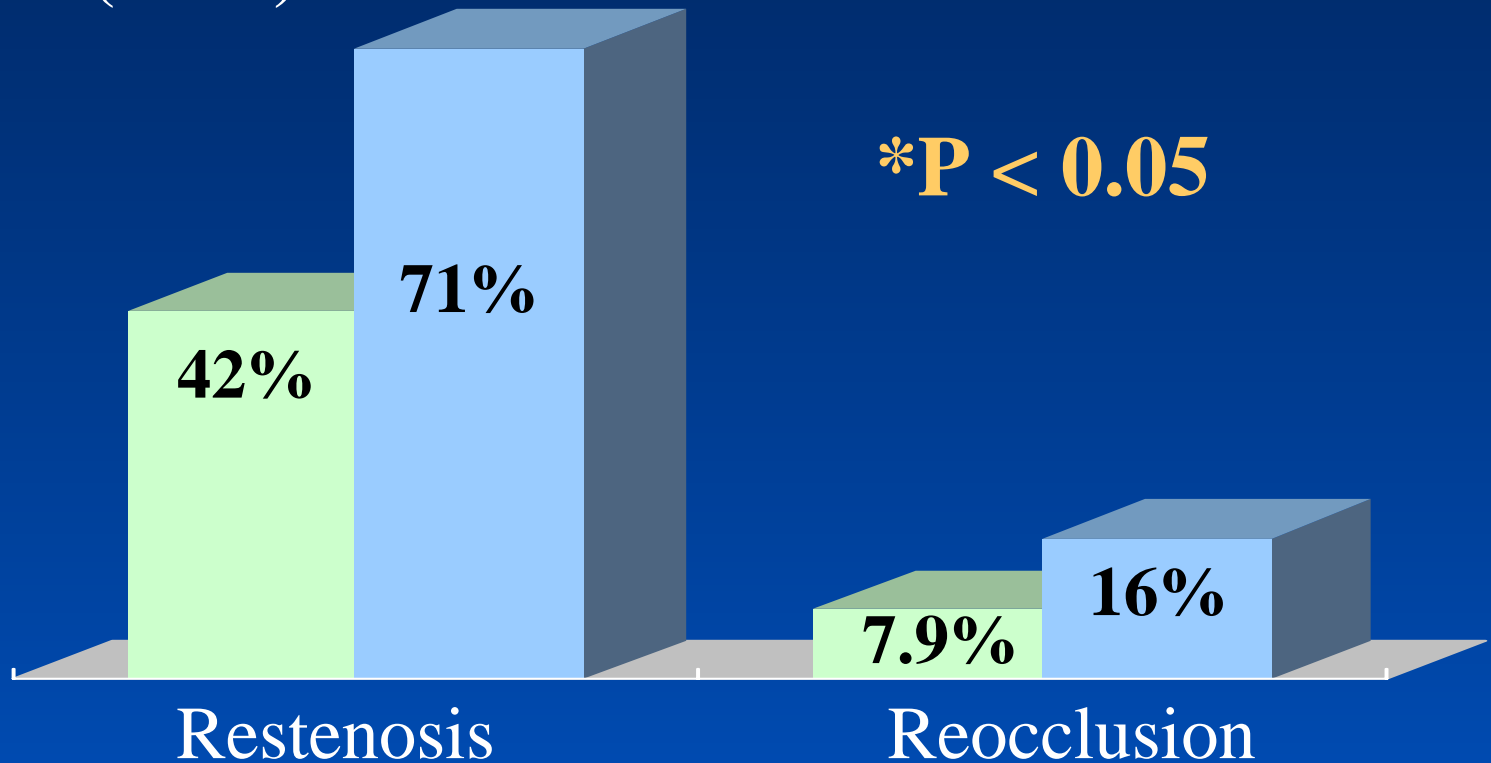
How ?

Stent vs PTCA
Debulking

Stent vs PTCA

STOP

■ Stent (n=48)
■ PTCA (n=48)

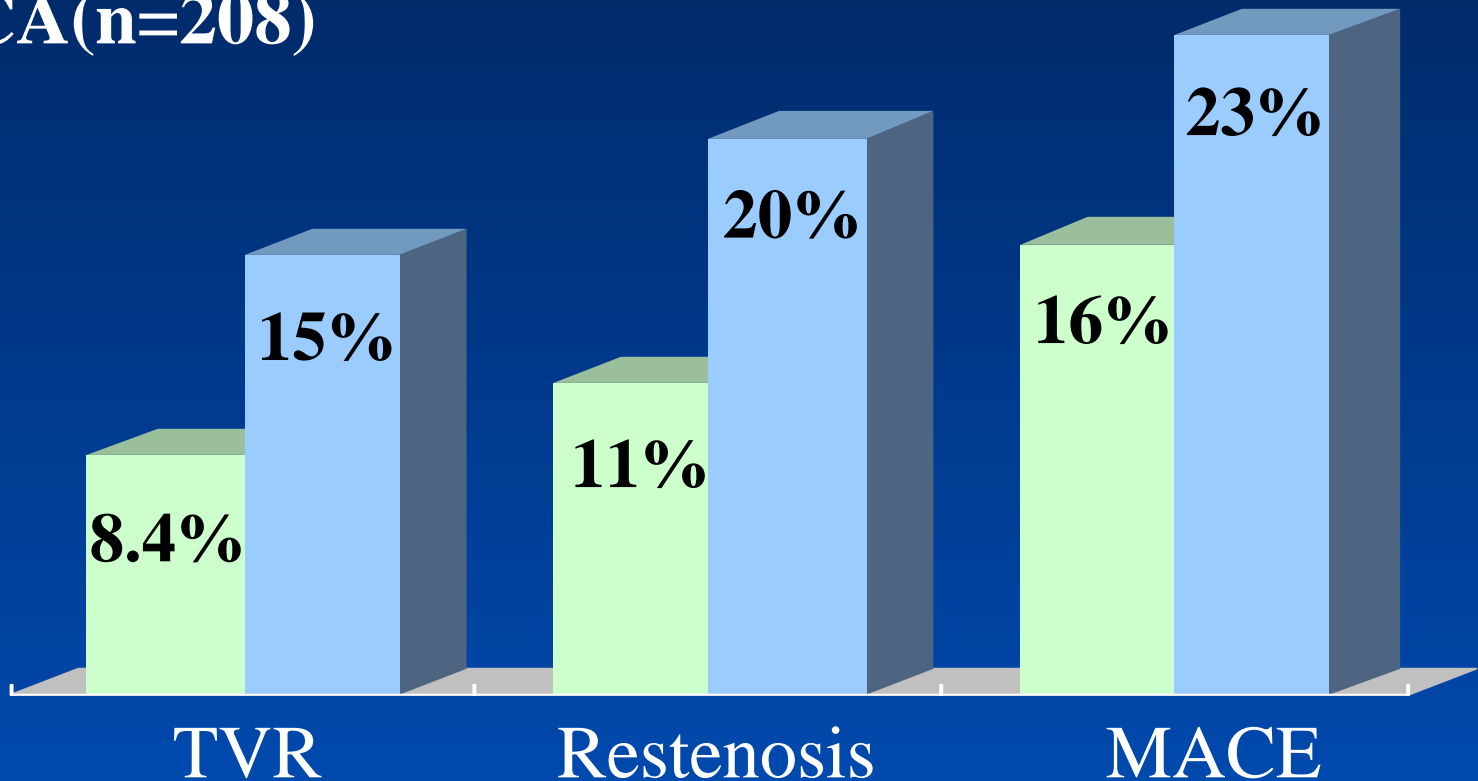


Lotan et al. Eur Heart J 2000;21:1960-6

Stent vs PTCA

TOSCA

■ Stent (n=202) *P < 0.05
■ PTCA (n=208)

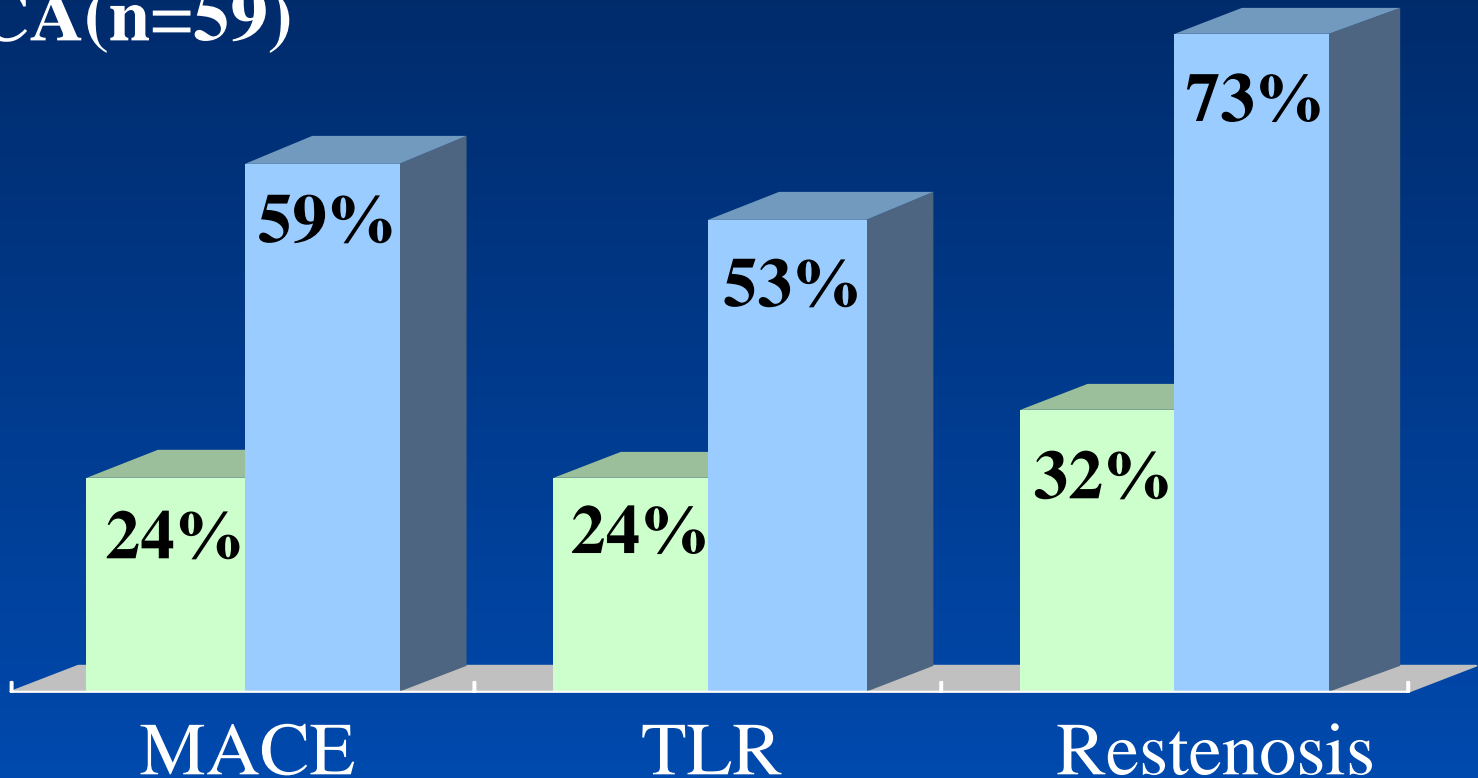


Buller et al. Circulation 1999;100:236-42

Stent vs PTCA

SICCO

■ Stent (n=58) *P < 0.05
■ PTCA (n=59)



Sirnes et al. JACC 1998;32:305-310

*STENT in CTO
improve reocclusion
and restenosis rates
over PTCA results .*

Late Clinical and Angiographic Outcomes after Stenting in CTO

AMC experience

Successful Recanalization of CTO

Procedural success

241/324 (74%)

Risk Factors

	Stent length < 20mm (n=113)	Stent length ≥ 20mm (n=107)
Current smoker	50(44.2%)	55(51.4%)
Diabetes mellitus	19 (16.8%)	22 (20.6%)
Hypercholesterolemia (> 200 mg/dL)	41 (32.3%)	45 (42.1%)
Systemic hypertension	52 (46.0%)	47 (43.9%)
Previous MI	15 (13.3%)	10 (9.3%)

Angiographic Characteristics

	Stent length < 20mm (n=113)	Stent length ≥ 20mm (n=107)
Lesion length (mm)	14.4±4.1	24.8±10.1*
Stent length (mm)	16.1±2.0	29.4±5.9 *
Balloon to artery ratio	1.11±0.12	1.13±0.16
Reference vessel size (mm)	3.14±0.47	3.12±0.48

* p<0.05

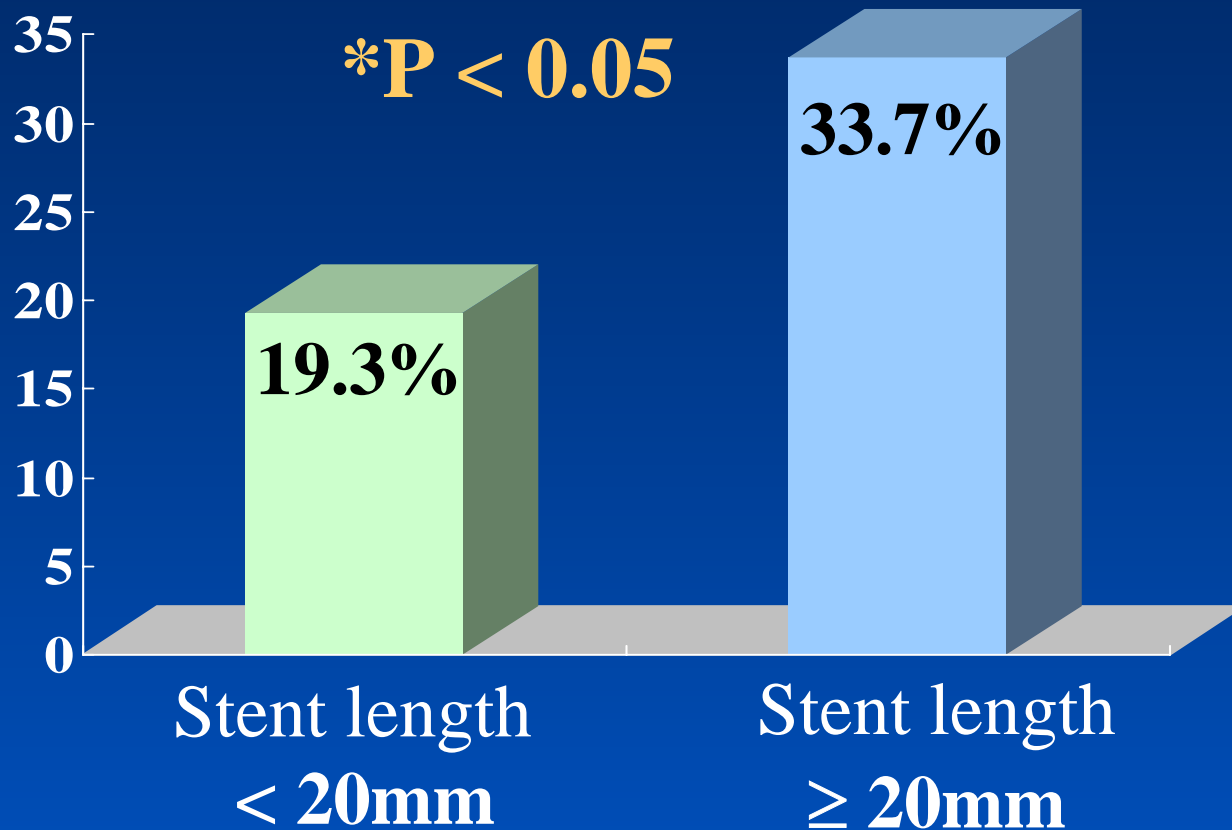
Angiographic Characteristics

	Stent length < 20mm (n=113)	Stent length ≥ 20mm (n=107)
Postintervention MLD	3.09±0.45	3.03±0.49
Follow-up MLD	1.91±0.94	1.72±0.87
Acute gain	3.09±0.45	3.03±0.49
Late loss	1.17±0.78	1.36±0.85
Loss index	0.39±0.27	0.44±0.27

MLD: minimal lumen diameter

Angiographic Restenosis

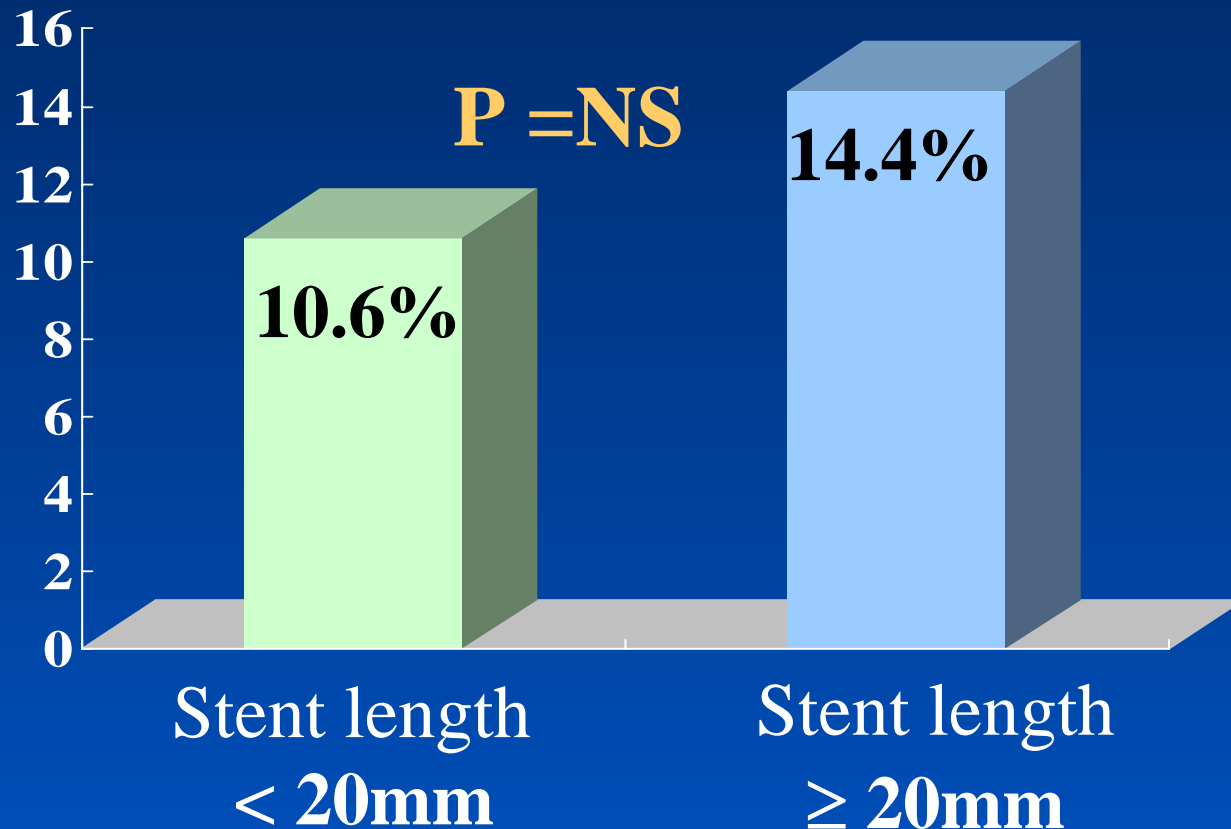
Overall restenosis: 26.4%



Major Cardiac Events

Death, MI, TLR

F/U 29.1±10.8 Months



Predictors of Restenosis

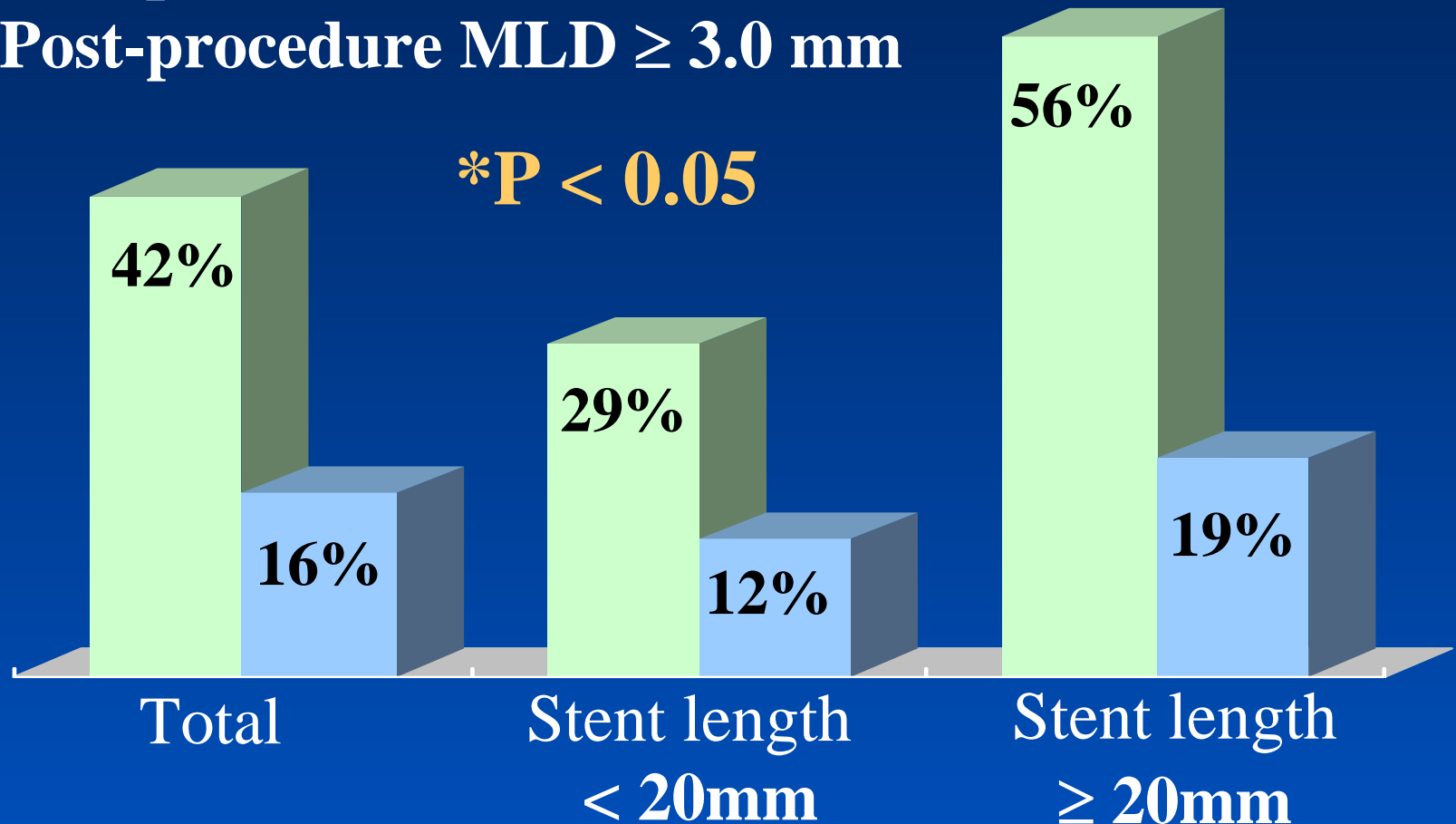
Multivariate analysis

*Postprocedural minimal
lumen diameter*

OR=0.20, 95% CI 0.08-0.49, p<0.01

Angiographic Restenosis According to MLD

- Post-procedure MLD < 3.0 mm
- Post-procedure MLD ≥ 3.0 mm



Debulking Strategy

*Additive effect over
stent alone ?*

Controversial

Debulking with Stent

Debulking with Excimer Laser, Directional or Rotational Atherectomy

	Debulking + S (n = 50)	Stent alone (n = 126)	P
Success (%)	100	97	NS
Final MLD (%)	2.7 ± 0.6	2.6 ± 0.7	NS
In-Hosp. MACE (%)	2.3	3.7	NS
MACE at FU (%)	26	20	NS
TLR (%)	16	14	NS

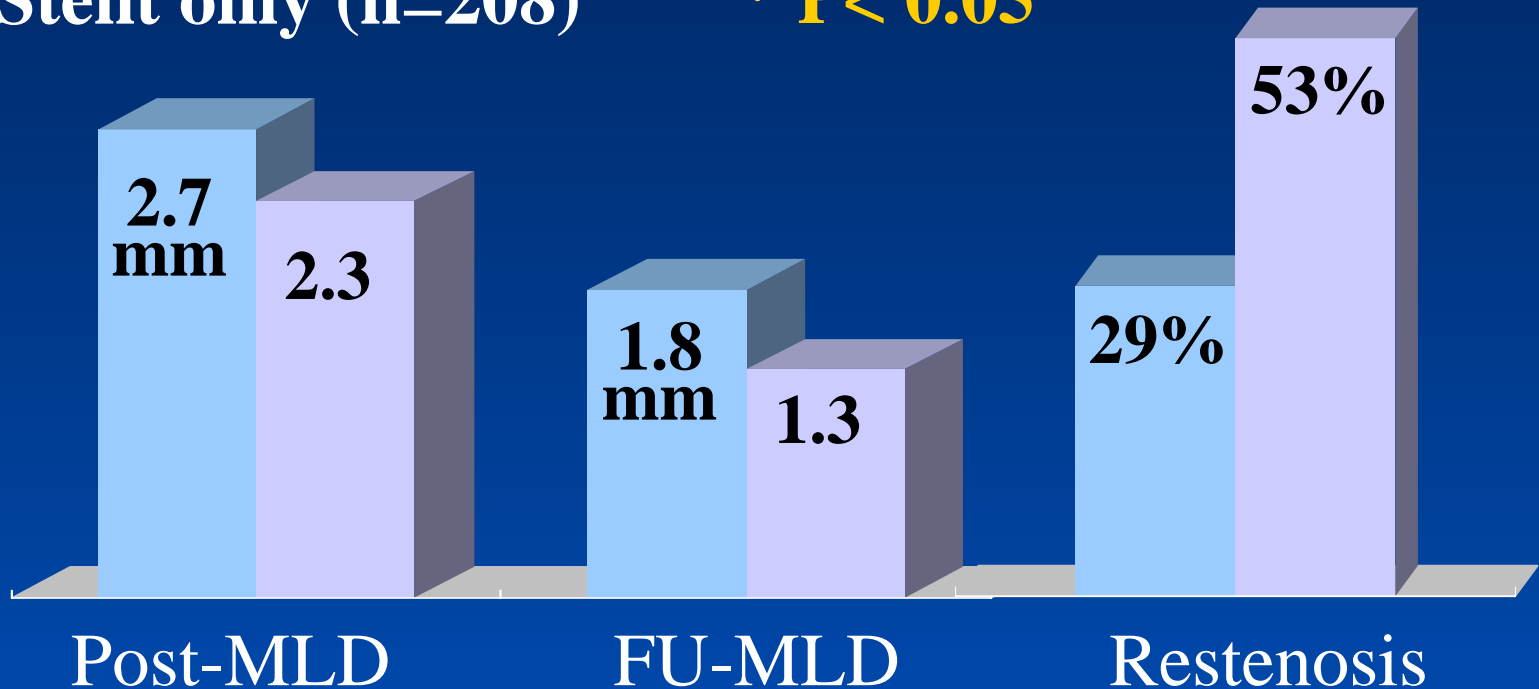
Gruberg L et al. JACC 2000;35:151-6

Debulking with Stent

Rotational Atherectomy

■ RA+Stent (n=202)
■ Stent only (n=208)

* $P < 0.05$



Tsuchikane E, et al. J Invasive Cardiol 2001;13:584-9

PCI for Chronic Total Occlusions

Future perspective

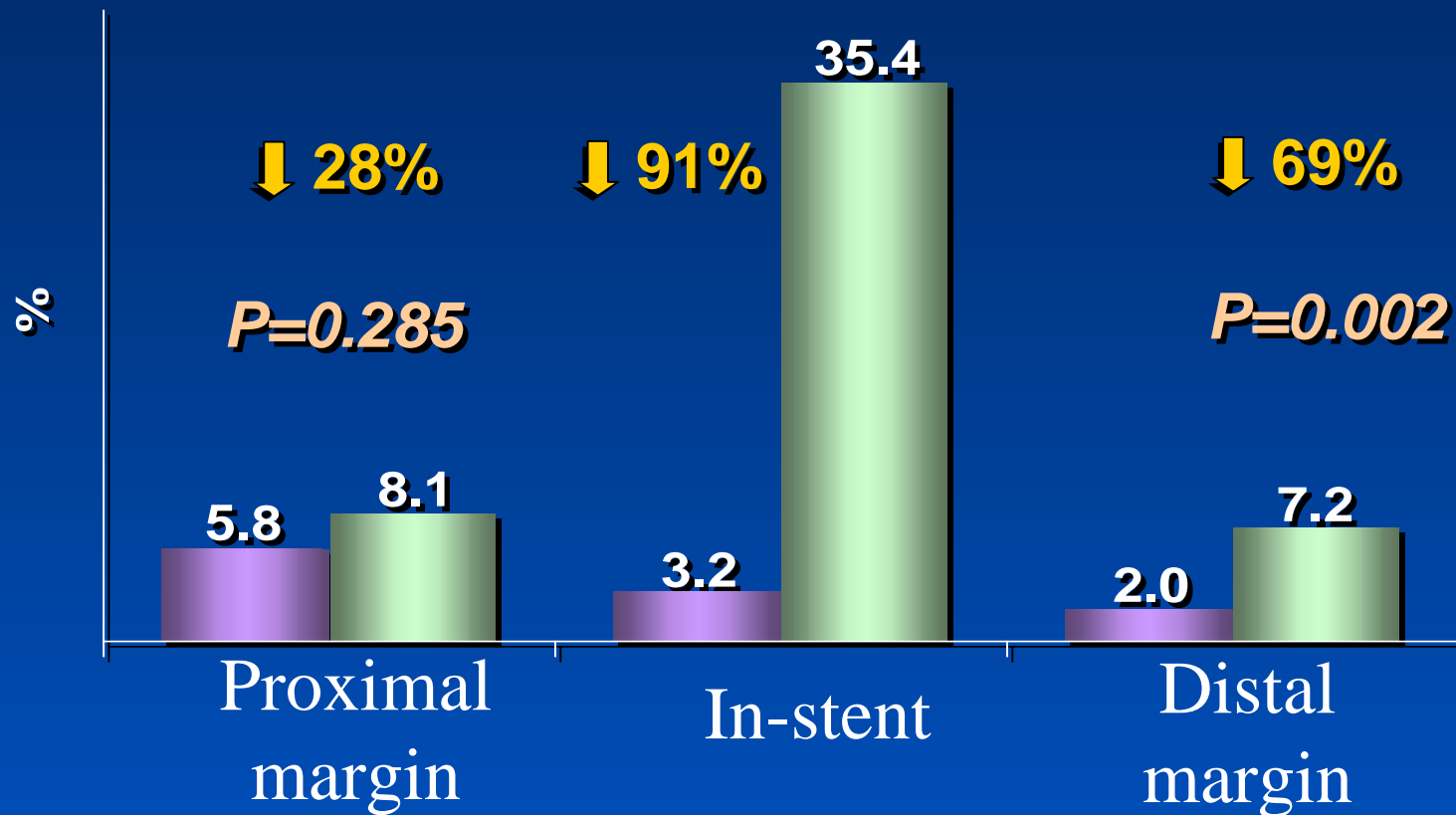
drug eluting stent ?

SIRIUS - QCA Peri-Stent Analysis

 Silorimus (n=349)

 Control (n=353)

P<0.001



Drug-Eluting Stents

- **Ostial lesions – no data**
- **Bifurcations – need more data**
- **In-stent restenosis – need more data**
- **SVGs – no data**
- **Small vessels – need more data**
- **Diffuse disease – need more data**
- **Left main disease – no data**
- **Total occlusions – no data**