PCI for Bifurcation Coronary Lesion

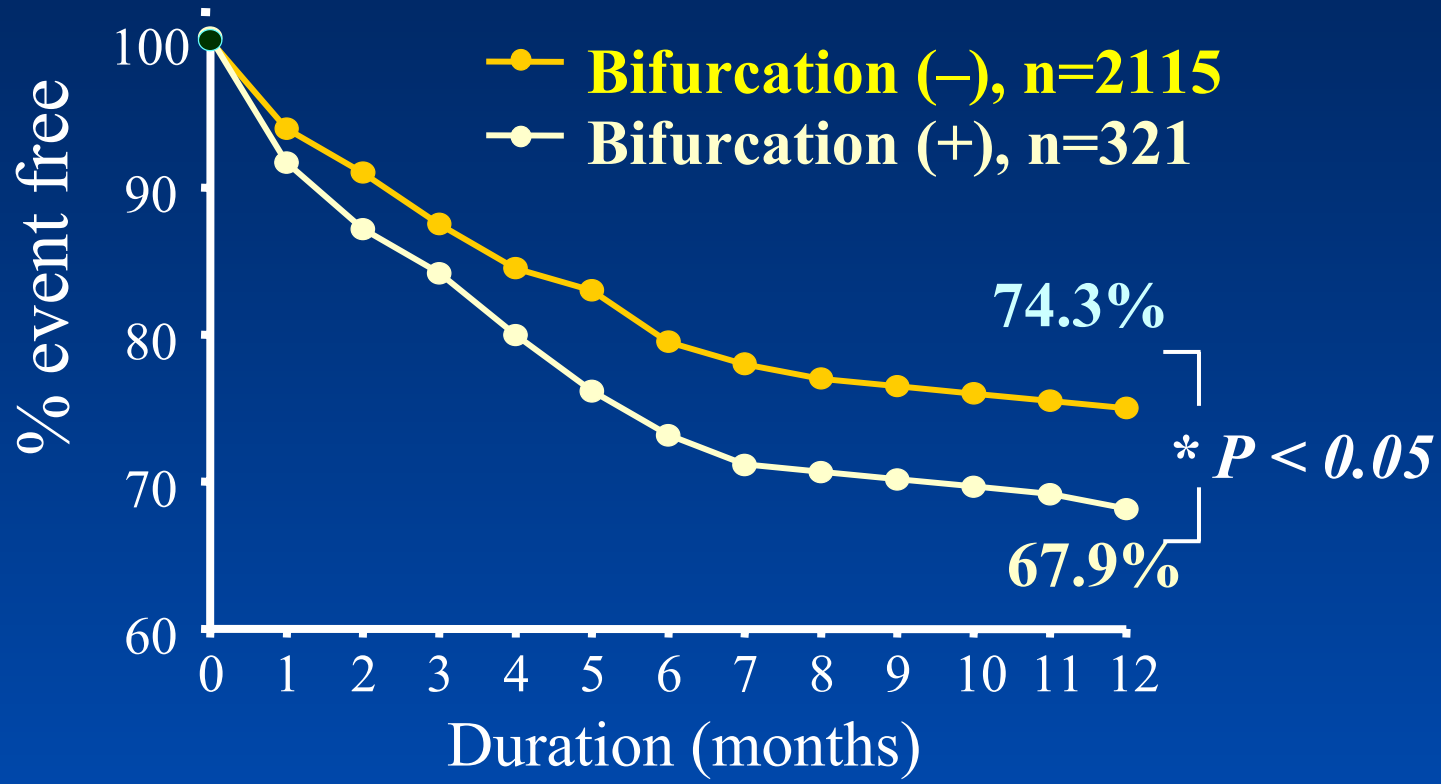
Bifurcation Lesions
PCI is Challenging

- Higher acute complication
- Lower success rates
- Higher restenosis & TLR

Restenosis Rate	21 ~ 57%
TLR	8 ~ 43%

Event Free Survival after PCI

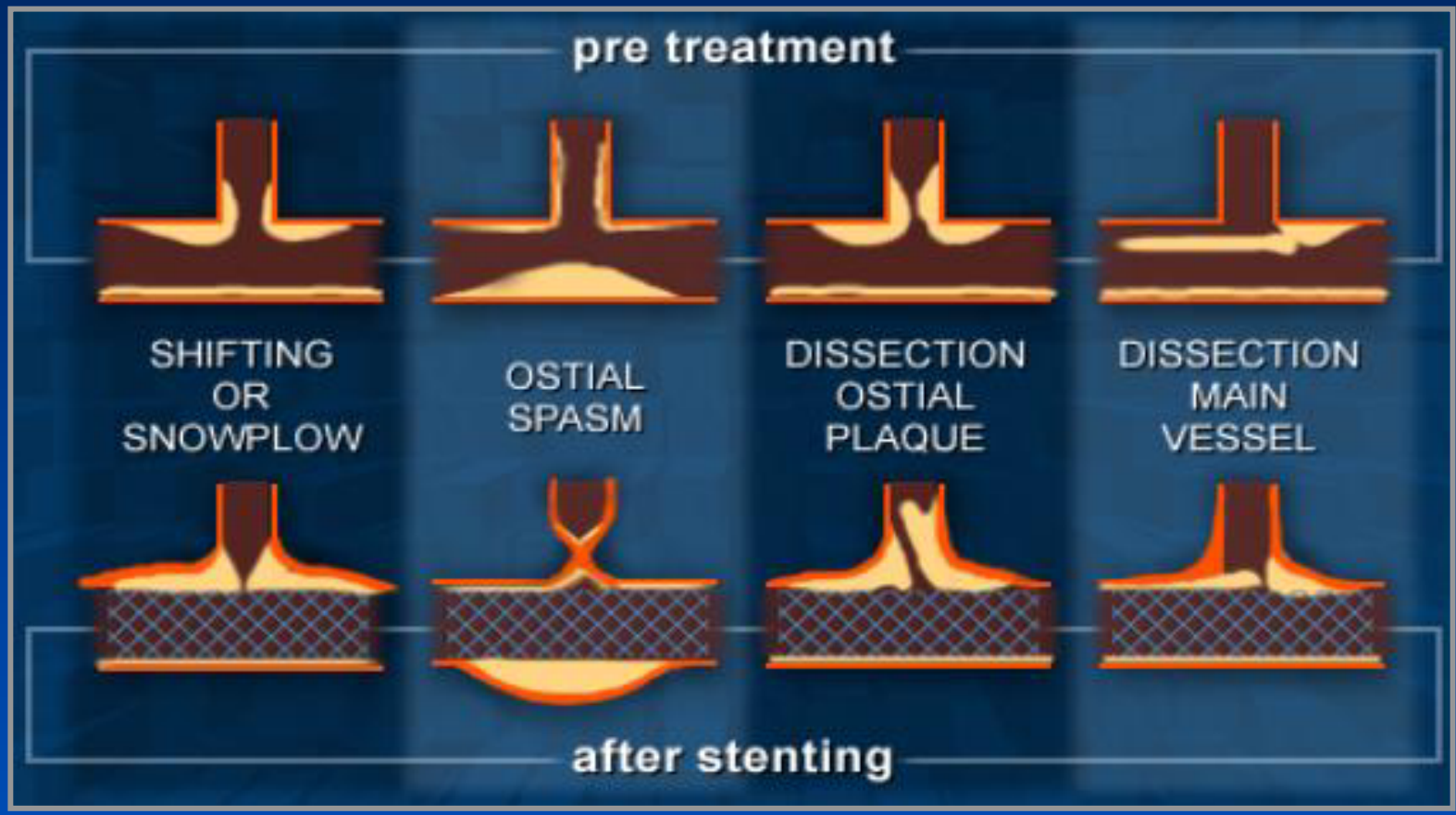
NHLBI Registry



Suwaidi J, et al. AJC 2001;87:1139-44

Side Branch Loss

Main Mechanism of Adverse Outcomes



Predictors of Side Branch Occlusion

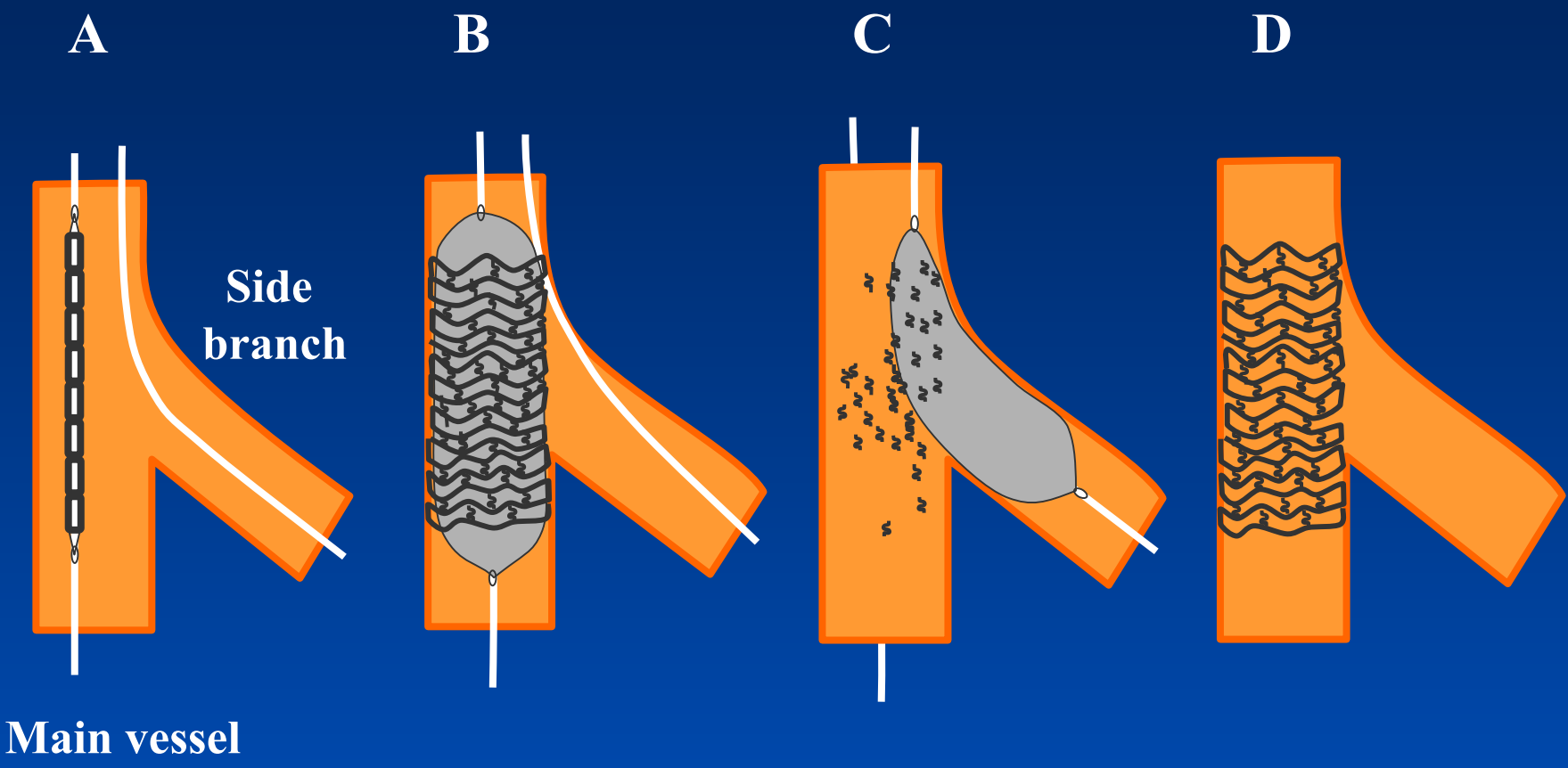
- Side branch DS > 50 %
- Disease burden in parent vessel at take-off of side branch
- Dissection of parent vessel

How to Stent ?

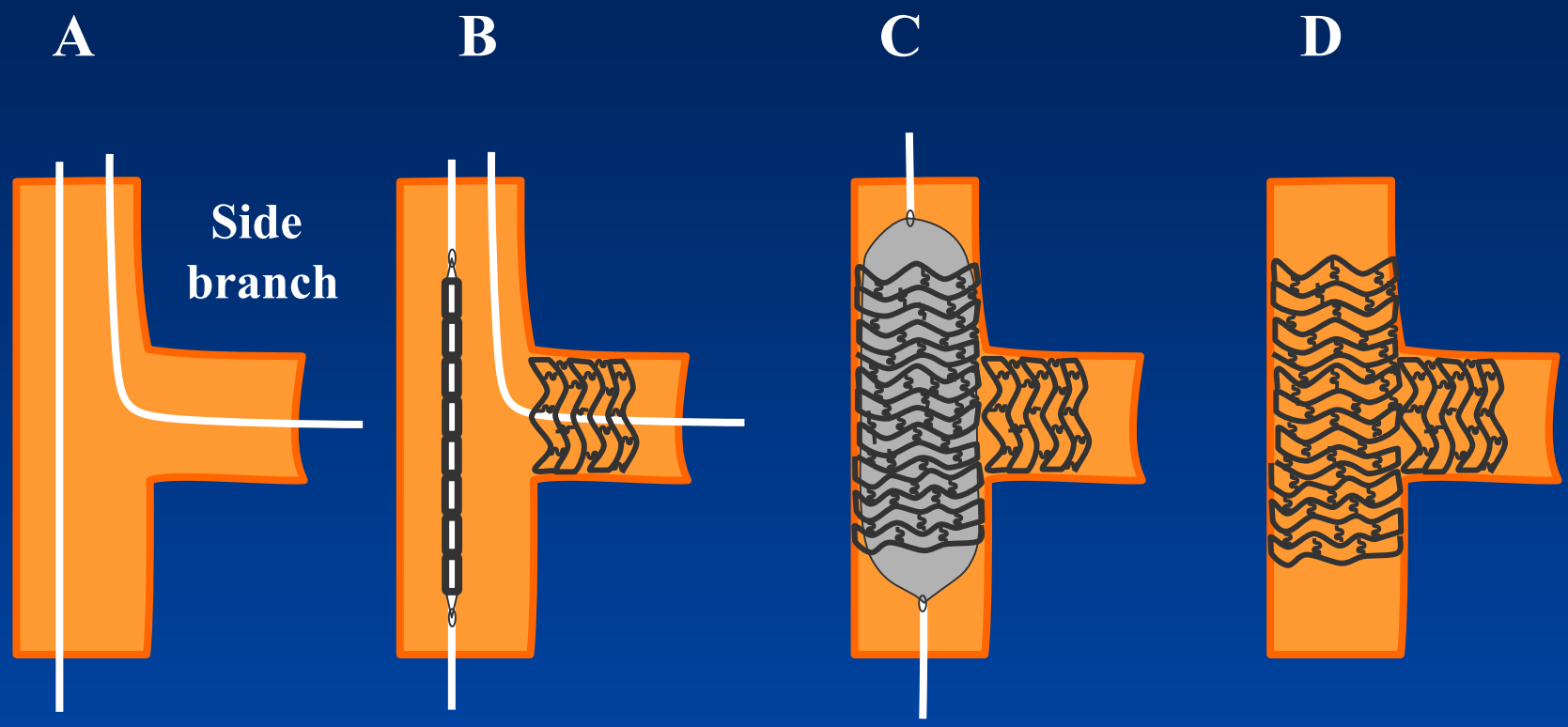
Stenting Technique

Stenting Crossing Side Branch

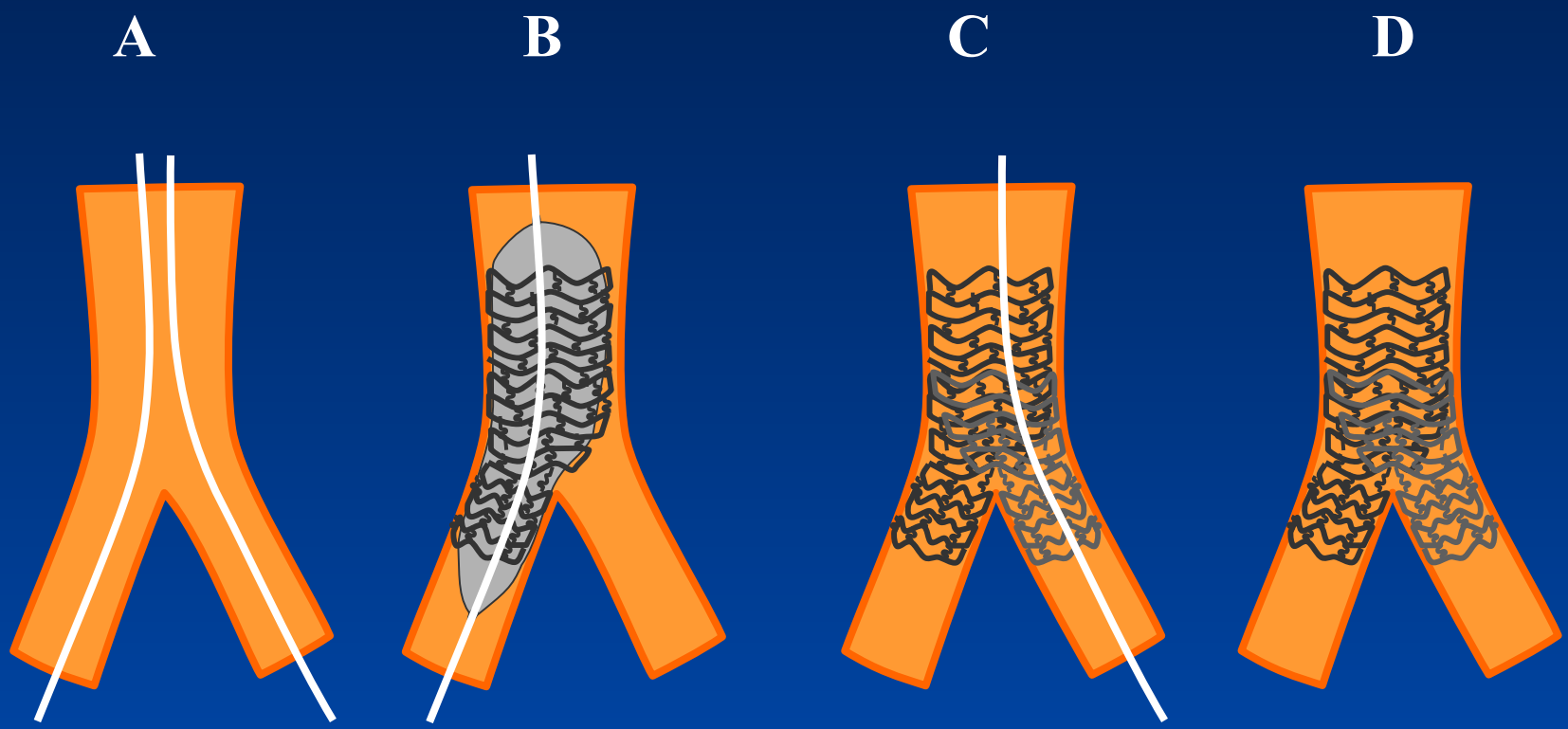
Normal or diminutive side branch ostium



T Stenting

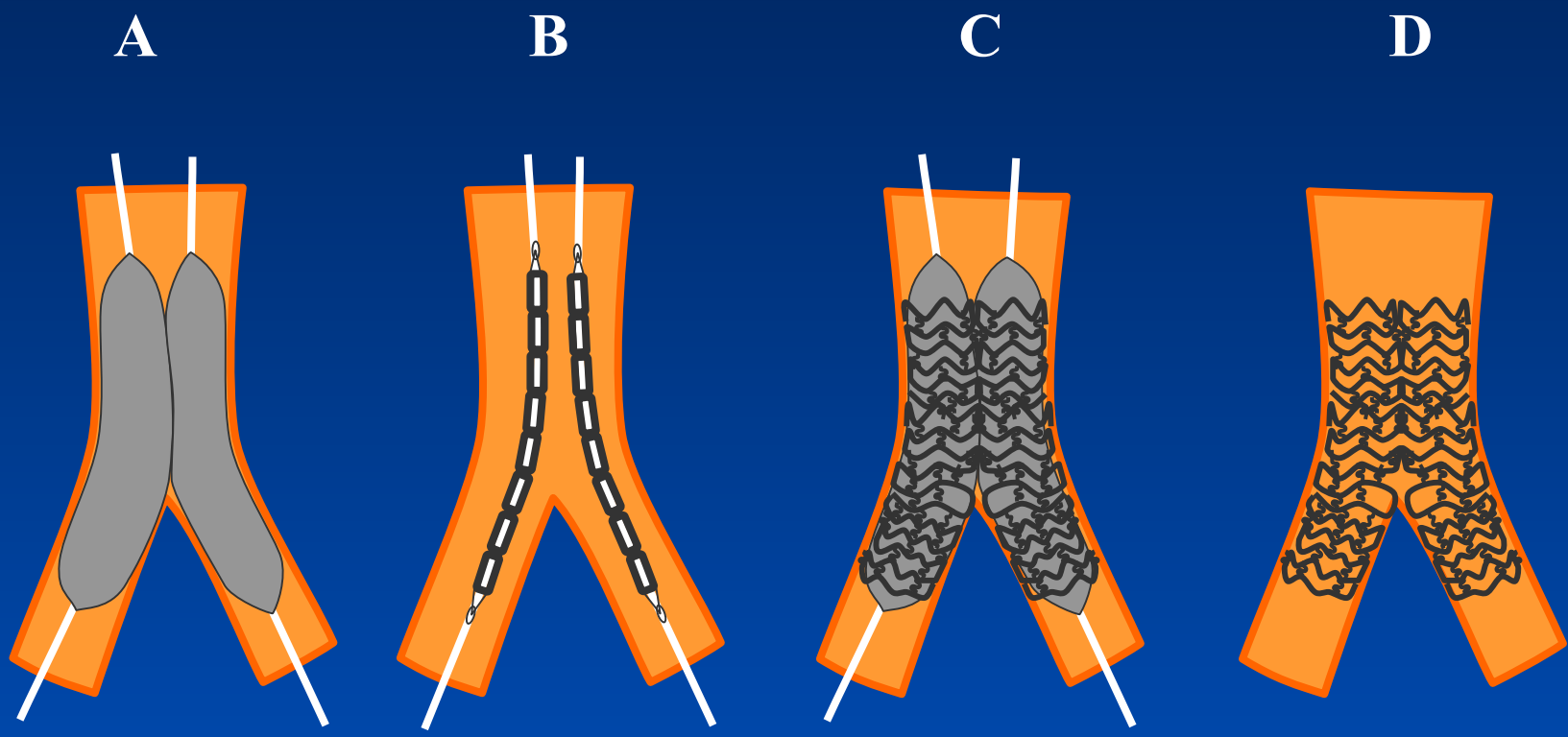


Y (Culotte) Stenting



Kissing Stenting

Large proximal reference size



Issues in the DES Era

For Bifurcation Disease

- BMS vs. DES
- Single stent vs. Multiple stent
- Stenting technique

DES is better than BMS

No doubt !

Striking reduction of intimal growth

at least in the main vessel

Single vs. Multiple Stents

Unanswered yet.

Single vs. Multiple Stents

In the Era of Bare Metal Stent

Single Stent vs. Two Stent

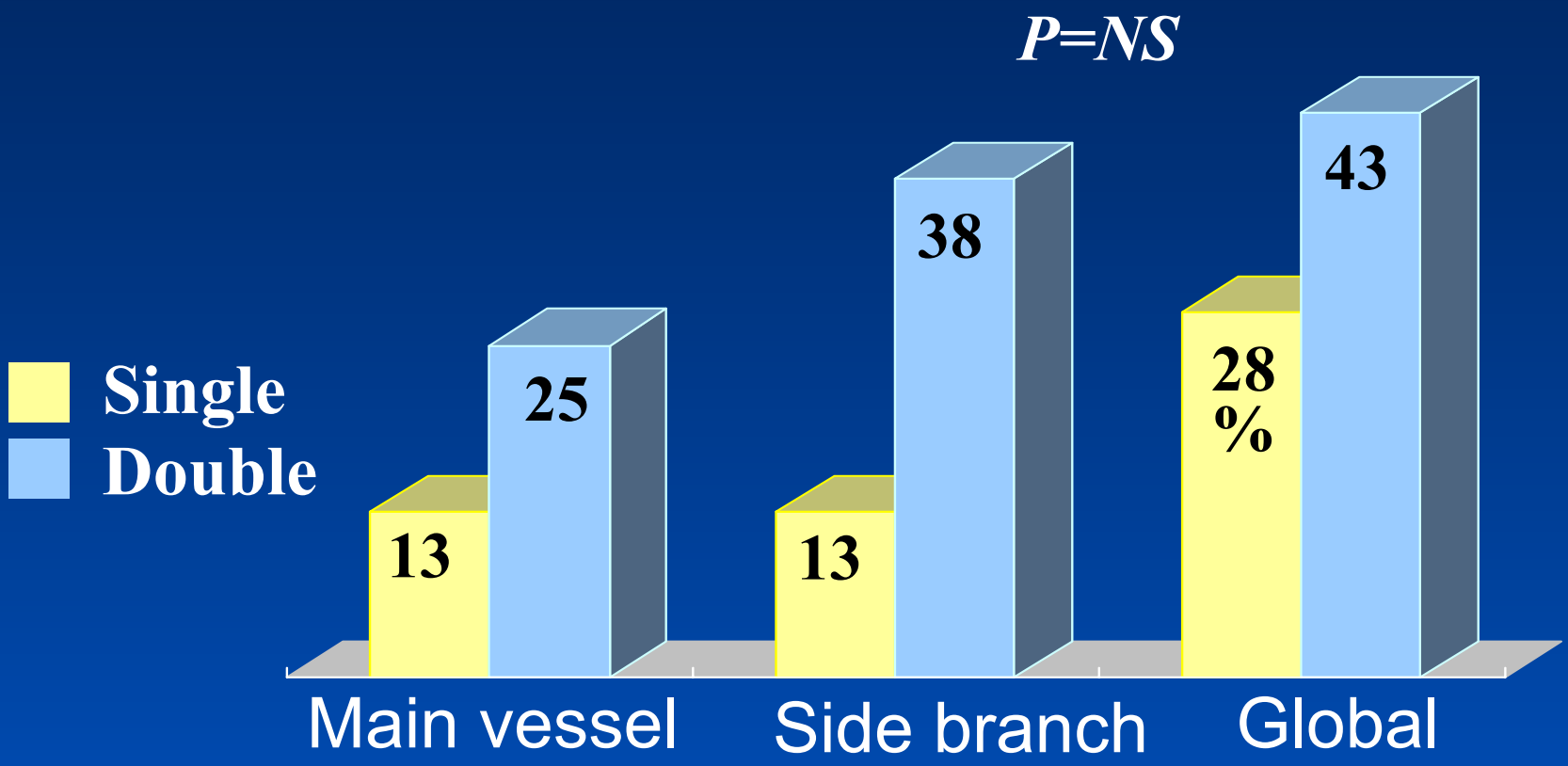
Procedural Results

	Single (n=39)	Double (n=53)	*P*
Ref. Vessel (mm)	3.0 ± 0.4	3.1 ± 0.6	NS
Kissing balloon (%)	56	92	< 0.05
Procedural time (min)	98 ± 45	127 ± 52	< 0.05
Success (%)	92	87	NS
In-hosp. MACE (%)	0	13	< 0.05

Yamashita T, et al. JACC 2000;35:1145-51

Single Stent vs. Two Stent

6 Month Restenosis Rate

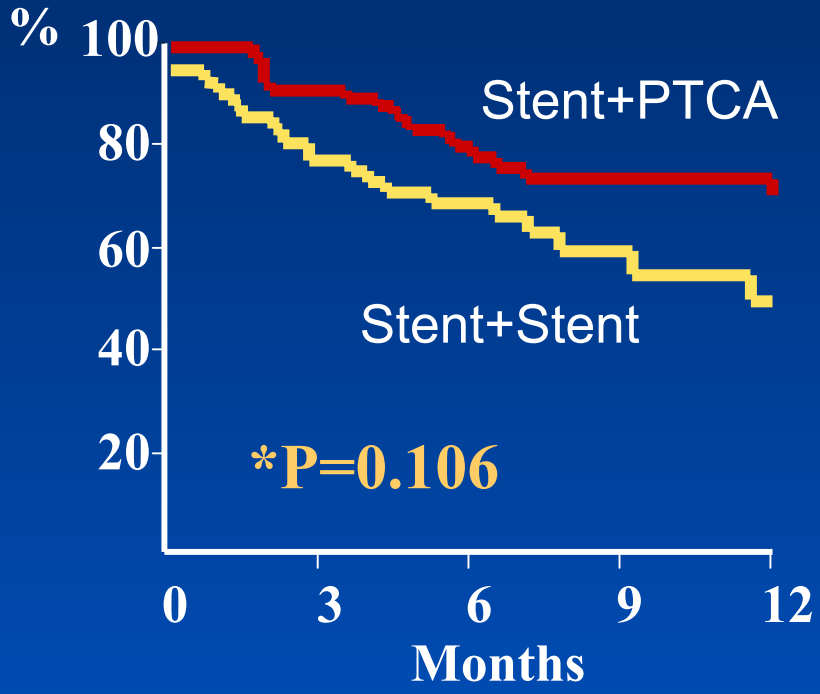


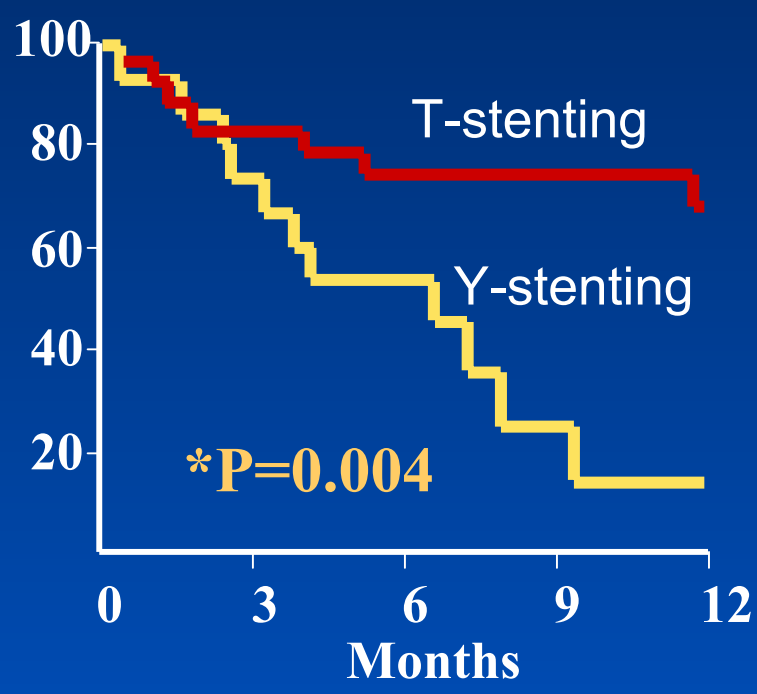
Anzuini A, et al. Am J Cardiol 2001;88:1246-50

Single Stent vs. Two Stent

Event Free Survival

Freedom from
death, MI, CABG, rePTCA & severe angina

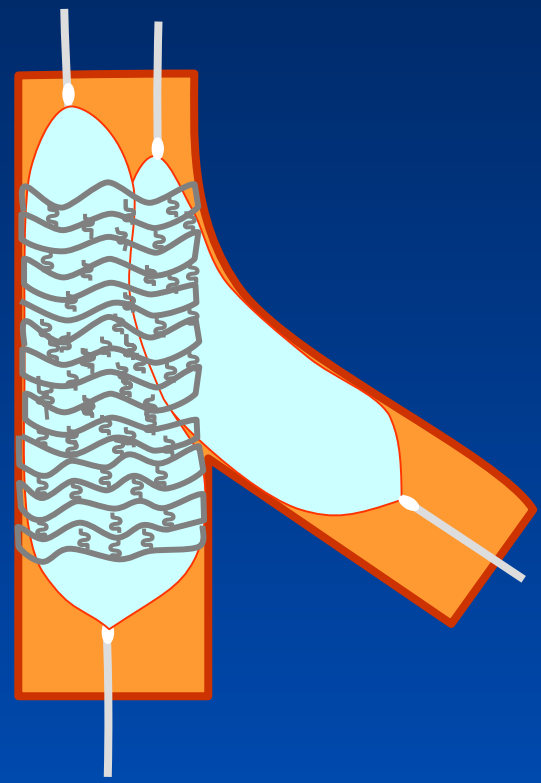




Suwaidi J, et al. JACC 2000;35:929-36

Two bare metal stents are not better than single stent.

Stent in main vessel and POBA in side branch with Optional kissing balloon



Single vs. Multiple Stents

In the Era of Drug Eluting Stent

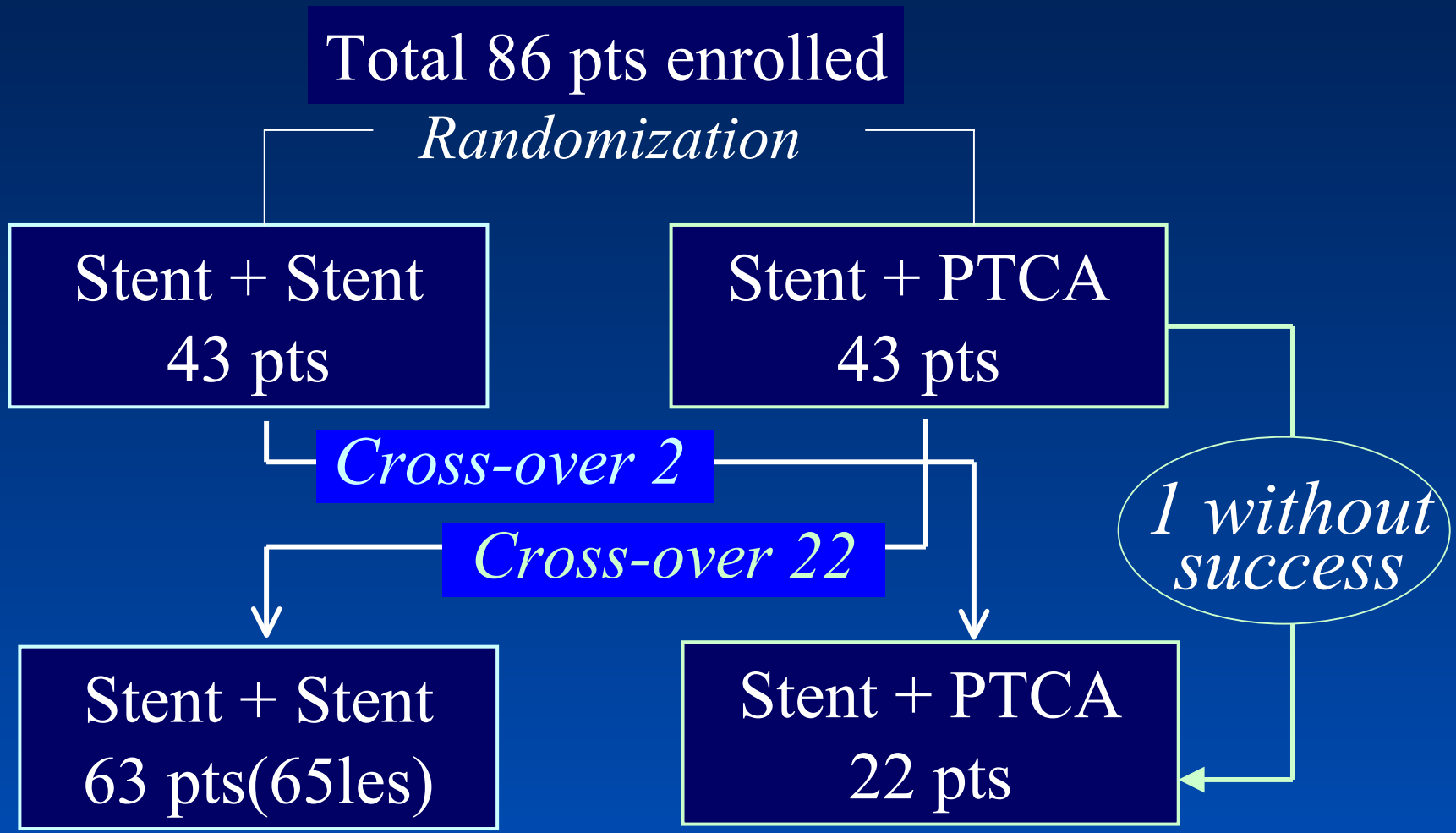
Cypher Bifurcation RCT

	PTCA of the SB (n=47)	Routine stent SB (n=44)	*P*
Death	0 (0 %)	1 (2.3 %)	NS
MI	2 (4.3 %)	0 (0 %)	NS
TLR	1 (2.1 %)	2 (4.5 %)	NS
MACE	3 (6.4 %)	3 (6.8 %)	NS
Restenosis			
Main vessel	1 (3 %)	2 (6 %)	NS
Side branch	2 (6 %)	4 (13 %)	NS

Pan M et al, ACC 2004

SIRIUS Bifurcation Study

Sirolimus Eluting Stent



A Colombo, et al. AHA 2002

Procedural Technique

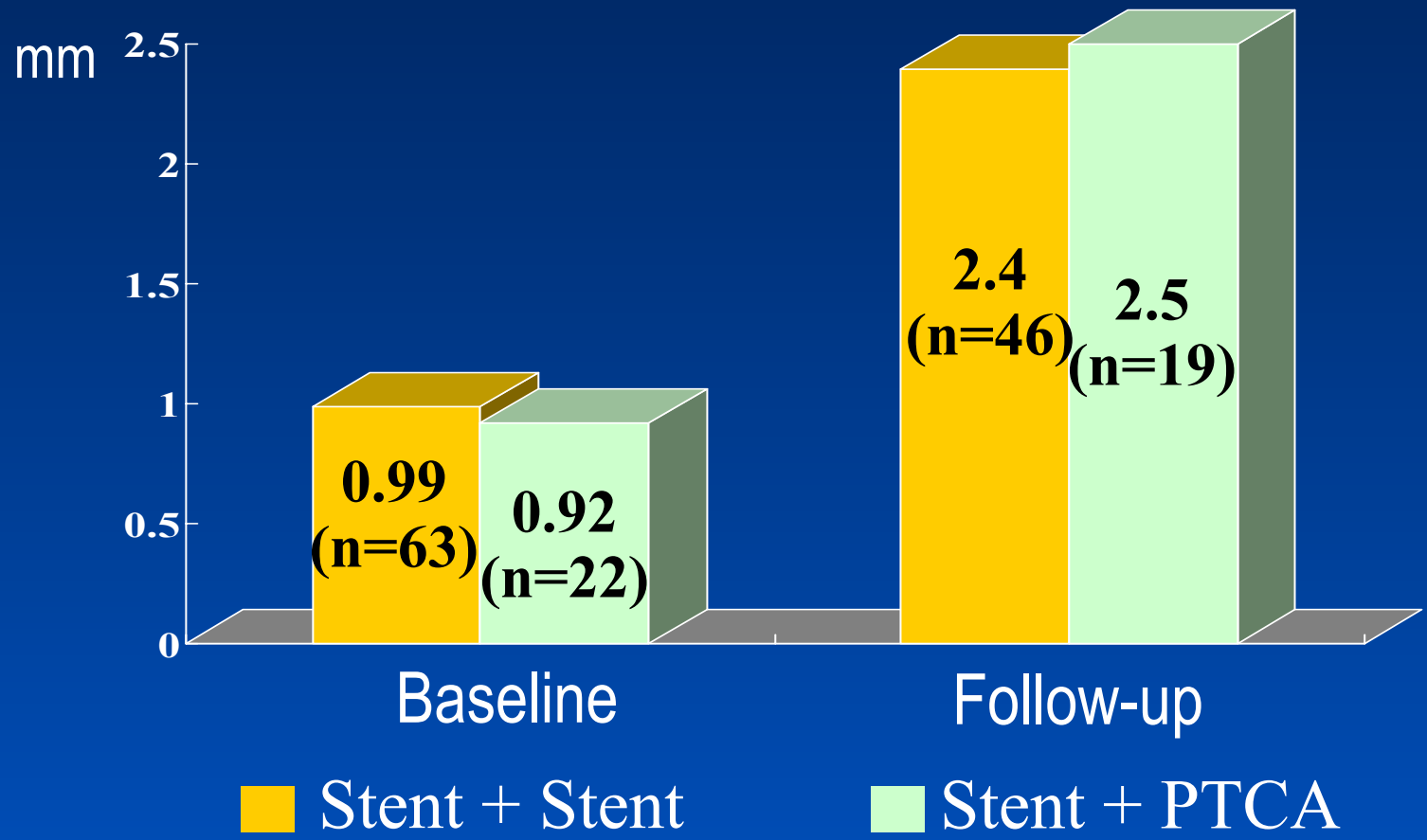
SIRIUS Bifurcation Study

Technique	Stent / Stent (n=63)	Stent / PTCA (n=22)
T- stenting	60	
Side branch first	40	
Main vessel first	20	
V- stenting	1	
Y- stenting	2	
Kissing balloon	60 (95%)	19 (86%)
GP Ⅱb/Ⅲa inhibitor	27 (43%)	8 (37%)

A Colombo, et al. AHA 2002

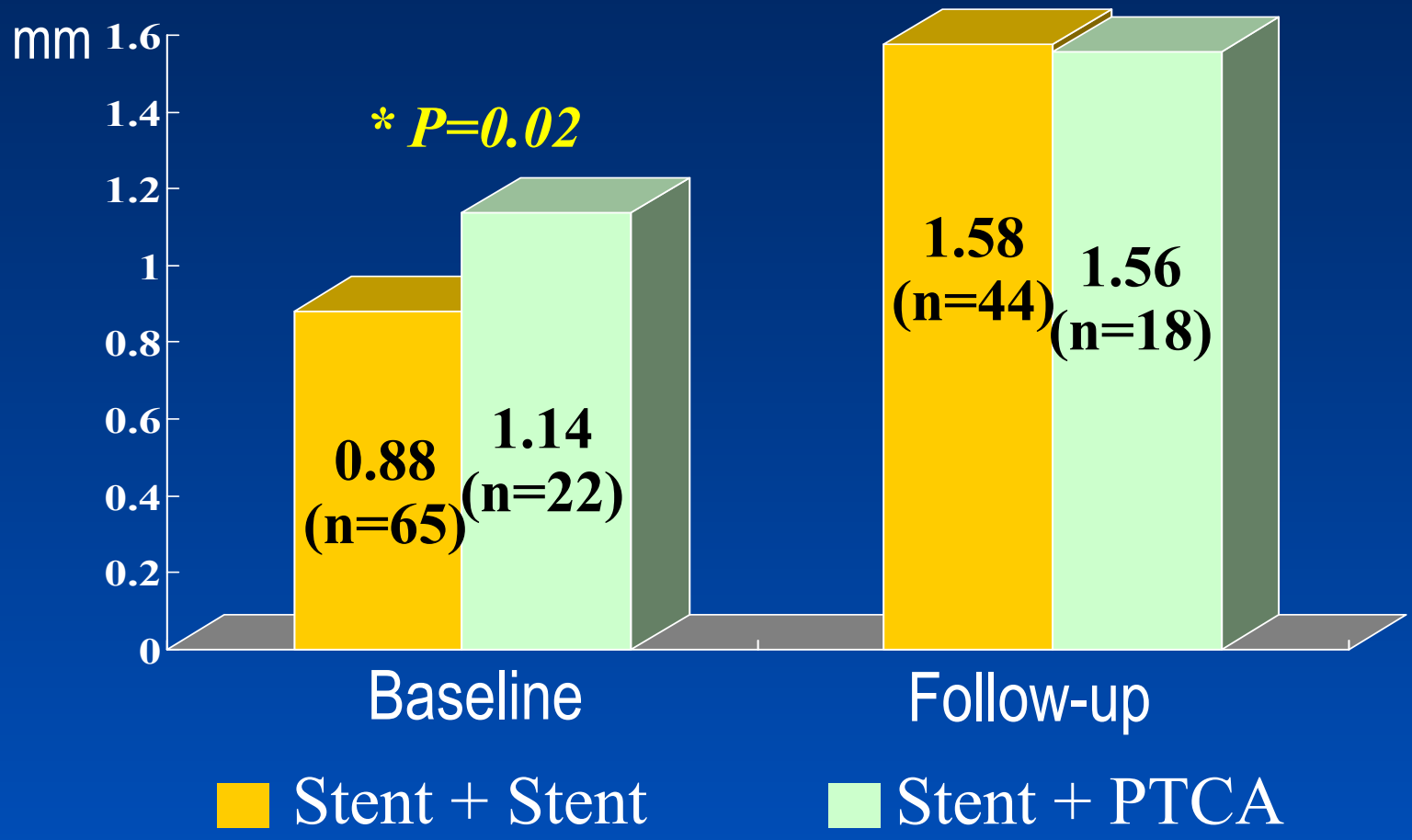
Main Vessel
Minimal Lumen Diameter

SIRIUS Bifurcation



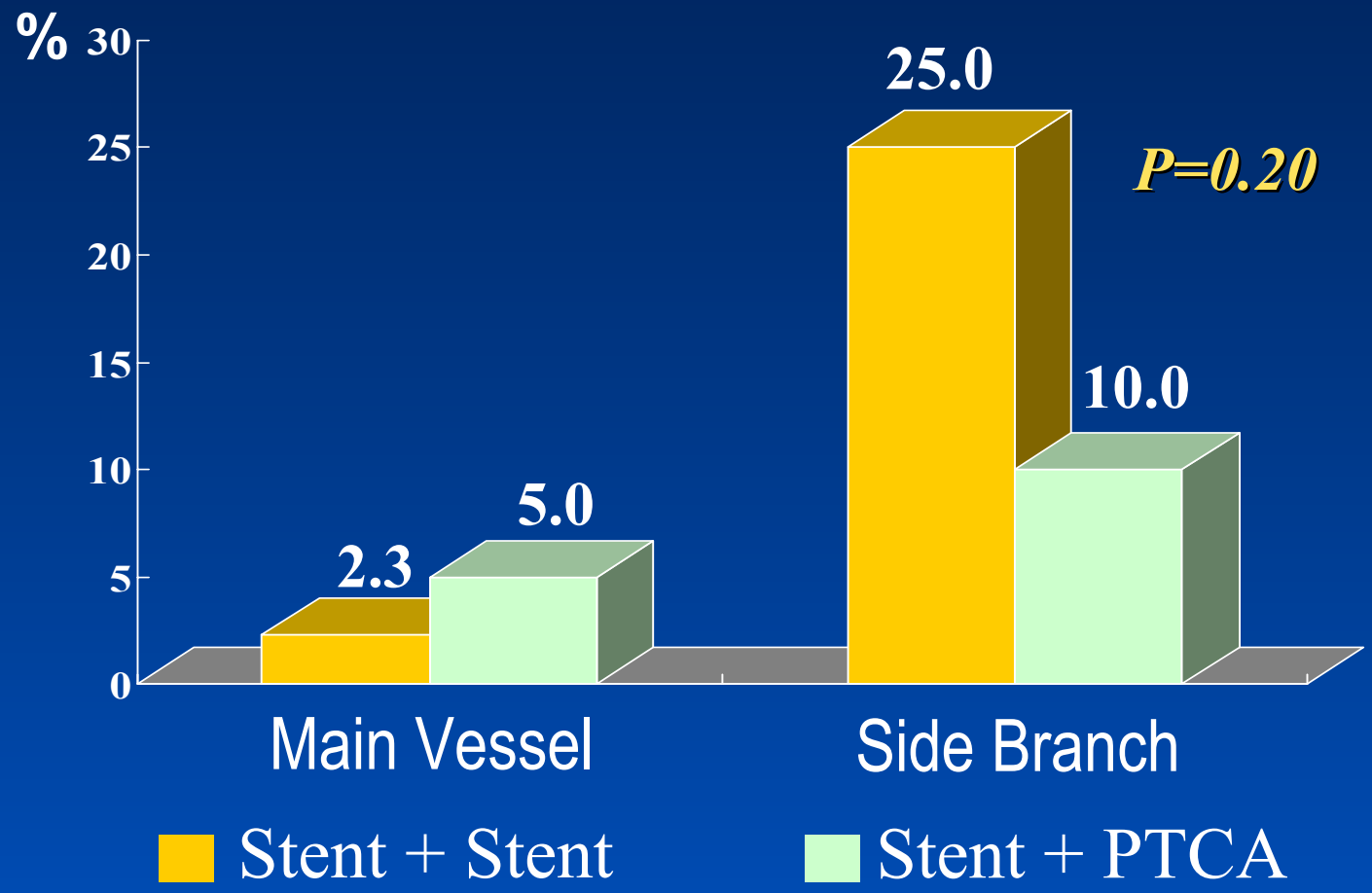
Side Branch
Minimal Lumen Diameter

SIRIUS Bifurcation



In-Segment Restenosis

SIRIUS Bifurcation



In-Segment Restensis Site

SIRIUS Bifurcation

	MB,S+S (n=1)	MB,S+P (n=1)	SB,S+S (n=11)	SB,S+P (n=2)
Ostium of SB	--	--	10	2
Distal to the Stent	--	--	1	--
Proximal to the Stent	1	1	--	--

A Colombo, et al. AHA 2002

What We Learned

DES In Bifurcation Lesion

- **Effective**

  Nearly eliminate restenosis in the main vessel

- **Ineffective**

  Persistent disturbingly high restenosis at the uncovered side branch ostium

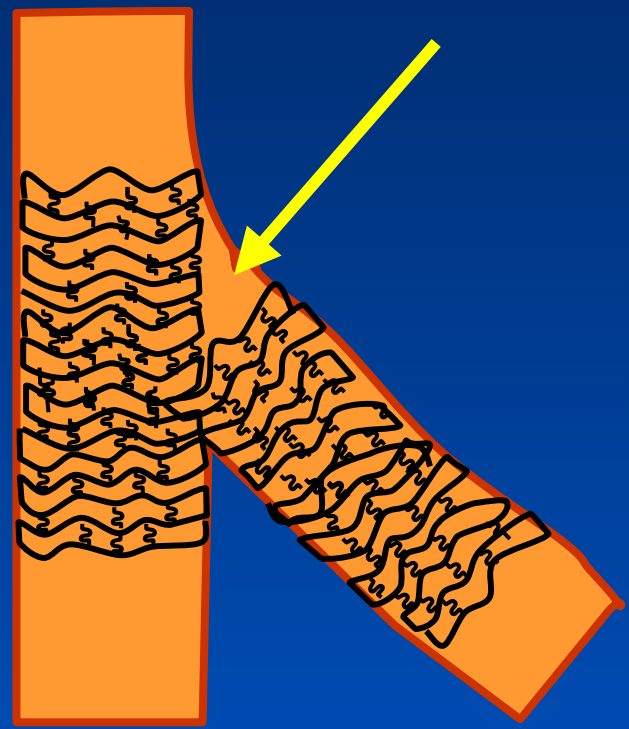
Stenting Technique

In the Era of Drug Eluting Stent

Lesson from SIRIUS Bifurcation

Limitation of T-Stenting

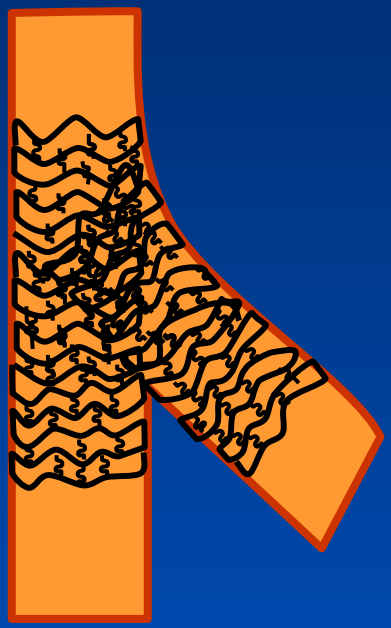
Potential gap susceptible to restenosis



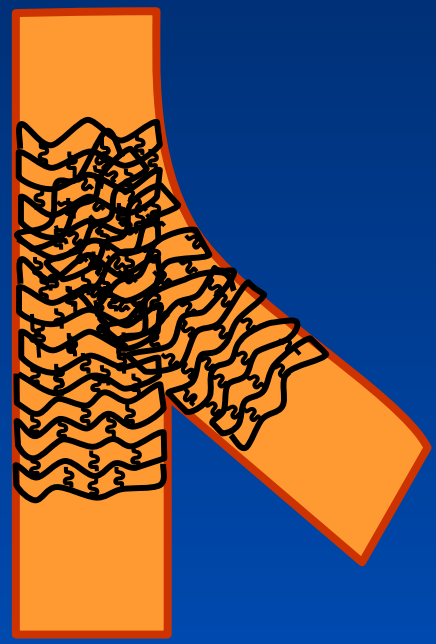
How to solve the problem ?

Complete coverage of side branch ostium

Modified T



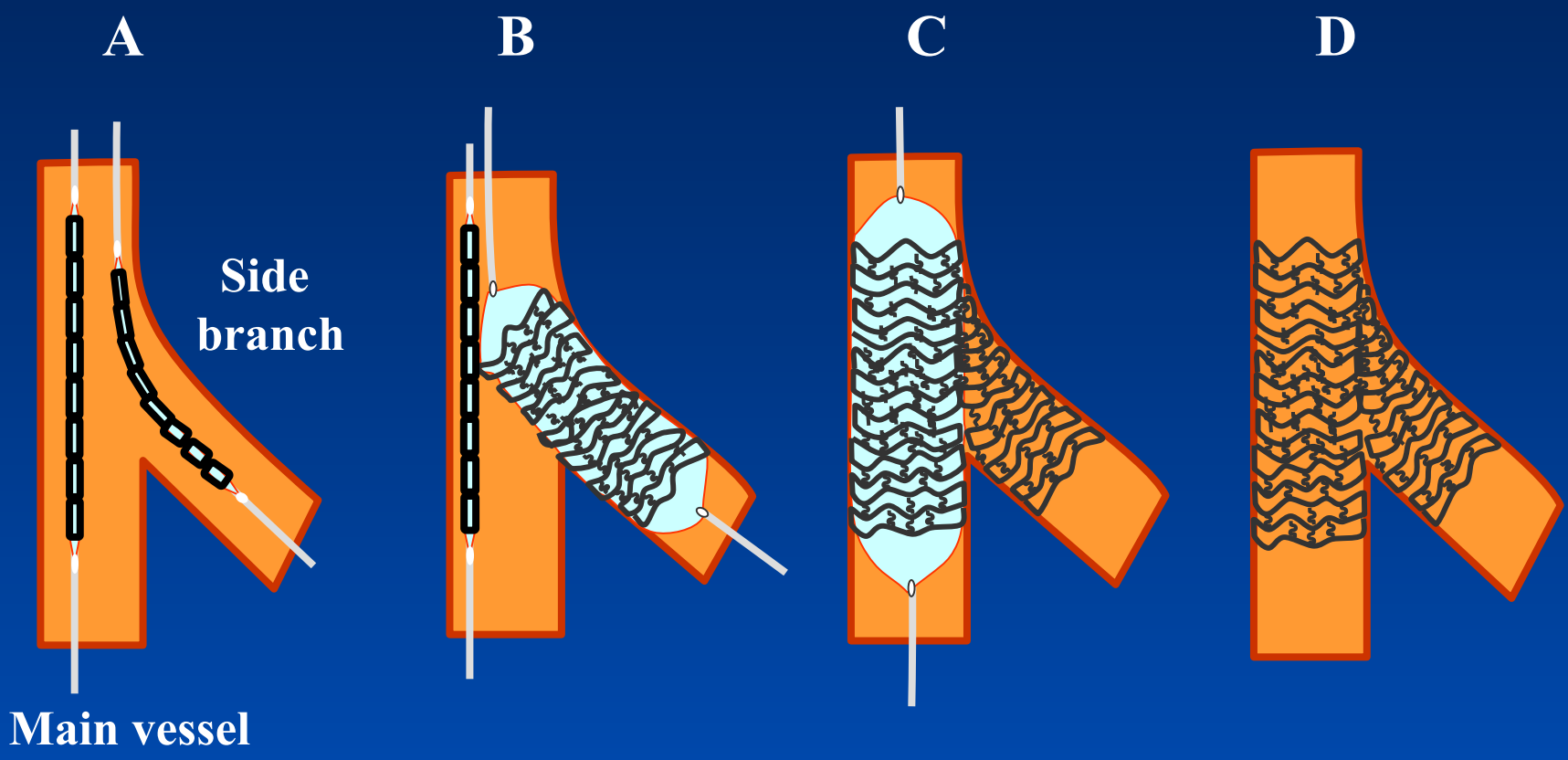
Y (Culotte)



Kissing

New Technique with DES

Stent - Crush



Stent Crush with Cypher

108 patients, April 2003 ~ Nov. 2003

In- hospital events

- No death, MI, CABG, urgent TLR

30- day outcome

- No death
- Stent thrombosis 1.9 % (2/108)

Intermediate- term clinical outcome

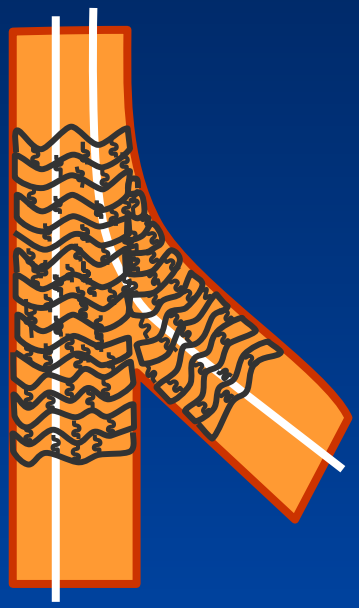
- No death, MI
- TLR 12 % (9/108)

I Moussa , ACC 2004

One More Step of Stent - Crush

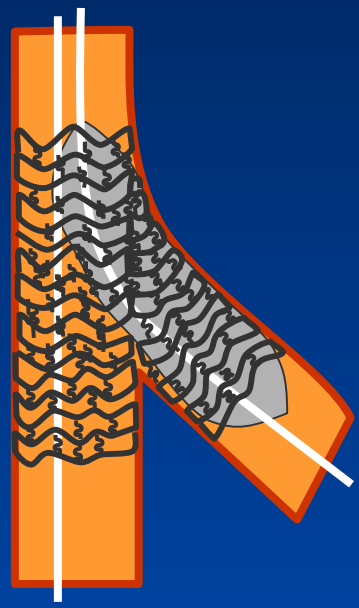
Final Kissing Balloon Dilatation

E



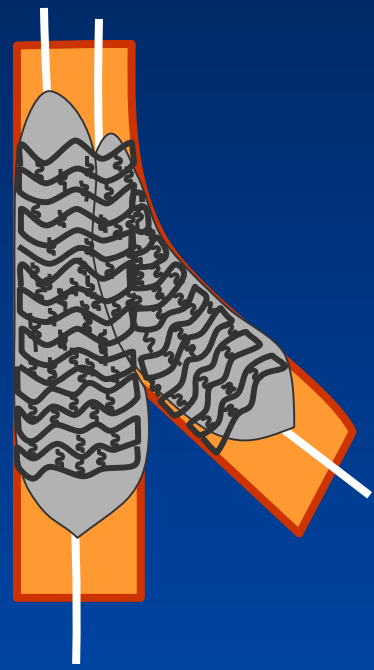
Re-advancement of wire into the side branch

F



Opening of the side branch ostium

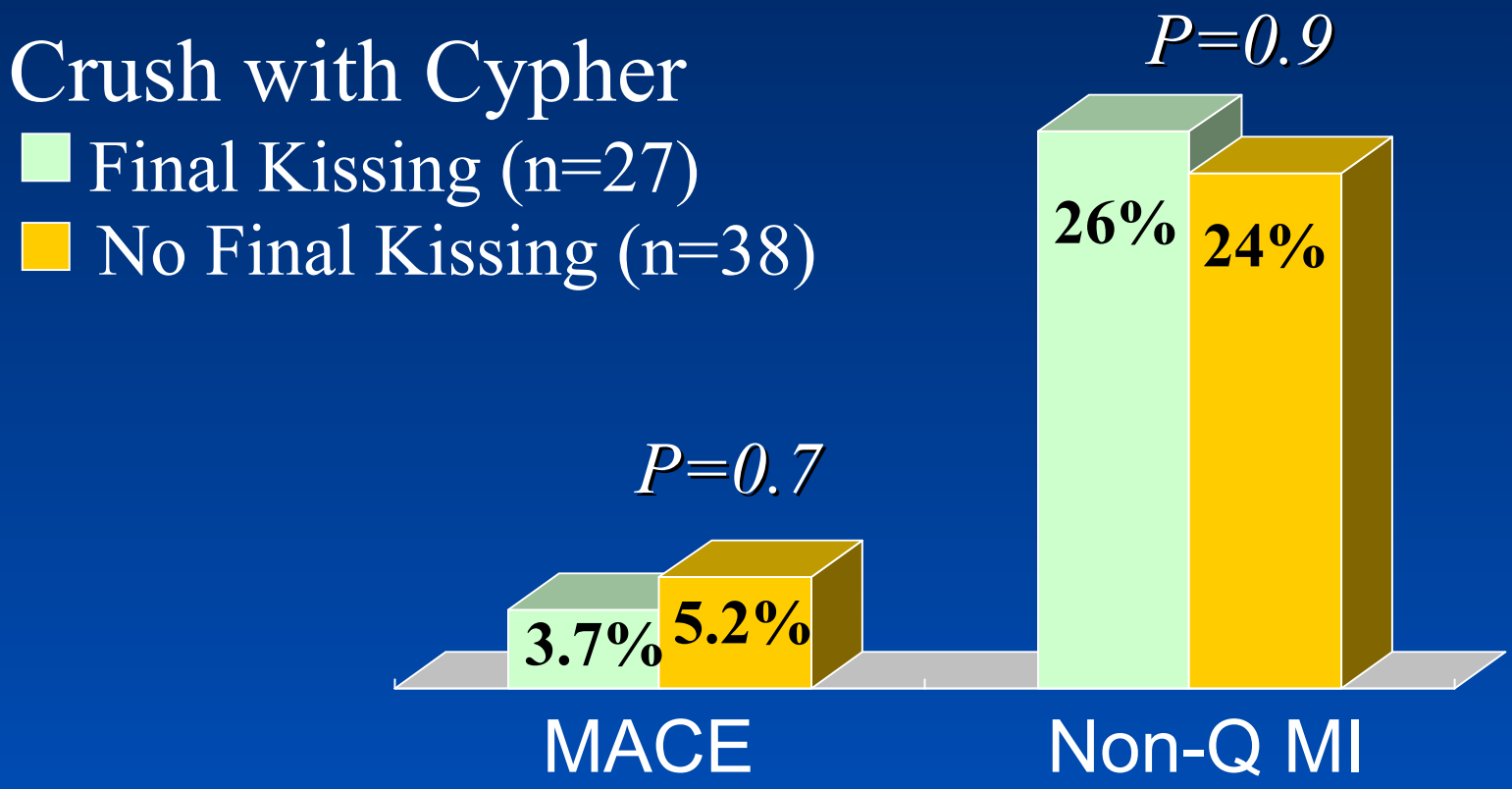
G



Final kissing balloon inflation

Final Kissing Necessary during Crushing with DES?

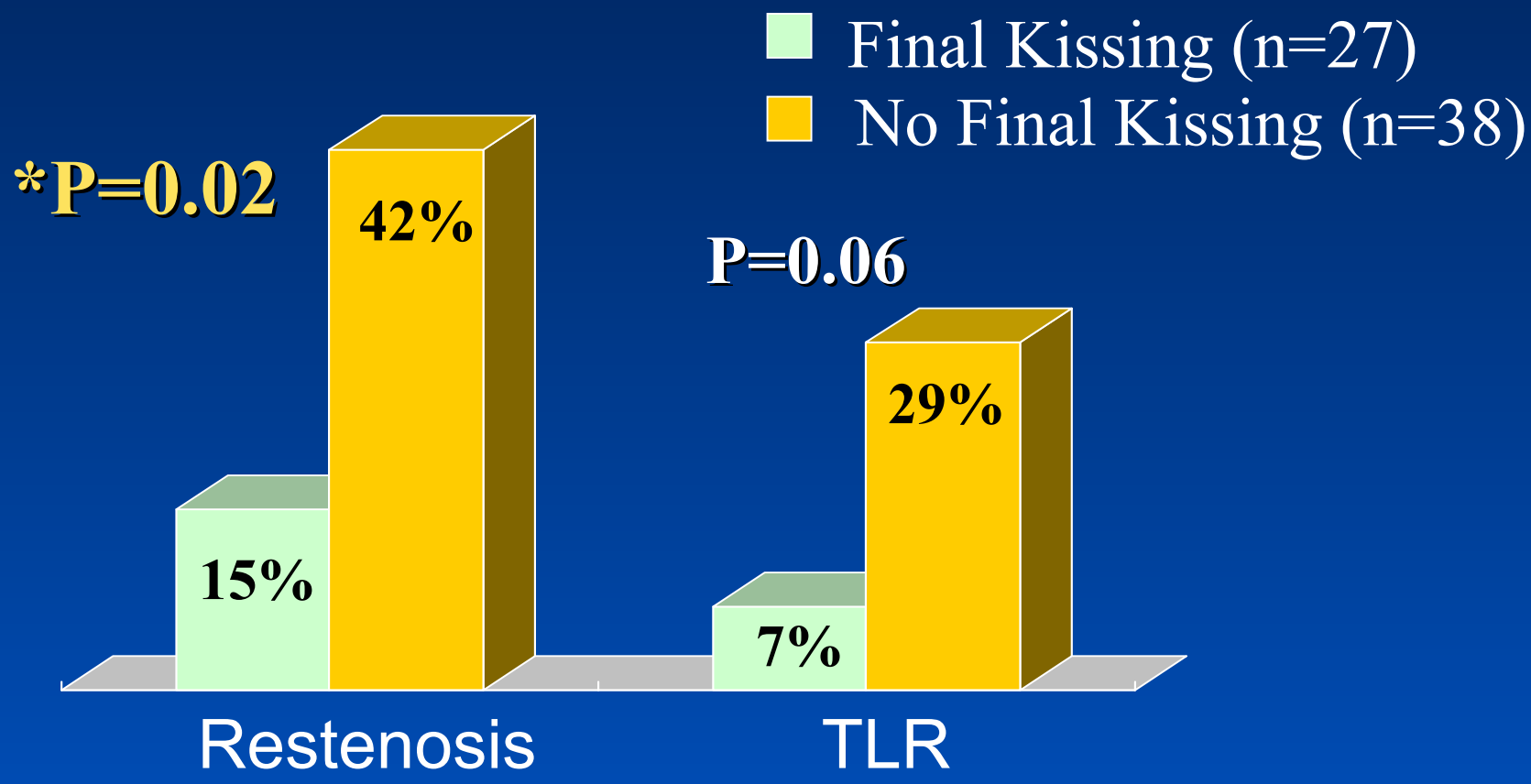
In-Hospital Clinical Outcome



A Colombo, ACC 2004

Crush with Final Kissing Balloon

Clinical Outcome at 6 Months



A Colombo, ACC 2004

Crush with Cypher
Final kissing vs No Kissing

Main Vessel

	FK	No FK	p
Acute gain, mm	2.05 ± 0.6	1.78 ± 0.6	< 0.001
Late loss, mm	0.49 ± 0.7	0.62 ± 0.6	0.01

Side Branch

	FK	No FK	p
Acute gain, mm	2.03 ± 0.7	1.27 ± 0.5	< 0.001
Late loss, mm	0.66 ± 0.8	1.10 ± 0.8	< 0.001

A Colombo, ACC 2004

Kissing Balloon Inflation Should be performed

- Full expansion of the side-branch stent
- Release of side-branch from jail
- Sequential inflation for increasing successful final kissing dilataion

Stent Crush with DES

What we know

- Acutely predictable result
- Guaranties stent coverage of the ostium of the side branch

What we don't know

- Acute & long-term safety
- Impact on restenosis

Wait the result of MATRIX Registry !

RESEARCH Bifurcation

SES (n=127) or PES (n=72)

- Subacute thrombosis 2.5 %
- TLR 7 %
- TVR 9 %
- Binary Restenosis
  - Main vessel 9 %
  - Side branch 14 %

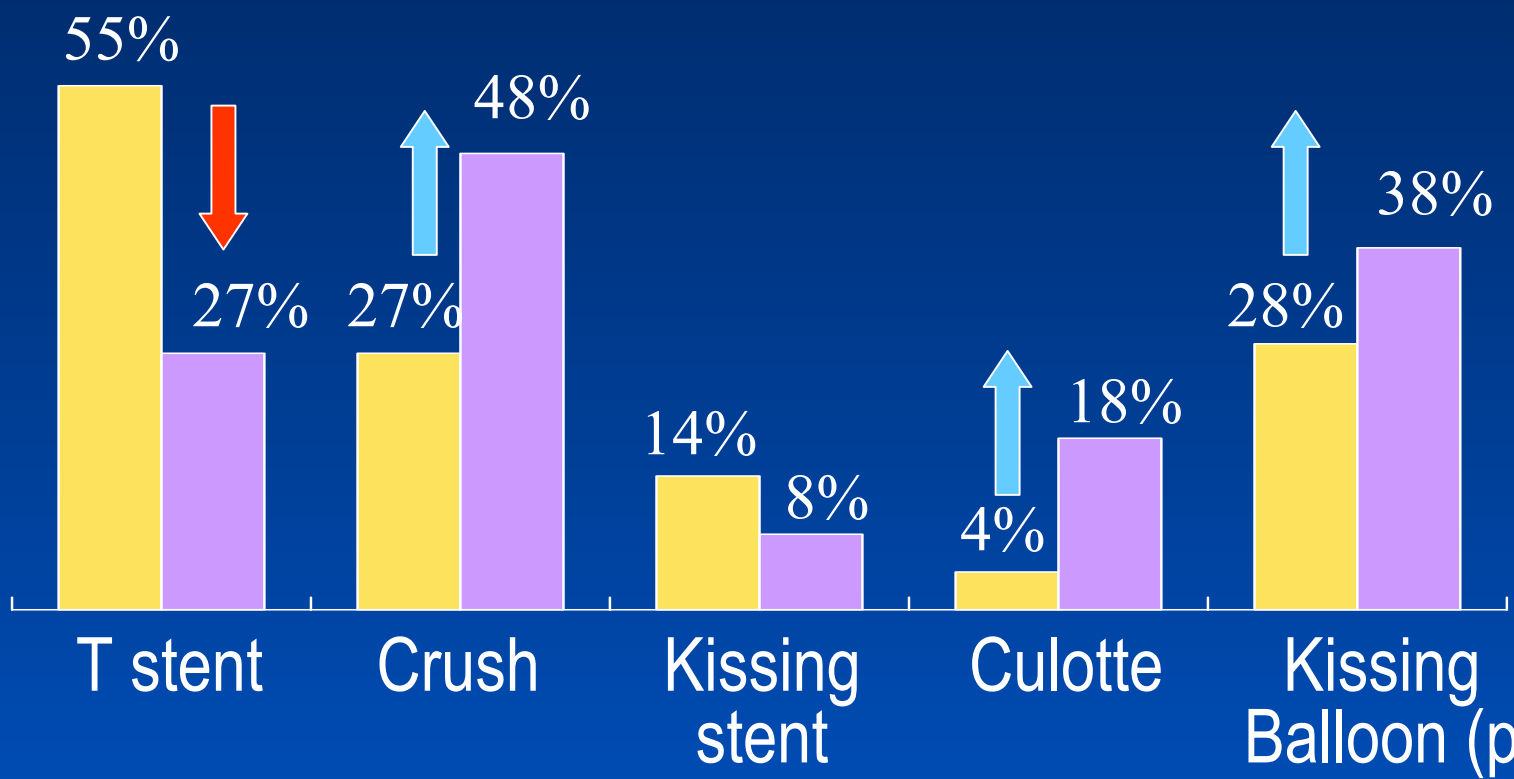
Serruys et al, ACC 2004

Stenting Technique

RESEARCH : CYPHER vs. TAXUS

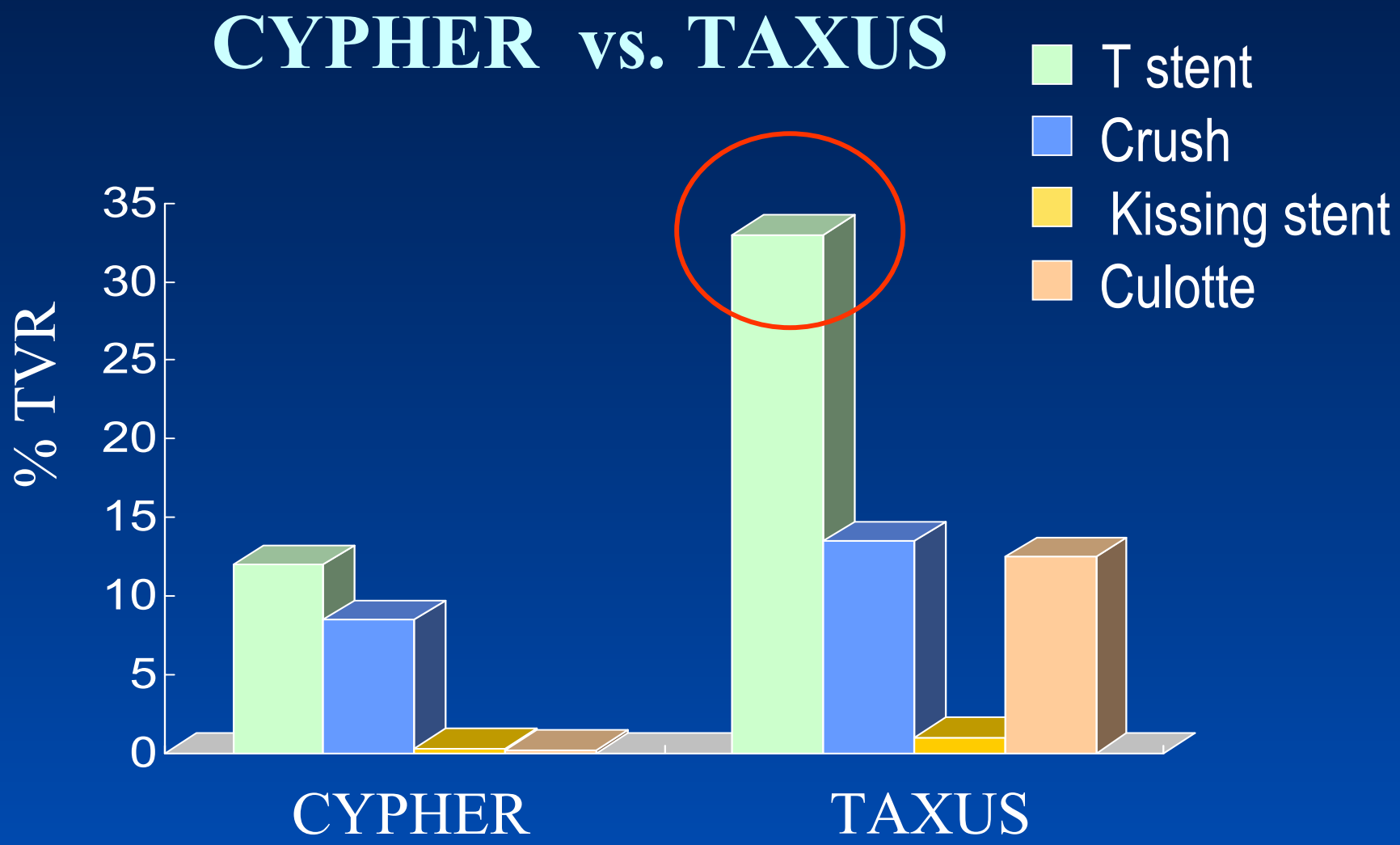
CYPHER (n=123)
April 2003 ~ April 2004

TAXUS (n=71)
Mar. 2004~ Sep. 2004



Serruys et al, ACC 2004

TVR in RESEARCH Bifurcation

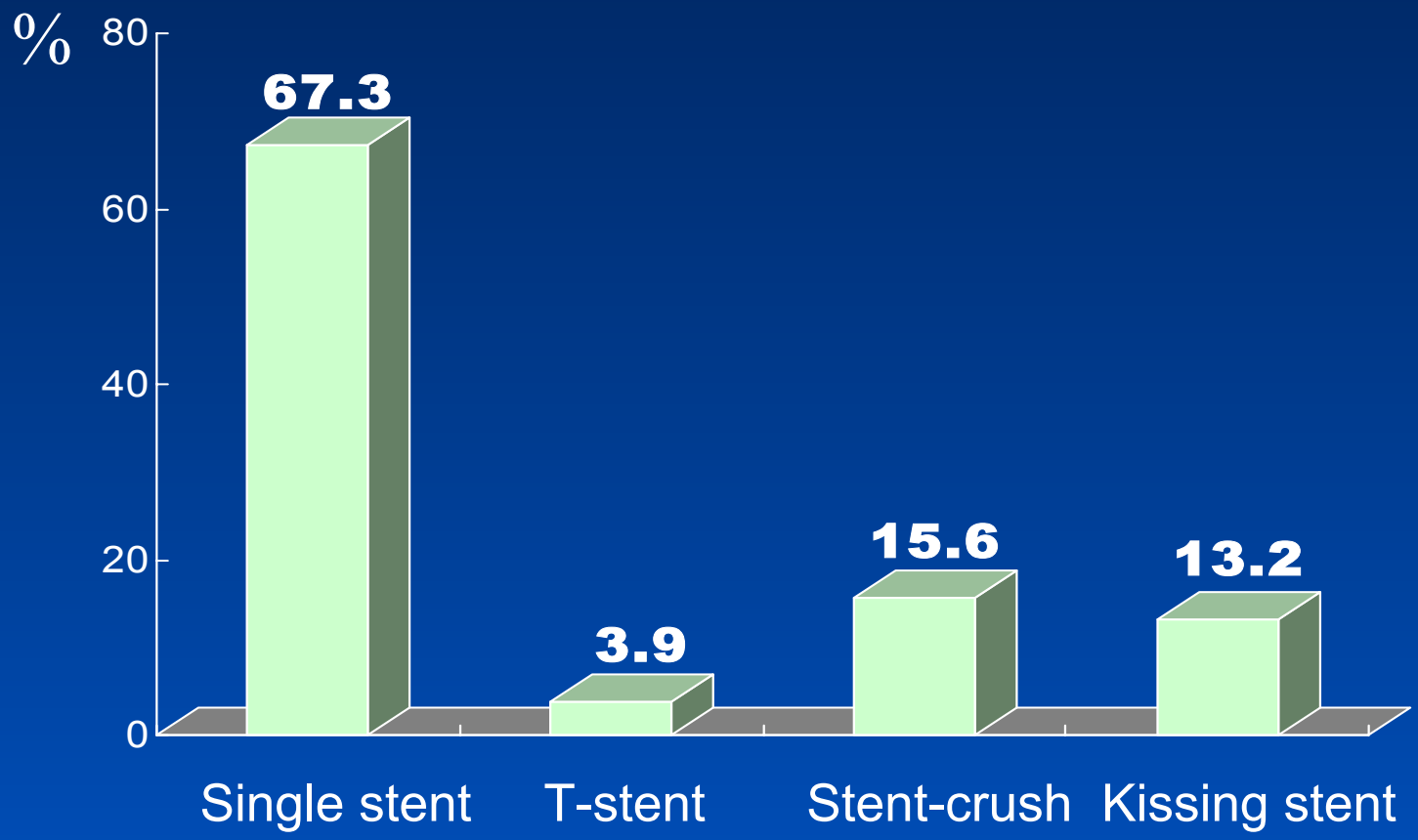


Serruys et al, ACC 2004

Bifurcation Lesions in AMC

Treatment Strategies

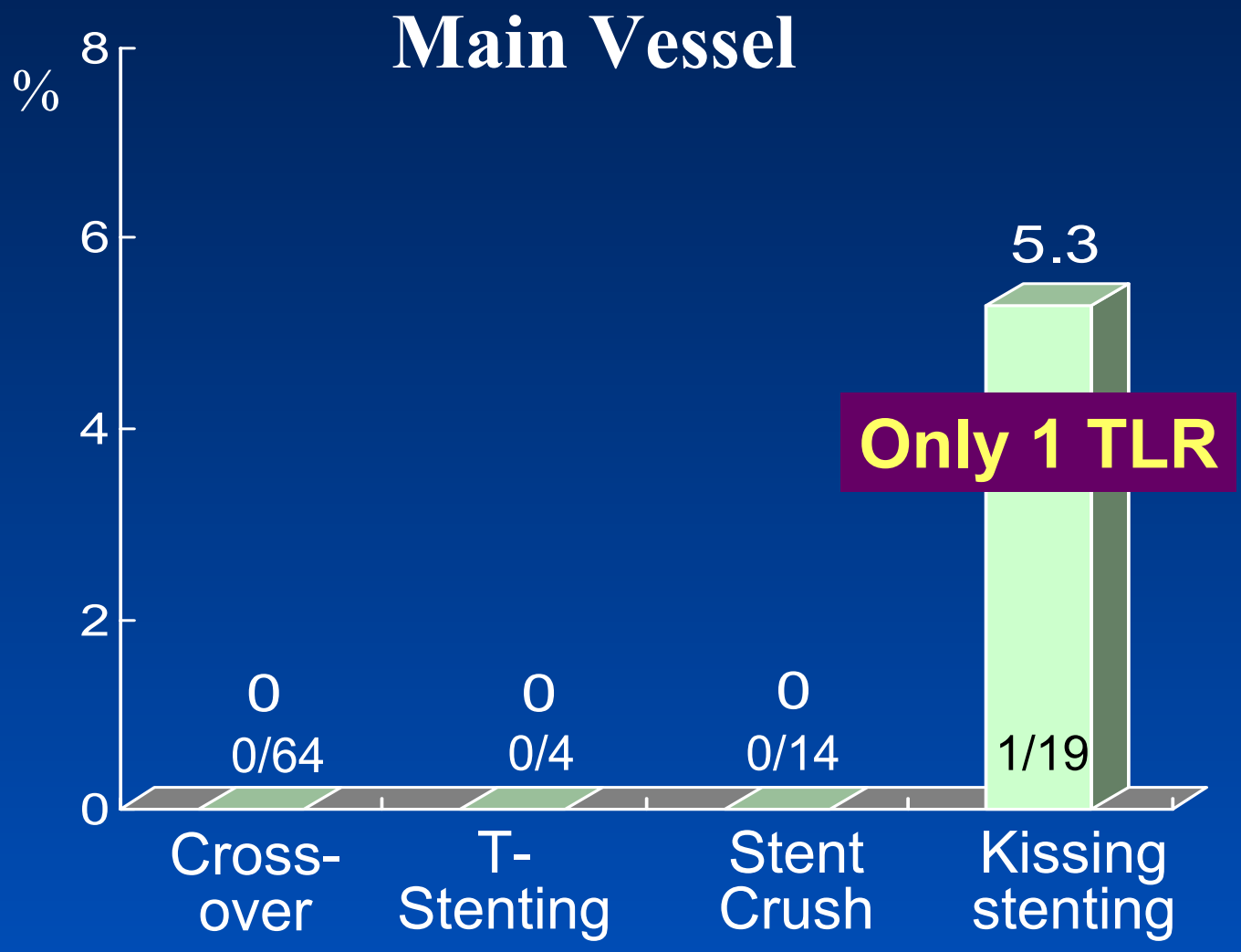
Total 205 lesions except left main bifurcation



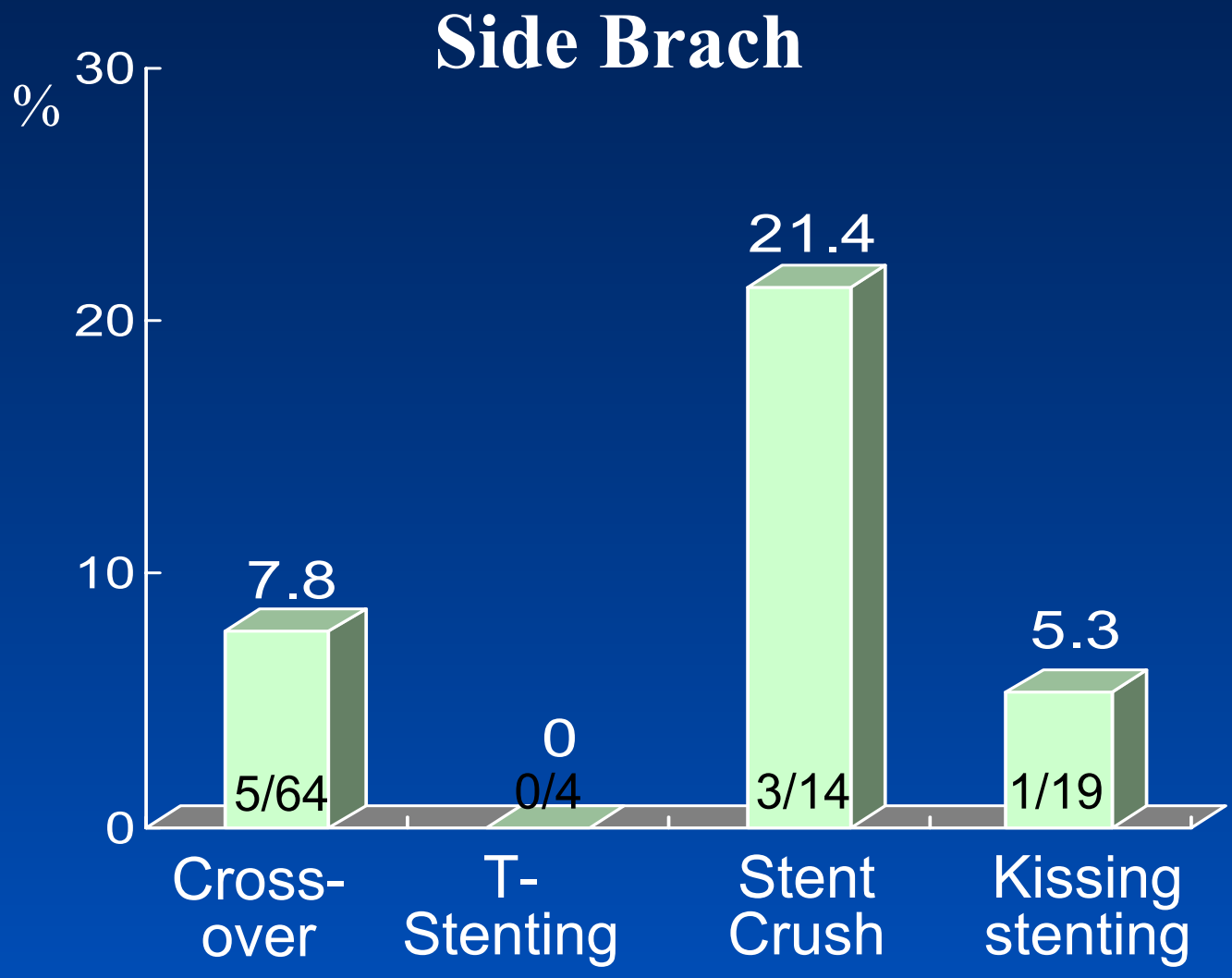
Late Loss
at 6-month angiography

	No	Main vessel	Side branch
Single stent	62	0.21±0.46	0.06±0.44
T-stent	4	0.21±0.46	0.16±0.49
Stent-crush	14	0.16±0.45	0.51±0.88
Kissing stent	19	0.55±0.60	0.34±0.34

Restenosis Rate



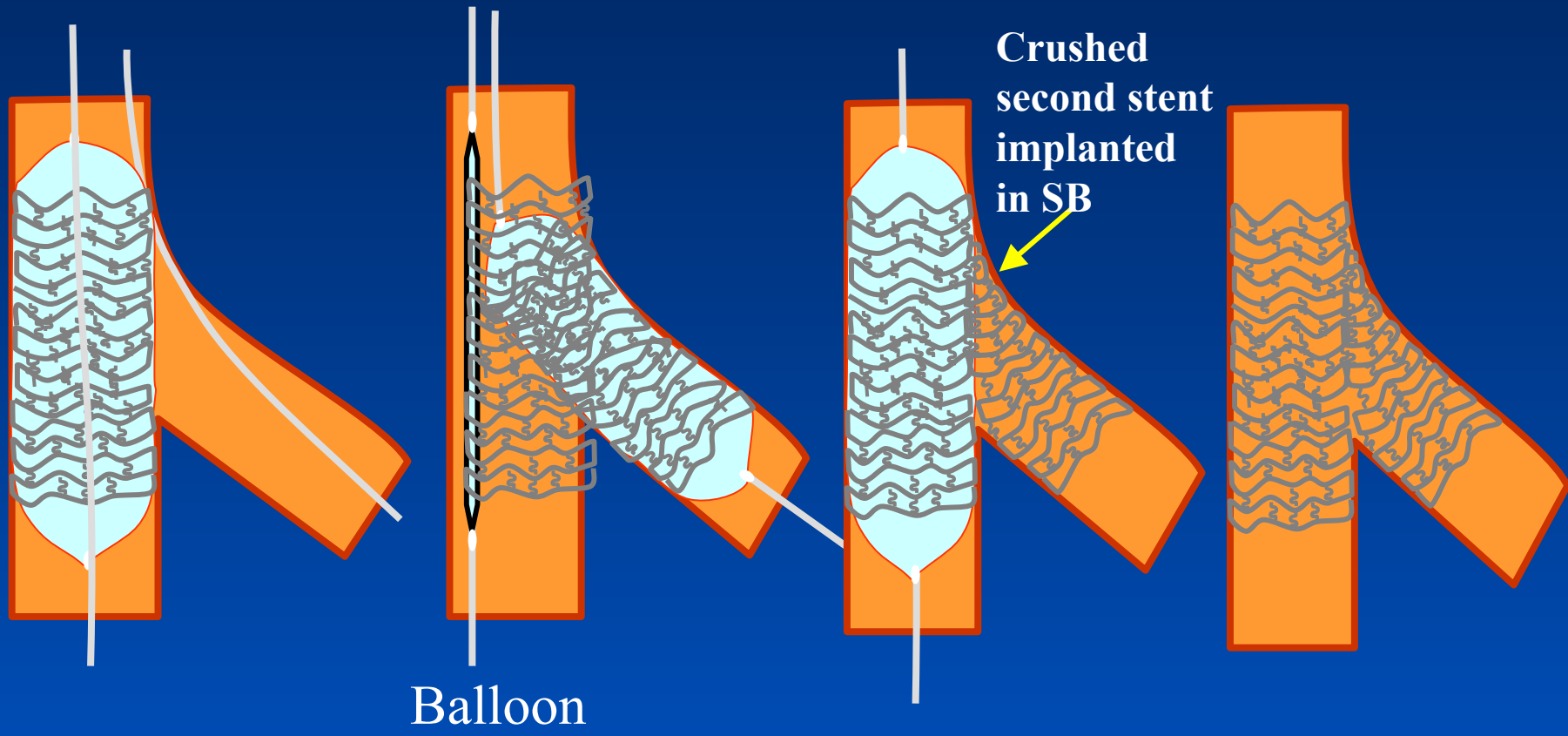
Restenosis Rate



Emerging New Technique

"Internal" or "Reverse" Crush

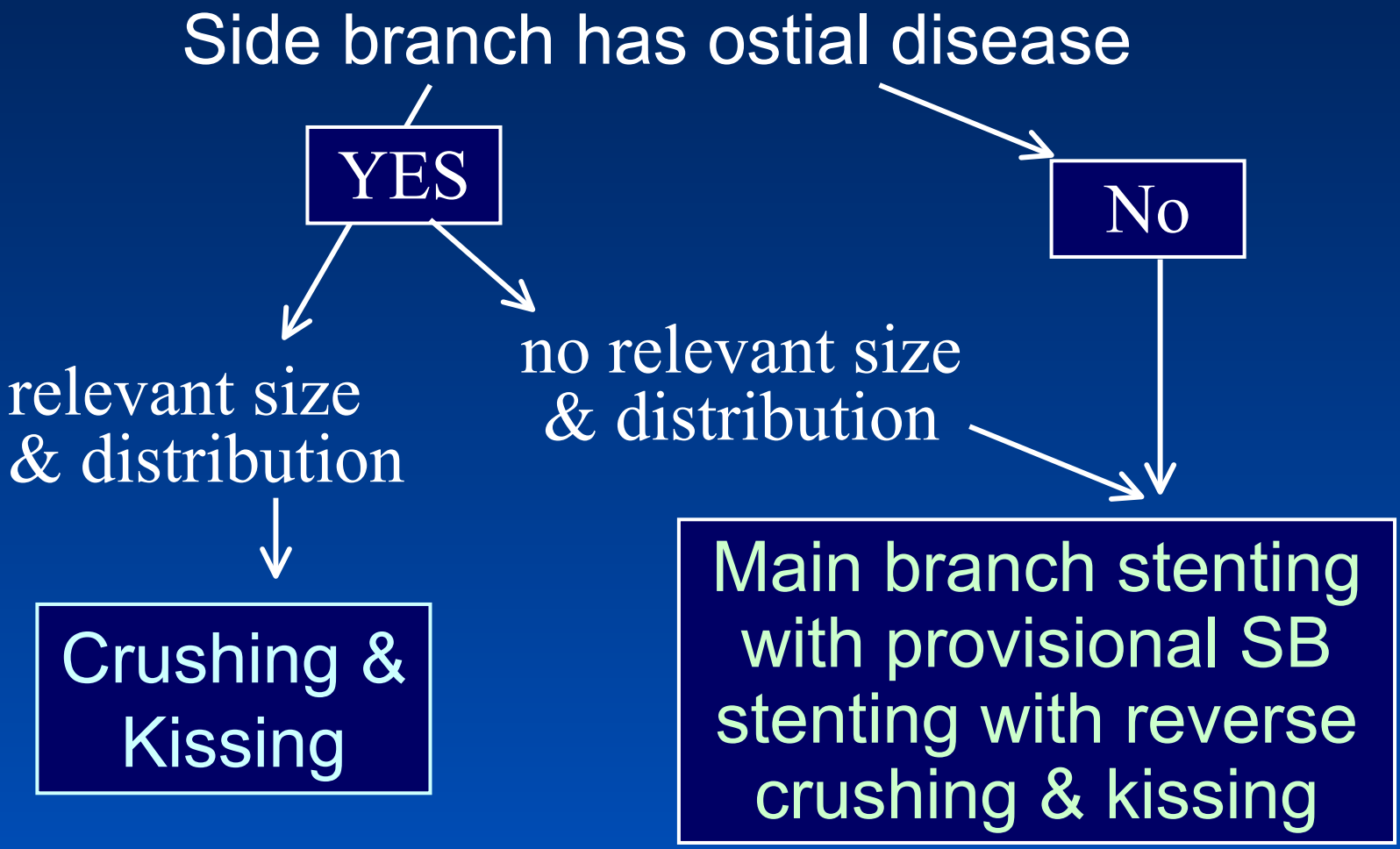
allows provisional SB stenting with full ostial coverage



Internal or Reverse Crush

- Allows provisional stenting of the side-branch with a fall-back strategy that delivers coverage of the side-branch ostium without gaps.
- Limitation : it may be difficult to pass stent to side-branch

Proposed Approach to Bifurcation Lesions with DES



Future Perspectives in the Era of DES

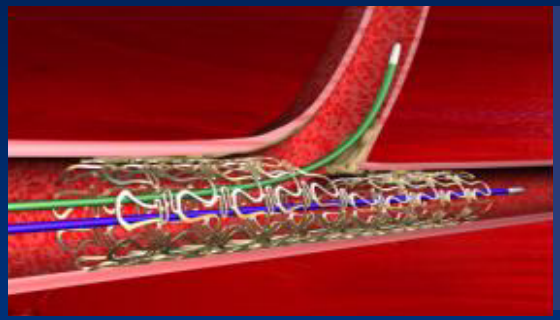
Following consideration should be evaluated

- Fate of side branch with DES
- Randomized comparison of
  - Two vs. Single DES
  - Different two DES tecnique
- New bifurcated stent

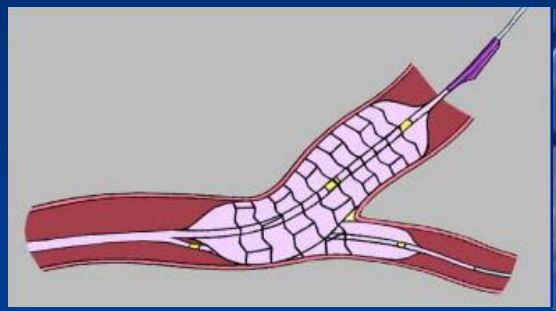
New Modality for Bifurcation Lesion ?

- *True Bifurcated Stent*
- *Drug Eluting Stent*

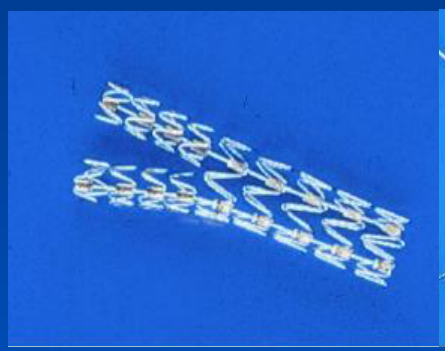
Bifurcated Stents



AST SLK-View Stent



Guidant Frontier Stent



BARD Bifurcate XT

Bifurcated Stent

Cordis DBS Stent

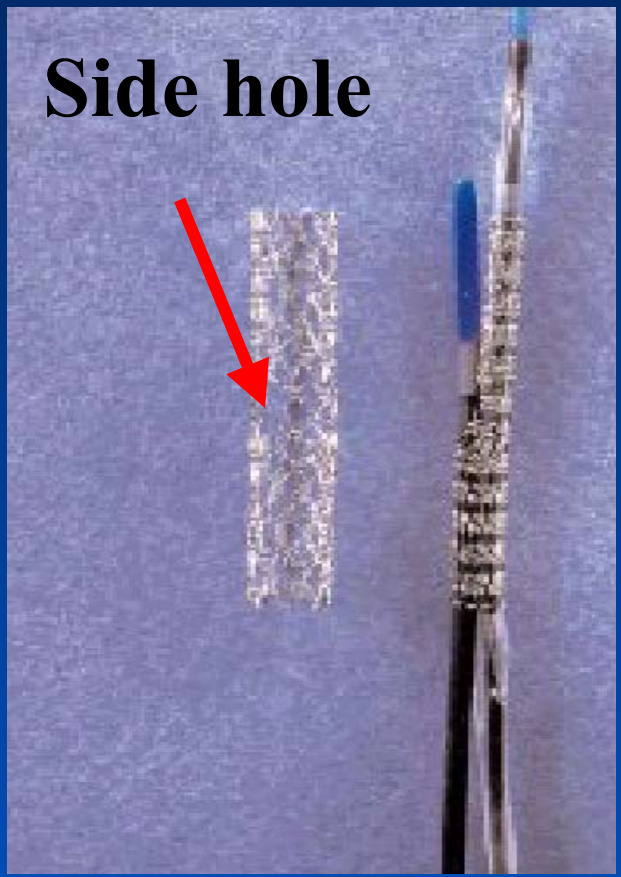
34 patients (mean 64 years)

- *Technical Success* *94%*
- *MACE @ 30 days* *0%*
- *Restenosis @ 6 Mo* *33%*
- *TLR* *19%*

Dibie A, et al. Am J Cardiol 2002;90:13H

Bifurcated Stents

AST SLK -View



Stent length = 17mm

Catheter length = 140 cm

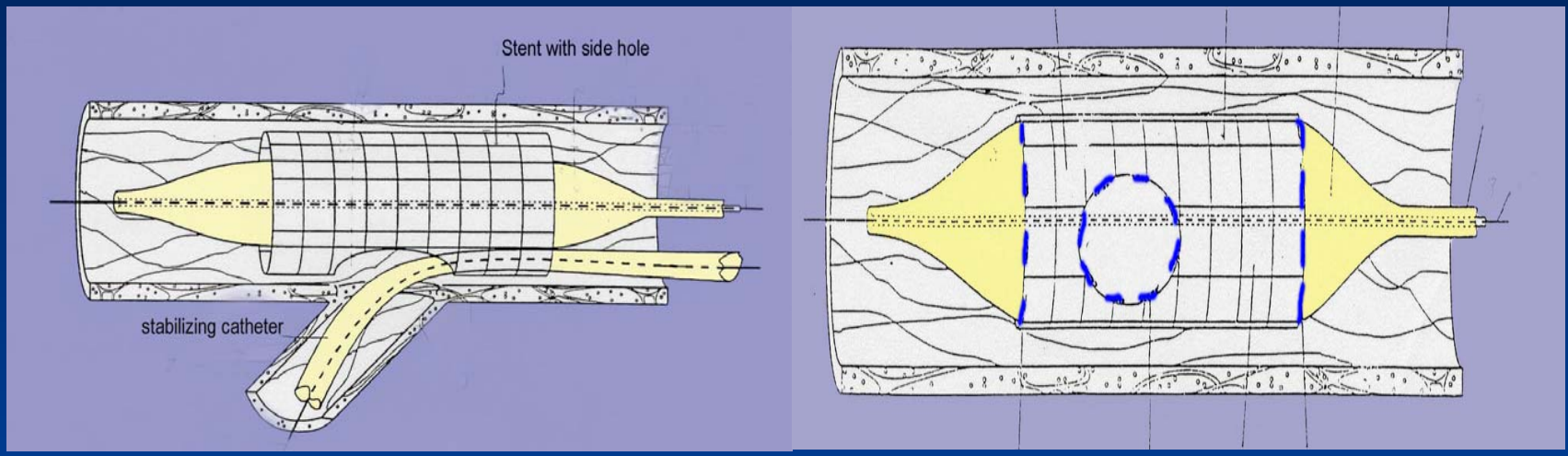
Crossing profile = 0.055 IN

Available in two sizes

- 3.0mm with 2.5mm side hole
- 3.5mm with 3.0mm side hole

Bifurcated Stents

AST SLK -View



Main catheter system comprises of a main stent with a side hole and a stabilizing catheter, which allows access to side branch after stenting

AST SLK-View Stent

AMC Experience

48 patients (mean 58 years), 50 lesions

	Parent vessel	Side branch
Technical Success	100 %	100 %
Side branch accessibility		100 %
Side branch preservation after stenting		100 %

Kim YH, et al. TCT 2002

AST SLK-View Stent

US Safety & Feasibility study

31 patients , 31 bifurcation lesions

• *Device Success*	*92.9 % (29 / 31)*
• *MACE @ in-hospital*	*0 %*
• *MACE @ 30 days*	*3.4 %*
• *MACE @ 6 Mo*	*48 % (14 pts)*
• *TLR*	*45 % (13 pts)*

Buchbinder et al. TCT 2003

Bifurcated Stent

Invatec DESIRE study

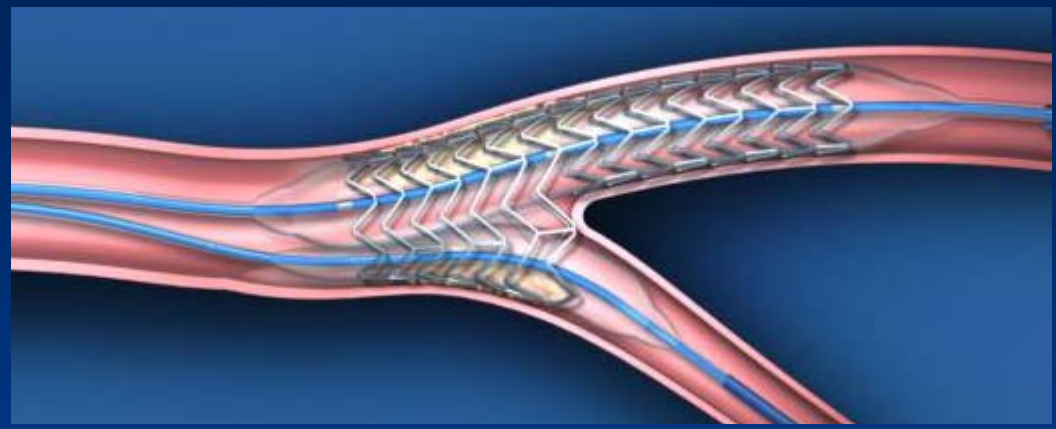
34 patients (mean 64 years)

- *Technical Success* *94%*
- *MACE @ 30 days* *0%*
- *Restenosis @ 6 Mo* *33%*
- *TLR* *19%*

A Colombo, et al. JIM 2004

Bifurcated Stent

Guidant Frontier Stent



105 patients (mean 62 years)

- *Device Success* *92%*
- *MACE @ 30 days* *3 %*
- *Restenosis @ 6 Mo* *29%*
- *TLR* *13%*

Lefevre, et al. TCT 2003