

Bifurcation Lesion Intervention

Samin K. Sharma, MD, FACC
Director, Cath Lab & Intervention
Professor of Medicine (Cardiology)

Mount Sinai Hospital , New York

I have no real or apparent conflicts of interest to report

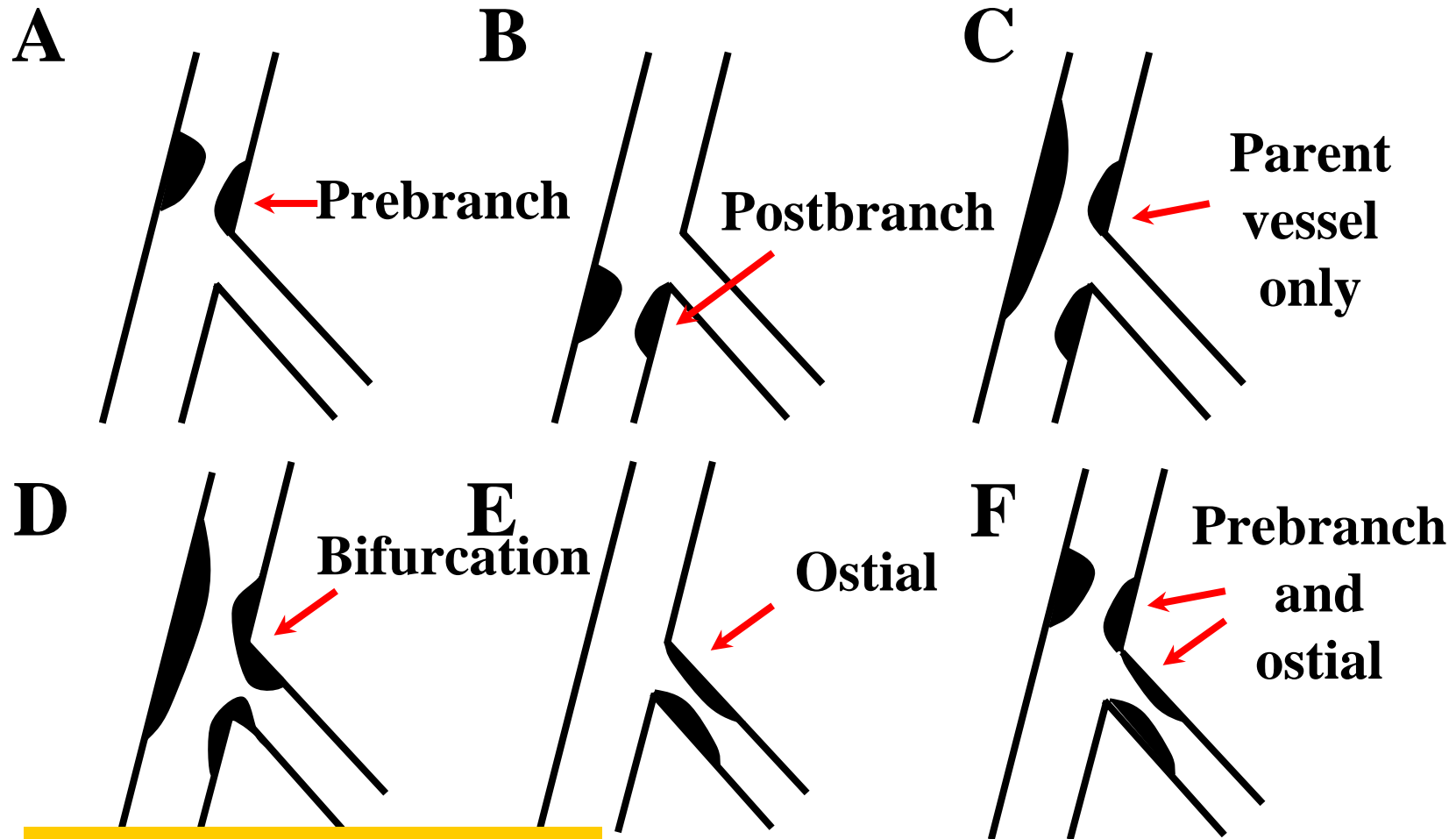
Bifurcation Lesion Intervention

Scope of The Problem

- **Bifurcation lesion intervention is performed in about 8-15% of PCI at most centers**
- **Most of these lesions are complex (type C of ACC/AHA class)**
- **Technically challenging with higher learning curve**
- **PCI of these lesions requires higher number of devices**
- **Higher LOS, higher MACE and higher restenosis**

Bifurcation Lesion Classification

Duke's

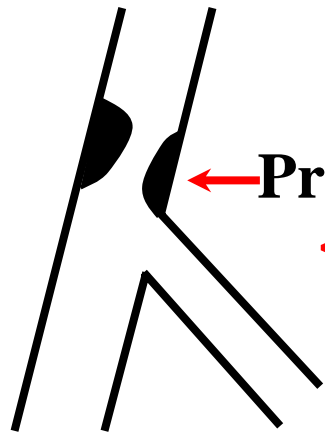


Most common = 45%

Bifurcation Lesion Classification

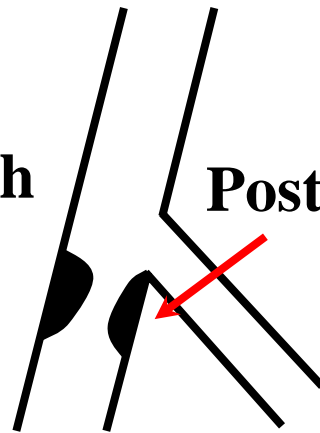
Side-branch Compromise After PCI

A



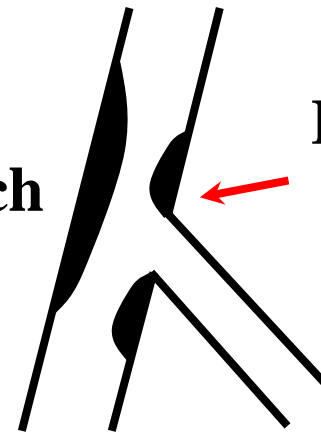
← Prebranch
<5%

B



← Postbranch
<5%

C



← Parent vessel only
5-10%

D



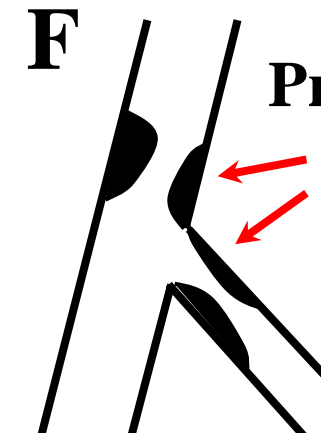
← Bifurcation
15-20%
Cause:
Plaque shift
Spasm
Dissection

E



← Ostial
<5%

F



← Prebranch and ostial
10-15%

Most common = 45%

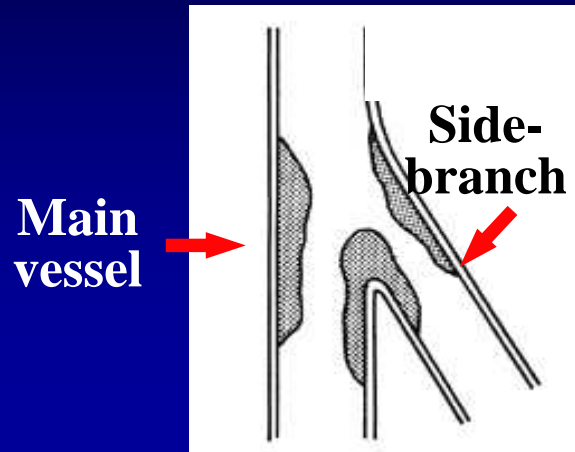
Bifurcation Lesion Intervention

Issues

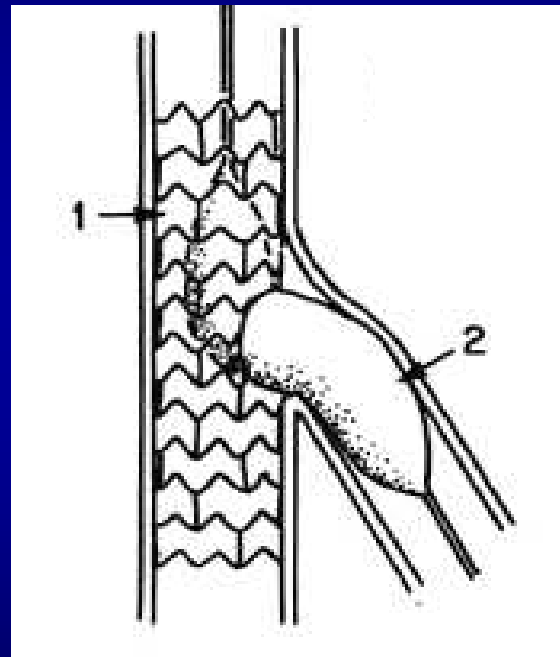
- **Plaque shift / displacement**
- **Elastic lesion / recoil**
- **Disparity in the size of parent vessel with distal vessel and sidebranch**
- **Sidebranch angulation (T vs. Y)**

Various Techniques for Stenting Bifurcation Lesions

Bifurcation Lesion



Stent the MV+
Balloon or Debulk SB

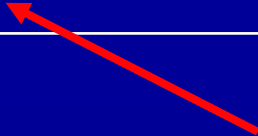


..and stent the
SB only if
suboptimal
results

**Provisional/
Conventional
Stent Technique**

Optimal Treatment of Bifurcation Lesions

Short & Long-term Results

Variable	Angiographic appearance	Acute complication	Restenosis	Technical challenge
Stent of parent vessel & PTCA+provisional stent of the side-branch	Excellent for parent vessel, suboptimal for SBr	1-3%	High for SBr	+
 <p>Conventional/Provisional Stent Strategy <i>is the</i> Best Recommended Strategy</p>				

Suwaidi, Holmes et al. JACC 2000;35:929

Yamashita, Colombo et al. JACC 2000;35:1145

Kobayashi, Colombo et al. CCD 1998;43:323

Pan et al. AJC 1999;83:1320

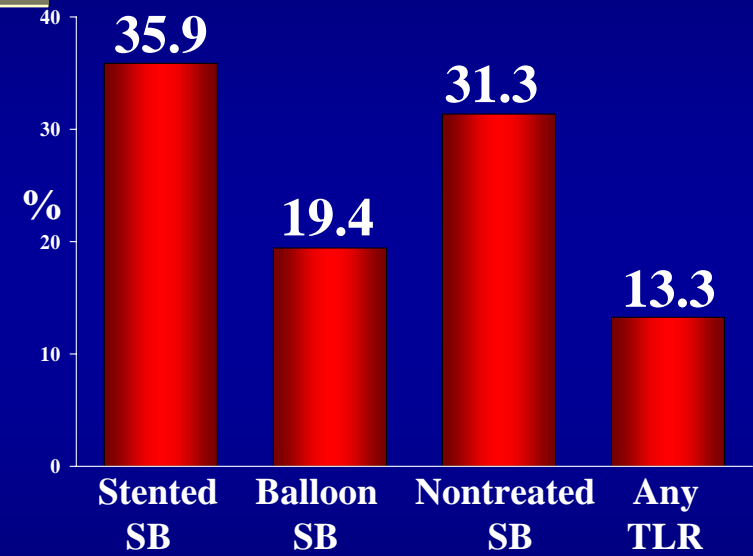
Dauerman et al. JACC 1998;32:1845

Oesterle et al. JACC 1998;32:1853

The FRONTIER Stent Registry

QCA Analysis

	Main Branch (n = 96)	Side Branch (n = 96)	Any branch (n = 96)
<i>Baseline</i>			
Reference diameter (mm)	2.77±0.51	2.10±0.67	-
MLD (mm)	1.07±0.35	1.23±0.45	-
<i>Post-procedure</i>			
MLD (mm)	2.43±0.41	1.47±0.40	-
Diameter stenosis (%)	15±10	25±13	-
<i>6-mo FU</i>			
MLD (mm)	1.59±0.56	1.13±0.47	-
In-segment binary restenosis (%)	29.9	29.1	44.8
Late lumen loss (mm)	0.48±0.55	0.34±0.45	-



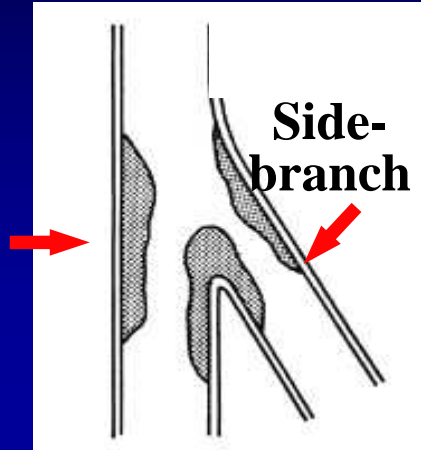
Bifurcation Lesion Stenting

What about 2 vs 1 Drug Eluting Stents?

Various Techniques for Stenting Bifurcation Lesions

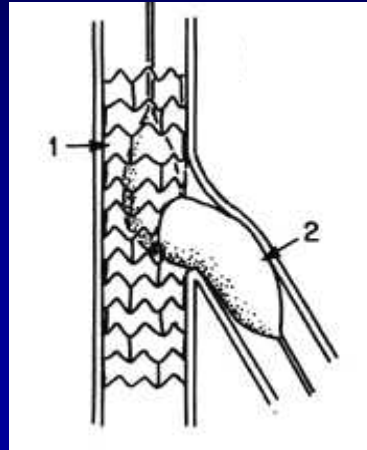
Bifurcation Lesion

Main vessel

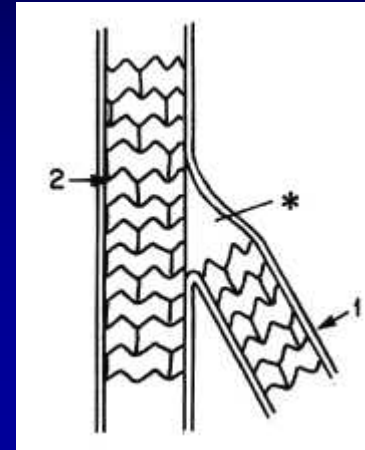


Side-branch

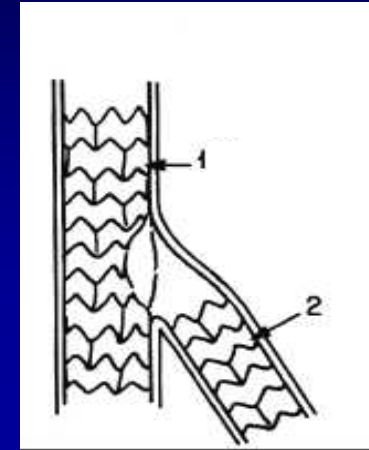
Stent+PTCA



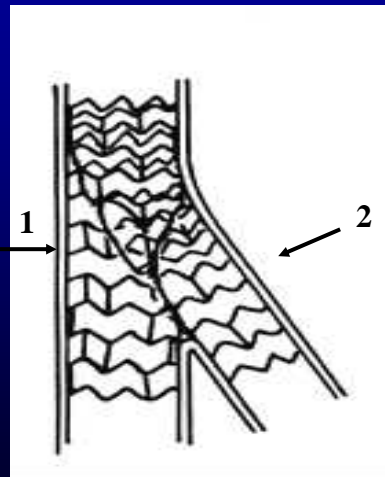
Stent+stent ("T stenting")



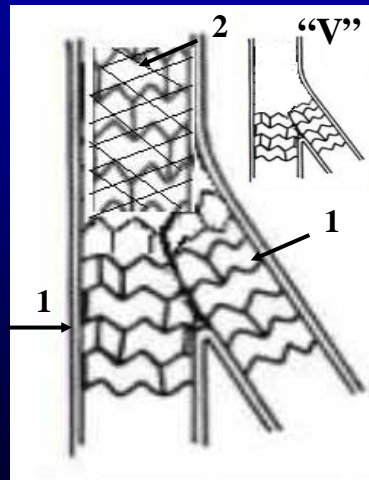
Stent+stent ("reverse-T")



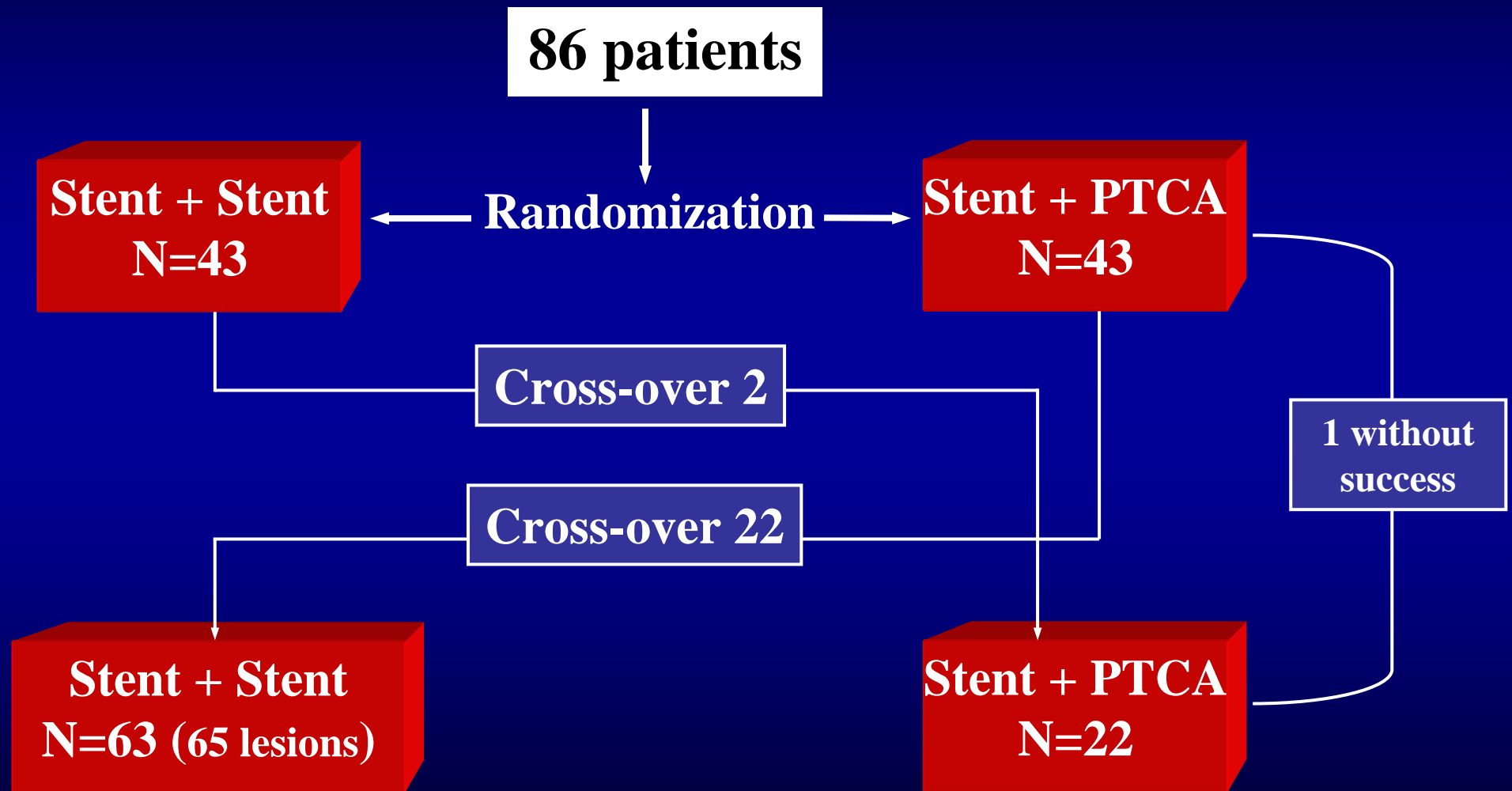
Stent+stent ("Culotte")



Stent+stent ("Y" or "V")



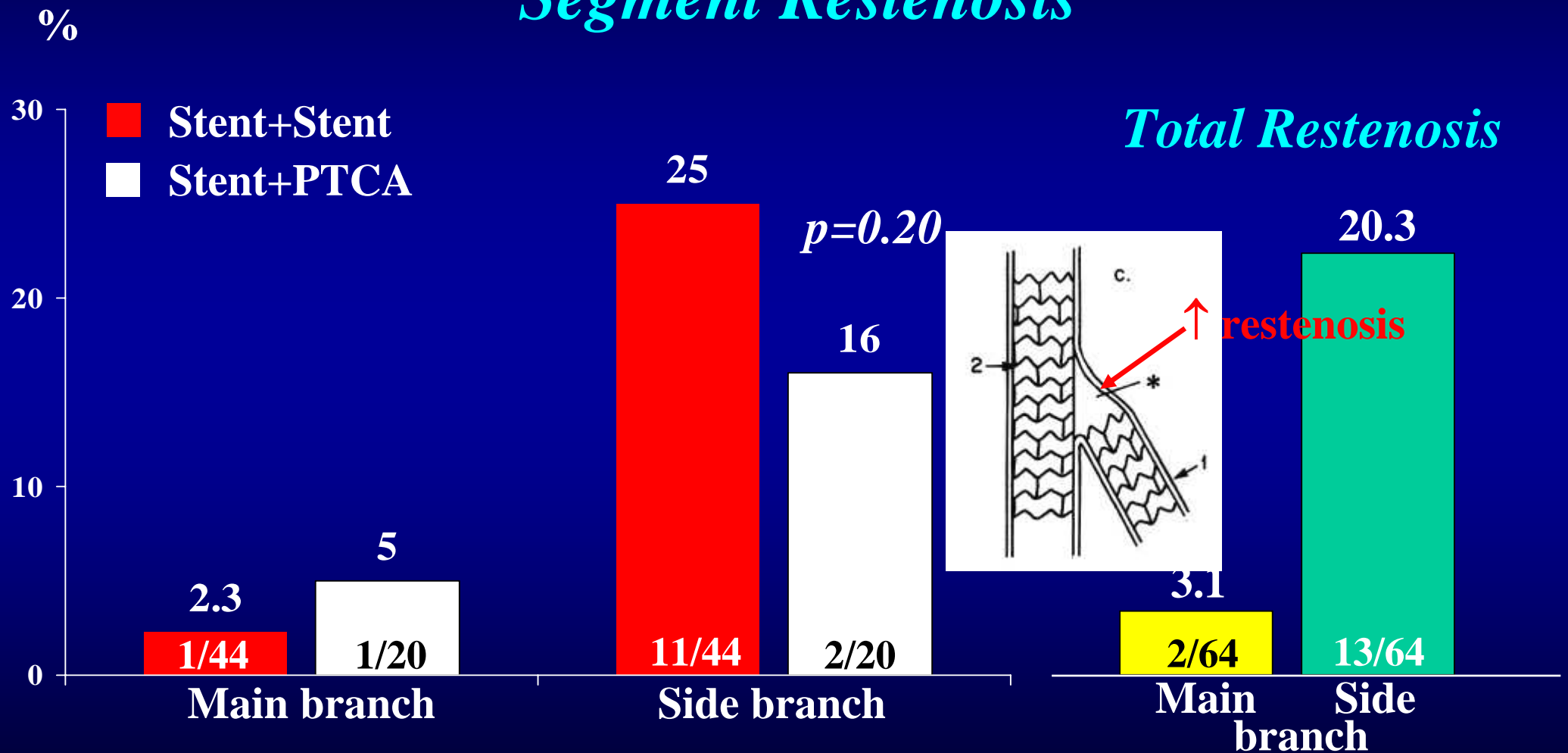
The Bifurcation Study With Cypher Sirolimus-Eluting Stent



Colombo et al. Circulation 2004;109:1244.

The Bifurcation Study With Cypher Sirolimus-Eluting Stent

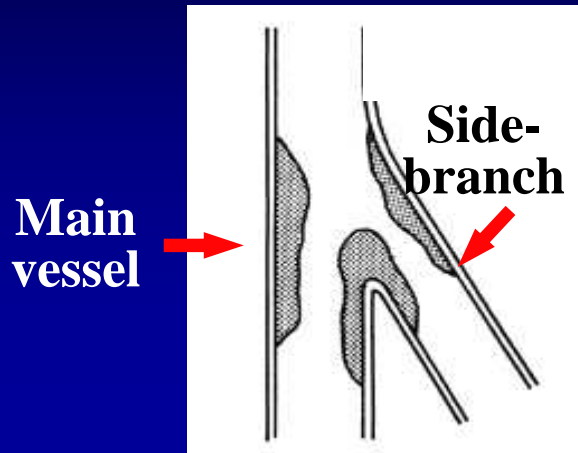
Segment Restenosis



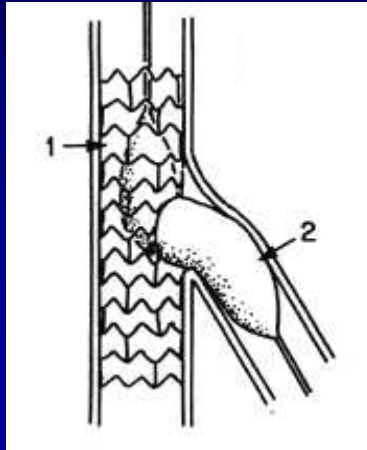
Colombo et al. Circulation 2004;109:1244.

Various Techniques for Stenting Bifurcation Lesions

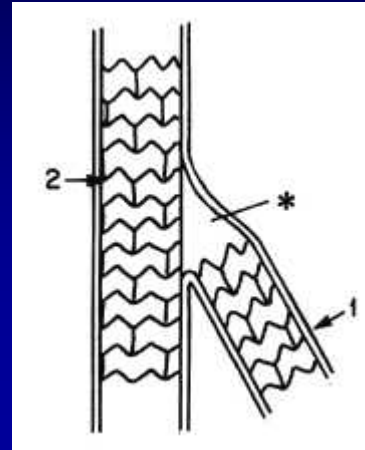
Bifurcation Lesion



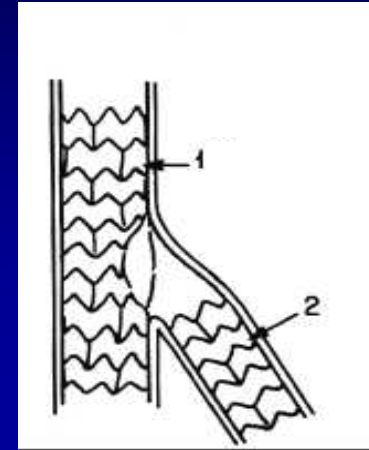
Stent+PTCA



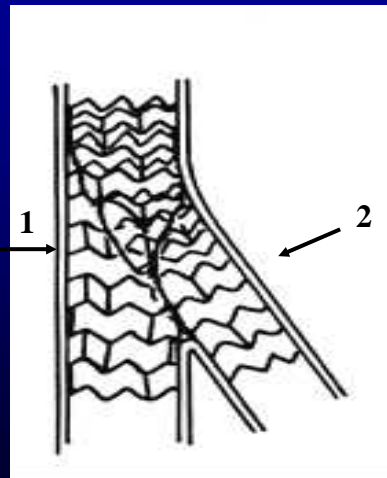
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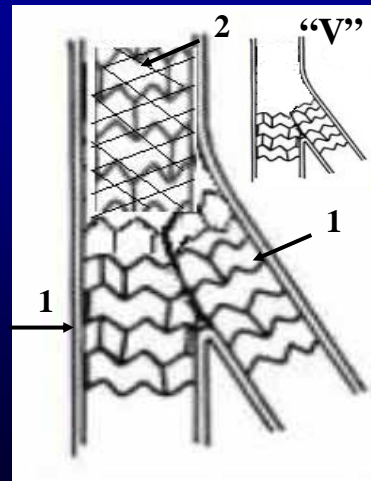
Stent+stent ("reverse-T")



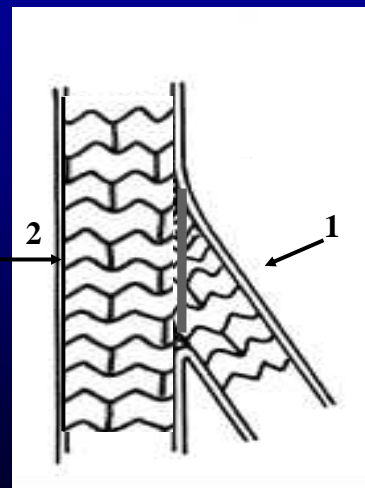
Stent+stent ("Culotte")



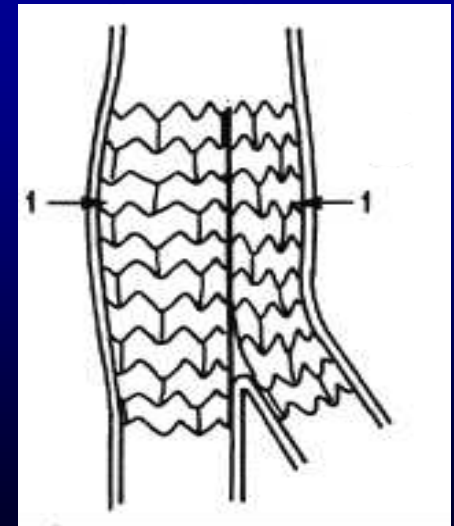
Stent+stent ("Y" or "V")



Stent+stent ("Crush")

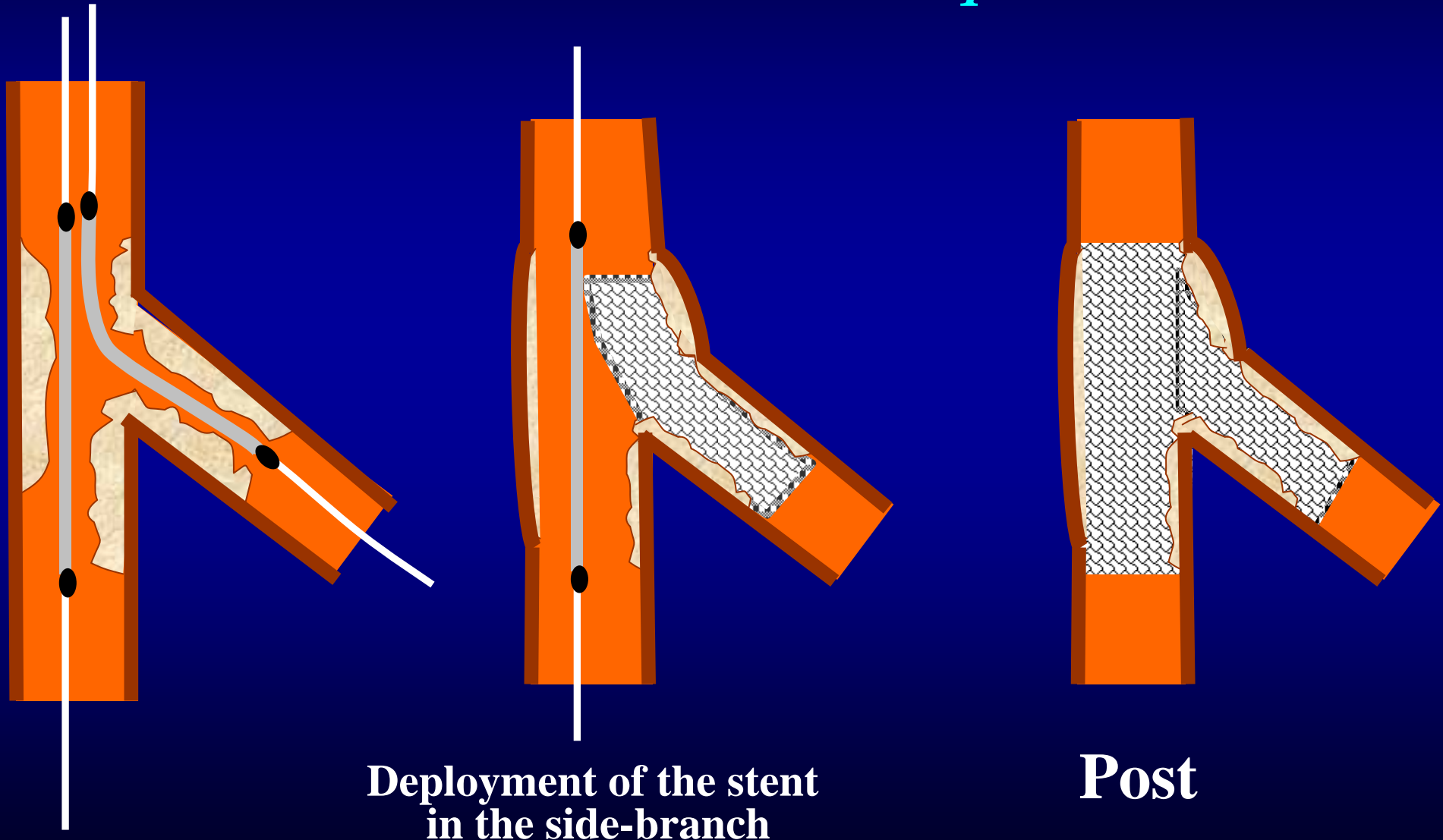


Stent+stent ("Kissing")



Bifurcation Lesion Intervention Using DES

“Stent Crush” Technique



Long-Term Outcome of “Crush” Stenting Technique

Clinical Outcomes

	Entire Cohort (n = 181 pts)	FKB Group (n = 116 pts)	Non-FKB Group (n = 65 pts)	P Value
9-months MACE (%)	26.5	19.8	38.5	0.008
Cardiac death	1.1	1.7	0	0.54
Q-wave MI	3.3	1.7	6.2	0.28
Non Q-wave MI	8.3	8.6	7.7	0.95
TLR	14.9	9.5	24.6	0.008
TVR	17.1	10.3	29.2	0.002
Stent thrombosis	2.8	2.6	3.1	0.78
Subacute	0.6	0	1.5	0.77
Late	2.2	2.6	1.5	0.95

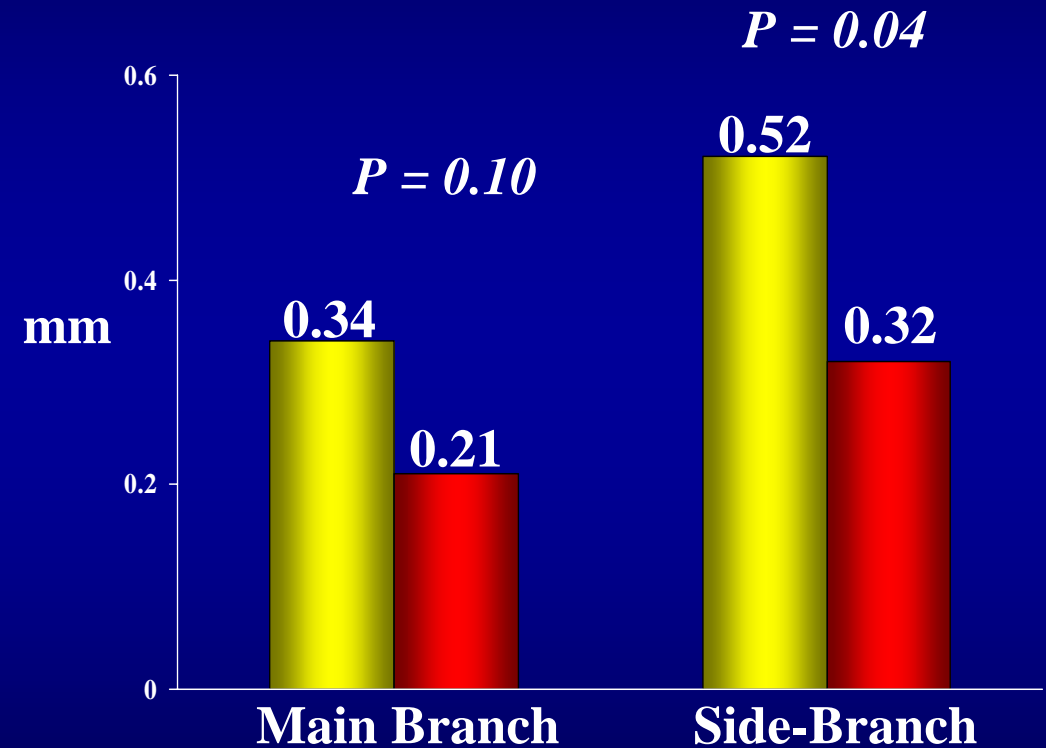
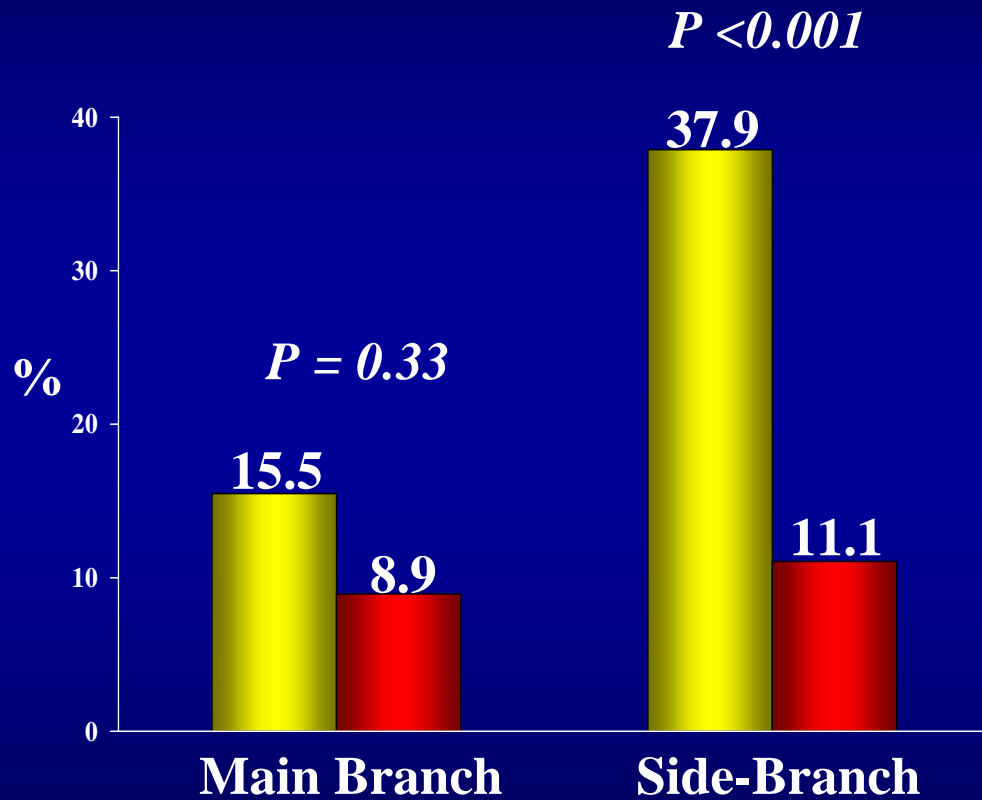
FKB = final kissing balloon after dilation



Ge et al, J Am Coll Cardiol 2005;46:613

Long-Term Outcome of “Crush” Stenting Technique

Restenosis Rate

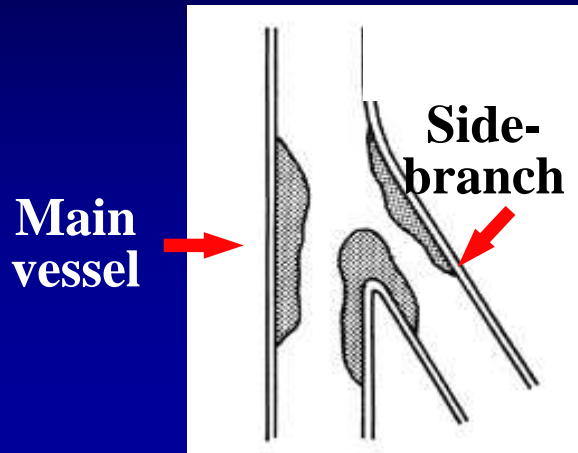
Late Lumen Loss



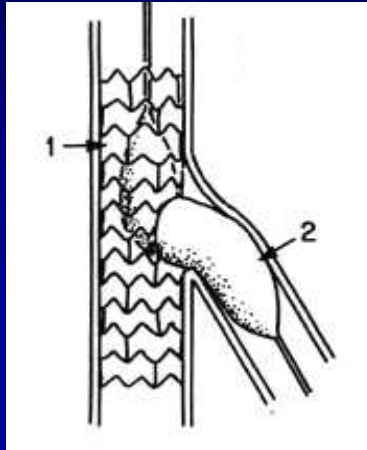
-  Without Kissing Balloon after dilatation (n = 67)
-  Kissing Balloon after dilatation (n = 118)

Various Techniques for Stenting Bifurcation Lesions

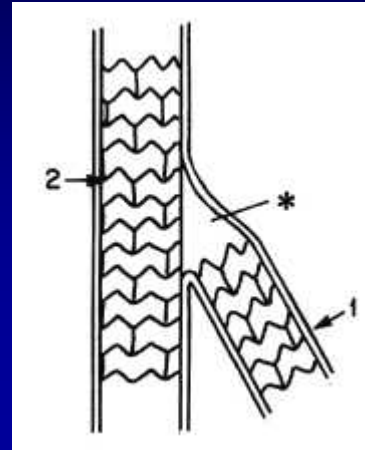
Bifurcation Lesion



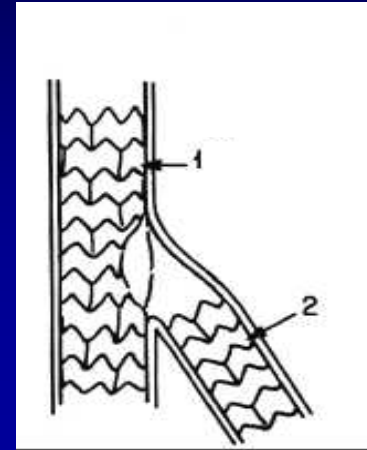
Stent+PTCA



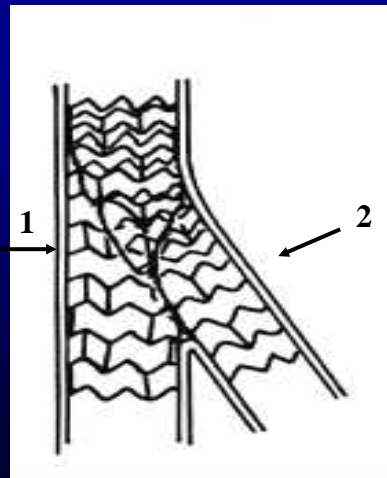
Stent+stent ("T stenting")



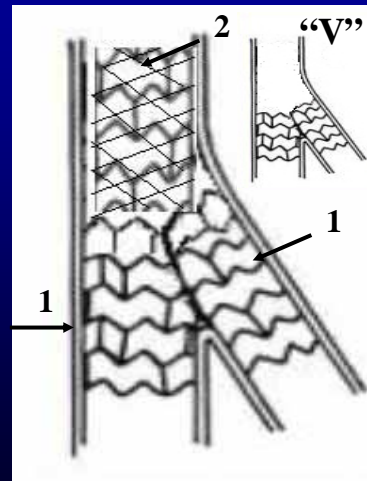
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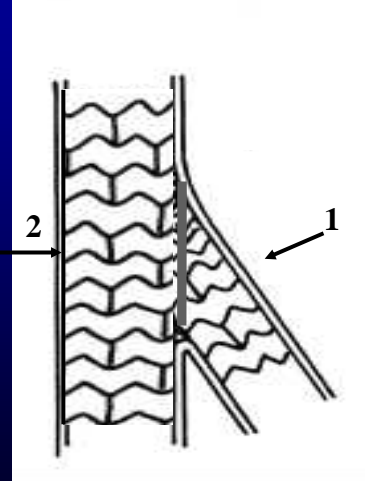
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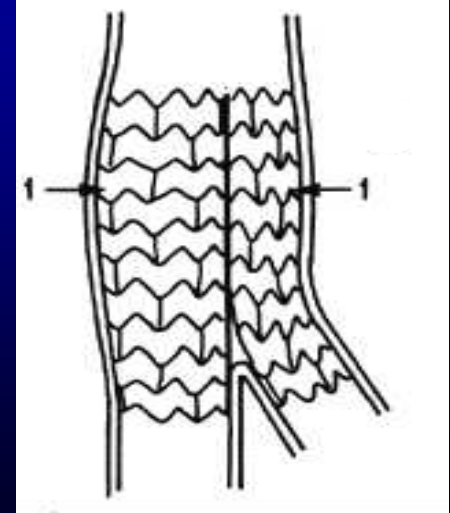
Stent+stent ("Y" or "V")



Stent+stent ("Crush")

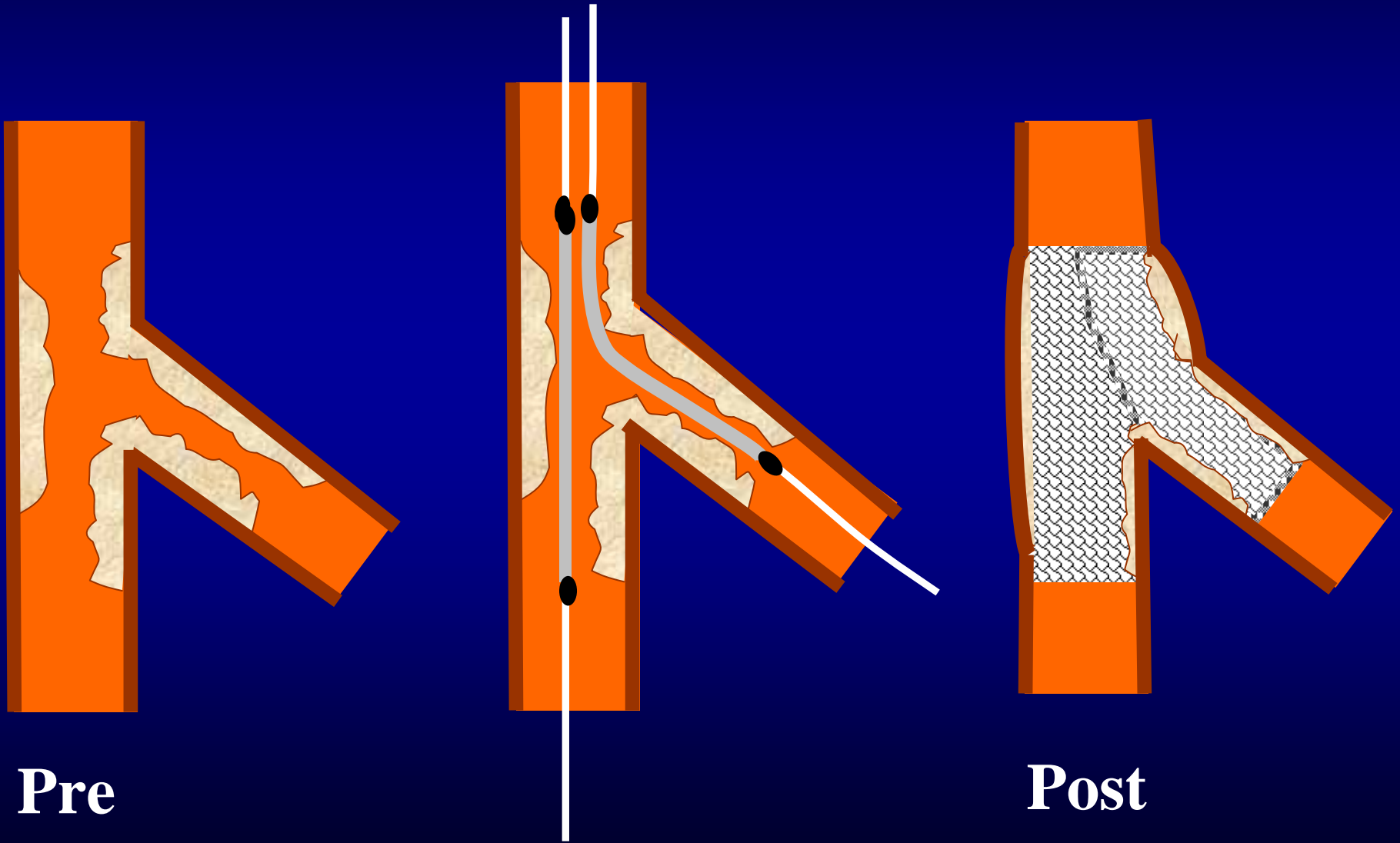


Stent+stent ("Kissing")



Bifurcation Lesion Intervention Using DES

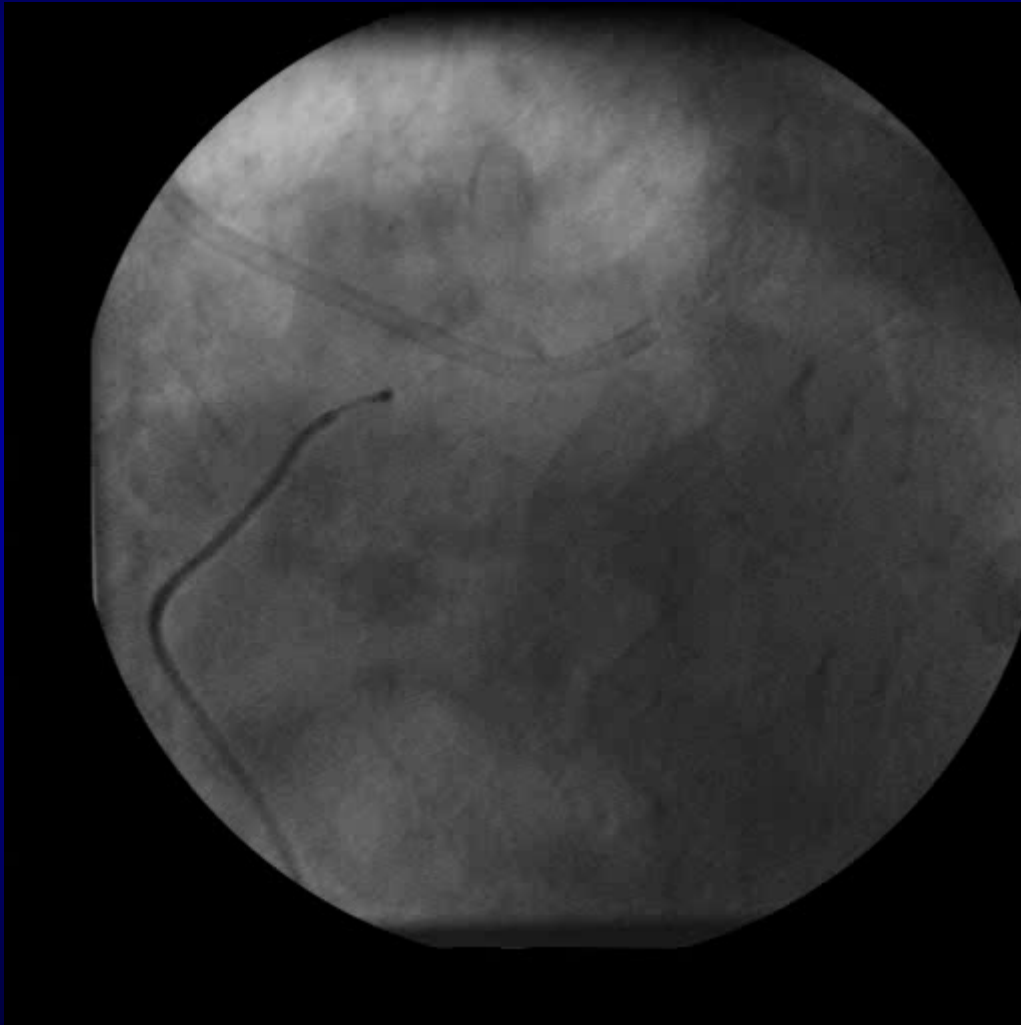
“Simultaneous Kissing Stent” (SKS) Technique



Pre

Post

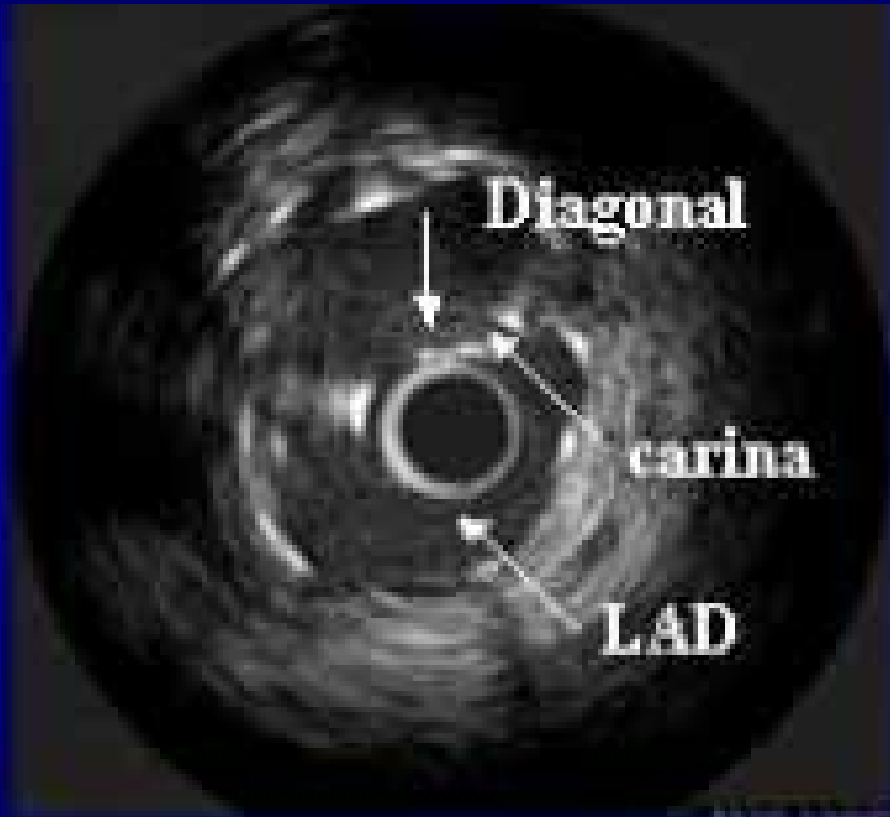
“Simultaneous Kissing Stent” Technique of Complex Unprotected LMCA / LAD & LCX Lesion



- 74-yr old woman presenting with non-Q wave MI, CHF, chronic type A dissection
- Risk factors: HTN, hyperlipidemia
CRF on dialysis, smoker
- ECG: LBBB
- Med: ASA, atorvastatin, β -blocker, captopril, amlodipine, clonidine
- Pre: - 70-80% LMCA
- 90% prox LAD
- 60-70% prox LCX
- PCI: “kissing” stent technique
- 3.5/18 mm Cypher in LMCA/LAD
& 3.5/13 mm Cypher in LMCA / LCX
- Post: -10% LMCA, LAD, LCX

SKS Technique

Bifurcation lesion involving LAD and Diagonal



LAD

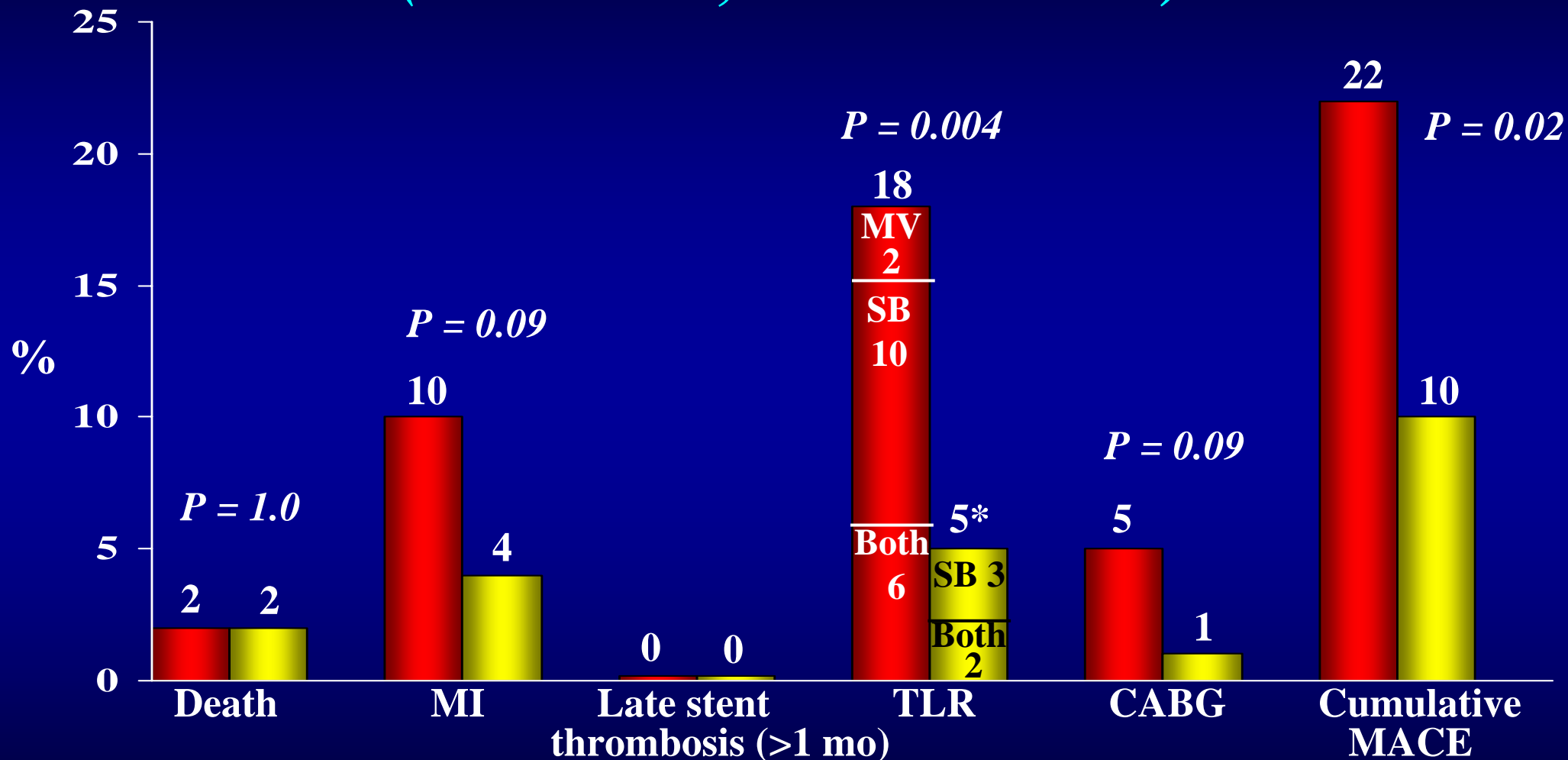


Diagonal

IVUS images revealing double lumen and carina

SKS Technique

Mid-Term (Min >6 mo; Mean 8 ± 4 mo) FU Results



■ CSS technique (n = 100; 100 lesions)
 ■ SKS technique (n = 100; 101 lesions)

*One restenosis in DES

Sharma et al. Am J Cardiol;94:913, 2004

Simultaneous kissing drug-eluting stent (SKS) technique for bifurcation lesions in large-size vessels

Baseline Clinical and Angiographic Characteristics (May 03 - June 04)

	SKS technique (n=200;202 lesions)
Age (yrs)	68 ± 8
Male (%)	67
Clinical syndrome: Stable/Unstable/MI (%)	55/42/3
Diabetes mellitus (%)	35
LVEF (%)	48 ± 5
GP IIb/IIIa Inhibitor use (%)	84
Clopidogrel preloading (%)	24
Multivessel disease (%)	42
Lesion location: LAD/LCx/RCA/LMCA (%)	52/15/26/7
Additional lesion PCI (%)	8

Simultaneous kissing drug-eluting stent (SKS) technique for bifurcation lesions in large-size vessels

Procedural and Angiographic Characteristics

SKS technique (n=200;202 lesions)

	MAIN VESSEL	SIDE-BRANCH
Reference vessel size (mm)	3.46 ± 0.61	2.58 ± 0.44
Minimum luminal diam (mm)	0.81 ± 0.42	0.71 ± 0.34
Lesion length (mm)	19.4 ± 4.2	12.2 ± 3.2
Debulking (%)	24	66
Rotablator	21	4
Cutting balloon	3	62
Direct stenting (%)	32	12
Maximal inflation press (atm)	18 ± 3	15 ± 2
Average length of carina (mm)	8 ± 5	
Total stent length (mm)	42 ± 8	
Total procedure time (minutes)	36 ± 14	

Sharma SK, Catheter Cardiovasc Interv 2005;65:10

Simultaneous kissing drug-eluting stent (SKS) technique for bifurcation lesions in large-size vessels

Procedural Results

SKS technique
(n=200;202 lesions)

Angiographic success (%)

Main vessel 100

Side-branch 99

Dissections requiring PTCA only (%) 6

Dissections requiring stent (%) 0

Coronary perforation (%) 1*

Post-procedural residual stenosis (%)

Main vessel – proximal 0 ± 5

Main vessel – distal 10 ± 8

Side-branch 12 ± 8

**Both type II perforations and sealed by prolonged balloon dilatation*

Sharma SK, Catheter Cardiovasc Interv 2005;65:10

Simultaneous kissing drug-eluting stent (SKS) technique for bifurcation lesions in large-size vessels

Procedural, In-hospital and 30-day Results

	SKS technique (n=200;202 lesions)
Peri-procedure MI (%)	3
Q-wave MI	0
Non Q-wave MI	3
Clinical success (%)	97
In-hospital MACE (%)	3
30-day MACE (%)	5
Stent thrombosis at 30-day (%)	1*
Hospital stay (days)	1.8 ± 0.4

**Both proximal to the overlapping stents*

Sharma SK, Catheter Cardiovasc Interv 2005;65:10

Simultaneous kissing drug-eluting stent (SKS) technique for bifurcation lesions in large-size vessels

Follow-Up Results (minimum >6 months post-PCI)

SKS technique (n=200;202 lesions)

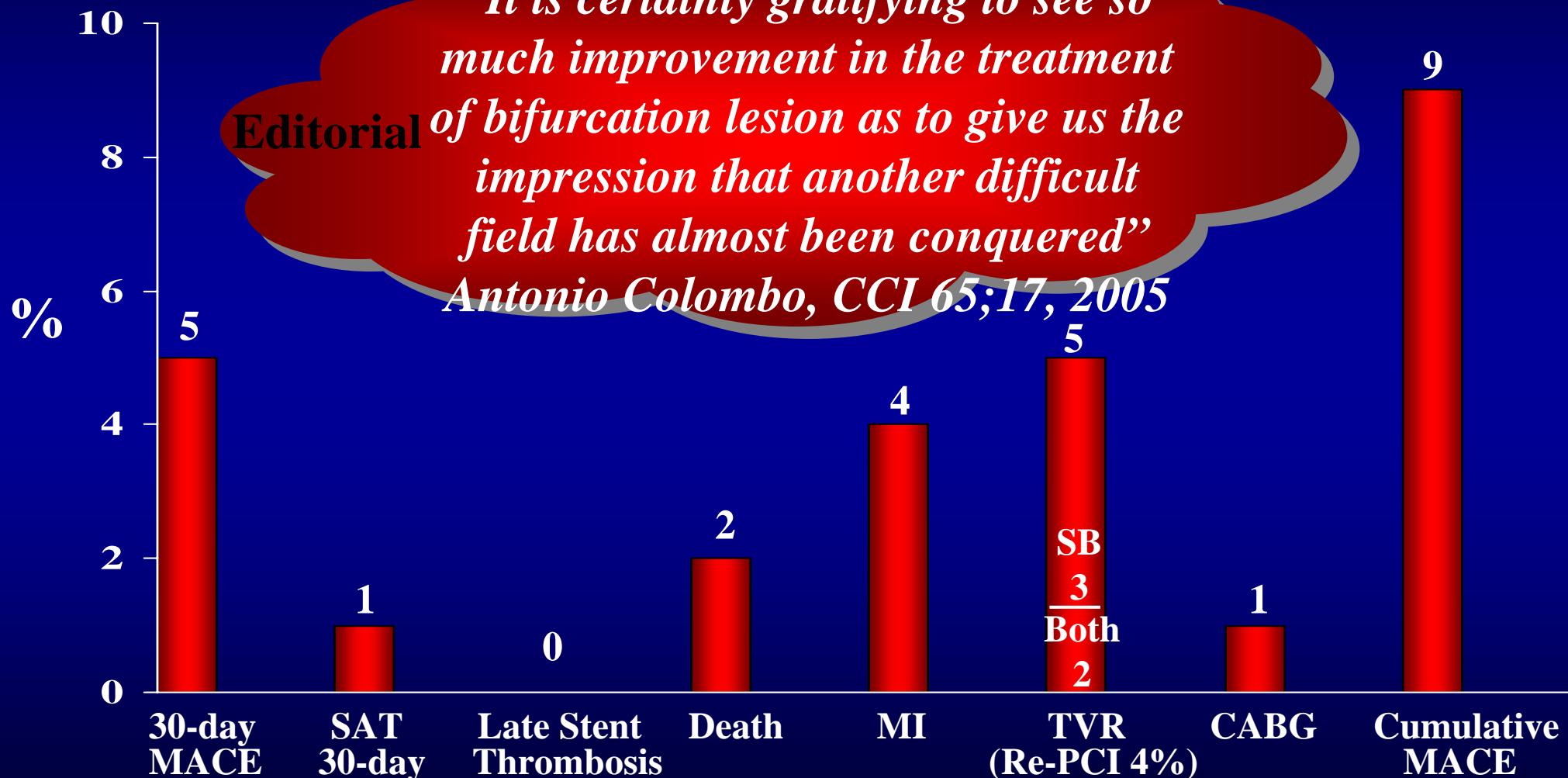
Average follow-up duration (months)	9 ± 2
Death (%)	2
Myocardial infarction (%)	4
Q-wave/Non Q-wave	1/3
Late stent thrombosis >1 month (%)	0
On dual antiplatelet therapy (%)	92
Clinical restenosis (%)	5
Main vessel only	0
Side branch only	3
Both	2
Target lesion revascularization (%)	5
CABG (%)	1
Freedom from MACE (%)	91

Sharma SK, Catheter Cardiovasc Interv 2005;65:10

SKS-DES Technique for Bifurcation Lesion

Mid-Term (9 ± 4 mo) F/U Results in 200 pts (202 lesions)

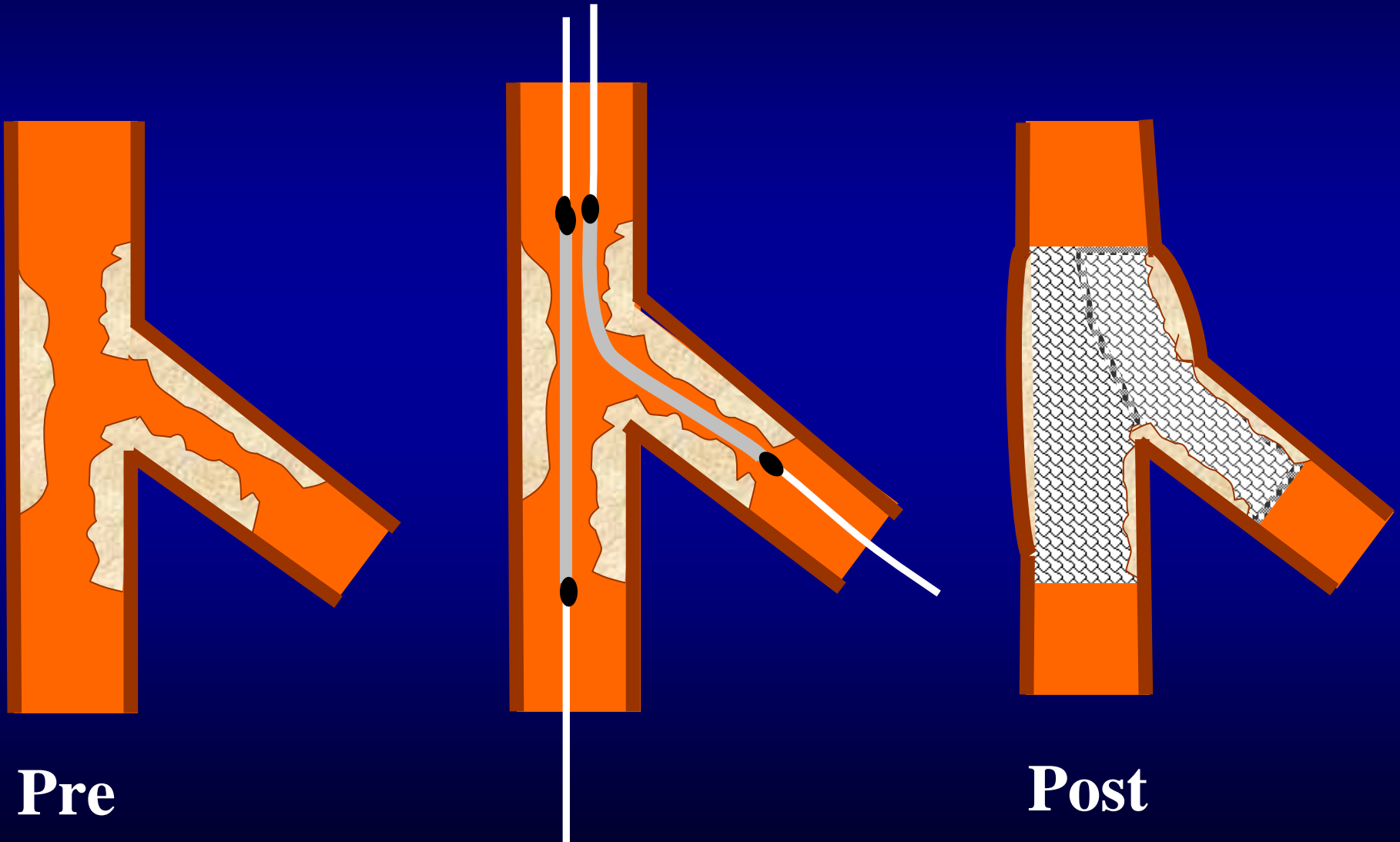
Editorial *“It is certainly gratifying to see so much improvement in the treatment of bifurcation lesion as to give us the impression that another difficult field has almost been conquered”*
Antonio Colombo, CCI 65;17, 2005



Sharma S. CCI;65:10, 2005

Bifurcation Lesion Intervention

“Simultaneous Kissing Stent” (SKS) Technique



PRECISE-SKS Pilot Study

Duke's Type D Bifurcation Lesion

Conventional Technique (n=50):
One stent in the main vessel
& provisional stent in the side-branch

SKS Technique (n=50):
Simultaneous kissing stent deployment
in the main vessel & side-branch

Primary endpoint: angiographic restenosis at 8-9 months

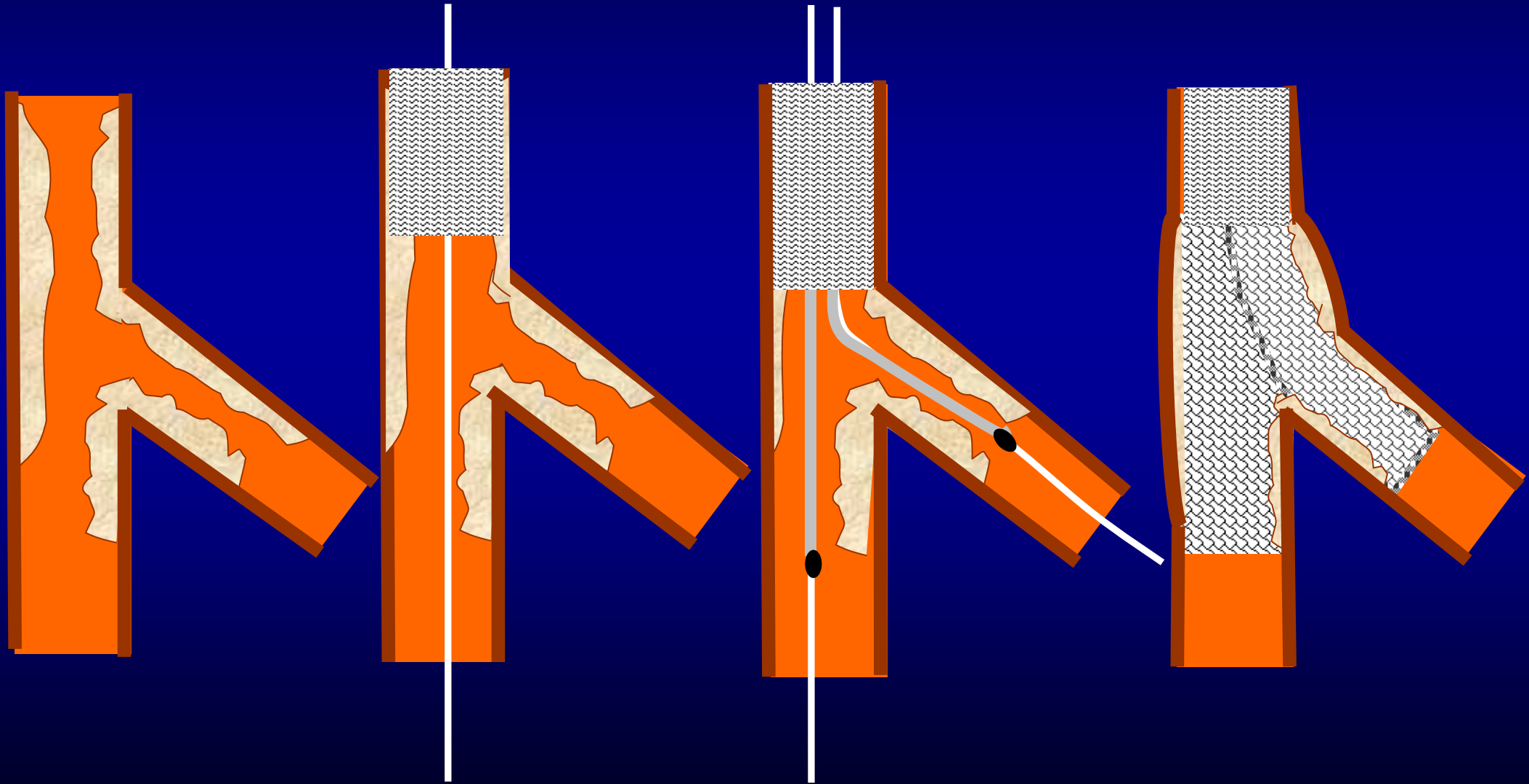
Secondary endpoints: 30-day clinical MACE
9-month TLR
1-year freedom from MACE
IVUS sub study of 20 pts in each arm

1-year clinical follow-up: death, TVR, MI

Sponsored by Cordis/JnJ

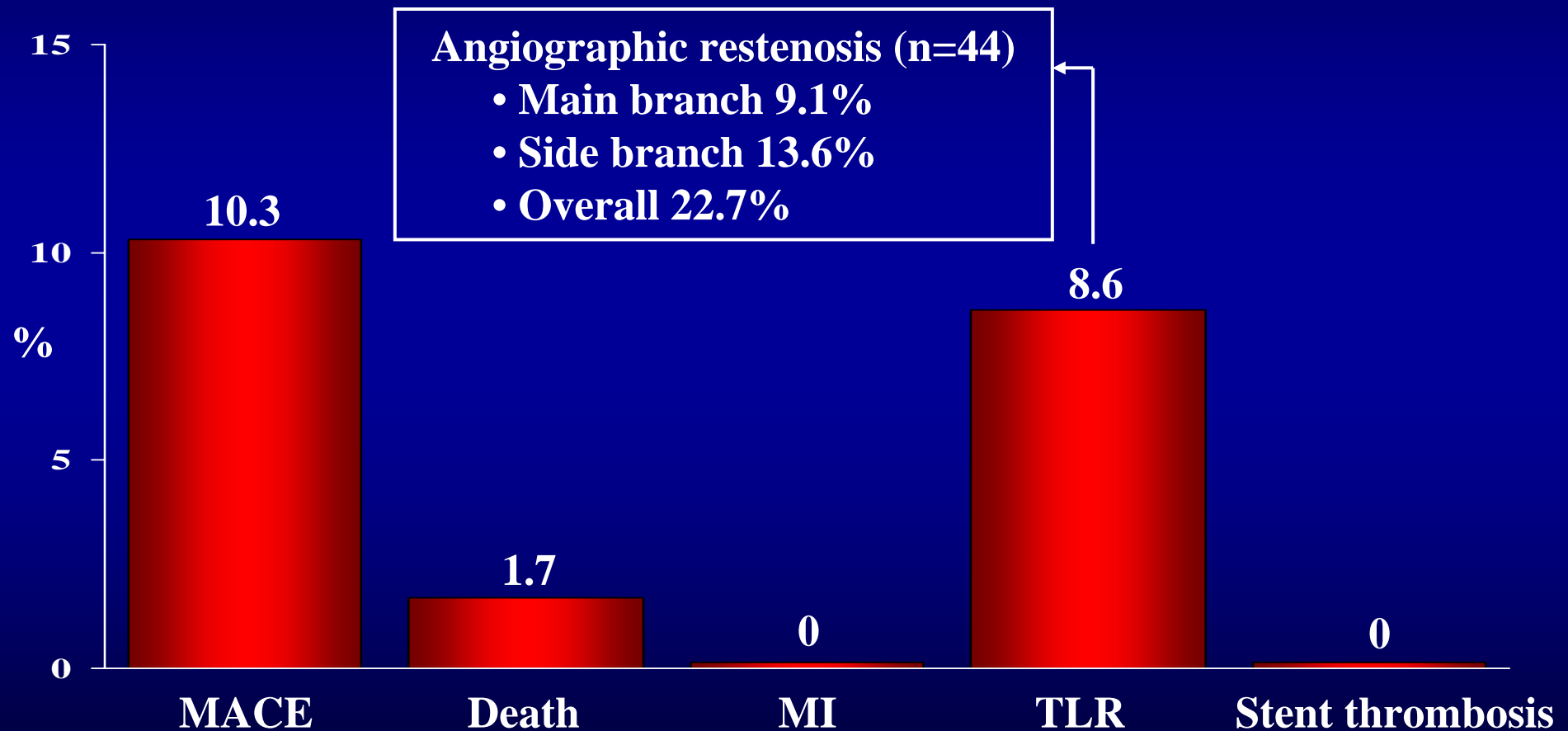
Bifurcation Lesion Intervention

*Modified SKS Technique for
Long Lesion Proximally to avoid New Long Carina*



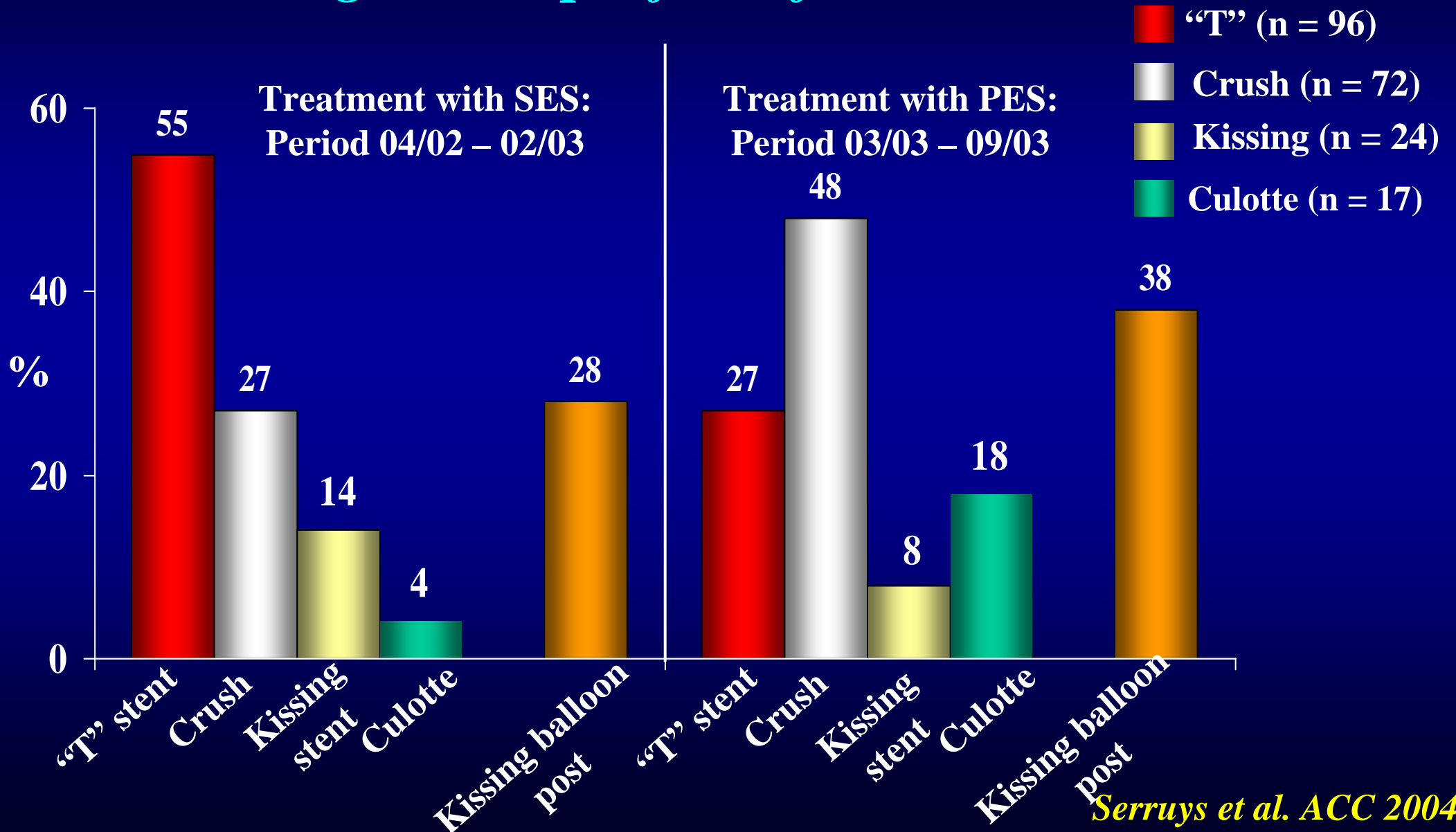
Restenosis following Bifurcation Sirolimus-Eluting Stents for De Novo Narrowings

6-Months Follow-Up (N = 58; 65 Lesions)



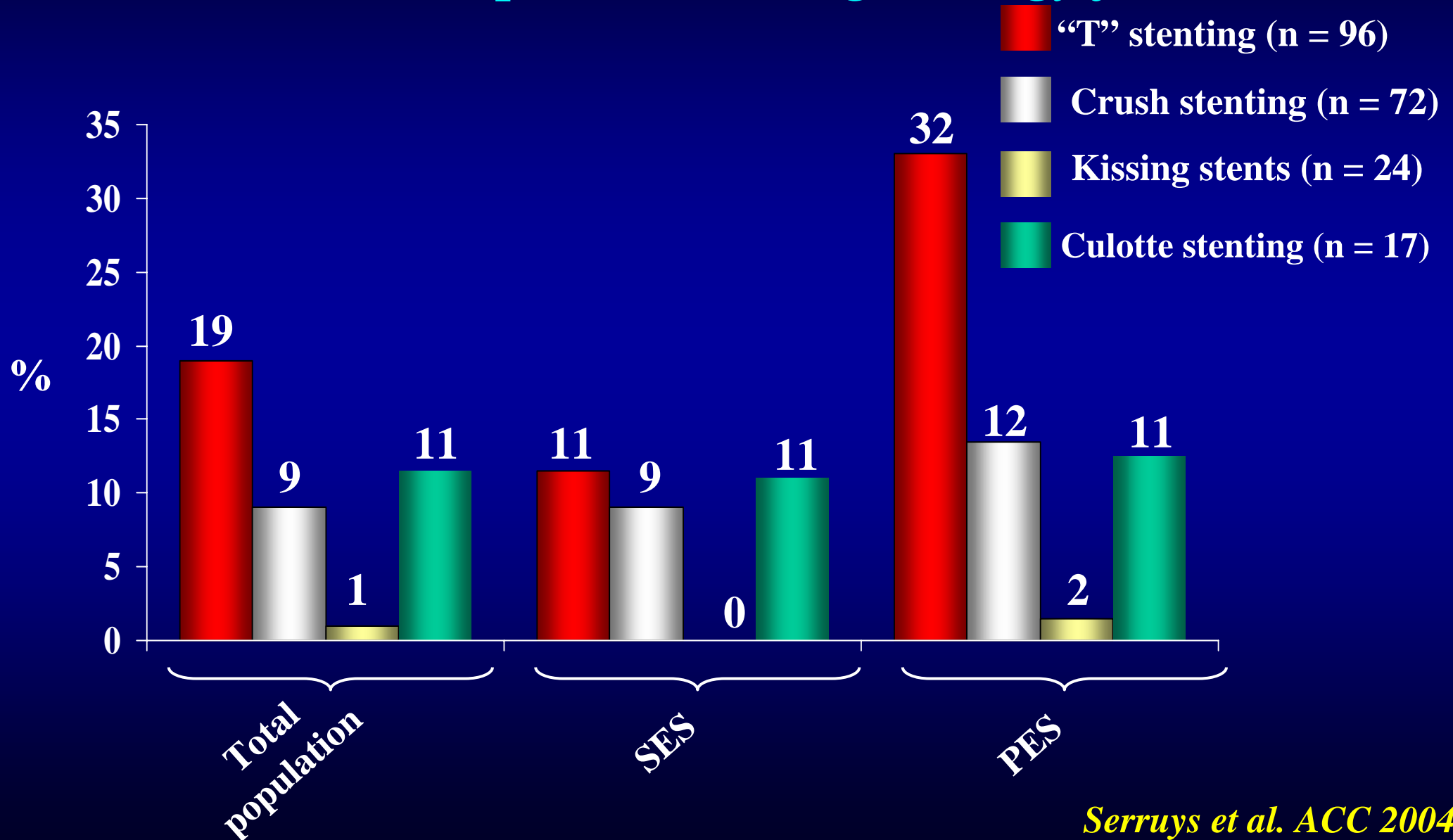
CYPHER 'Research' vs. TAXUS 'T-Search'

Stenting Technique for Bifurcation Lesions



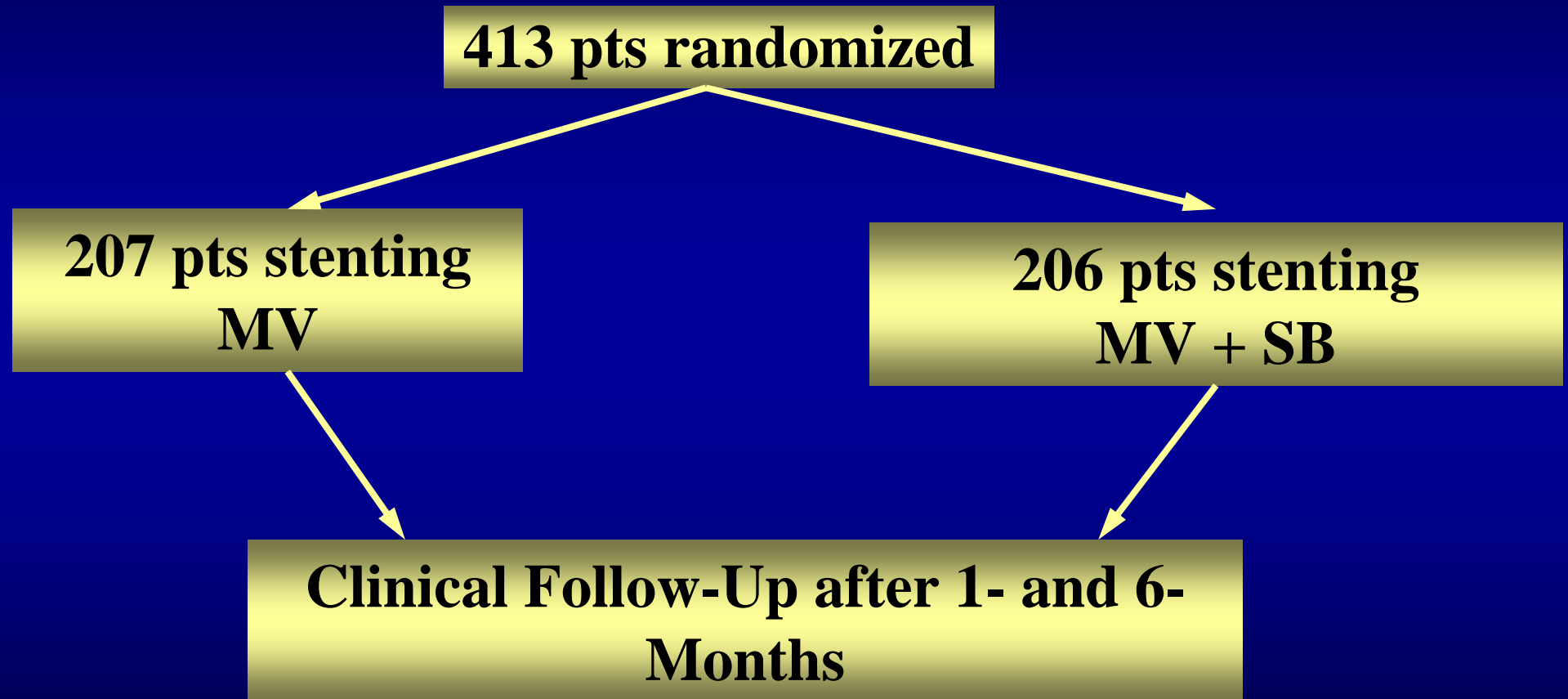
CYPHER 'Research' vs. TAXUS 'T-Search'

TVR with respect to stenting strategy for BL



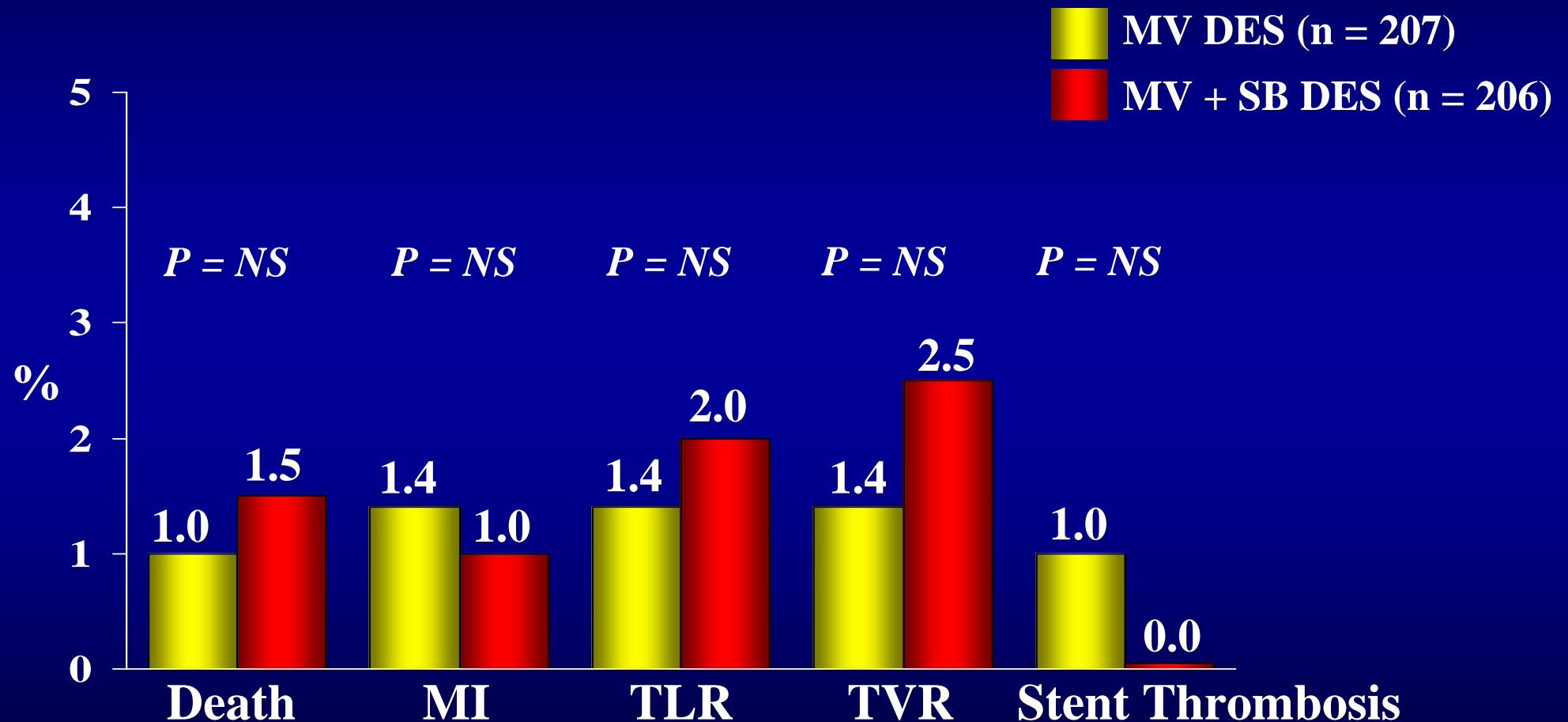
NORDIC DES Bifurcation Study

Study Design



NORDIC DES Bifurcation Study

6-Months Follow-Up



NORDIC DES Bifurcation Study

Procedural Data

	MV DES (n = 207)	MV + SB DES (n = 206)	<i>P value</i>
Procedure time (min)	59 ± 30	74 ± 30	<0.001
Fluoro time (min)	15 ± 9	21 ± 10	<0.001
Contrast (ml)	233 ± 93	283 ± 117	<0.001
CK-MB ↑ >3x (%)	8	18	0.011
SB stented (%)	4.3	95.1	<0.001

Bifurcated Stents

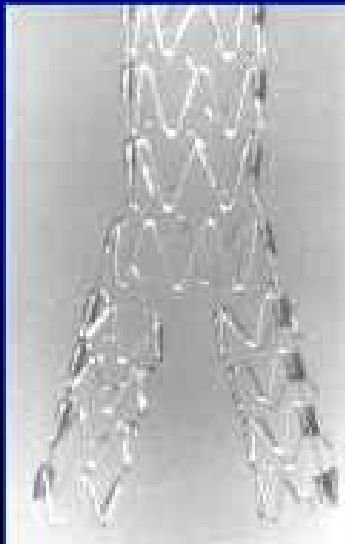
ACS stent



AVE stent



Bard stent



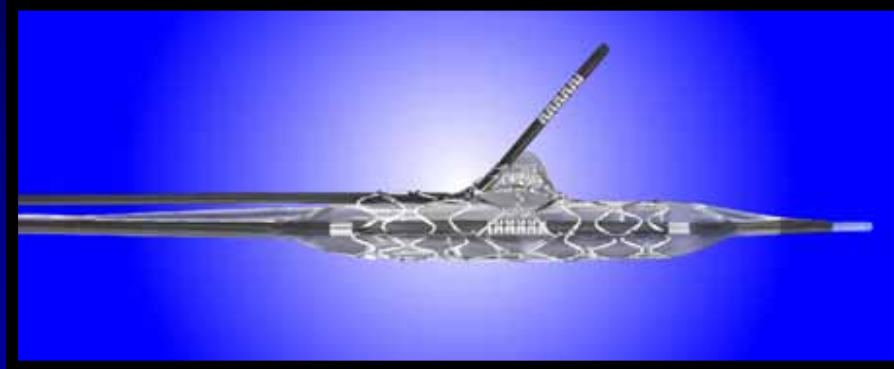
Cordis stent



Side-branch Access Stents

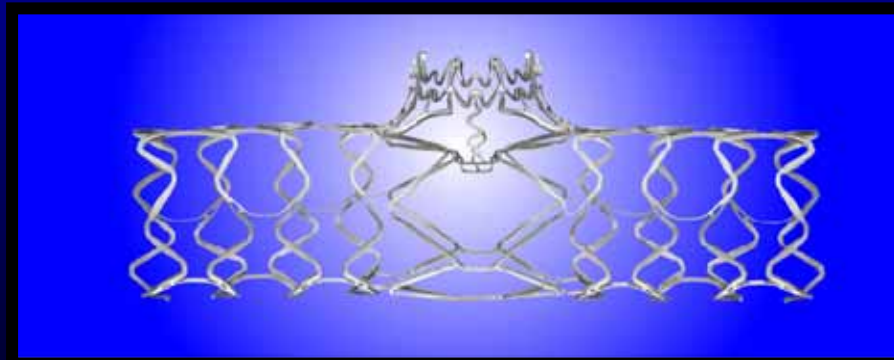
- NIRSide stent
- Jo stent
- ACS Access stent
- AST-SLK view stent

Paclitaxel Dedicated Bifurcation Stent System (AST Petal™)*



Advantages

- *Special stent feature to cover ostium/proximal portion of side-branch (~ 2 mm)*
- *Reduces/eliminates gap*
- *Reduces frequency of 2nd stent*
- *Placing 2nd stent after provisional T stenting is intuitive*



*Under development. Not currently available in the US.

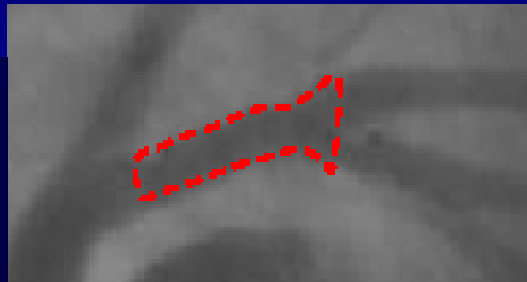
A Dedicated Bifurcation DES (DEVAX)

Flared Distal-End Stent Design
Self Expanding Nitinol Material

8, 10, or 12 mm
flare diameter

4.8F Rx Delivery System

Biolimus A9
antiproliferative
strut coating

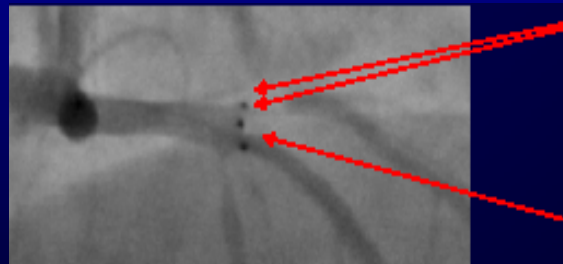


The flared shape of the **AXXESS PLUS** stent matches the flared geometry of a bifurcation.

The **AXXESS PLUS** stent can expand into both the MB and SB providing complete vessel coverage at the level of the carina.

2 distal stent markers in D1

1 distal stent marker in LAD



Interventional Algorithm for Bifurcation Lesions

DES for Bifurcation lesion

Side-branch size

>2.75 mm

2.25 – 2.75 mm

<2.25 mm

Lesion preparation: Rota, CB

Bifurcation stenting

- “SKS” technique
- “T” stent technique
- “Cullote” technique
- “Crush T” technique

Plaque modification of the side-branch

- Atherotomy, Rota



Leave the wire in the SBr



Stent only the main vessel

For side-branch...

Save the 2nd stent for restenosis

Call 1-800-FLOWERS