Approach to Bifurcation PCI:
A Step By Step Refresher

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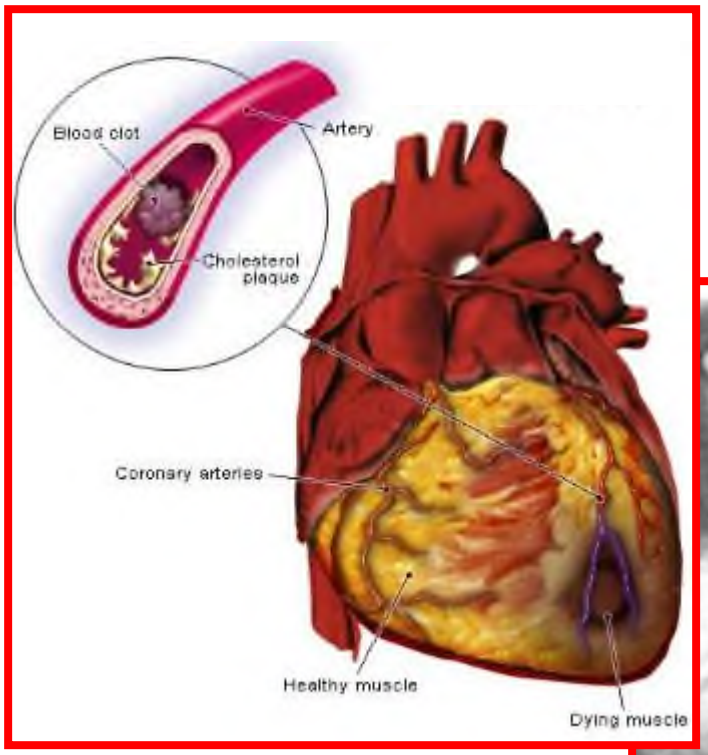
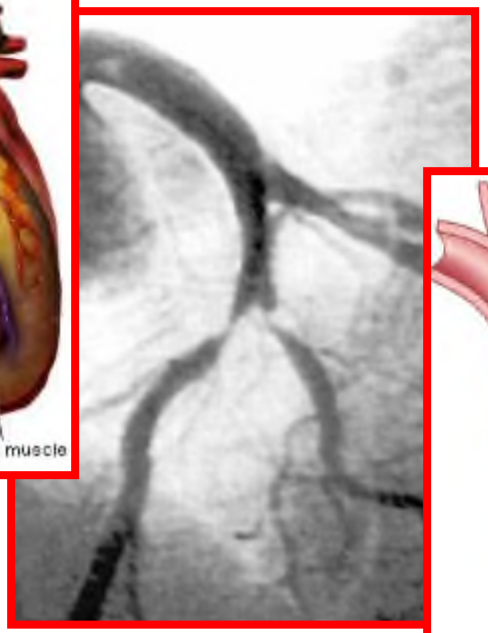
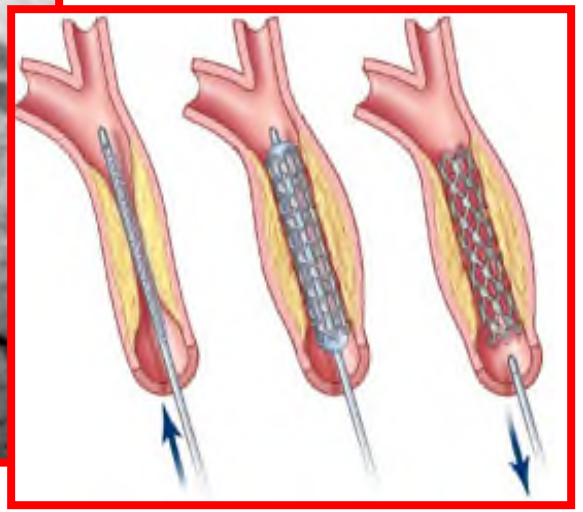


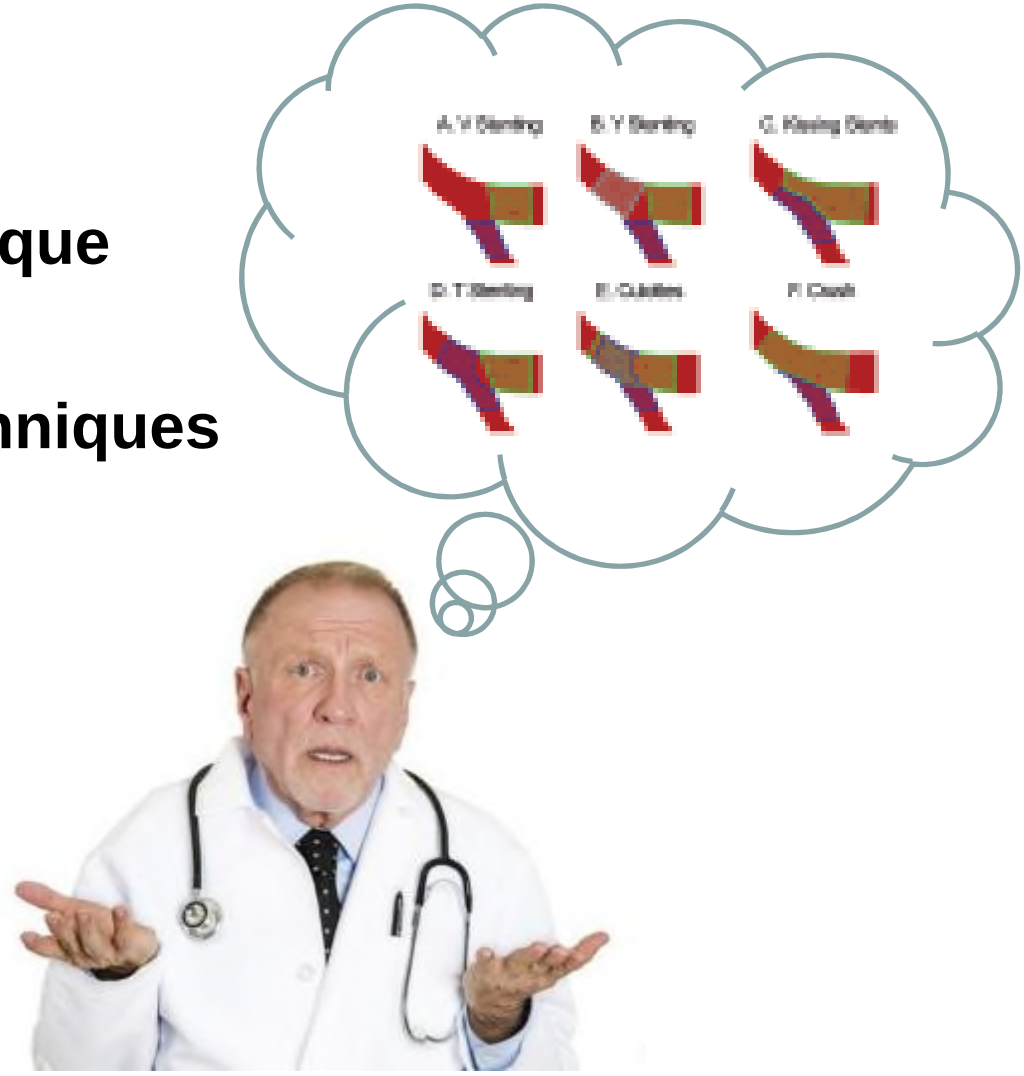




PCI Bifurcation Techniques:

How to Decide?

- **Provisional Stent Technique**
- **Crush Techniques**
- **Simultaneous Stent Techniques**
- **T Stent Techniques**
- **Culotte Technique**



RULE OF THUMB:
If the ostium is ½ the size (or smaller) than the proximal vessel, then it is involved

STEP 2:
What are the vessel sizes?

- **Provisional Stent Technique**
- **Crush Techniques**
- **Simultaneous Stent Techniques**
- **T Stent Techniques**
- **Culotte Technique**

Requires a large enough proximal vessel (2/3 of the sum of the 2 branch stent diameters)

Requires similar sized vessels

NOTE:
Any vessel less and 2mm should be ignored for purposes of PCI planning

STEP 3:
Is There a Specific Need for a Particular Technique?

- **Provisional Stent Technique** → Side branch ostium is not significantly diseased
- **Crush Techniques** → Side branch ostium is severely diseased and you are concerned it will close
- **Simultaneous Stent Techniques** → Need to minimize ischemic time (ie: LM bifurcation disease in crashing patient)
  - T Stent Techniques
  - Culotte Technique

STEP 4:
What Equipment is Needed?

- **Provisional Stent Technique**
- **Crush Techniques**
- **Simultaneous Stent Techniques**
- **T Stent Techniques**
- **Culotte Technique**

Traditional Crush requires 7Fr or larger guide catheter

"Step Crush" can be performed with a 6Fr guide

Requires minimum of 7Fr guide catheter

STEP 5:
Which Vessels Should I Wire?

So…. Why wire a side branch in the first place?

“To Protect the Side Branch”

But… what does that *really* mean?

If the side branch gets pinched after the main branch is stented, then the side branch wire will need to be removed and the vessel rewired before any PCI can be performed

If the vessel completely occludes, then the wire serves as a marker of where the vessel is so you can rewire it, or the wire can be used to convert to a reverse crush

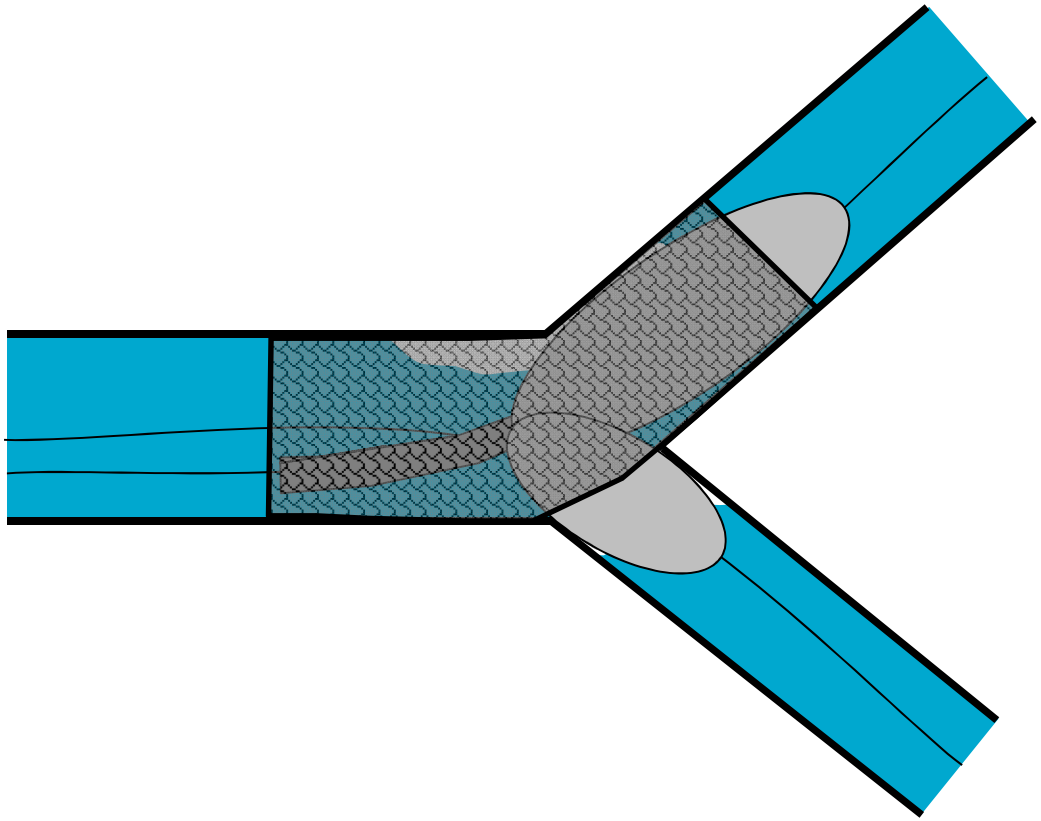
SO… the only reason to really wire a side branch is if you think you are going to completely close it when the main branch is stented

Bifurcation Techniques

- Provisional Stent Technique
- Crush Techniques
- Simultaneous Stent Techniques
- T Stent Techniques
- Culotte Technique

Provisional Stent Technique:

Use when the side branch ostium is not significantly diseased



Wire main vessel

Pre-dilate as needed

Stent main branch

Rewire and balloon side branch if needed

Provisional Stent Technique: Plan B

- **If a second stent is needed after provisional stenting is performed (ie: dissection or compromise of the side branch) the following techniques can be used:**

- **Culotte Technique**
- **Reverse Crush Technique**
- **TAP Technique**

Provisional Stent Technique

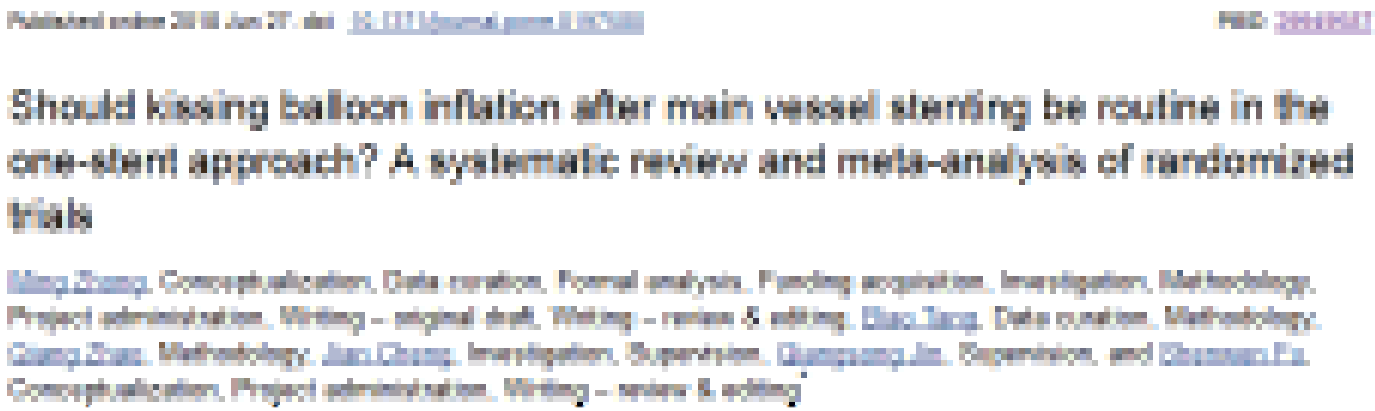
ADVANTAGES:

- **Simple**
- **Less Metal**
- **Potentially easier to treat restenosis**
- **Less thrombosis?**

DISADVANTAGES:

- **Residual stenosis at side branch**
- **If side branch stent needed, it can be more difficult to insert it through first stent**

If I Use a One Stent Strategy and the Side Branch isn't Compromised, Do I Need to do a Final Kissing Inflation?



Should kissing balloon inflation after main vessel stenting be routine in the one-stent approach? A systematic review and meta-analysis of randomized trials

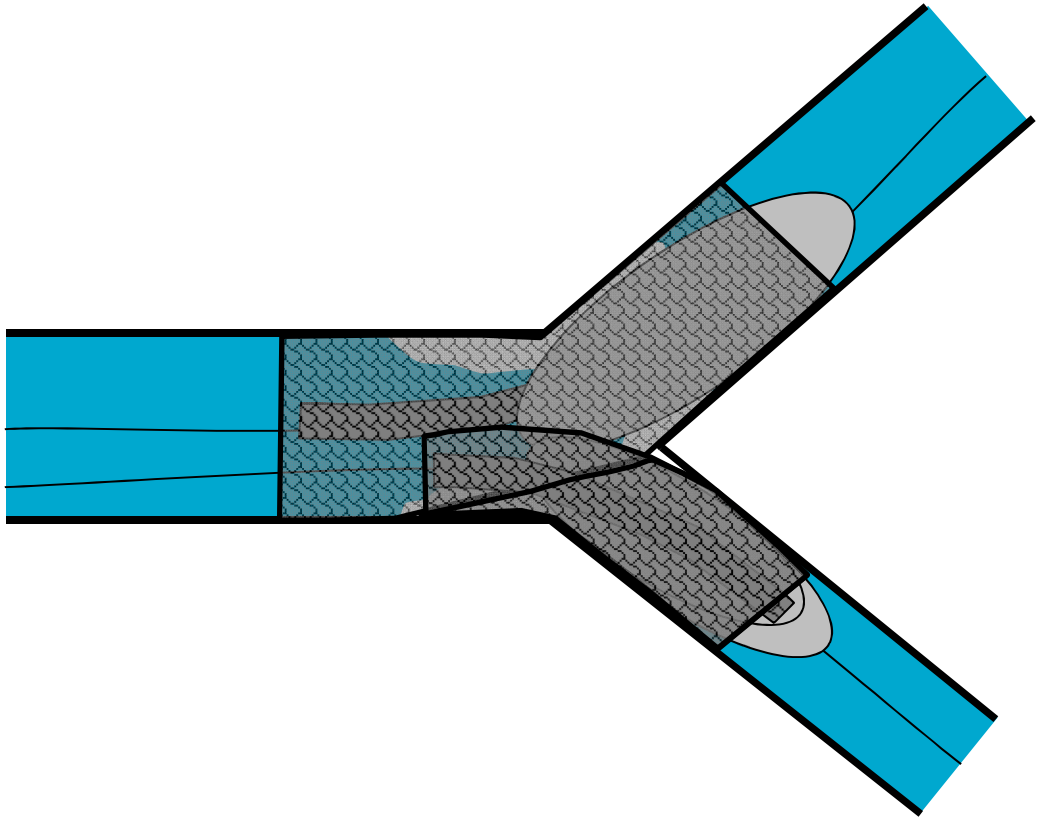
Meta-analysis of all published studies that included kissing balloon inflation vs. no kissing balloon inflation when using a single stent strategy

Kissing balloon inflation was associated with a higher restenosis rate of the main branch and no difference in overall clinical outcome

Commonly Used Bifurcation Techniques

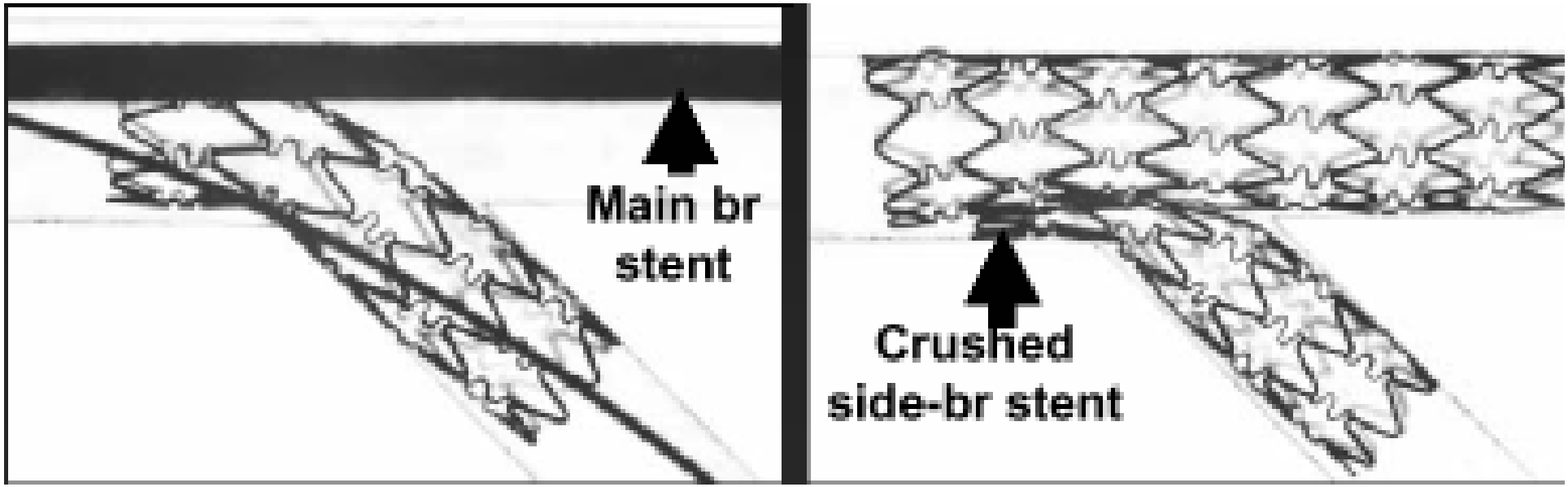
- Provisional Stent Technique
- Crush Techniques
- Simultaneous Stent Techniques
- T Stent Techniques
- Culotte Technique

The Classic Crush Technique

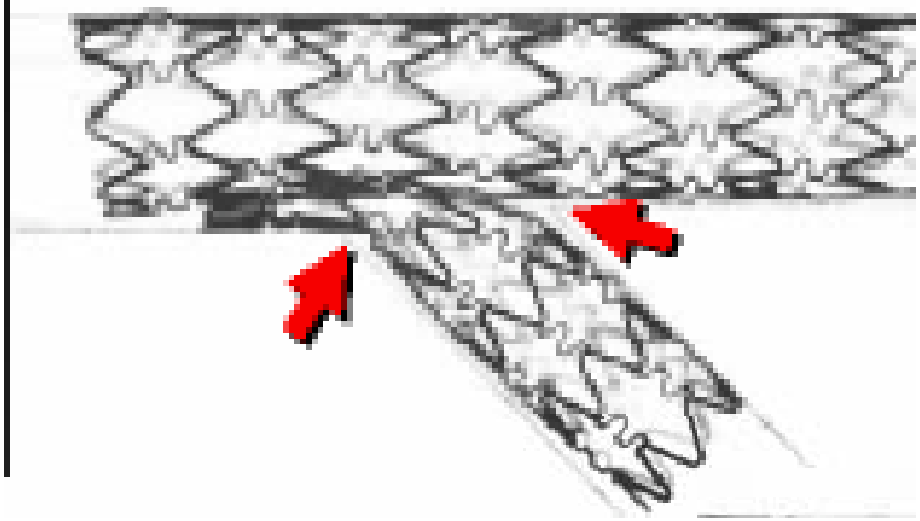


- Wire both vessels
- Pre-dilate as needed
- Position stents
- Deploy side branch stent, remove balloon/wire
- Deploy main branch stent- ‘crushes’ side branch stent
- Rewire side branch and perform kissing balloon inflation

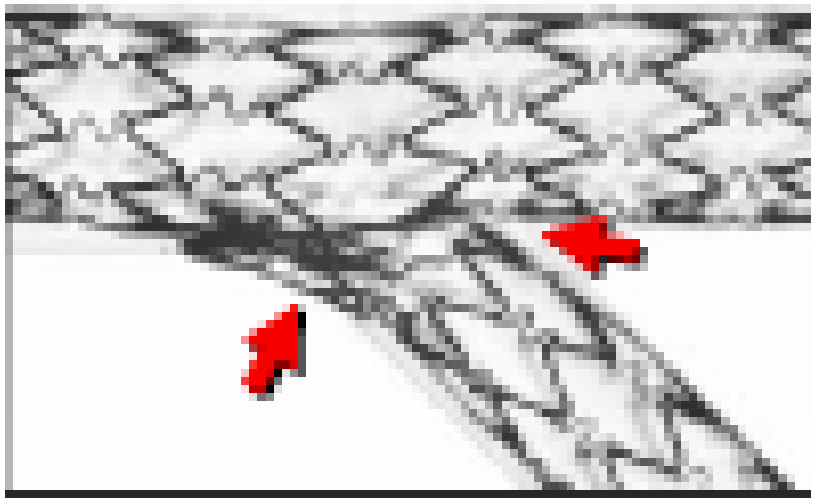
The Crush Technique



The Evolution of the ‘Crush’ Technique:
Post-Crush Kissing Balloon Inflation



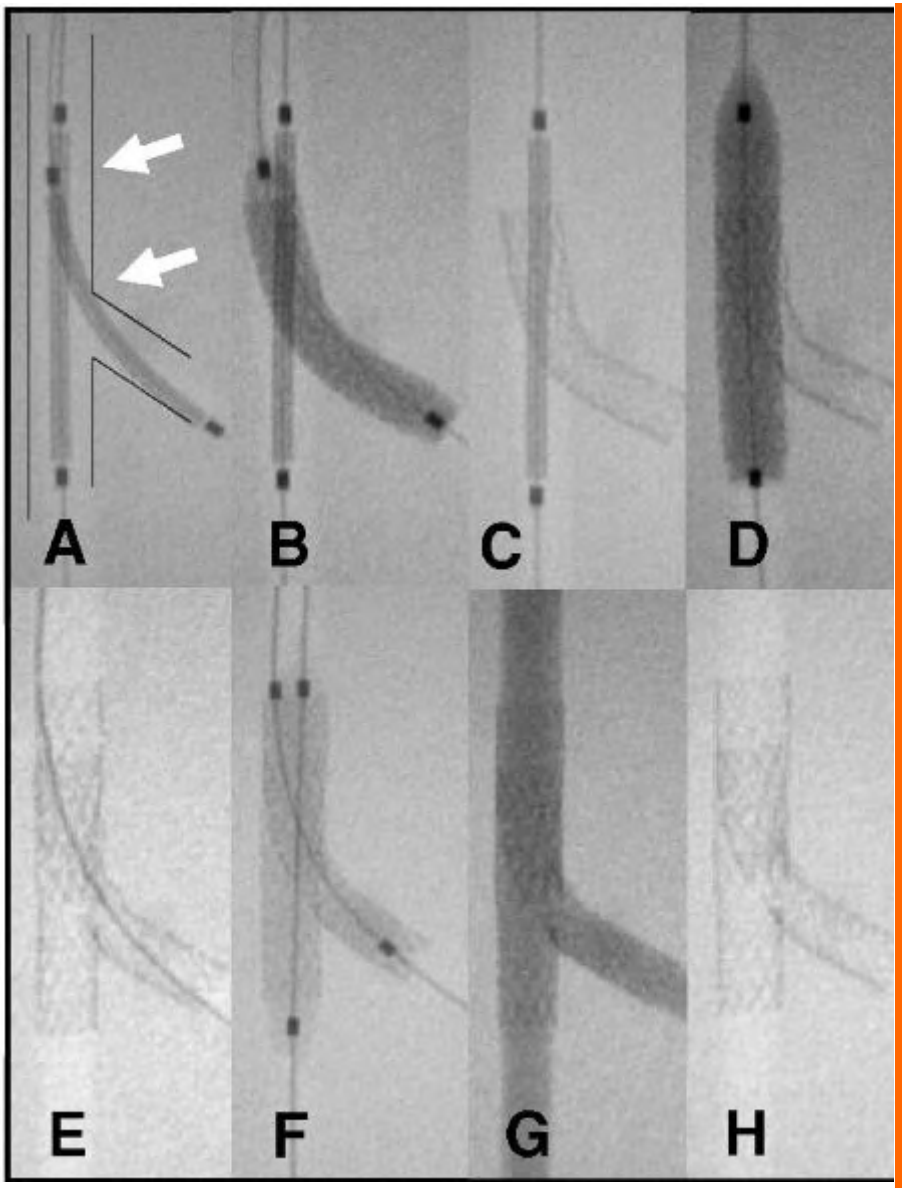
After Kissing Balloon Inflation



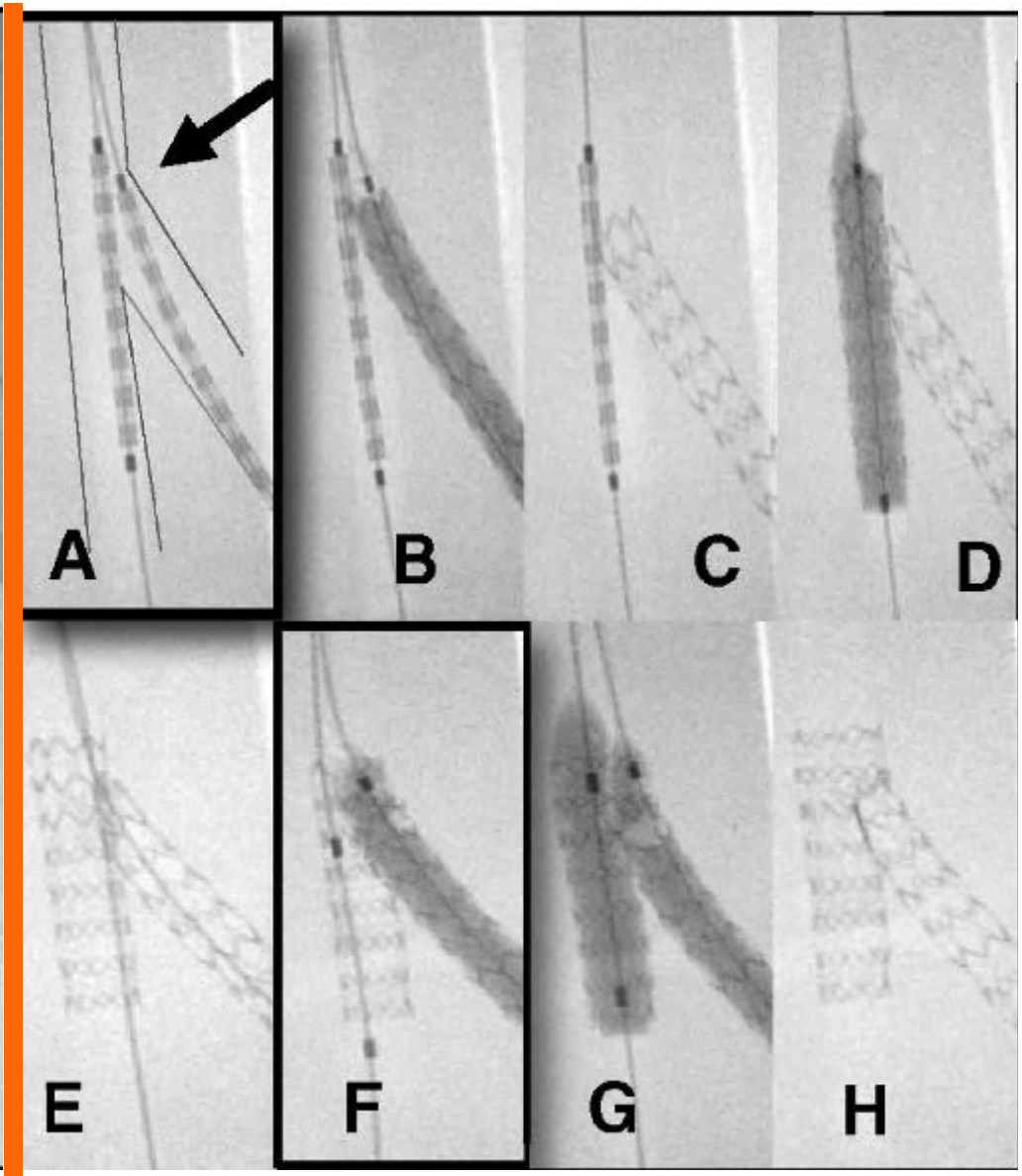
Before Kissing Balloon Inflation

Crush Technique: Variations

- Classic Crush
- Mini Crush
- Double Kissing Crush (DK Crush)
- Reverse Crush
- Step Crush

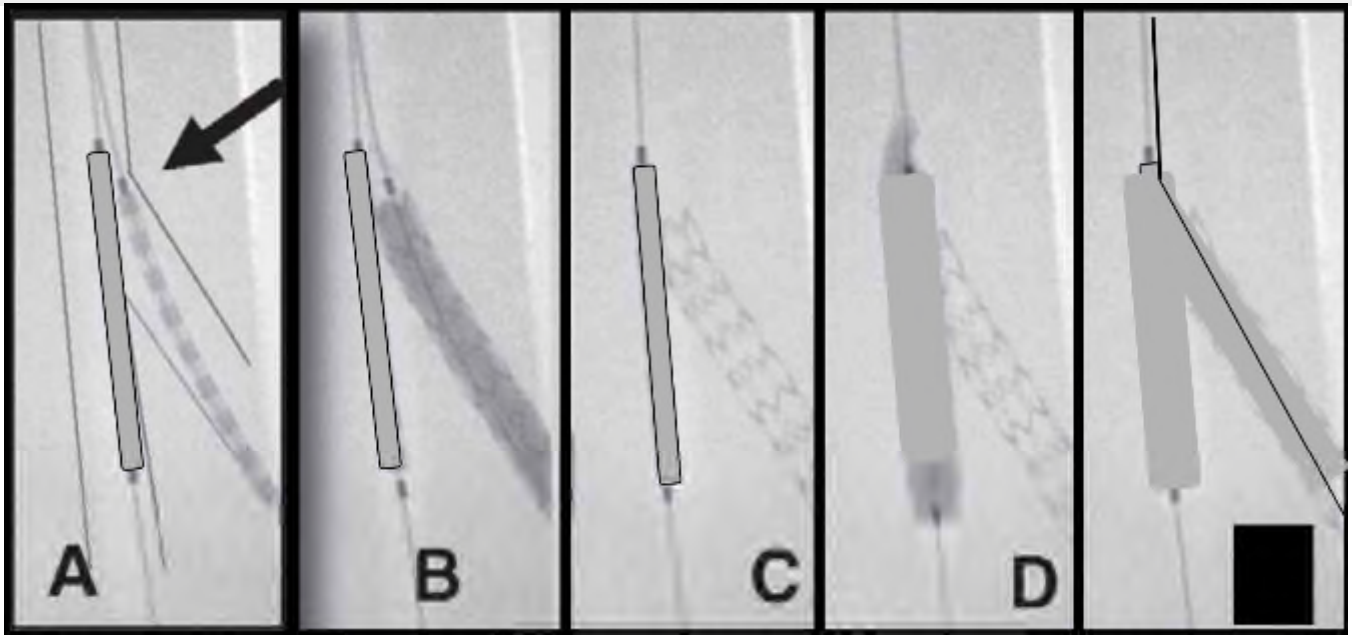


Classic Crush Technique



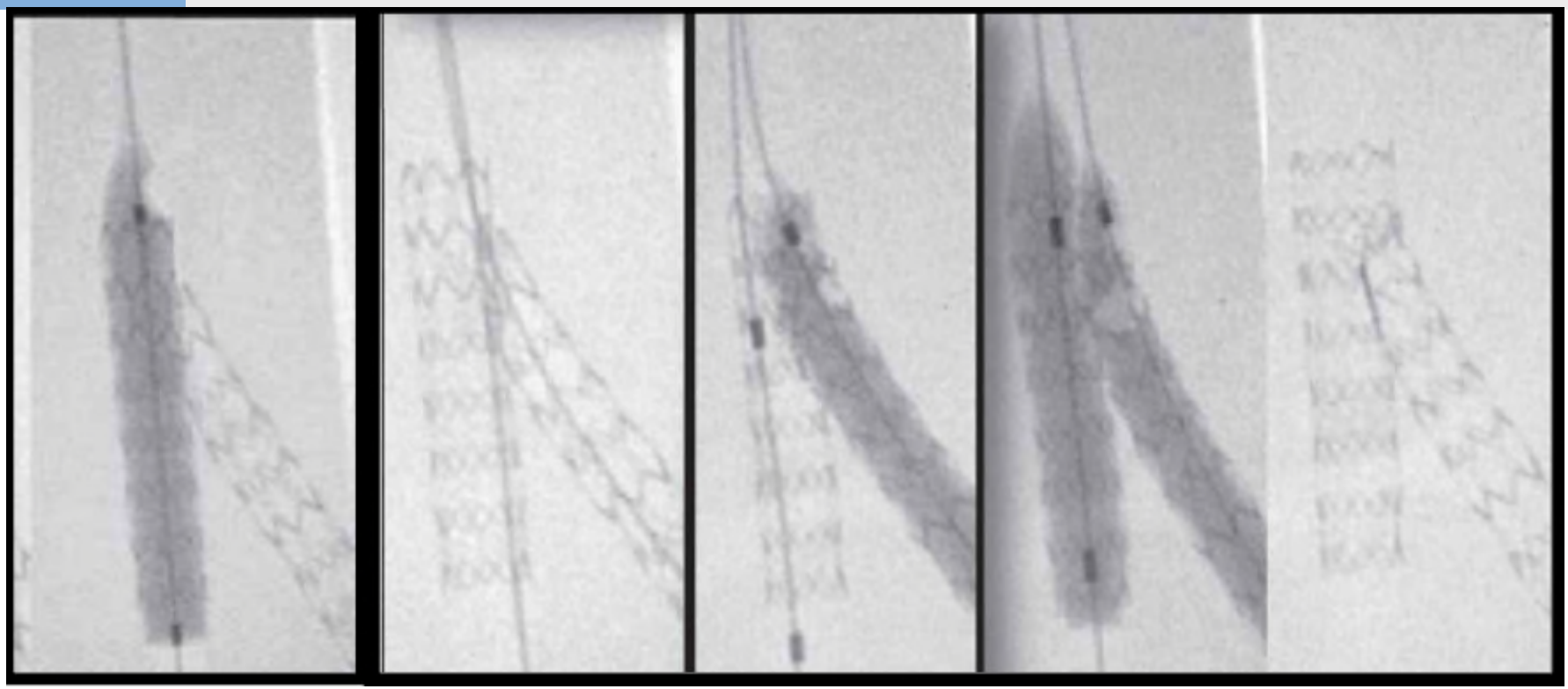
Mini Crush Technique

DK Crush Technique



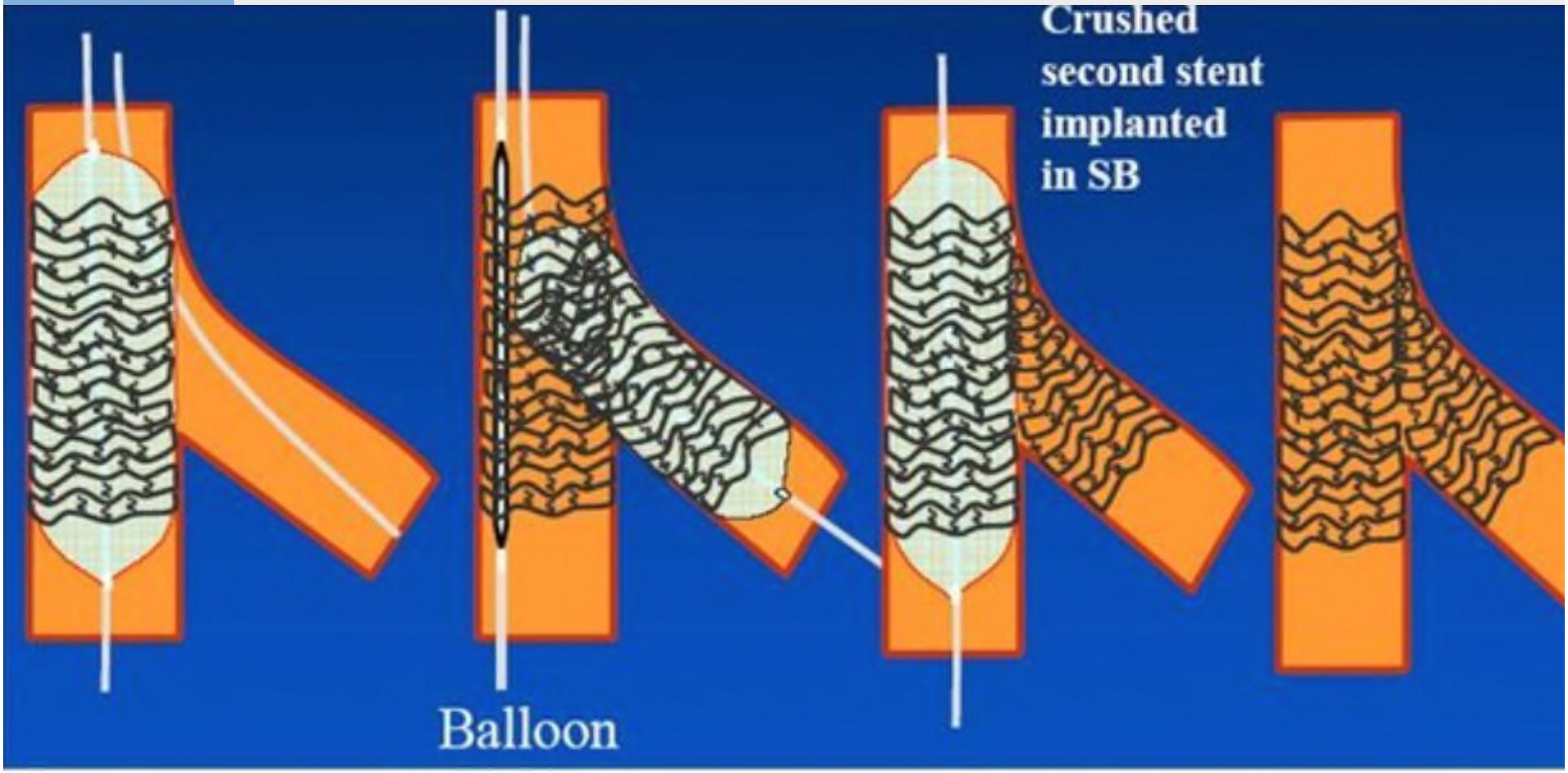
- Position side branch stent as if performing a Mini Crush, in conjunction with a balloon in the main branch
- Deploy side branch stent, withdraw side branch stent balloon slightly, then reinflate to high pressures to “flare” the proximal side branch stent
- Remove side branch balloon and wire
- Crush side branch stent with main branch balloon
- Rewire side branch and perform a kissing balloon inflation

DK Crush Technique



- Remove side branch wire and balloon
- Position stent in the main branch and deploy it
- Rewire side branch and perform final kissing balloon inflation

Reverse Crush Technique



Performed as a bailout strategy if provisional stenting of the main branch is suboptimal

Crush Stent Technique

ADVANTAGES:

- **Assures coverage of side branch ostium**
- **Prevents loss of side branch**
- **Can be used if side branch and main branch are of significantly different sizes**

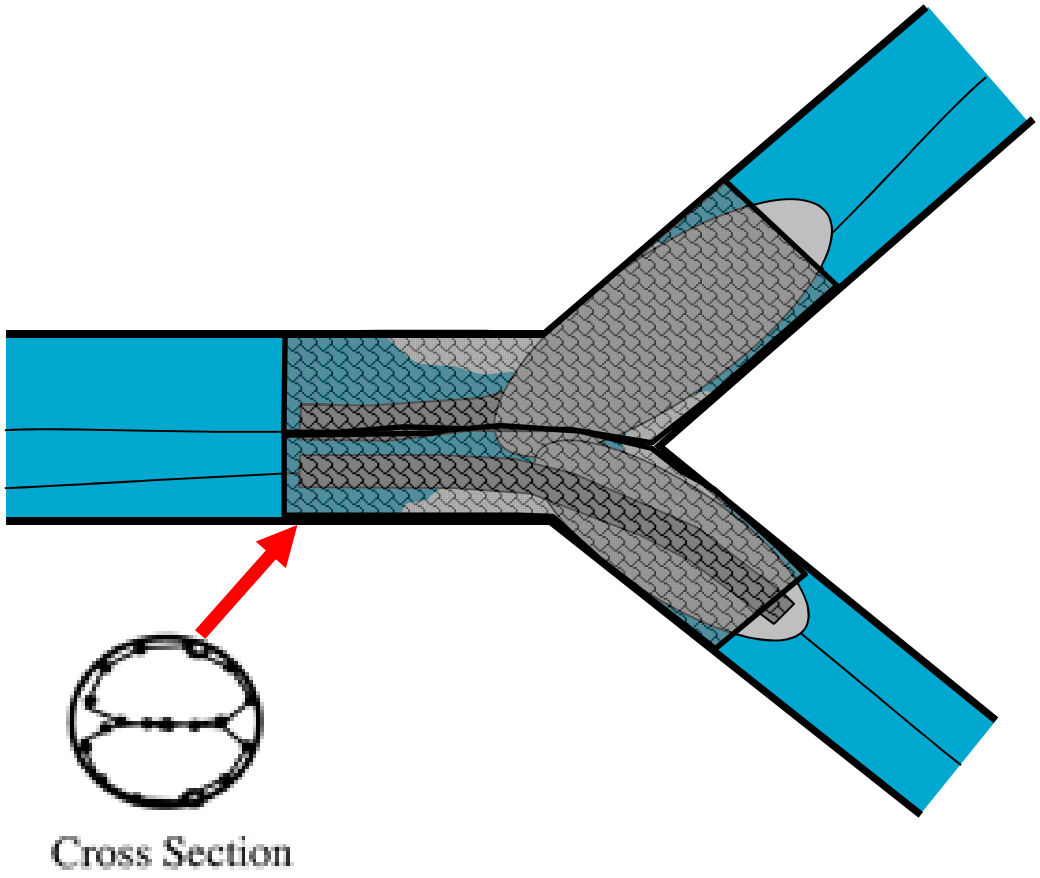
DISADVANTAGES:

- **More complex**
- **Time consuming**
- **More costly (additional wires/balloons)**
- **Sometimes unable to perform the final kiss-** ***destined for a worse outcome***
- **More difficult to treat restenosis**

Commonly Used Bifurcation Techniques

- Provisional Stent Technique
- Crush Techniques
- Simultaneous Stent Techniques
- T Stent Techniques
- Culotte Technique

The Simultaneous Kissing Stent (SKS) Technique



Wire both vessels

Pre-dilate as needed

Position stents

Deploy stents simultaneously

Perform kissing balloon post-dilatation

Simultaneous Kissing Stent Technique (SKS)

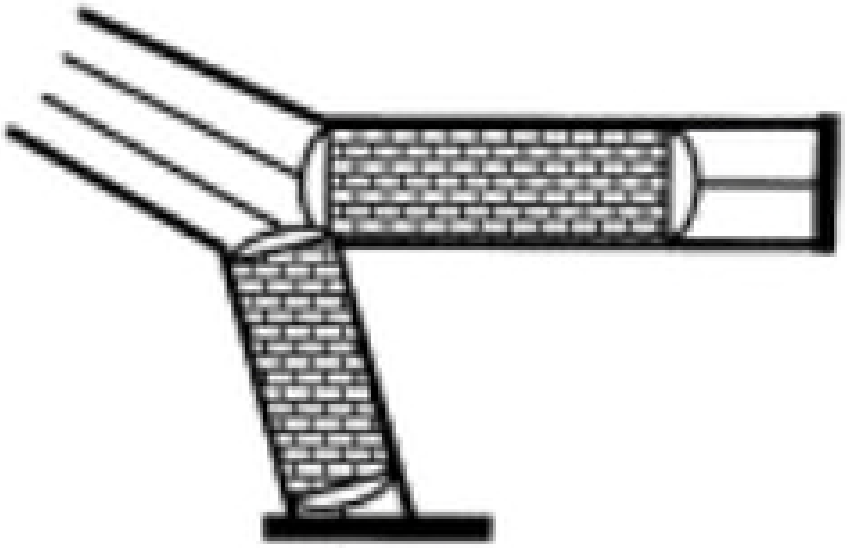
ADVANTAGES:

- Simple
- Maintain wire access to both branches at all times
- Minimal ischemic time

DISADVANTAGES:

- Can be difficult to treat later due to neocarina
- Requires larger vessels of similar size
- Treating proximal dissection or residual disease highly problematic

Simultaneous V Stenting Technique



- **Identical to the SKS technique, but without the creation of a new carina**

Simultaneous V Stenting Technique

ADVANTAGES:

- Simple
- Maintain wire access to both branches at all times
- Minimal ischemic time

DISADVANTAGES:

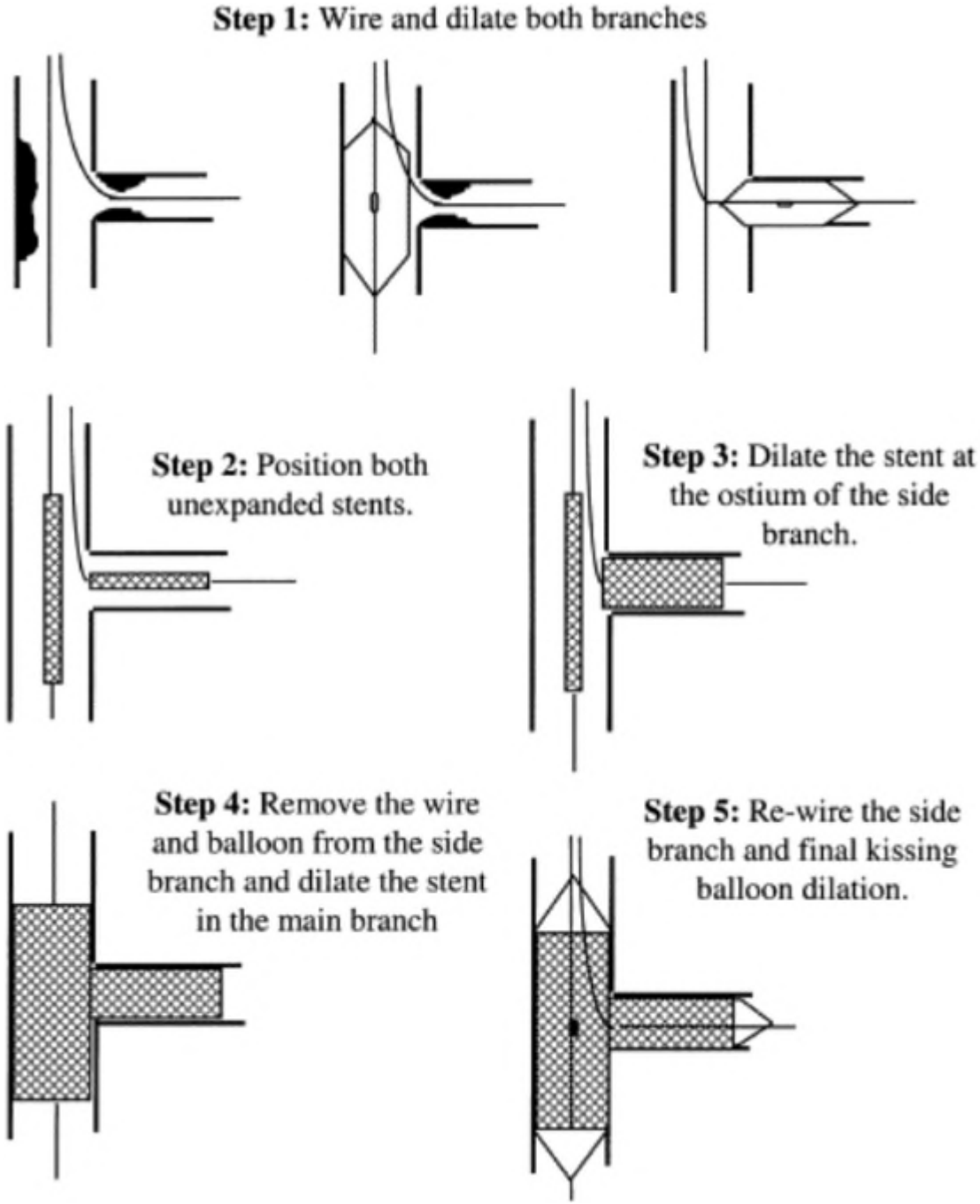
- Only works if proximal main branch is free of disease
- Plaque shift more proximally can be difficult to treat:

Add a stent proximally and potentially leave a gap vs. convert to SKS

Commonly Used Bifurcation Techniques

- Provisional Stent Technique
- Crush Techniques
- Simultaneous Stent Techniques
- T Stent Techniques
- Culotte Technique

Traditional T Stent Technique



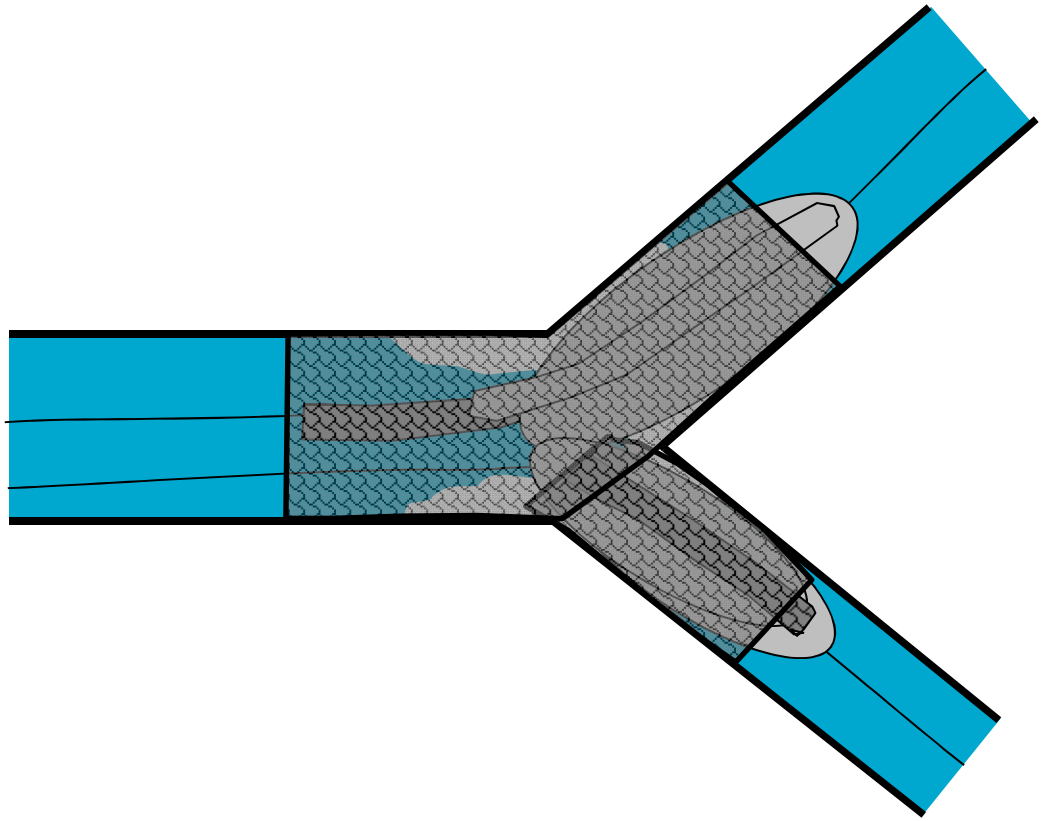
PROBLEM:

Almost NEVER is there a perfect 90 degree angle between main branch and side branch!

Use of the traditional T stent technique is associated with high risk of missing the side branch ostium

The TAP Technique

T stent And Protrusion



- Wire both vessels
- Pre-dilate as needed
- Position and deploy main branch stent
- Rewire side branch and balloon dilate
- Position side branch stent so proximal edge protrudes slightly into main branch, ‘backstop’ balloon in main branch
- Deploy side branch stent first, then inflate main branch balloon to kiss

TAP Technique

ADVANTAGES:

- Relatively simple
- Assures coverage of side branch ostium
- Less metal at side branch ostium compared to Crush technique
- Works when vessels are different sizes

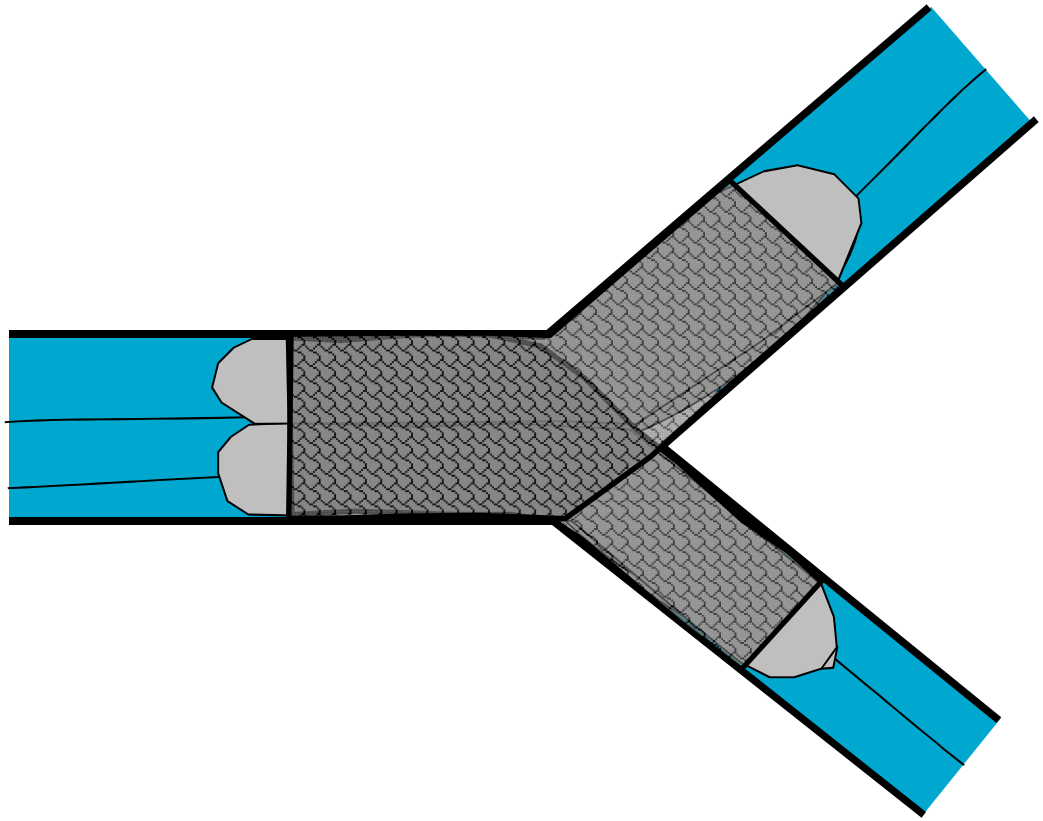
DISADVANTAGES:

- Excessive stent protrusion can lead to trouble accessing distal main branch in the future

Commonly Used Bifurcation Techniques

- Provisional Stent Technique
- Crush Techniques
- Simultaneous Stent Techniques
- T Stent Techniques
- Culotte Technique

The Culotte Technique



- Wire both vessels
- Pre-dilate as needed
- Position and deploy stent in most angulated branch
- Remove first wire, wire second branch and balloon dilate
- Position second branch stent so proximal portion equal with previous stent edge and deploy
- Rewire initially stented branch and perform kissing post-dilitation

Culotte Technique

ADVANTAGES:

- **Assures side branch ostium coverage**
- **Excellent radial strength in main branch**

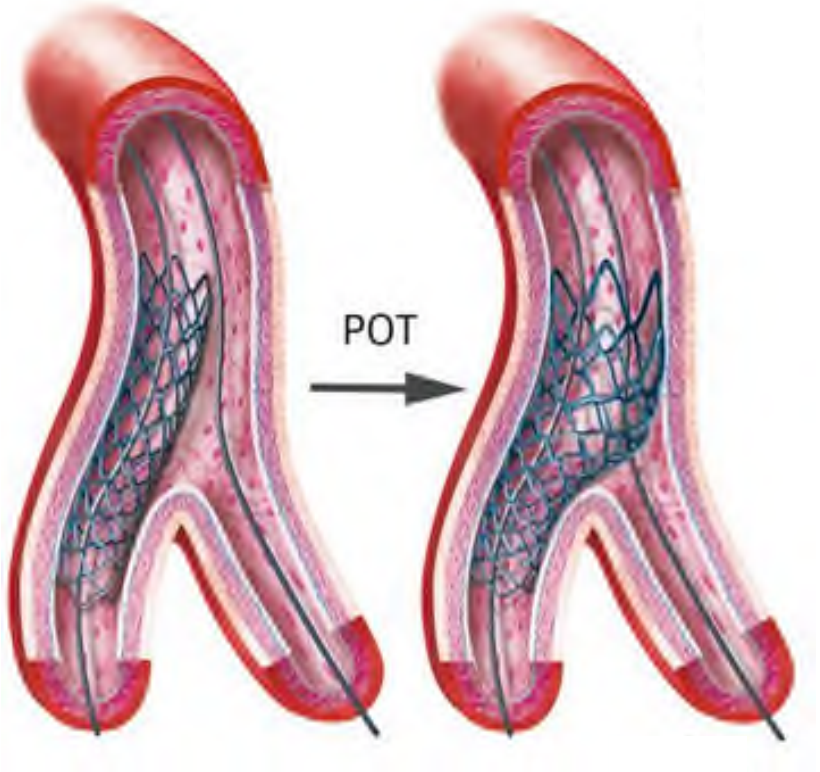
DISADVANTAGES:

- **Complex**
- **Vessels must be of similar size**
- **Somewhat time consuming**

What is POT?

Proximal **O**ptimization **T**echnique

Dilatation of the stent within the proximal vessel to an appropriate size to achieve proper apposition to avoid rewiring behind the stent and causing inadvertent crush or distortion of the stent



Does it Really Matter What Technique I Use?

Long-Term Outcomes of Different Two-Stent Techniques With Second-Generation Drug-Eluting Stents for Unprotected Left Main Bifurcation Disease: Insights From the FAILS-2 Study

Author(s): Marco Pavani, MD[1]; Federico Conrotto, MD[1]; Enrico Cerrato, MD[2]; Fabrizio D'Ascenzo, MD[1]; Hiroyoshi Kawamoto, MD[3,4]; Ivan J. Núñez-Gil, MD[5]; Mauro Pennone, MD[1]; Roberto Garbo, MD[6]; Francesco Tomassini, MD[2]; Francesco Colombo, MD[6]; Paolo Scacciatella, MD[1]; Ferdinando Varbella, MD[2]; Alaide Chieffo, MD[4]; Antonio Colombo, MD[4]; Javier Escaned, Prof, MD[5]

Issue Number:
Volume 30 - Issue 8 - August, 2018

A registry of unprotected left main bifurcation lesions treated with T-stenting, mini-crush, and Culotte techniques

Long-Term Outcomes of Different Two-Stent Techniques With Second-Generation Drug-Eluting Stents for Unprotected Left Main Bifurcation Disease: Insights From the FAILS-2 Study

Table 3. Long-term outcomes (median follow-up, 2.27 years).

	T-Stenting (n = 66)	Mini-Crush (n = 103)	Culotte (n = 68)	*P*-Value
Long-term follow-up (years)	2.2 ± 1.5	2.1 ± 1.4	2.2 ± 1.5	.90
Planned angiographic follow-up	32 (50.0%)	69 (68.0%)	54 (79.5%)	<.01
Major adverse cardiac events	14 (22.0%)	27 (26.0%)	21 (31.0%)	.50
Death	6 (9.3%)	9 (9.0%)	3 (4.5%)	.48
Myocardial infarction	1 (1.5%)	1 (1.0%)	1 (1.4%)	.93
TVR	9 (14.0%)	20 (19.5%)	17 (25.0%)	.28
Angio-driven TVR	5 (7.8%)	9 (8.7%)	10 (14.7%)	.34
Ischemia-driven TVR	4 (6.0%)	11 (10.6%)	7 (10.3%)	.60
TLR	8 (12.5%)	18 (17.5%)	14 (20.5%)	.41
Angio-driven TLR	5 (7.8%)	8 (7.7%)	7 (10.3%)	.82
Ischemia-driven TLR	3 (4.7%)	10 (9.7%)	6 (8.8%)	.49
TLR on left main	2 (3.0%)	6 (6.0%)	2 (3.0%)	.63
TLR on left anterior descending	4 (6.2%)	4 (4.0%)	2 (3.0%)	.62
TLR on circumflex	6 (9.3%)	16 (15.5%)	11 (16.0%)	.44
Stent thrombosis (definite/probable)	0 (0.0%)	0 (0.0%)	0 (0.0%)	N/A
Possible stent thrombosis	1 (1.5%)	3 (3.0%)	0 (0.0%)	.47

TLR = target-lesion revascularization; TVR = target-vessel revascularization;

DK Crush vs. Provisional Stenting for Left Main Bifurcation Lesions

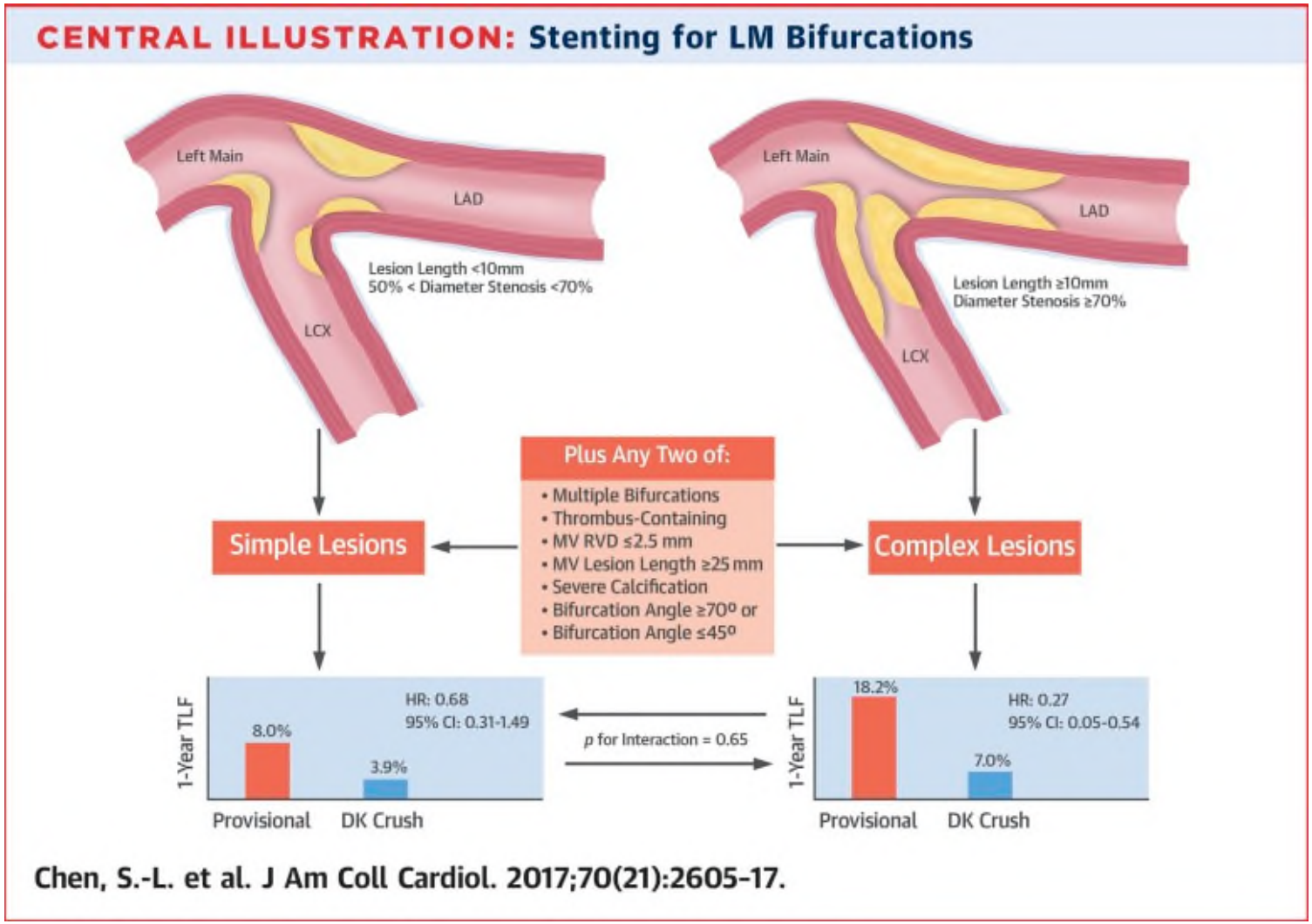
Double Kissing Crush Versus Provisional Stenting for Left Main Distal Bifurcation Lesions: DKCRUSH-V Randomized Trial

Shao-Liang Chen MD [a], Jue-Jie Zhang PhD [a], Yaling Han MD [b], Jing Kan MBBS [a], Lianglong Chen MD [c], Chunguang Qiu MD [d], Tiemin Jiang MD [e], Ling Tao MD [f], Hesong Zeng MD [g], Li Li MD [h], Yong Xia MD [i], Chuanyu Gao MD [j], Teguh Santoso MD [k], Chootopol Paiboon MD [l], Yan Wang MD [m], Tak W. Kwan MD [n], Fei Ye MD [o], Nailiang Tian MD [o] ... Gregg W. Stone MD [aa]

482 patients from 26 centers in 5 countries with true distal LM bifurcation lesions (Medina 1,1,1 or 0,1,1) randomized to provisional stenting (n = 242) or DK crush stenting (n = 240)

Chen et al. JACC Volume 70, Issue 21, 28 November 2017, Pages 2605-2617

DK Crush vs. Provisional Stenting for Left Main Bifurcation Lesions



Chen, S.-L. et al. J Am Coll Cardiol. 2017;70(21):2605-17.

Conclusions

- **Multiple techniques have been developed to effectively treat bifurcation lesions**
- **Each has unique advantages and disadvantages and details of why you would want to use one over the other**
- **Being proficient with multiple techniques will assure that you are able to perform PCI regardless of varying patient anatomy with excellent technical success**

Thank You