

# Technical Variations of Two-Stent Bifurcation Treatment

## Indications and Examples



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# Conflict of Interest

- No conflict to report in relation to this presentation



# Discussion Plan

- In clinical practice, Patients undergoing elective double stenting have more complex lesions than patients undergoing provisional stenting.
- When a decision is made to employ an elective double stenting technique several questions need to be answered:
  - Which technique to use?
    - Crush, Culotte, T, V, SKS
    - Is there an evidence-base for decision making?
    - How to choose among the various technique?
  - How to perform the procedure?



# Elective Double Stenting Techniques

- T Stenting
- Crush Technique
- Culotte Technique
- V stenting
- Simultaneous Kissing Stenting (SKS)



# Variants of Elective Double Stenting Techniques

## Style or Substance?

- The value of a variant technique should be judged based on its additive impact on:
  - Ease of performance
  - Bifurcation stent geometry (coverage, deformation)
  - Clinical outcome

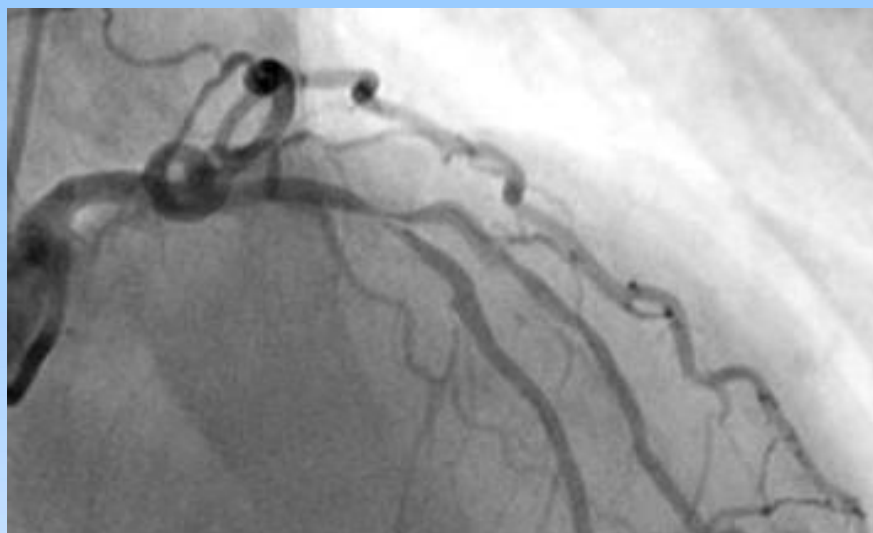


# How to choose a specific EDS technique?

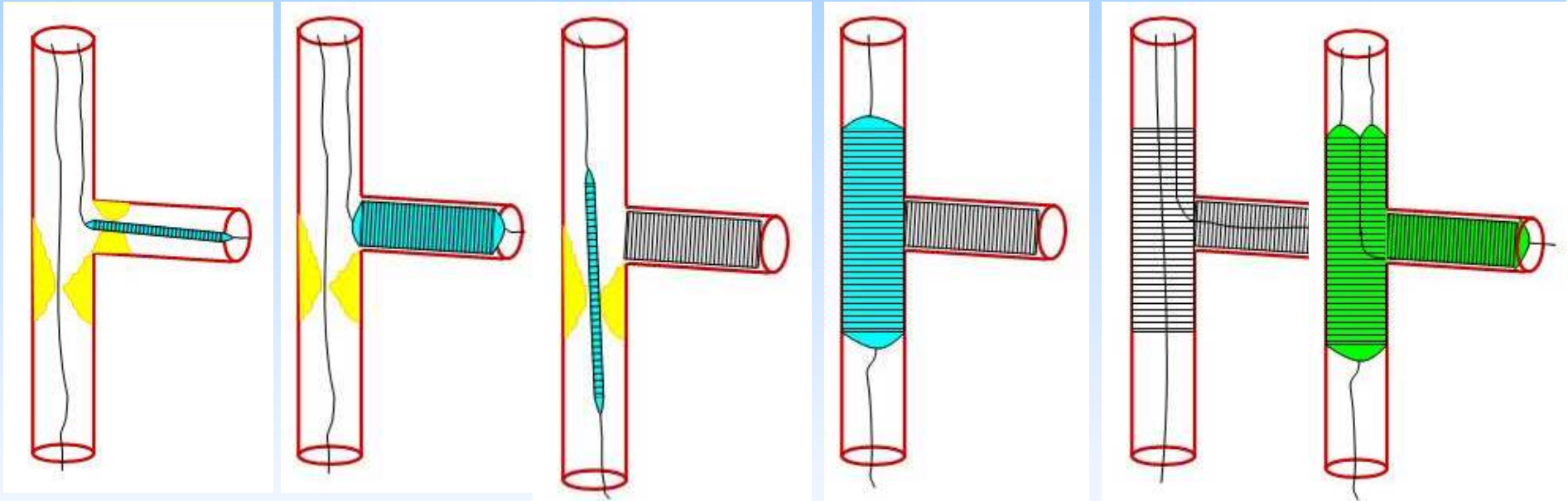
- Bifurcation anatomy
  - Bifurcation angle
  - Extent of disease in the MB proximal to the carina
  - Severity of the ostial SB stenosis (does it require aggressive pre dilatation)
- Operator experience



Which  
Technique?



# Classical T stenting





# Classical T stenting

- **Indications**

- Bifurcation lesions with an angle between MB and SB of  $\sim 90$  degrees.

- **Advantages**

- The technique is easy, fast and not technically demanding.

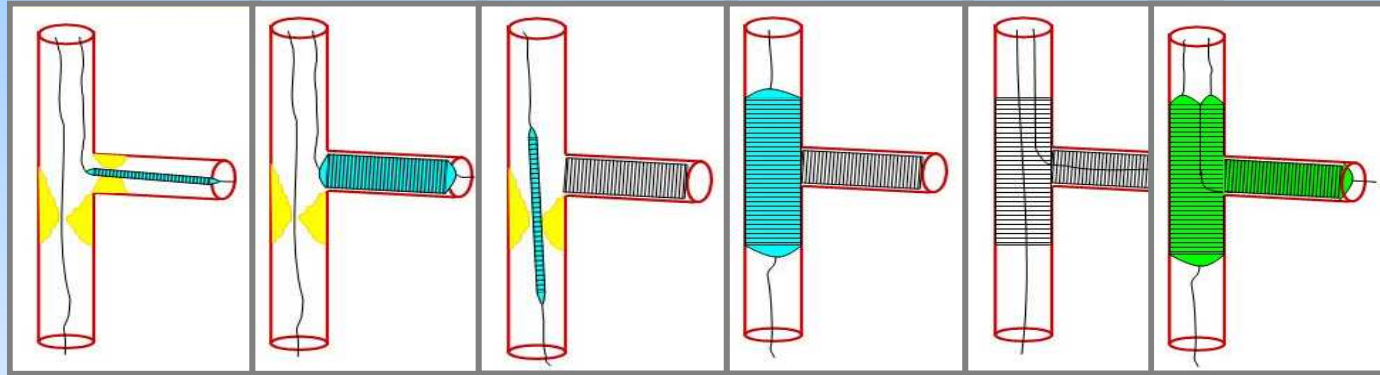
- **Drawbacks**

- When trying to position the SB stent exactly at the ostium without minimal protrusion into the MB the stent often misses the ostium (gap).
- This technique has been largely replaced by the Modified T stenting technique

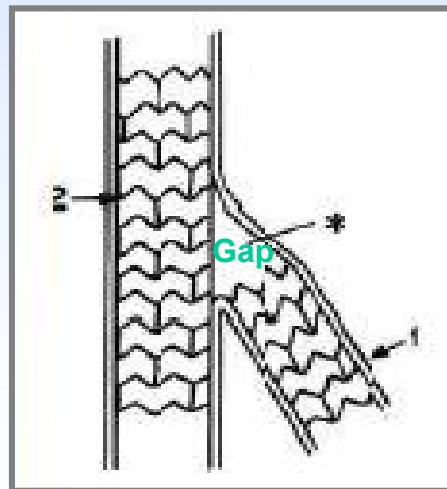


# Classic T-Stenting Problems

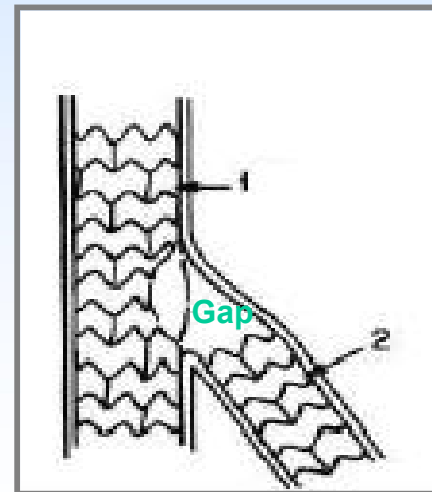
Hope



Elective



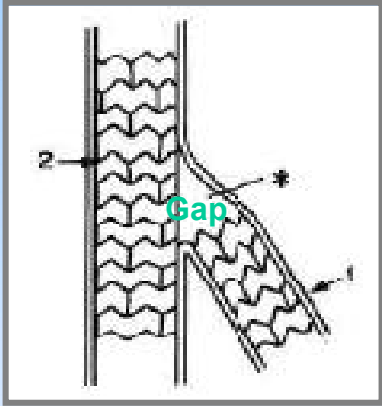
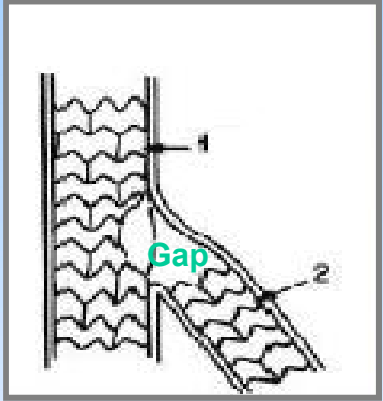
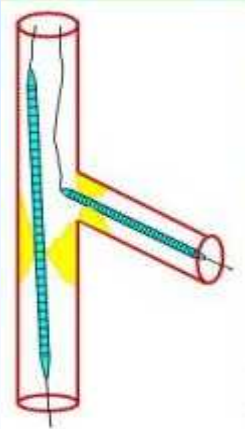
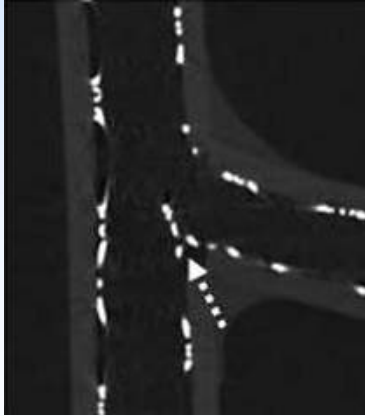
Provisional



Reality

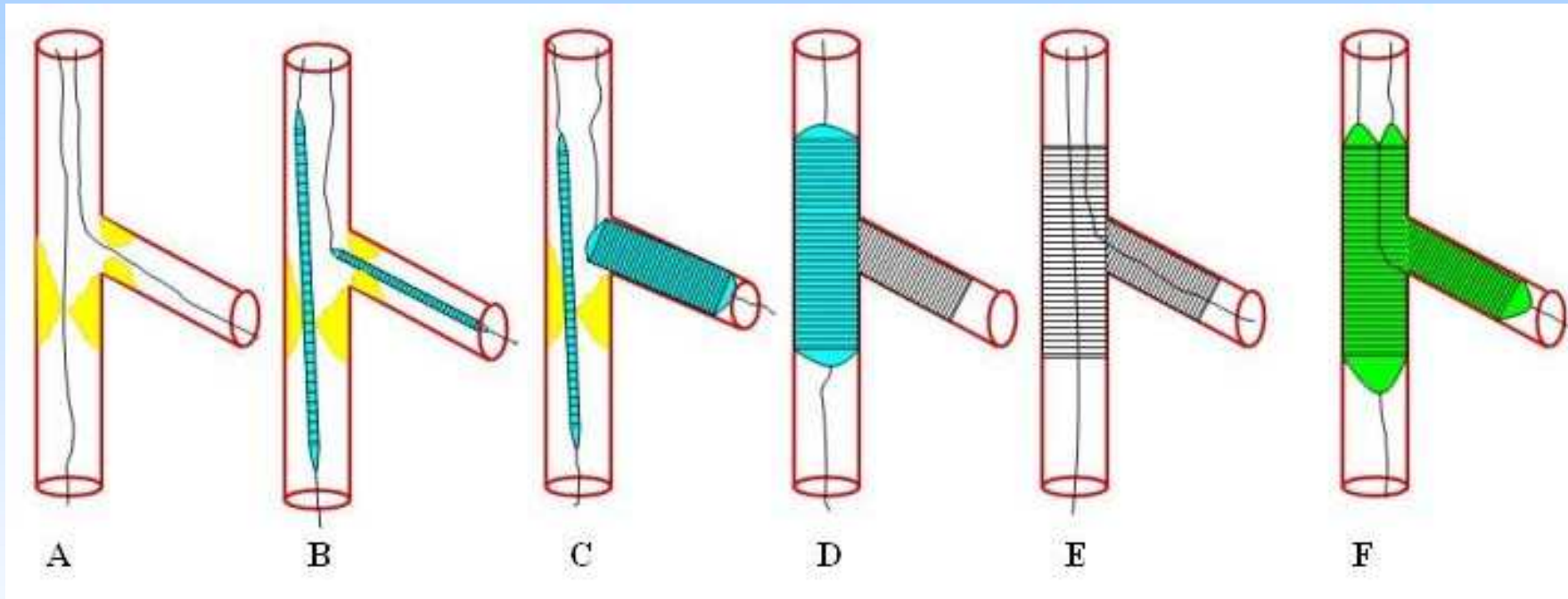


# Variants of T-Stenting

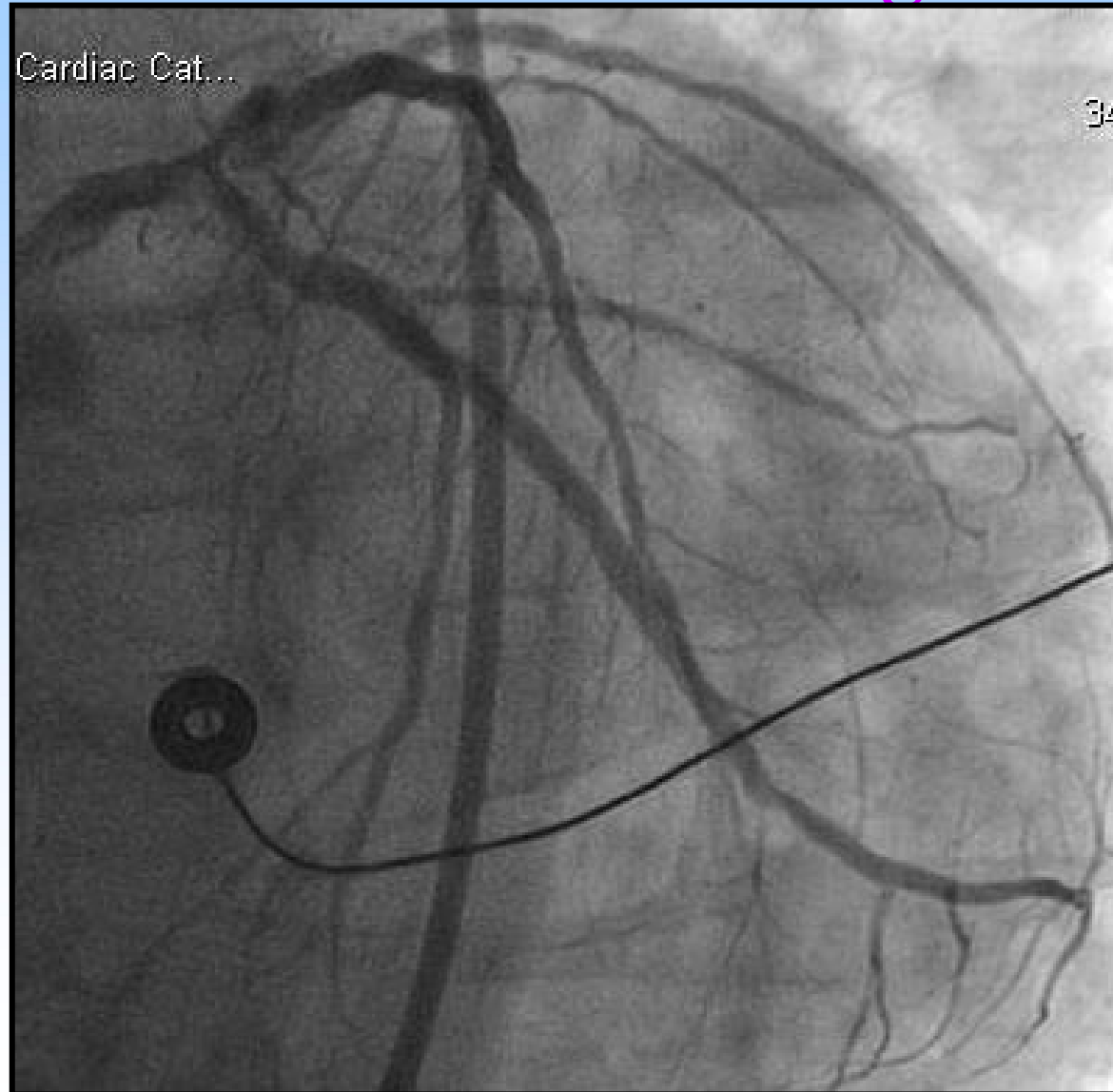
	Elective	Provisional
Classic-T		
Variant-T		
	<b>Modified-T</b>	<b>TAP</b>



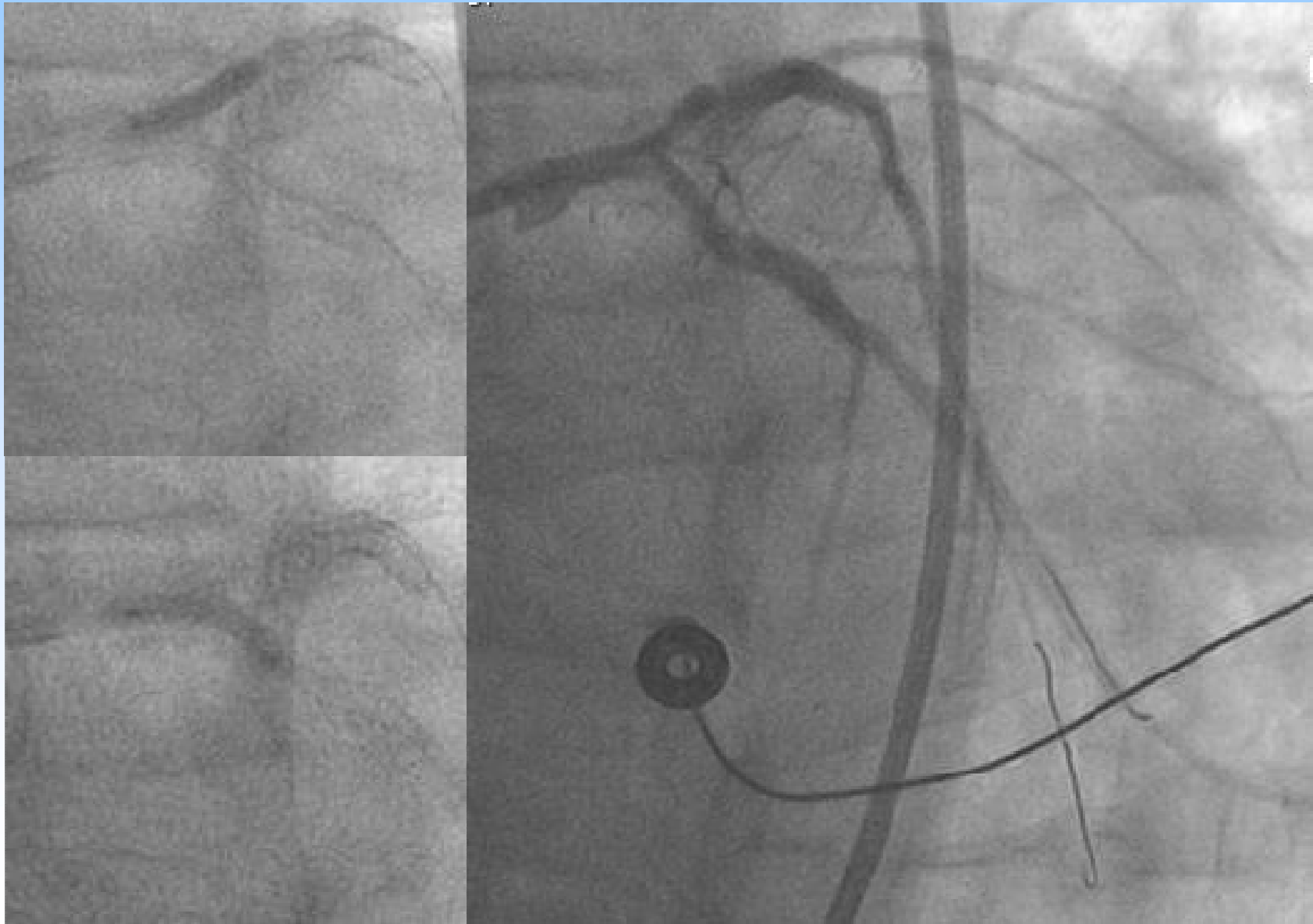
# Elective Modified T-Stenting



# Elective Modified T-Stenting

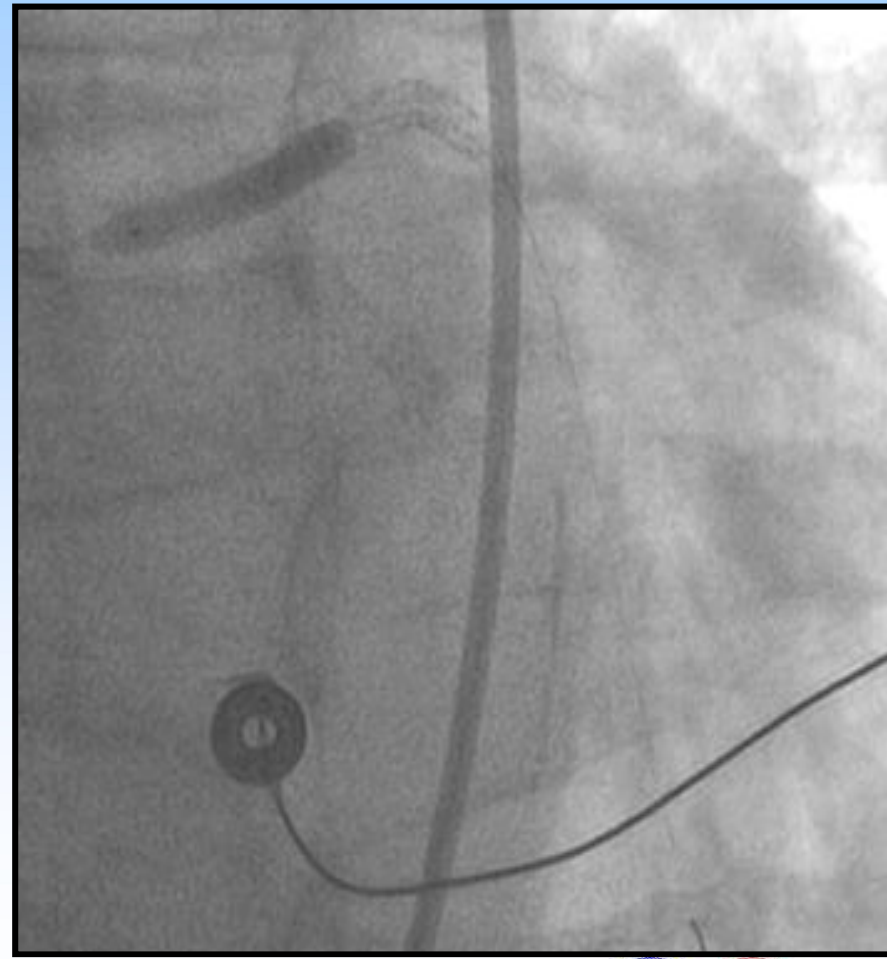
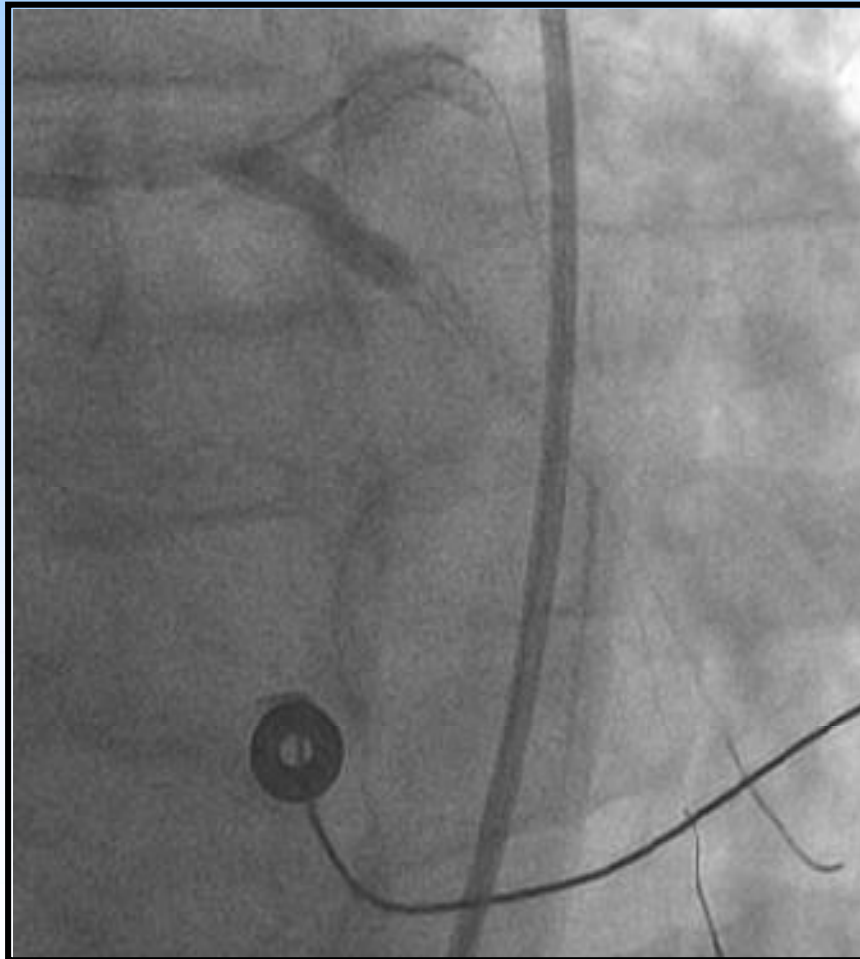


# Lesion Preparation



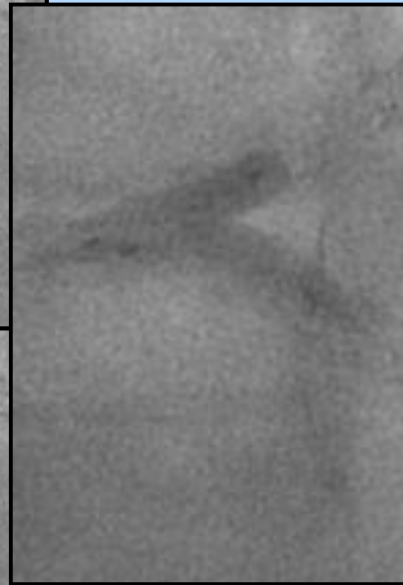
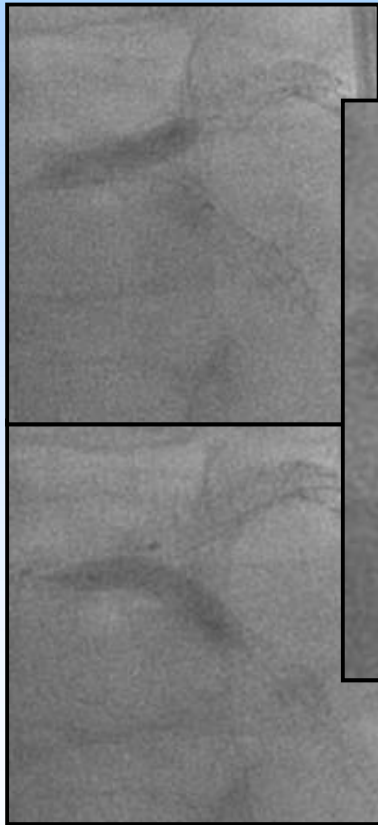
# Elective Modified T-Stenting

## Sequential Stent Deployment



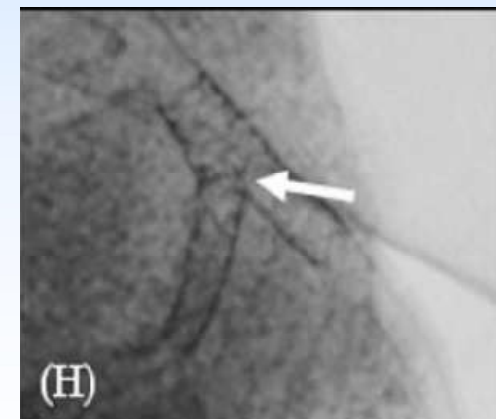
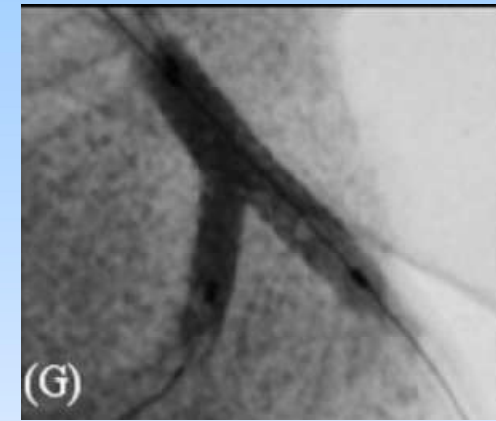
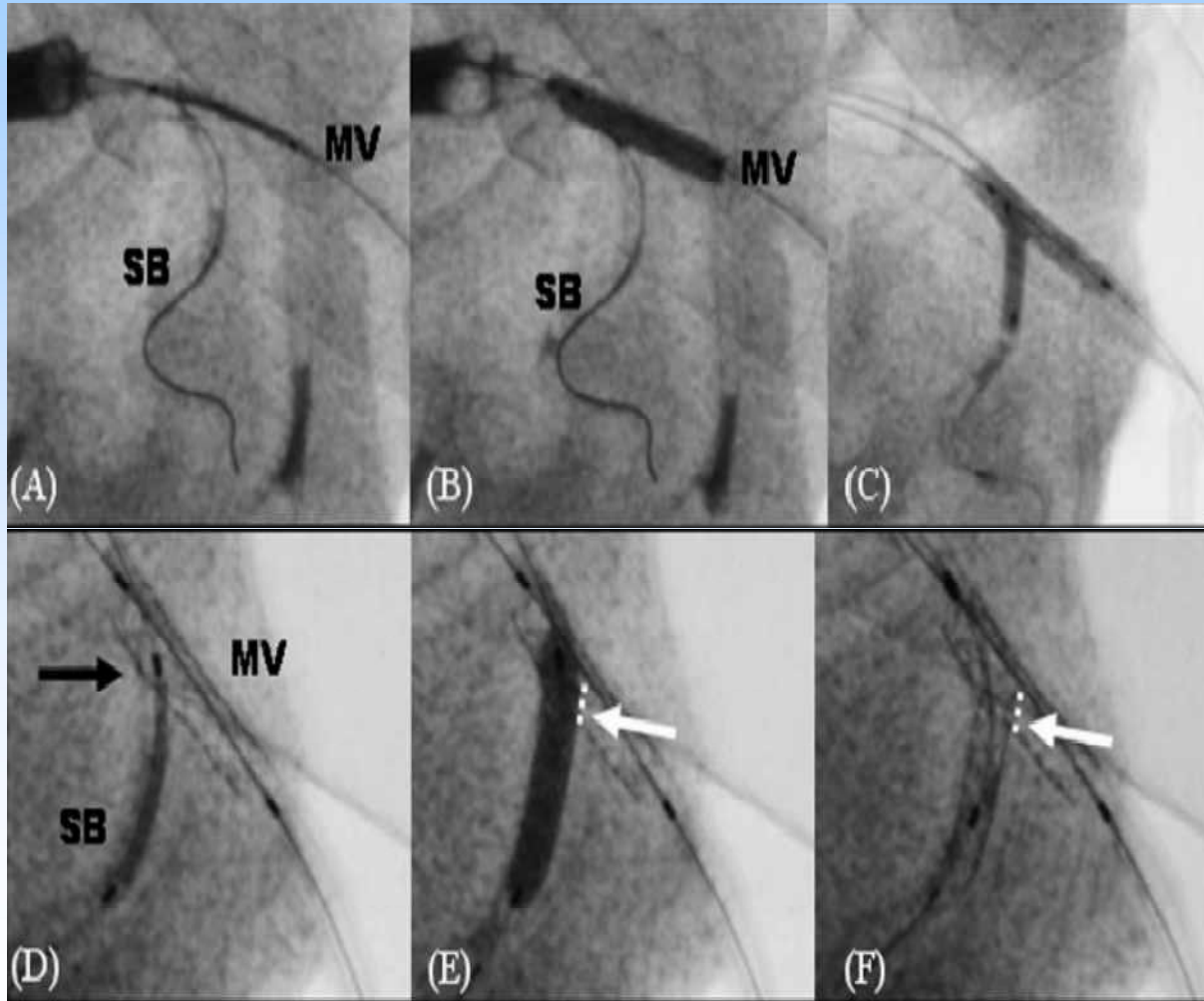
# Elective Modified T-Stenting

Sequential High Pressure Inflation + Final Kissing

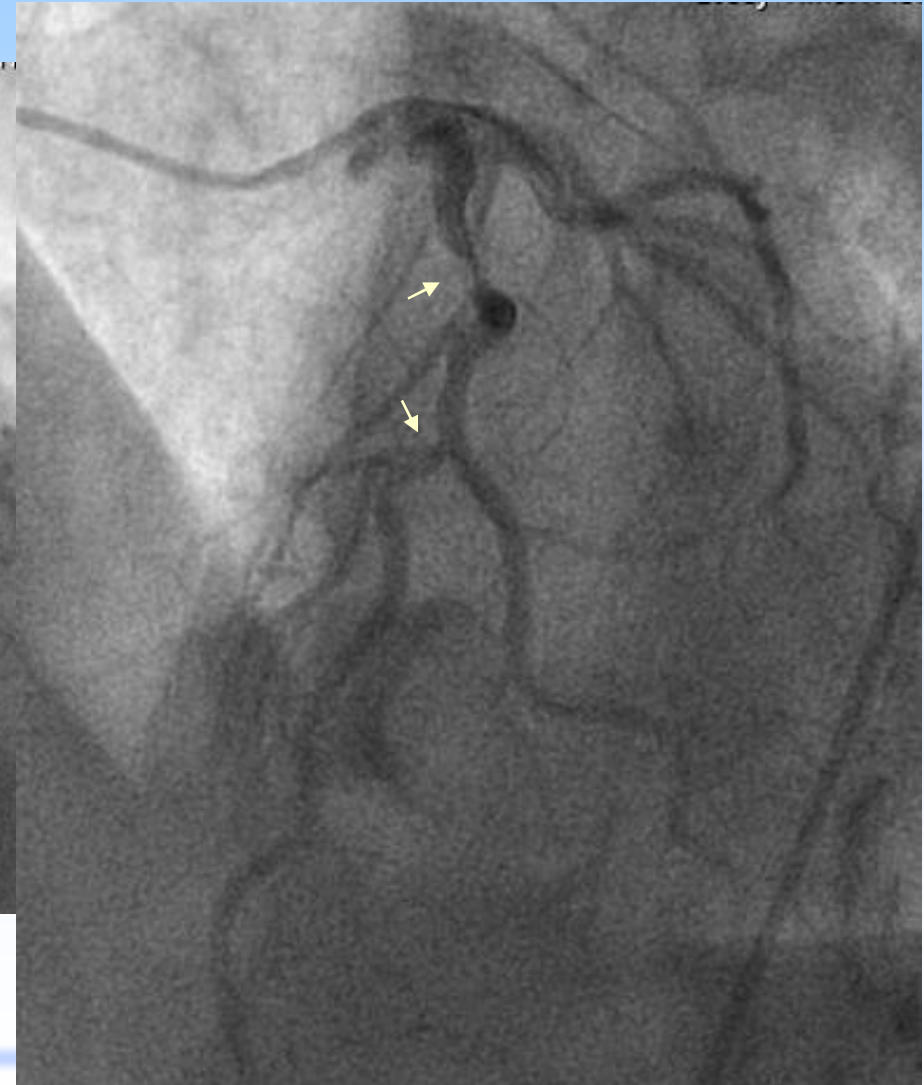




# Provisional “TAP” Technique

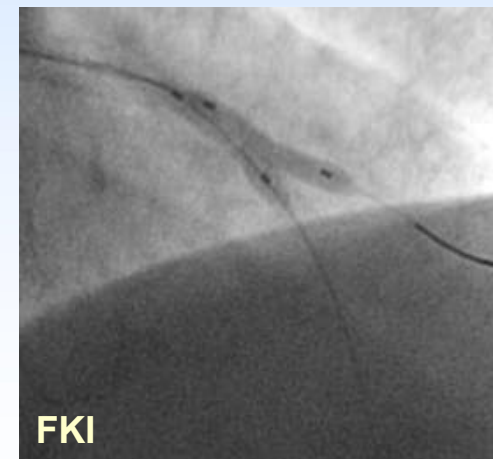
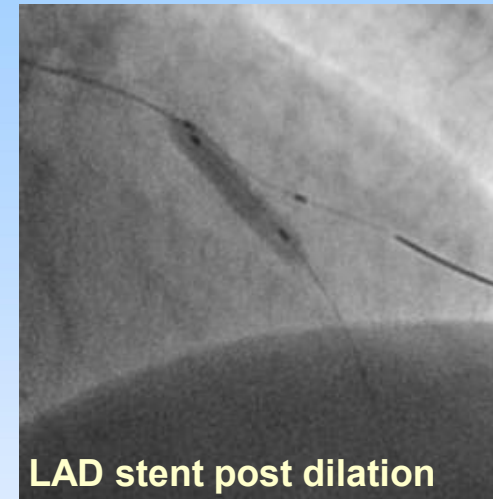
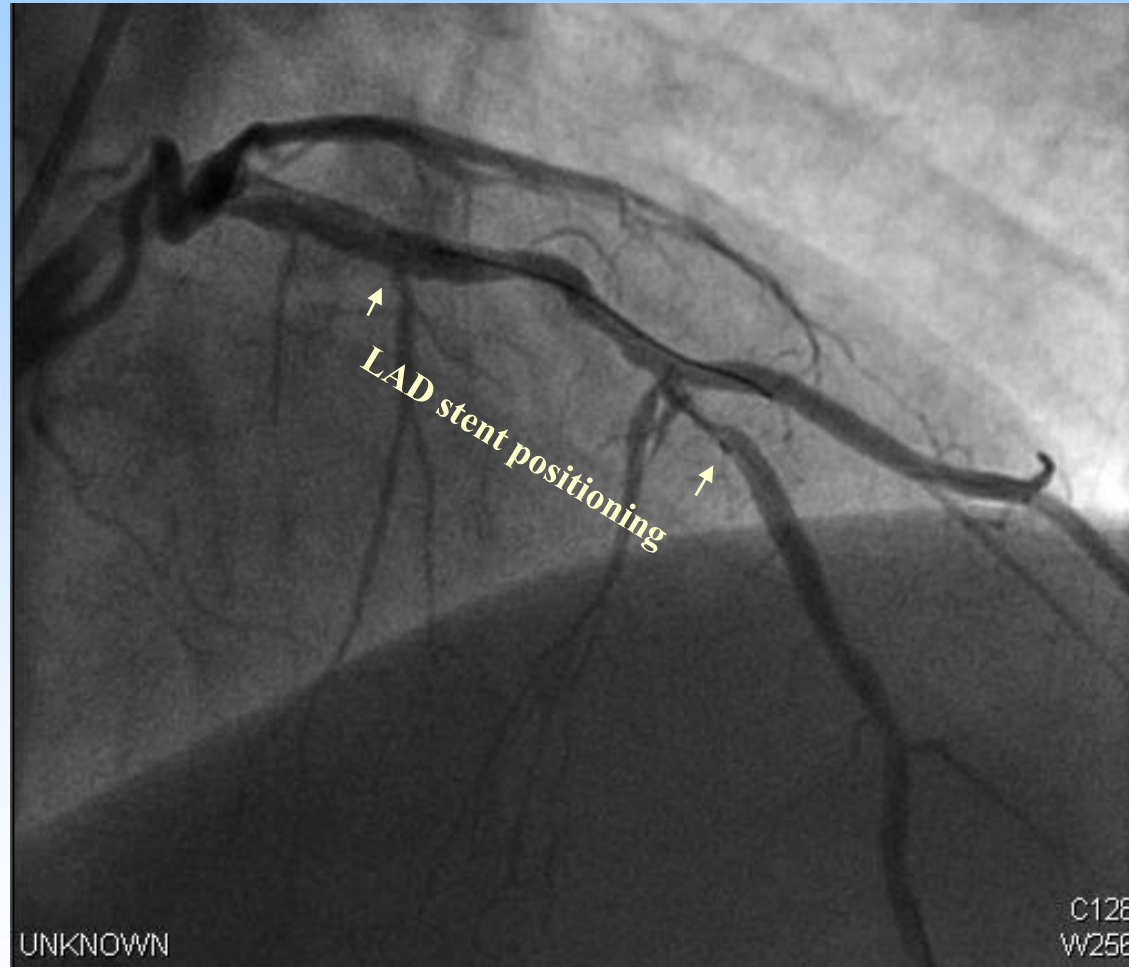


# Provisional “TAP” Technique



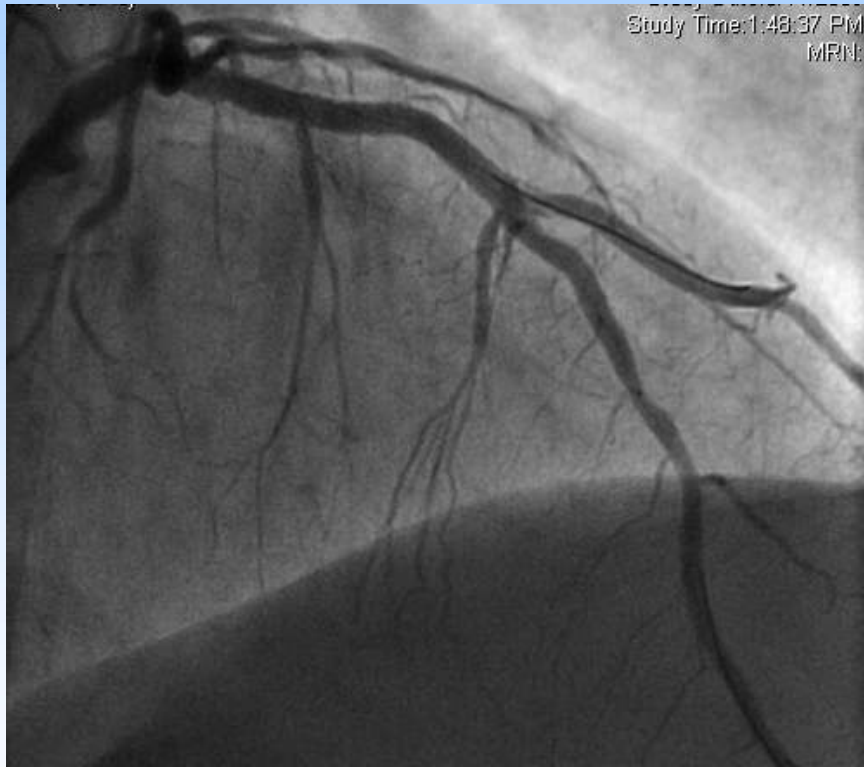
# Provisional “TAP” Technique

## MV stenting...and SB dilatation



# Provisional “TAP” Technique

## SB dissection post dilatation



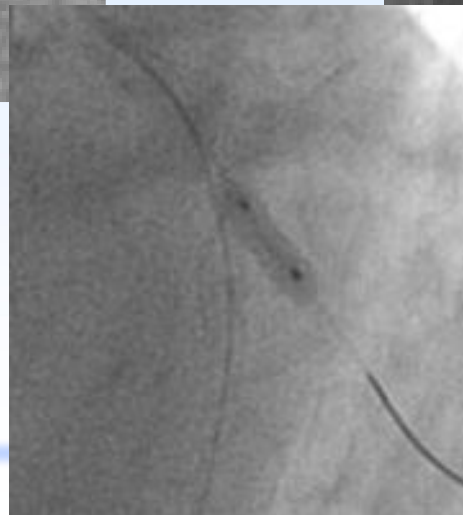
# Provisional “TAP” Technique SB Stent Positioning...What’s Wrong?



Cranial RAO

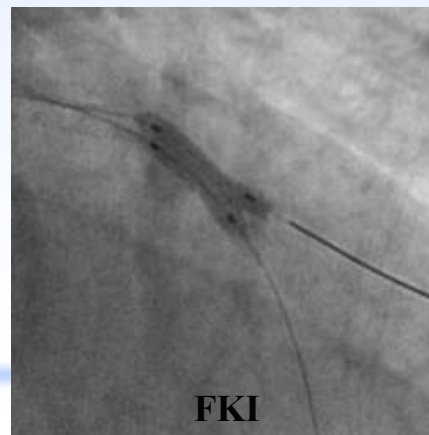
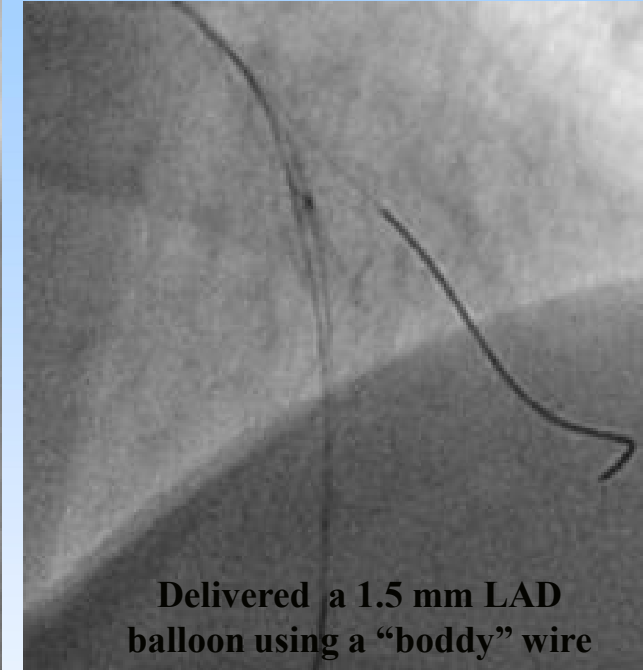
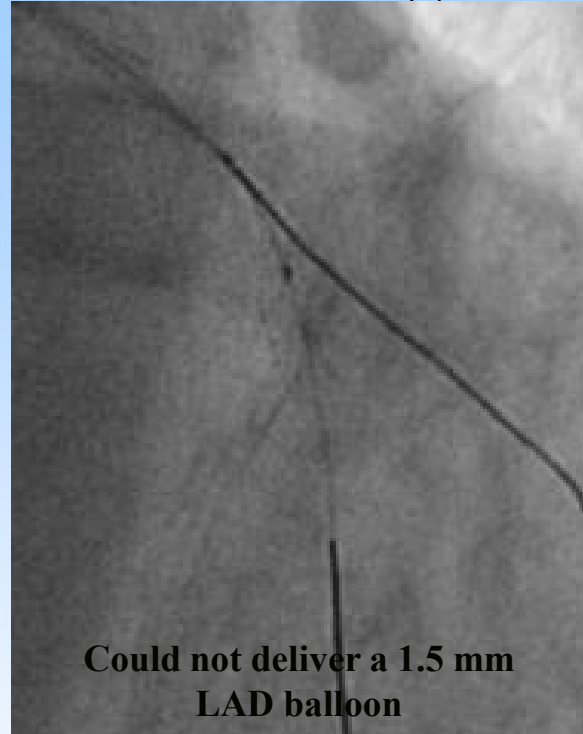
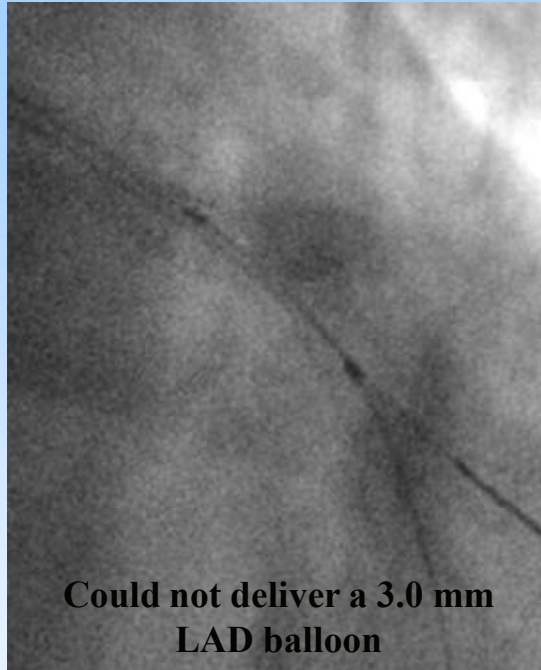


Cranial LAO

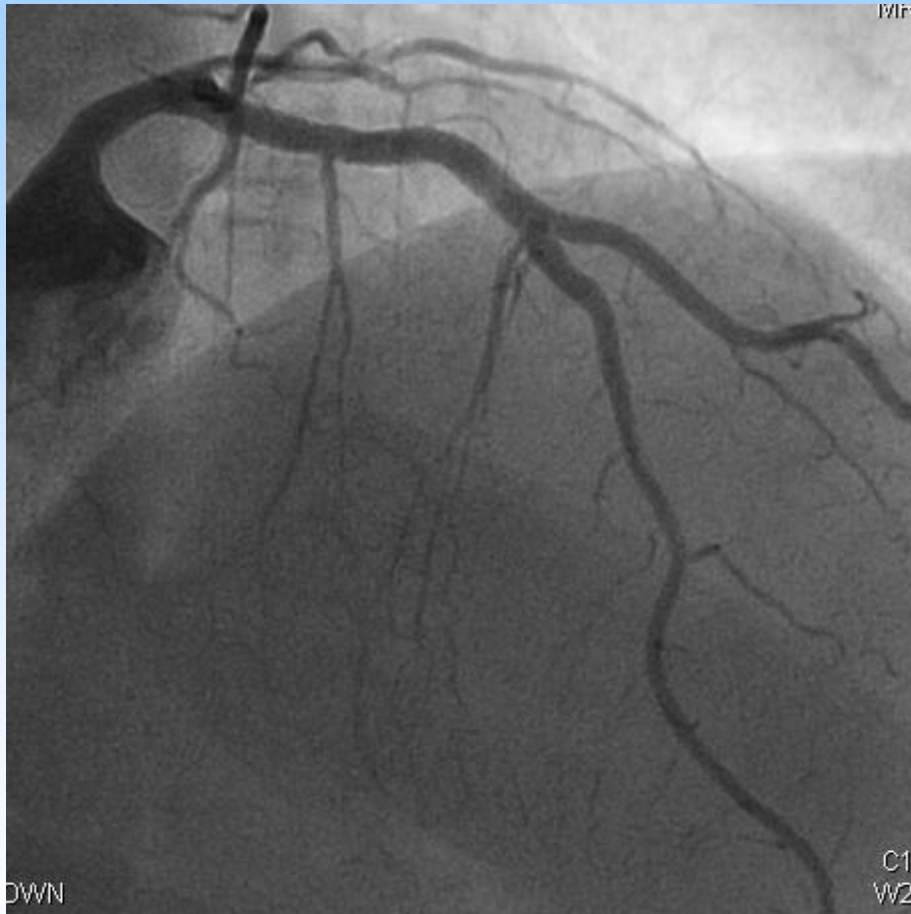


# Provisional “TAP” Technique

## The Price of Omitting an Important Step



# Provisional “TAP” Technique



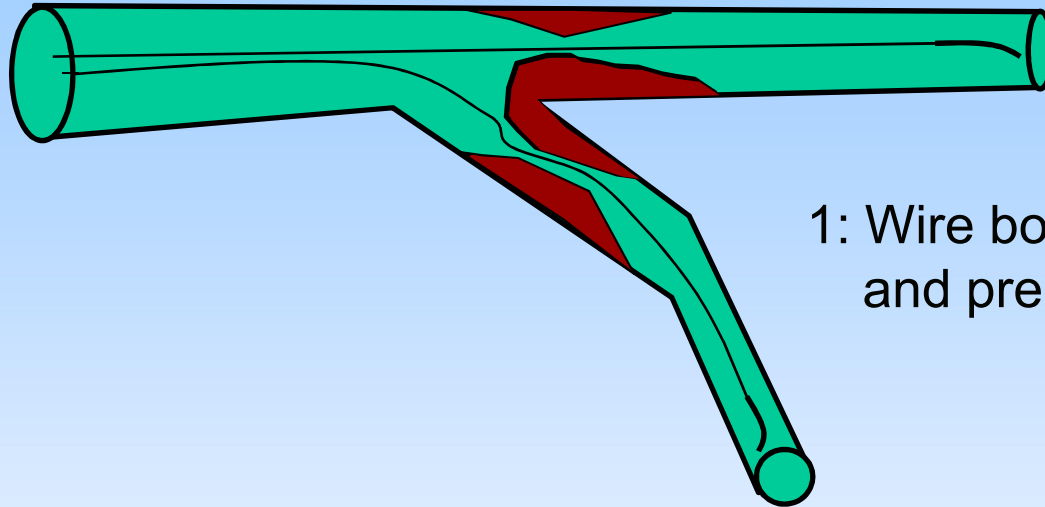
# Provisional “TAP” Technique

- Always keep the MV balloon in place as the SB stent is deployed.
- Not an optimal technique when the SB-DMV angle is  $<50-60$  degrees (difficult to avoid too much protrusion).

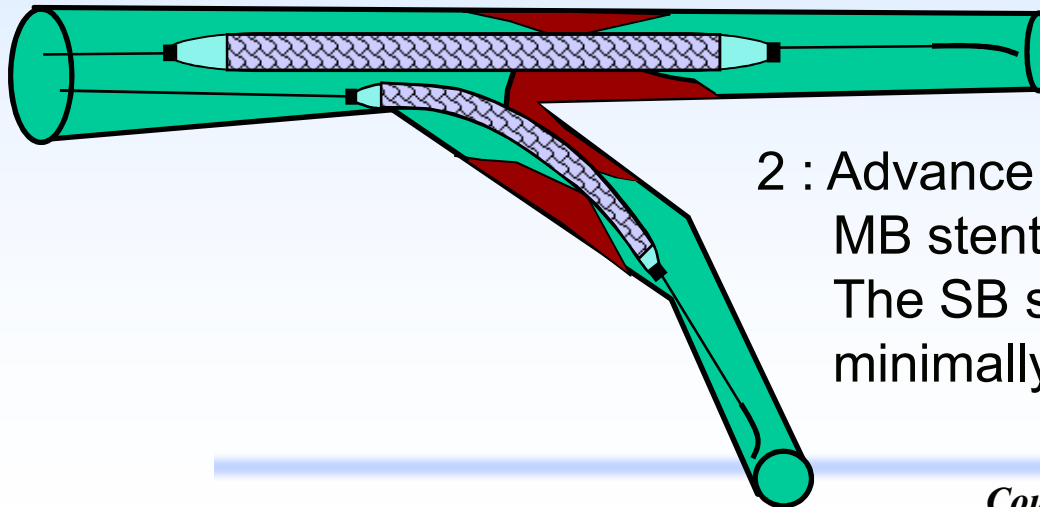




# Crush stenting



1: Wire both branches  
and predilate if needed

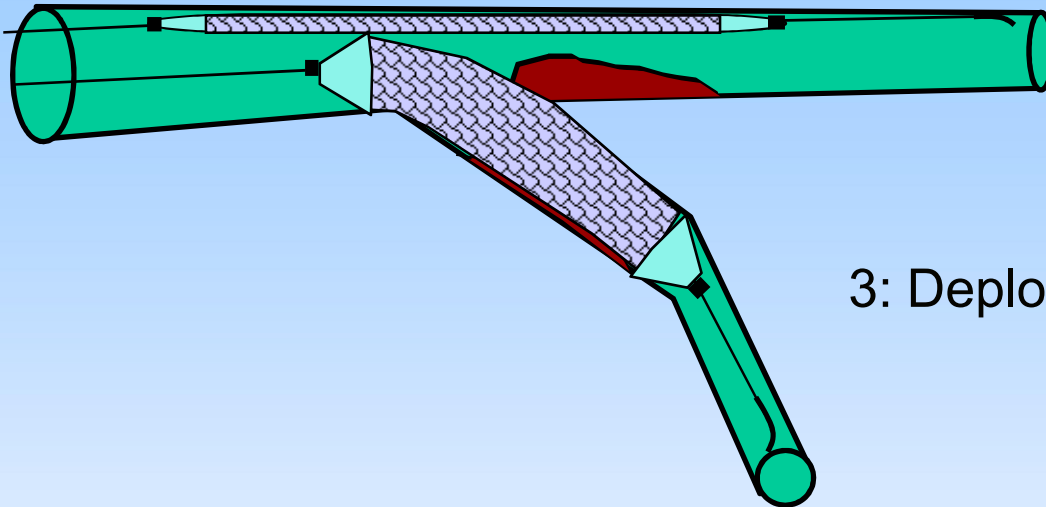


2 : Advance the 2 stents.  
MB stent positioned proximally.  
The SB stent will protrude only  
minimally into MB.

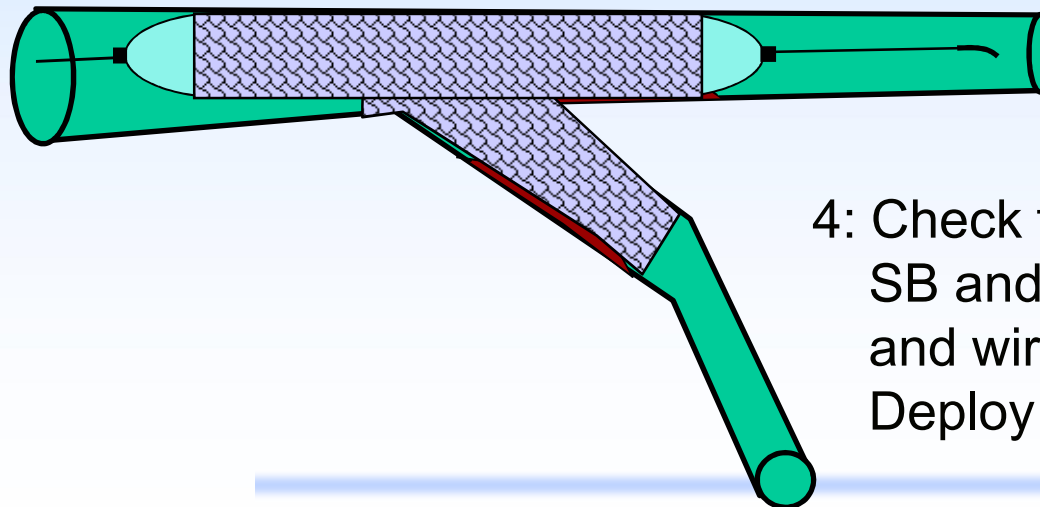


*Courtesy of Antonio Colombo, MD.*

# Crush stenting



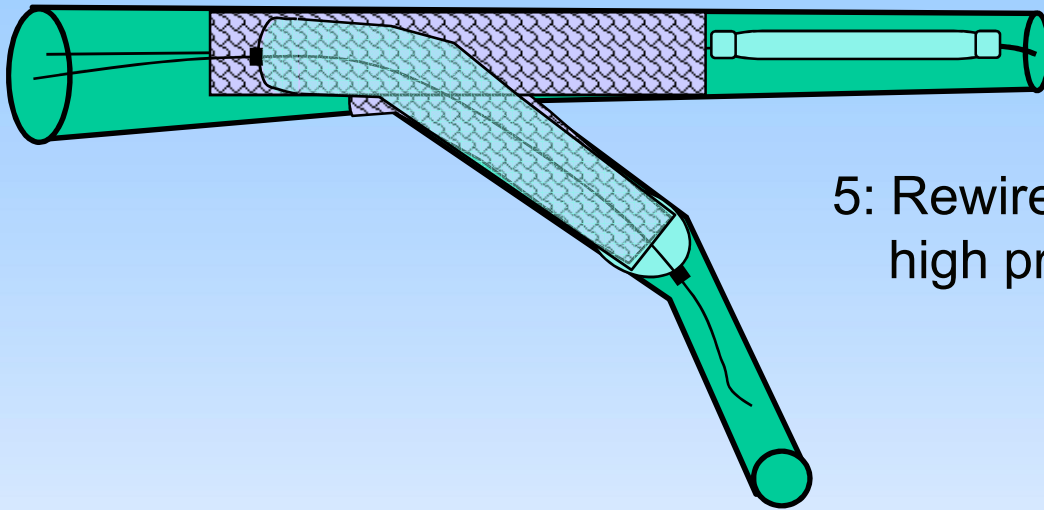
3: Deploy the SB stent



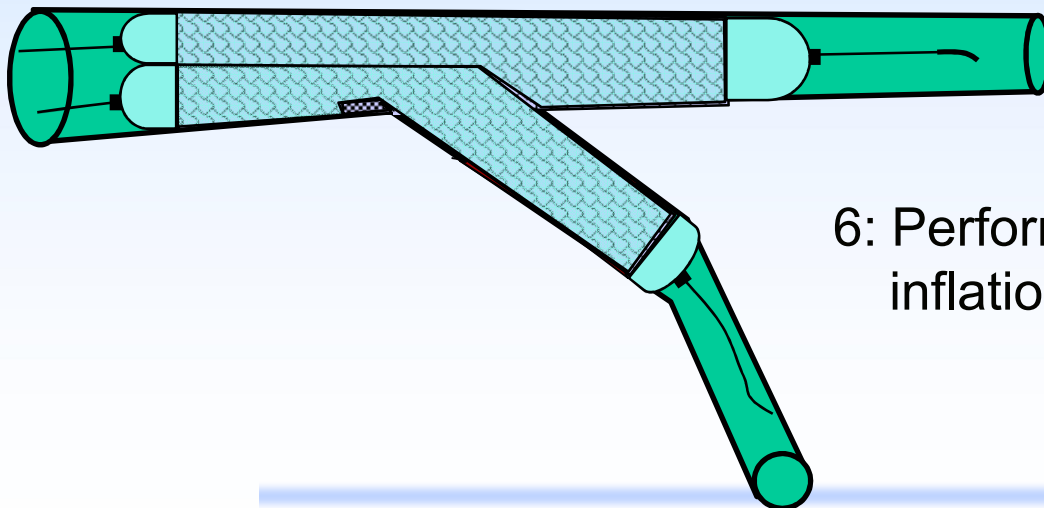
4: Check for optimal result in the SB and then remove balloon and wire from SB.  
Deploy the MB stent



# Crush stenting



5: Rewire the SB and perform high pressure dilatation



6: Perform final kissing balloon inflation



# The Crush Technique



Baseline



Final Result

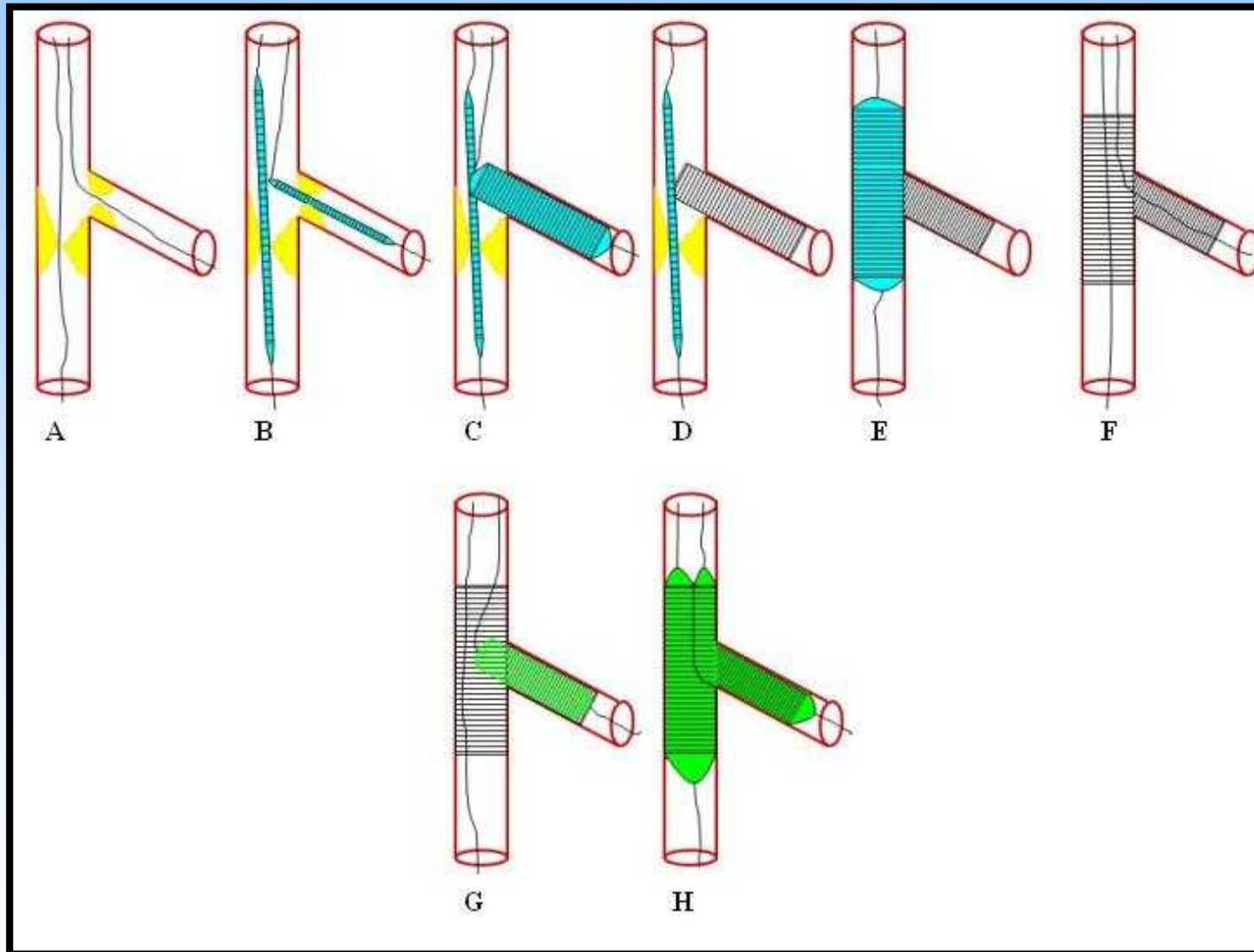


# The (Mini) Crush Technique

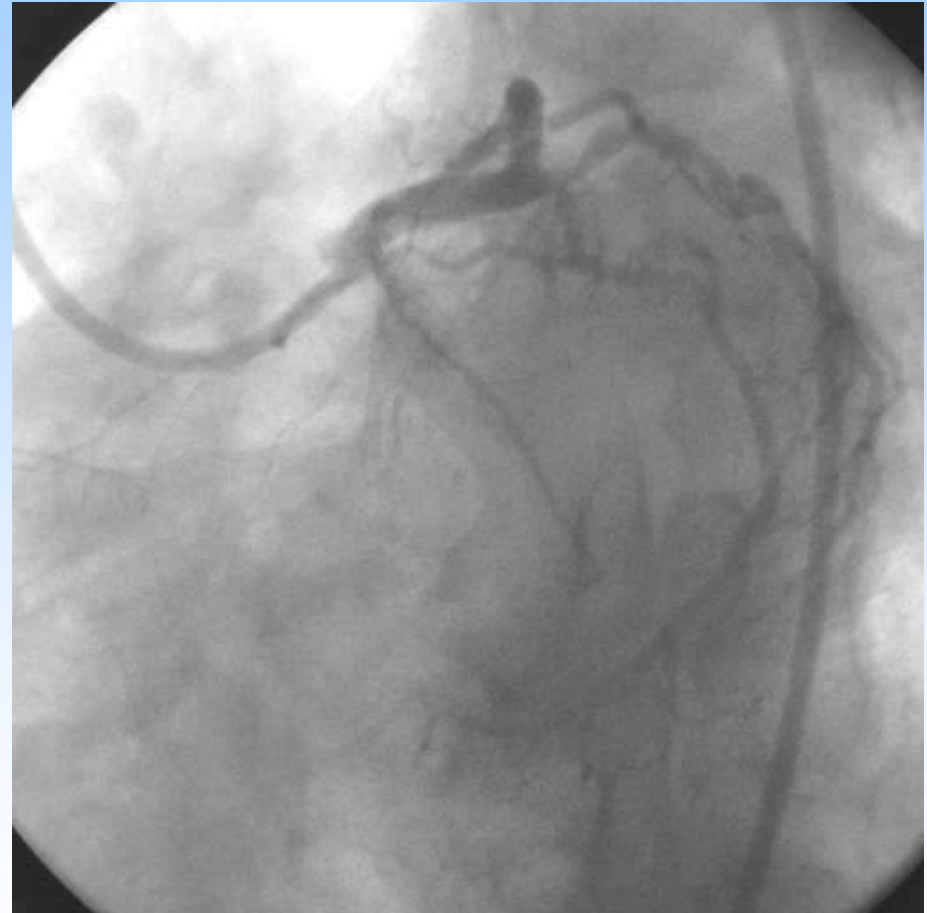
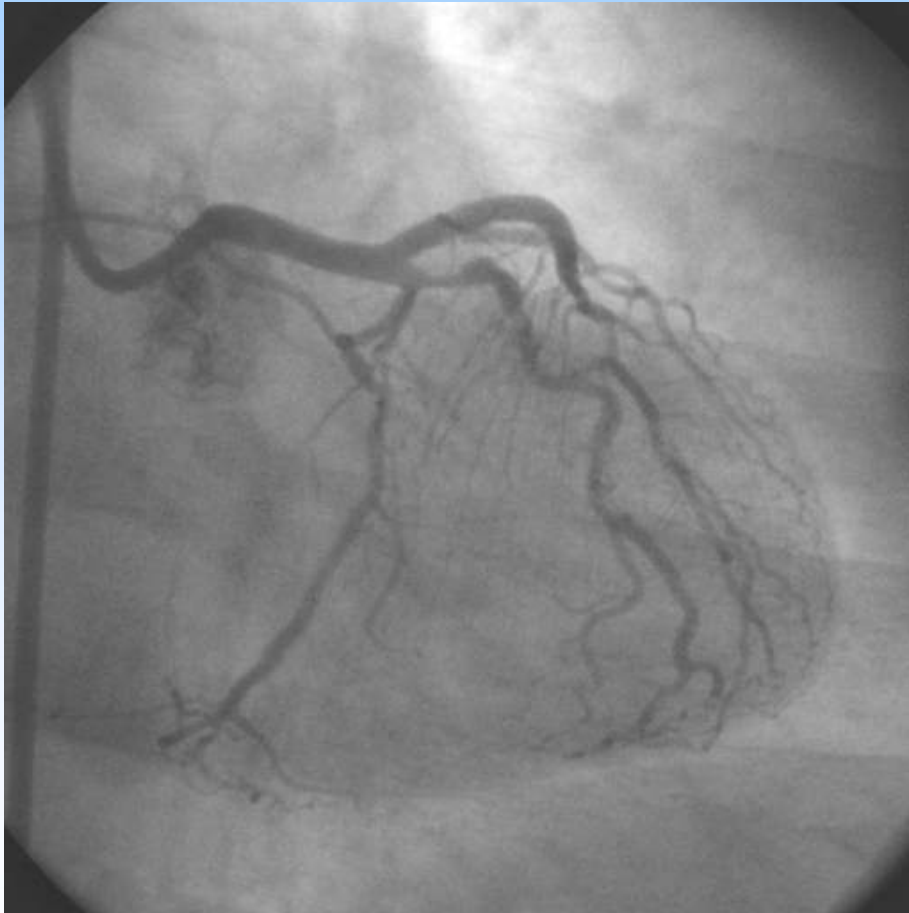
- **Advantages**
  - Guarantees the complete coverage of the SB ostium while ensuring the patency of both branches throughout the procedure. Compared to the culotte technique, there is need to rewire only the SB and not both branches.
- **Disadvantages**
  - Excessive metal (3 layers) in the MB proximal to the origin of the SB which can complicate rewiring and balloon re crossing.



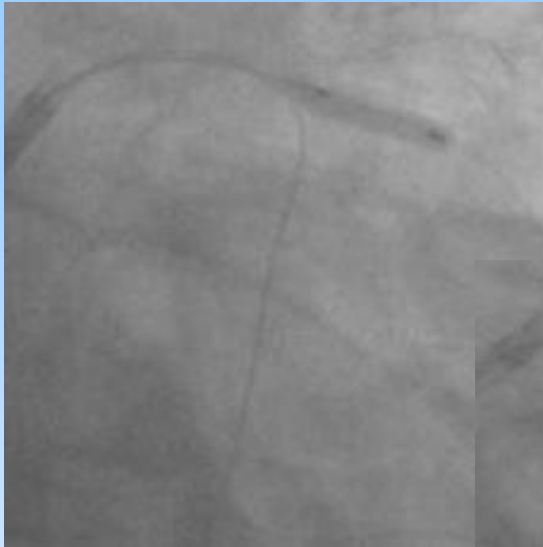
# The (Mini) Crush Technique



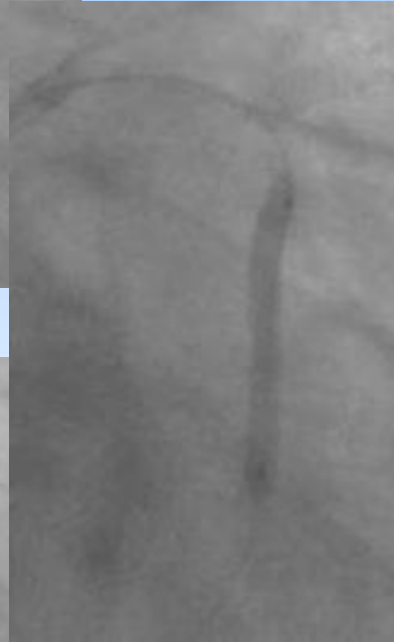
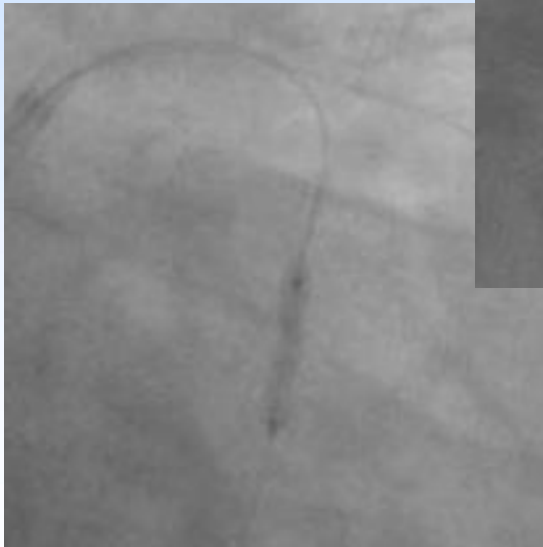
# The (Mini) Crush Technique



Pre dilate MB



Pre dilate SB



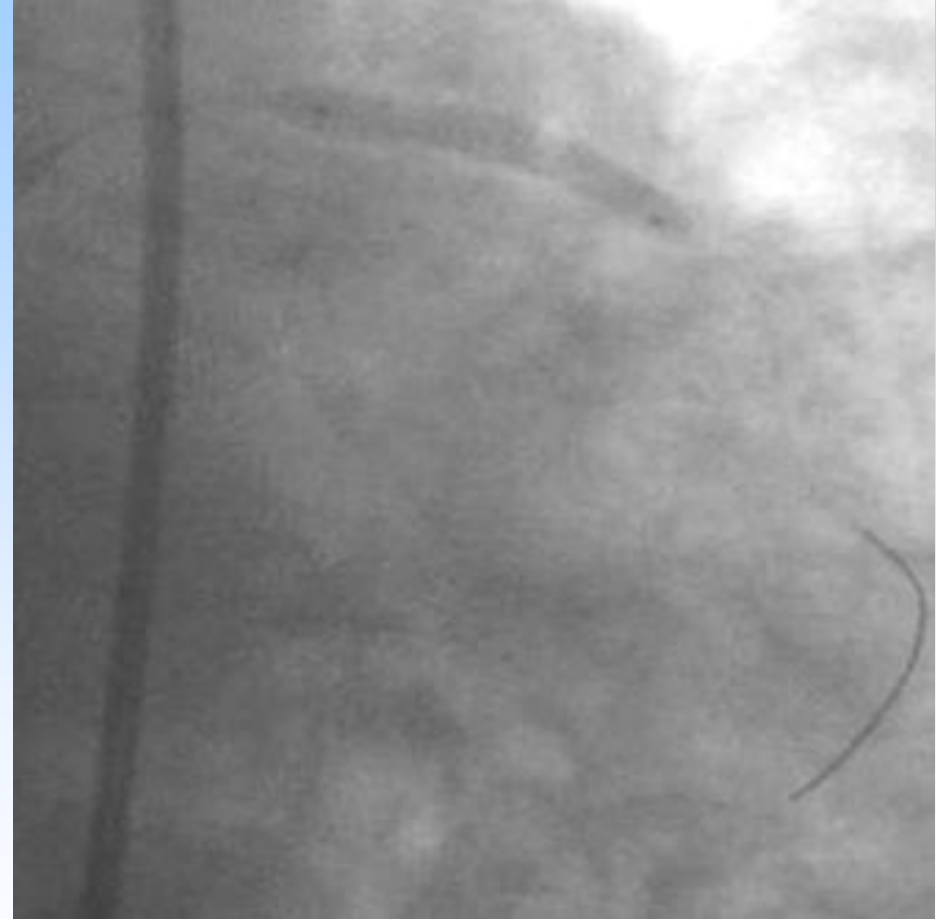


# The (Mini) Crush Technique

## Sequential Stent Deployment



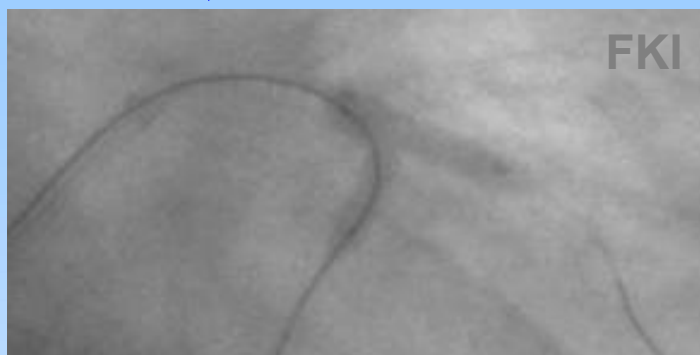
Distal Lcx stent deployment



Ramus stent deployment



# The (Mini) Crush Technique



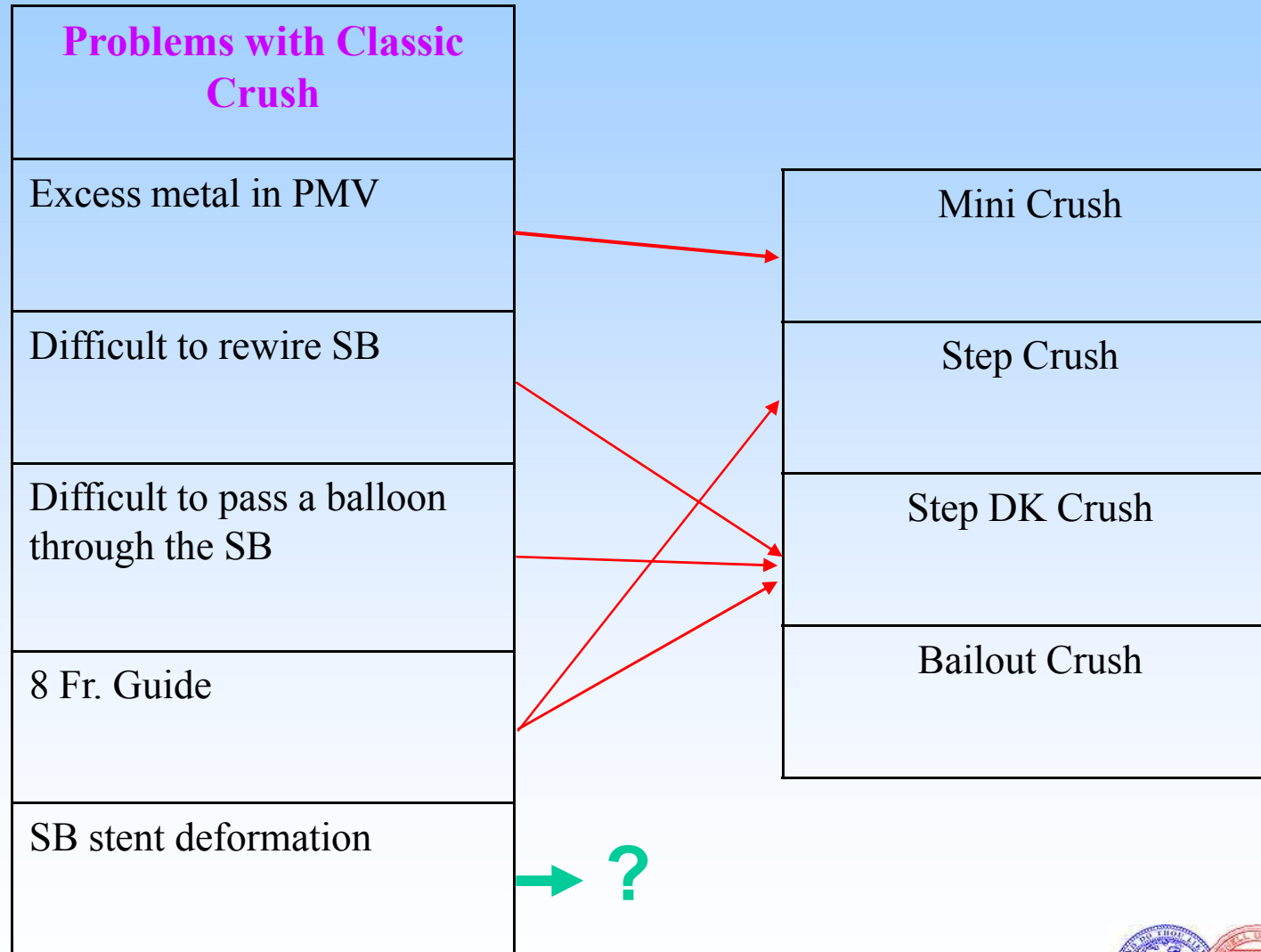
# The CRUSH Technique

## Failure Modes and How to Address Them

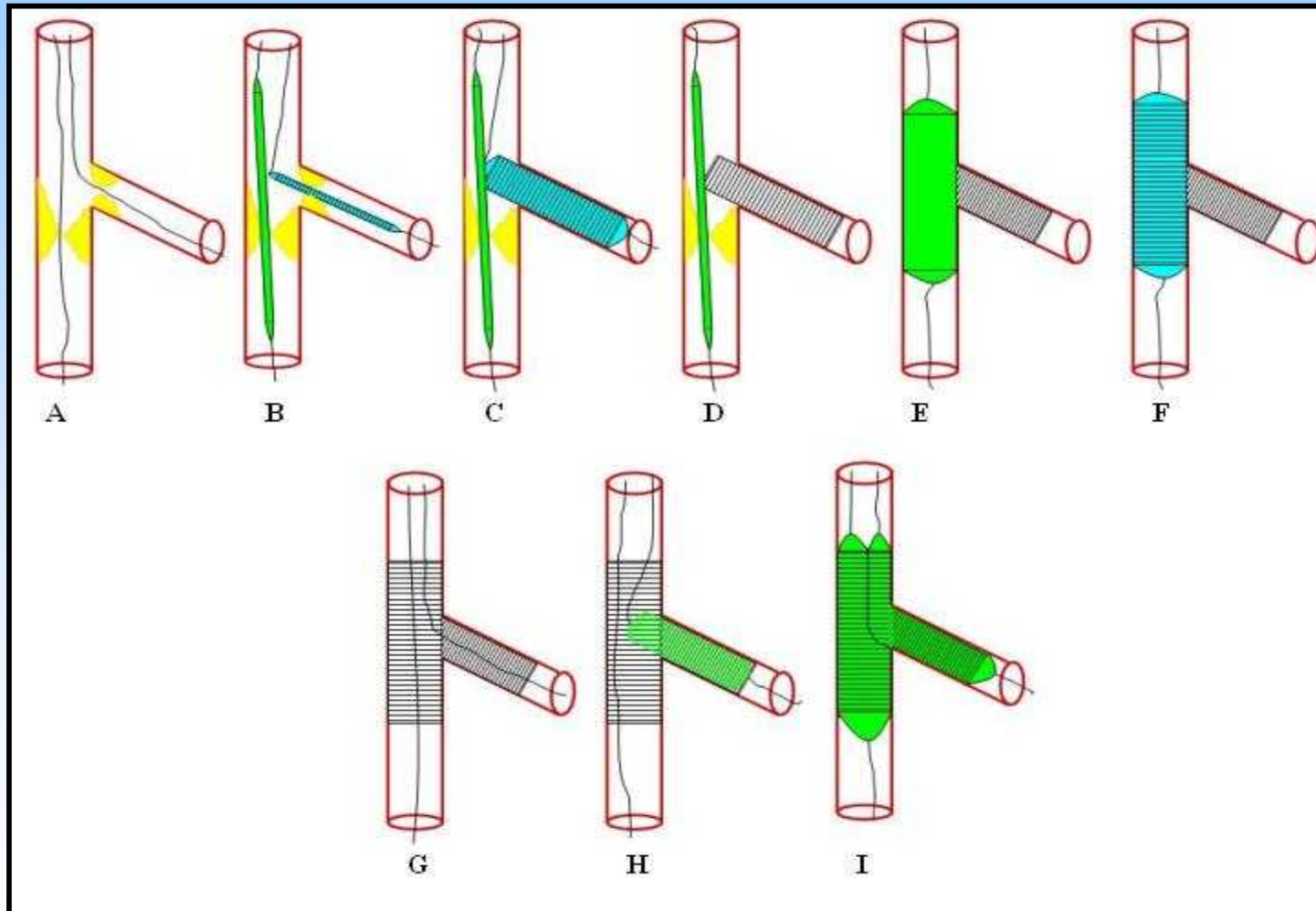
- Inability to rewire the side branch
  - Use hydrophilic wires (careful manipulation). If they fail consider stiffer tapered tip wires (Miracle wire series).
- Inability to pass a balloon into the side branch
  - Use a 1.5 mm balloon
  - If it fails re wire the SB with a second wire at a different entry site
  - If it fails use a fixed wire balloon system (ACE, etc..)



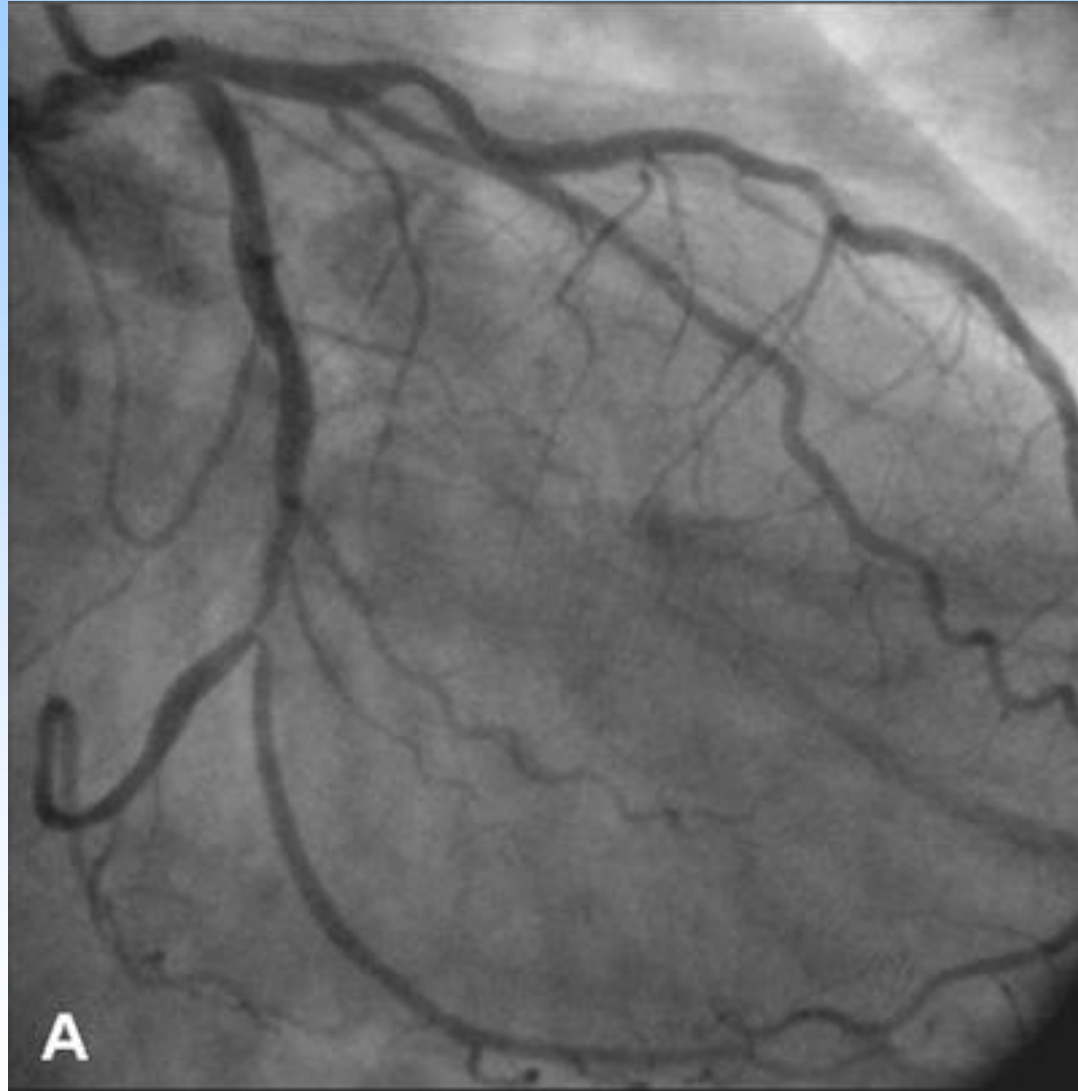
# Variants of Classic Crush



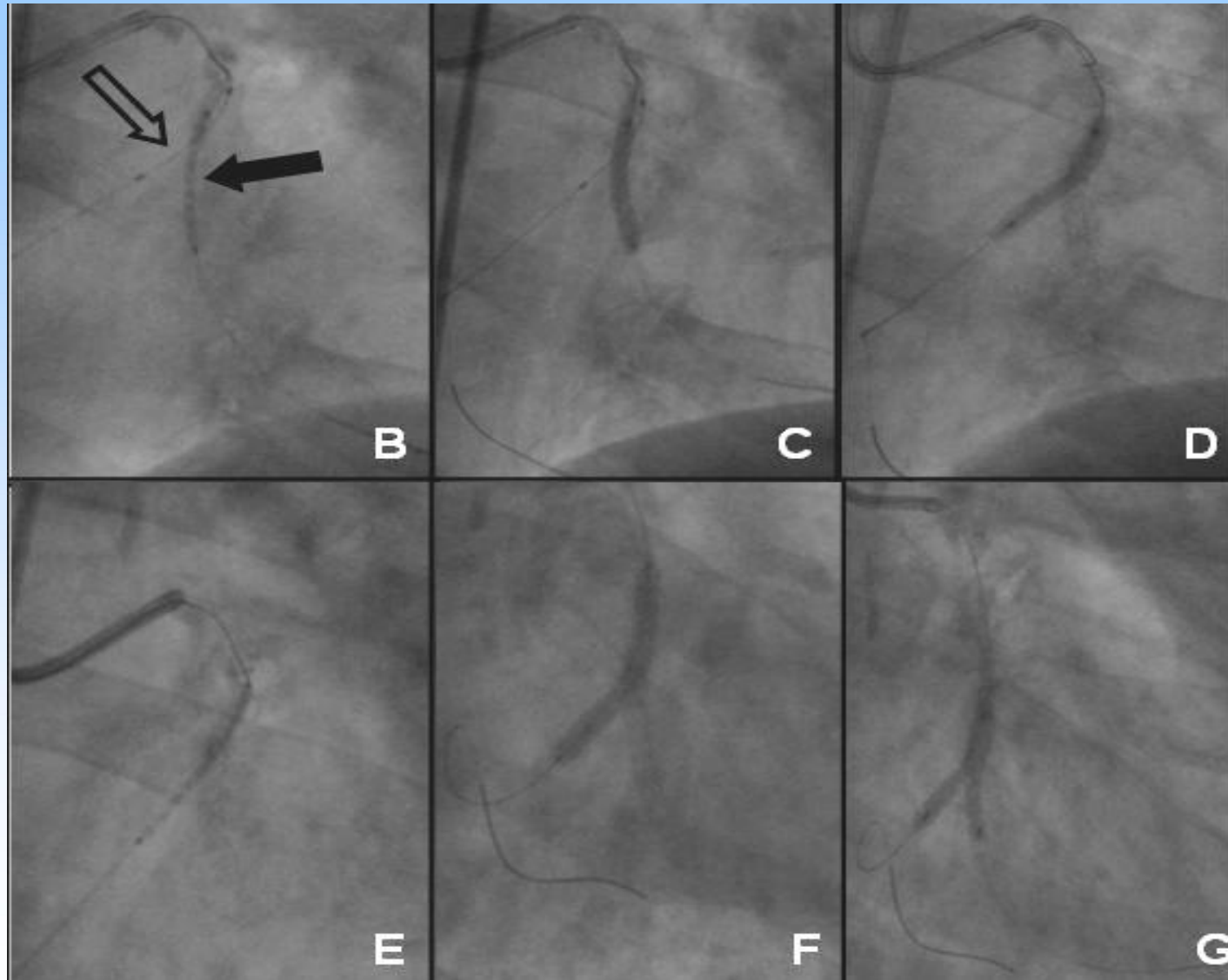
# The Step Crush Technique



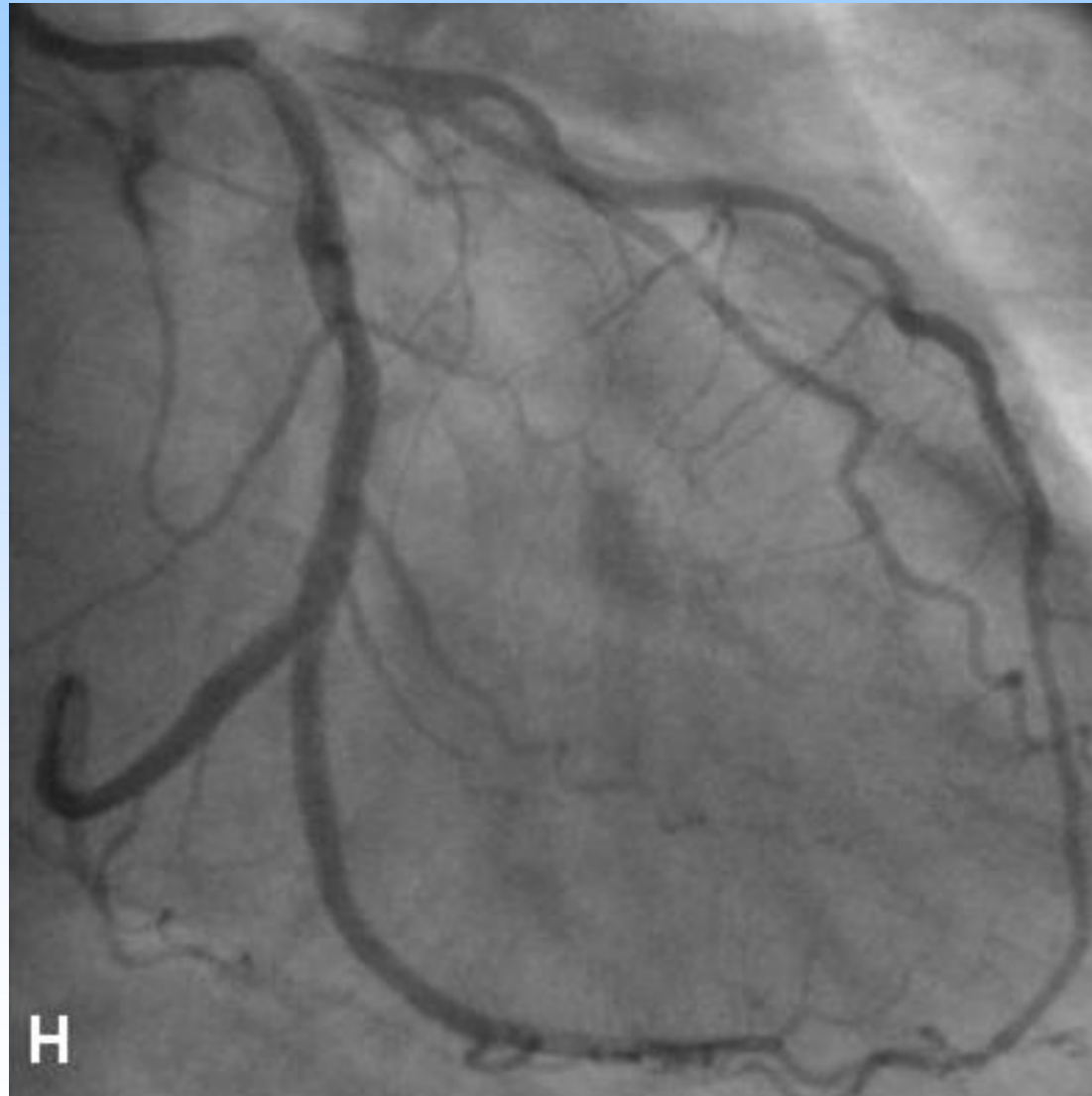
# The Step Crush Technique



# The Step Crush Technique



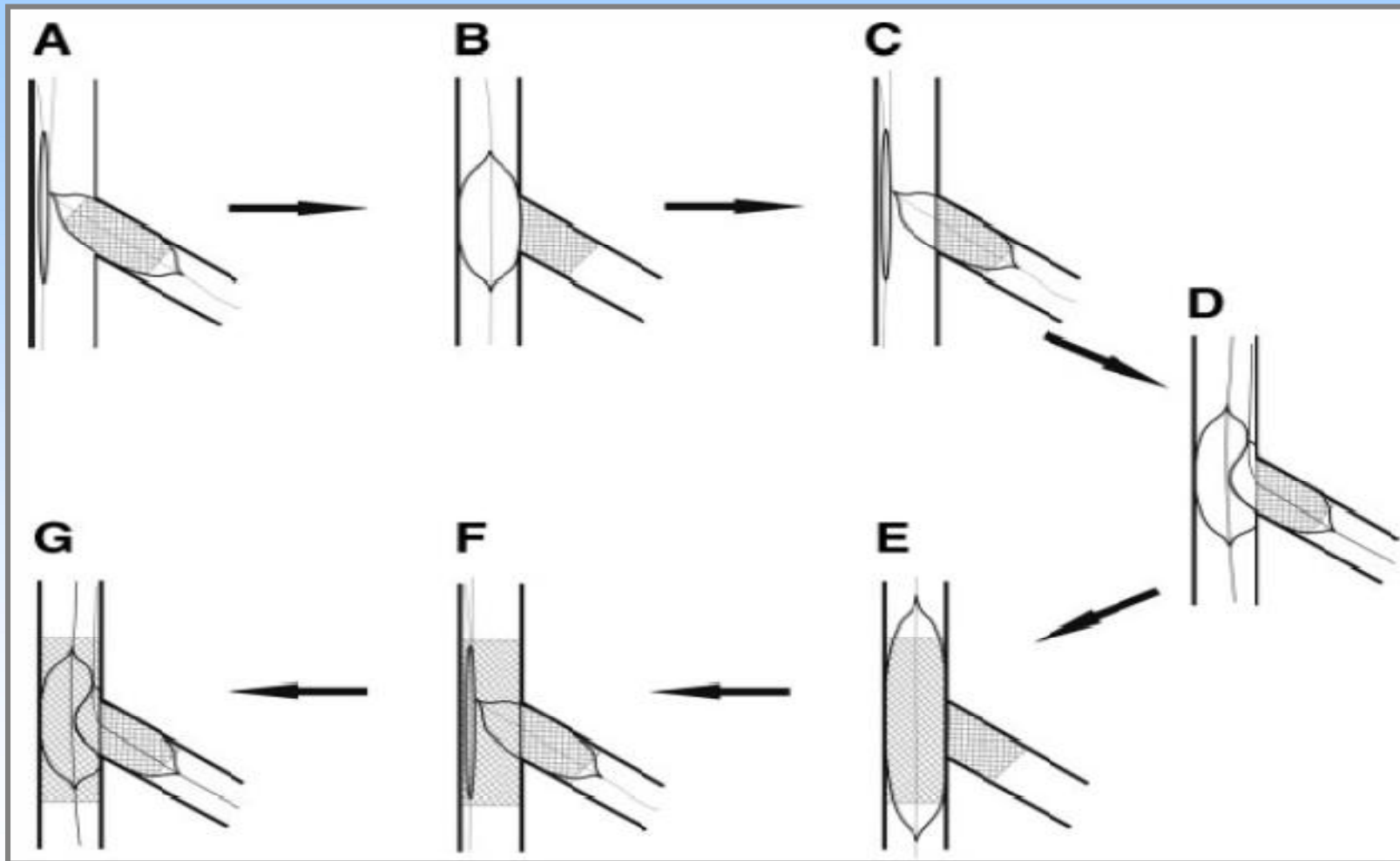
# The Step Crush Technique





# Step DK Crush Technique

## Sleeve Technique

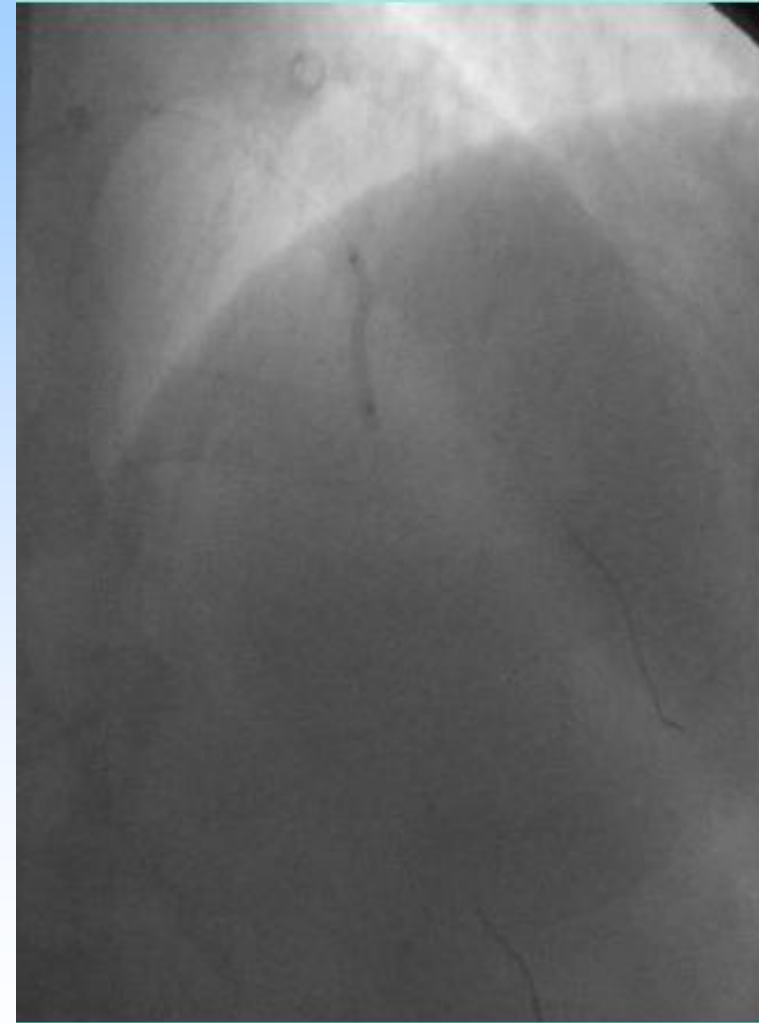


# “Bailout” Crush Technique

After SKS Technique



Baseline



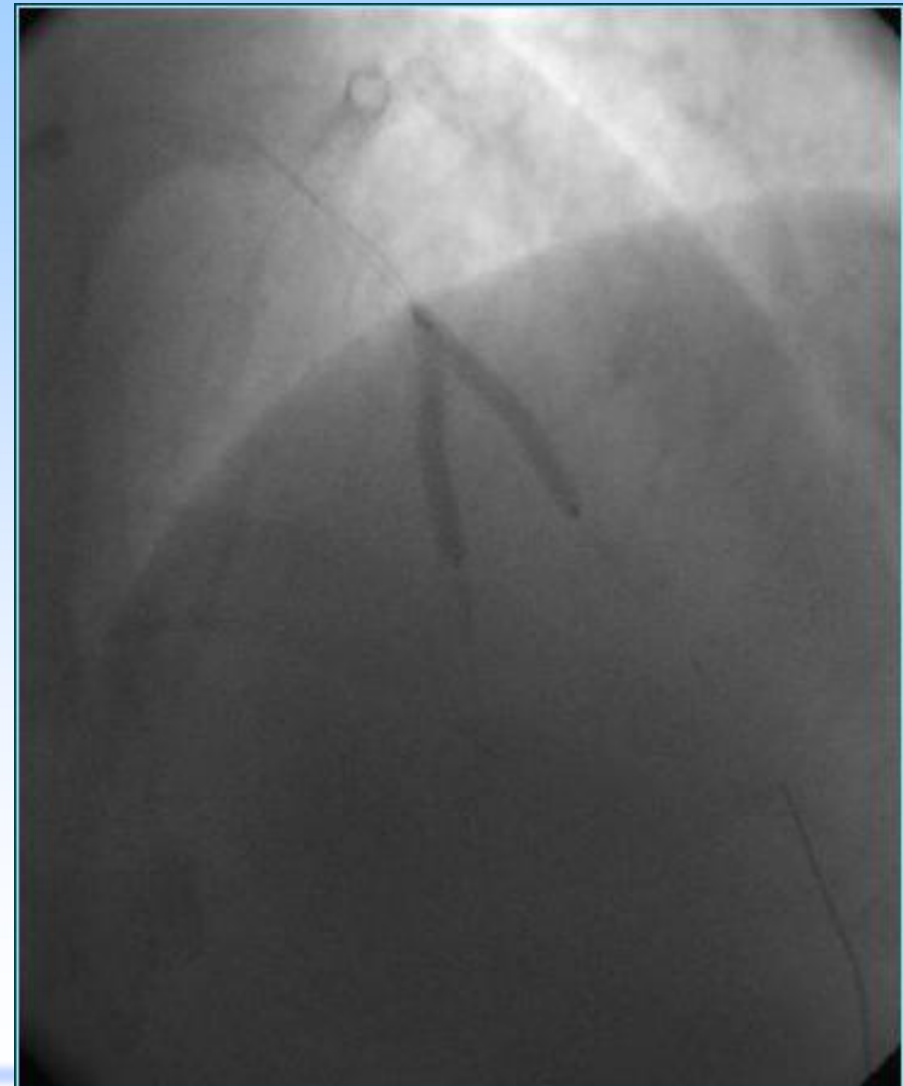
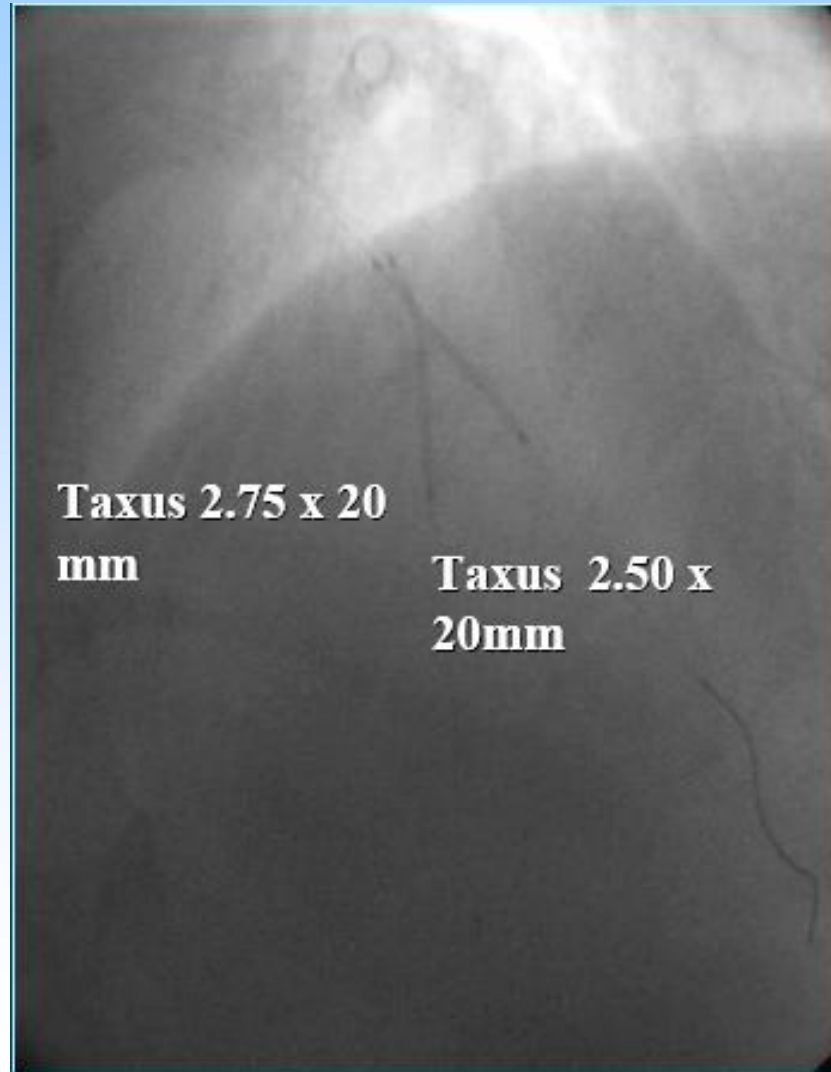
Pre dilatation

*Courtesy of Antonio Colombo, MD.*



# “Bailout” Crush Technique

*After SKS Technique*



Simultaneous stent insertion and deployment



# “Bailout” Crush Technique After SKS Technique

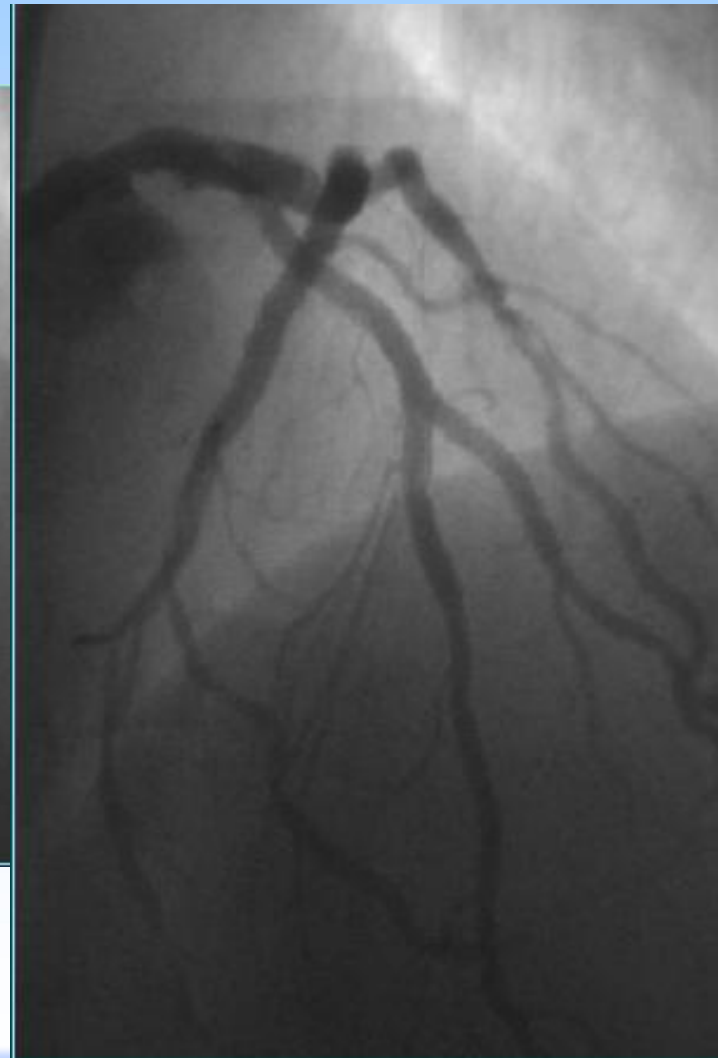


After SKS



Taxus 3.0 x 16  
mm

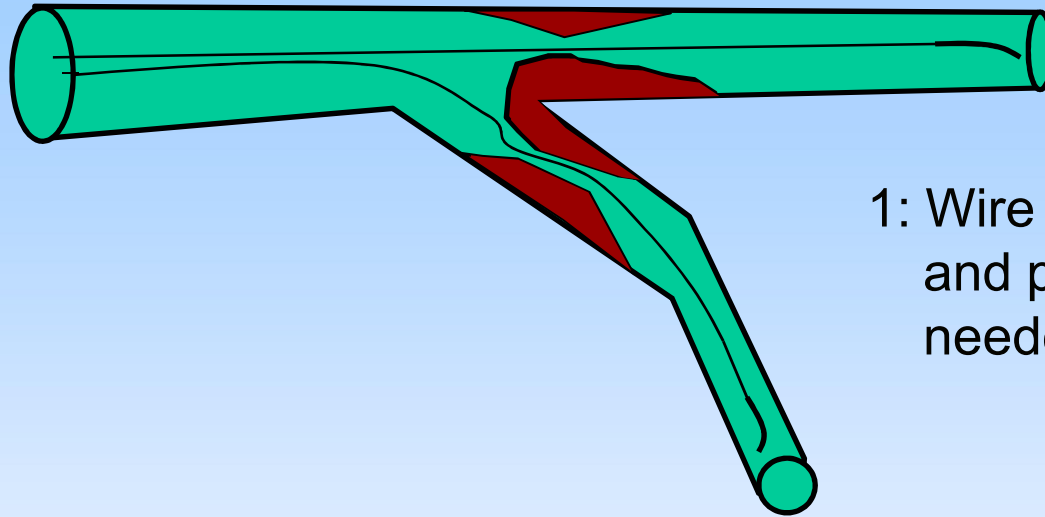
stent  
deployment  
with crush of  
diagonal stent



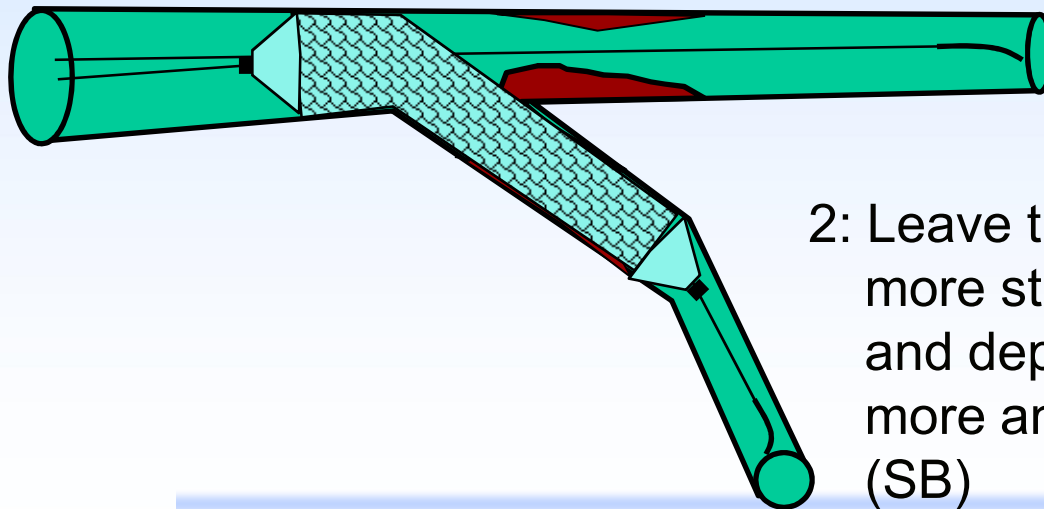
Final result



# Culotte stenting



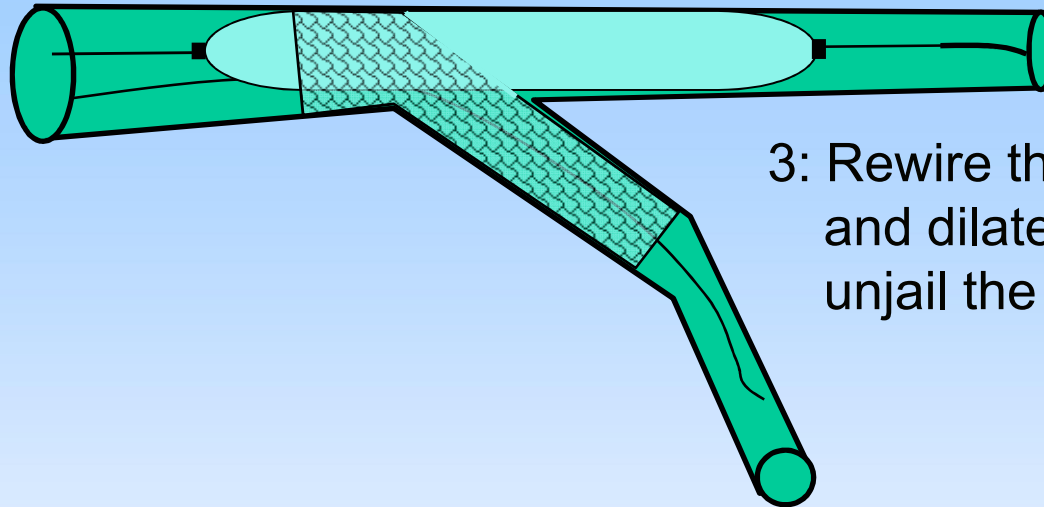
1: Wire both branches and predilate if needed



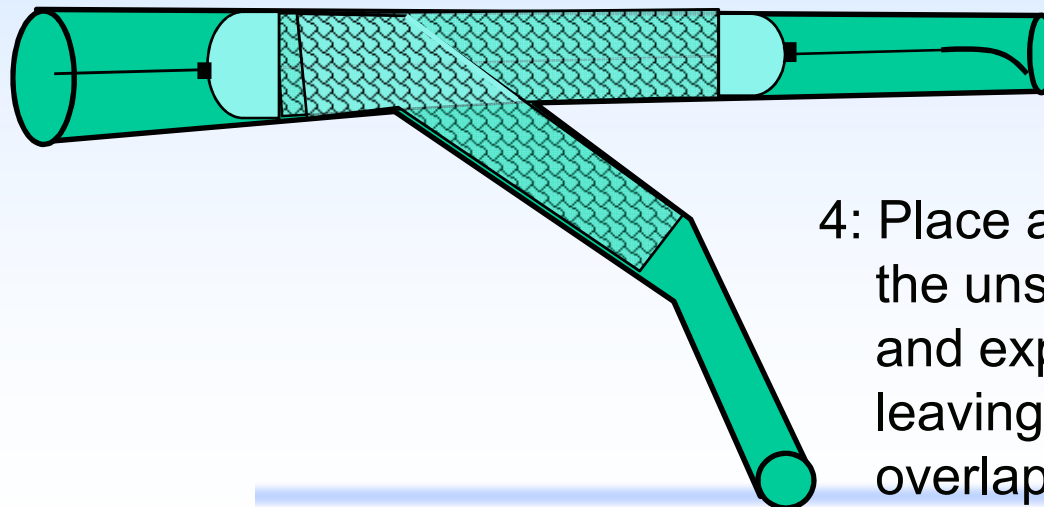
2: Leave the wire in the more straight branch (MB) and deploy a stent in the more angulated branch (SB)



# Culotte stenting



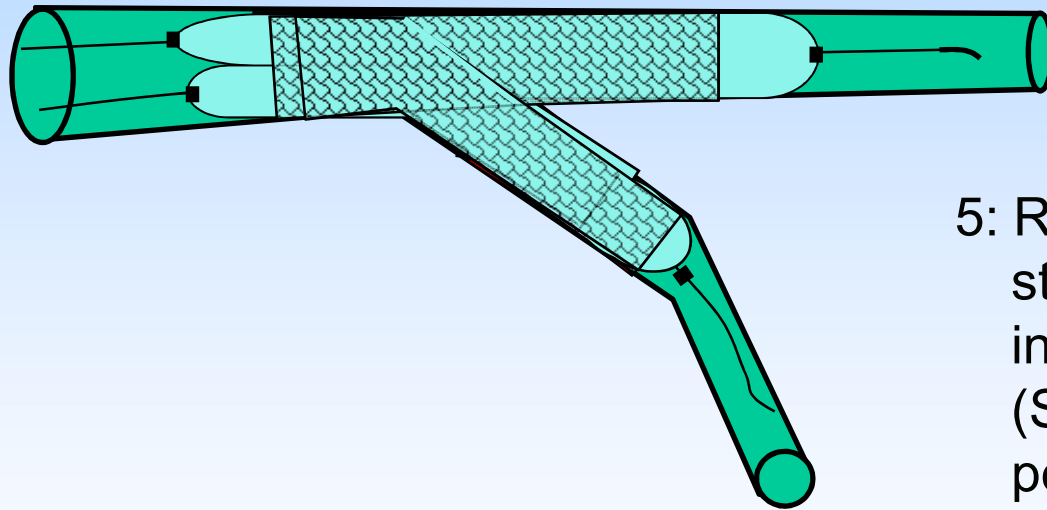
3: Rewire the unstented branch and dilate the stent struts to unjail the branch (MB).



4: Place a second stent into the unstented branch (MB) and expand the stent leaving some proximal overlap



# Culotte stenting



5: Re-cross the 2nd stent's (MB) struts into the 1st stent (SB) with a wire and perform kissing balloon inflation.



# Culotte stenting

- **Indication**

- True bifurcation lesions particularly when the MB and the SB have the same diameter.

- **Advantages**

- The angle between MB and SB does not constitute a problem using this technique.
- Achieves the most homogeneous distribution of the struts at the bifurcation.

- **Disadvantages**

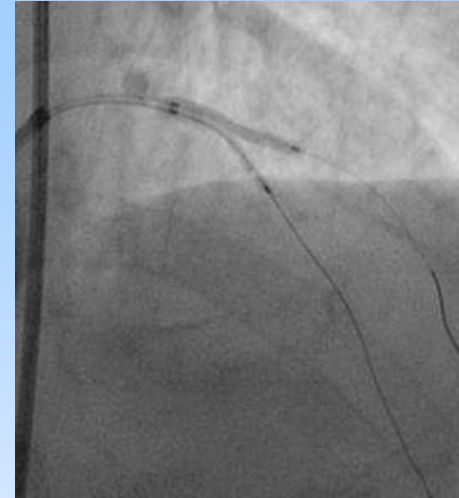
- Excess metal (double layer) at the proximal MB and at the level of the carina. Therefore,
- SB stent malapposition to the proximal MB stent can be an issue when there is large discrepancy between the proximal MB and SB diameters.
- This technique requires rewiring of both branches through the stent struts which can be technically demanding and time consuming.
- Open-cell stents are preferable to closed-cell stents because it permits a larger intra strut opening toward both branches.





# Culotte Stenting

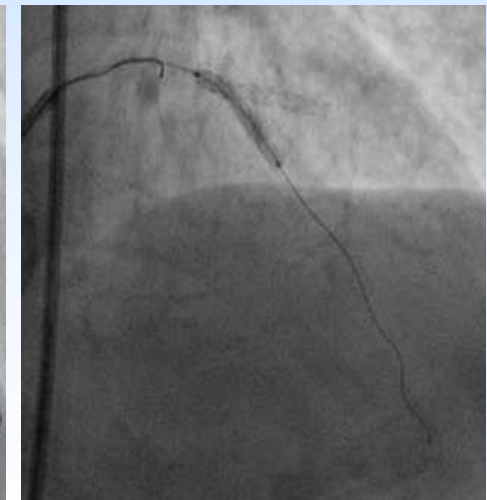
Pre dilatation



Stent SB



Stent MB



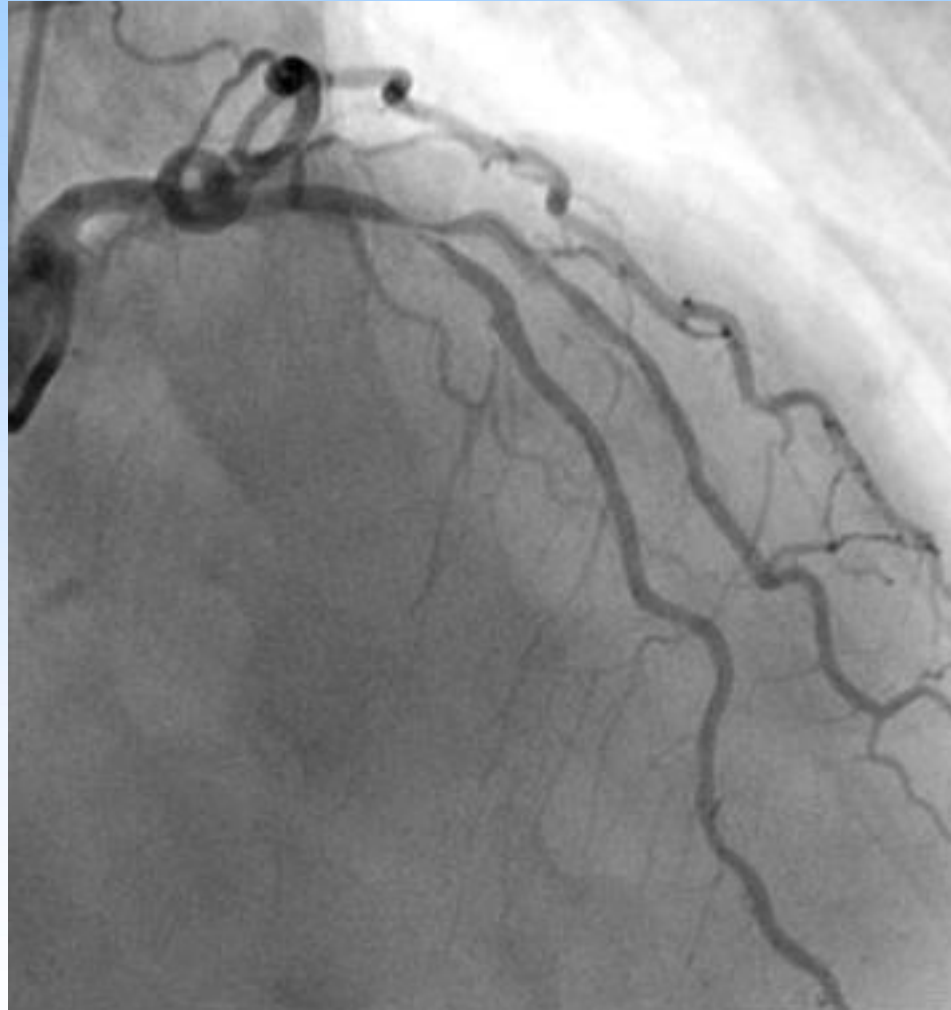
Baseline



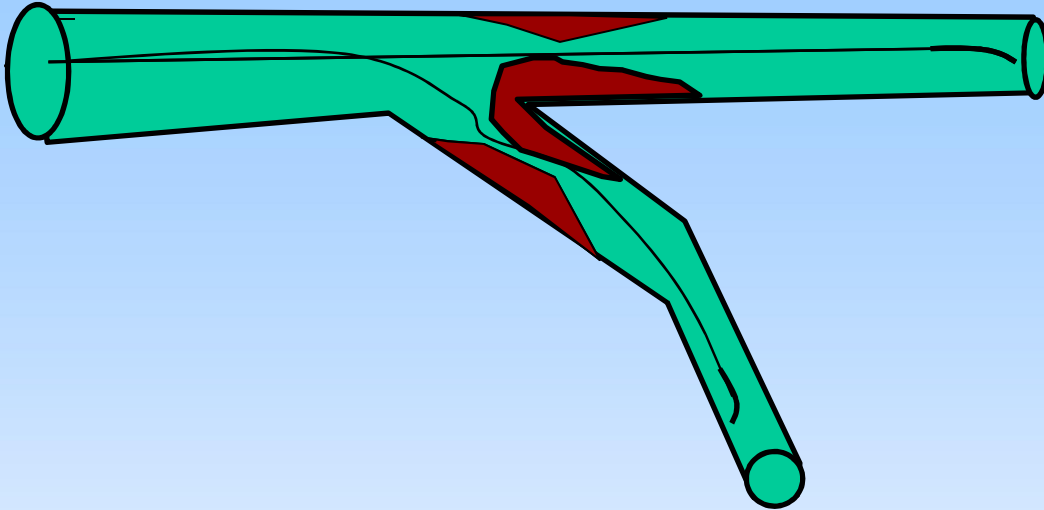
# Culotte Stenting



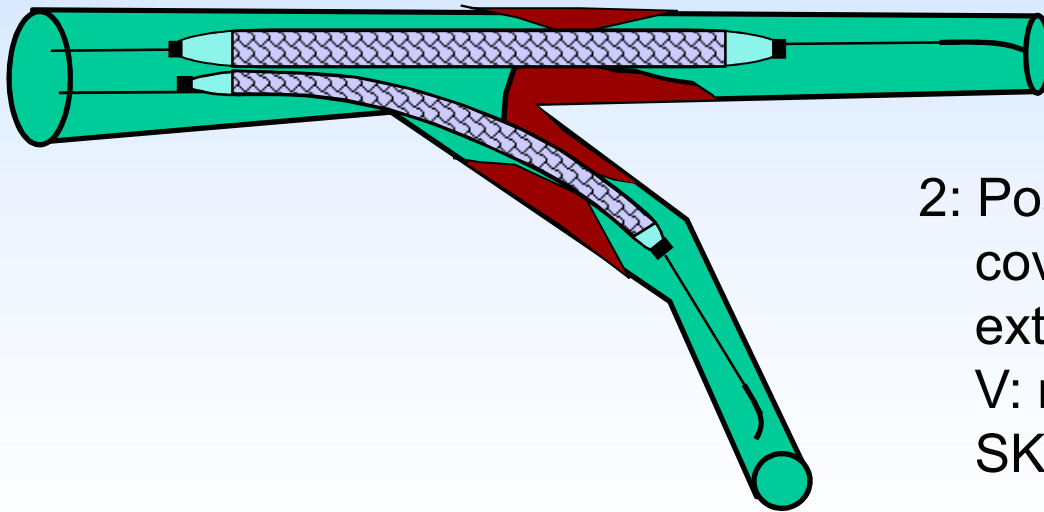
# Culotte Stenting ??



# SKS stenting



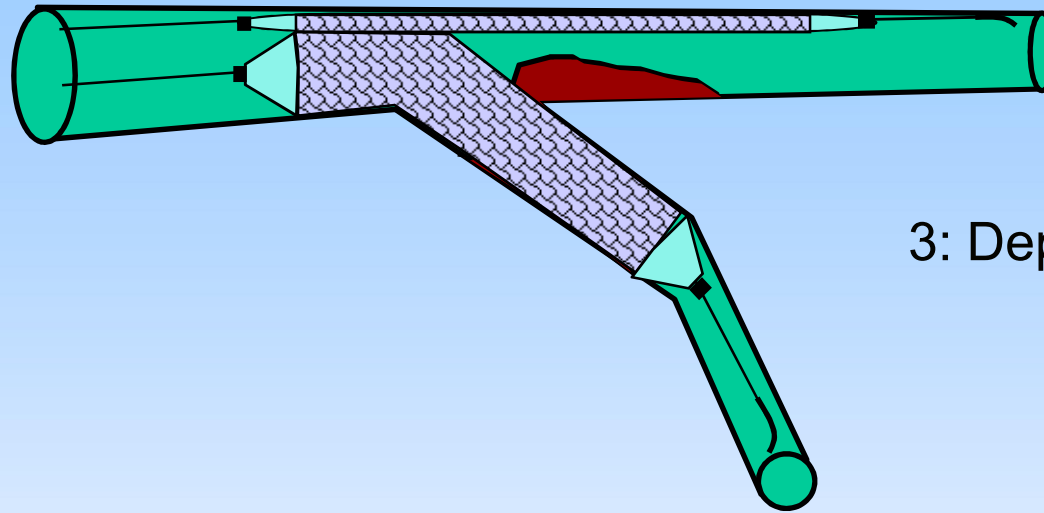
1: Wire both branches  
and predilate if  
needed



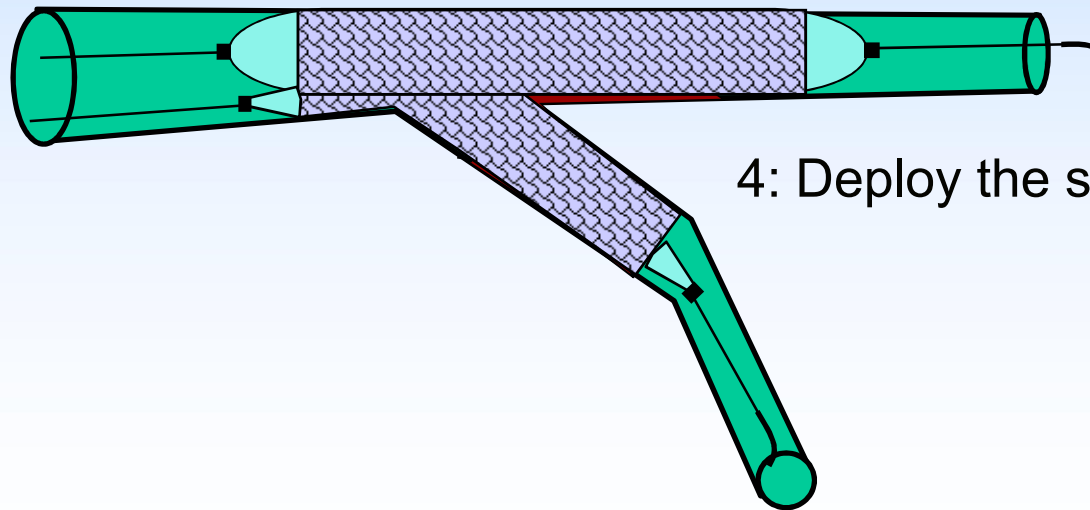
2: Position two parallel stents  
covering both branches and  
extending into the MB  
V: minimal protrusion into MB  
SKS: double barrel into the MB



# SKS stenting



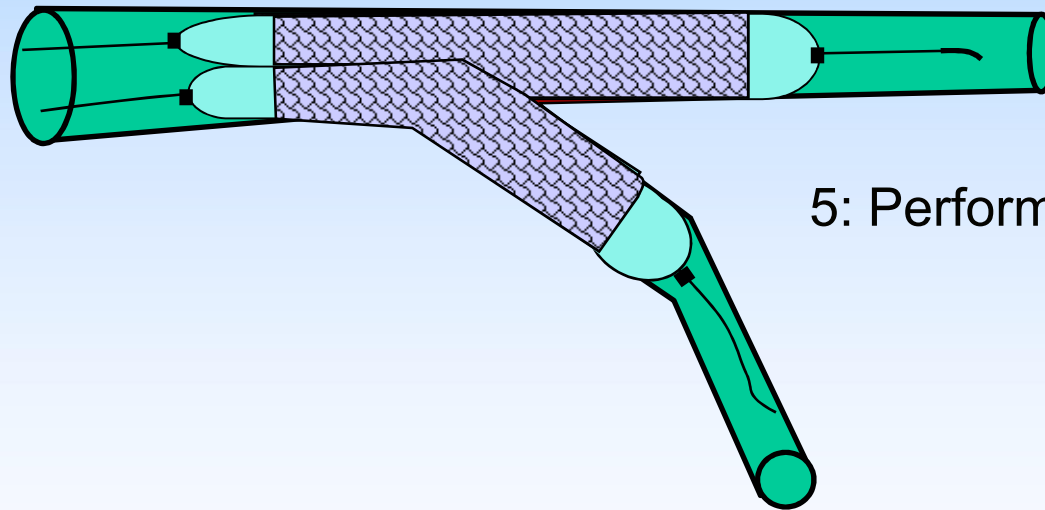
3: Deploy one stent



4: Deploy the second stent



# SKS stenting



5: Perform final kissing inflation



# SKS

- **Indication**

- Medina 0,1,1 bifurcations in which the proximal MB is relatively free from disease with an angle between both branches  $< 90$  degree.

- **Advantages**

- Access to both branches is always preserved during the procedure with no need for rewiring any of the branches. Its is relatively easy and fast.

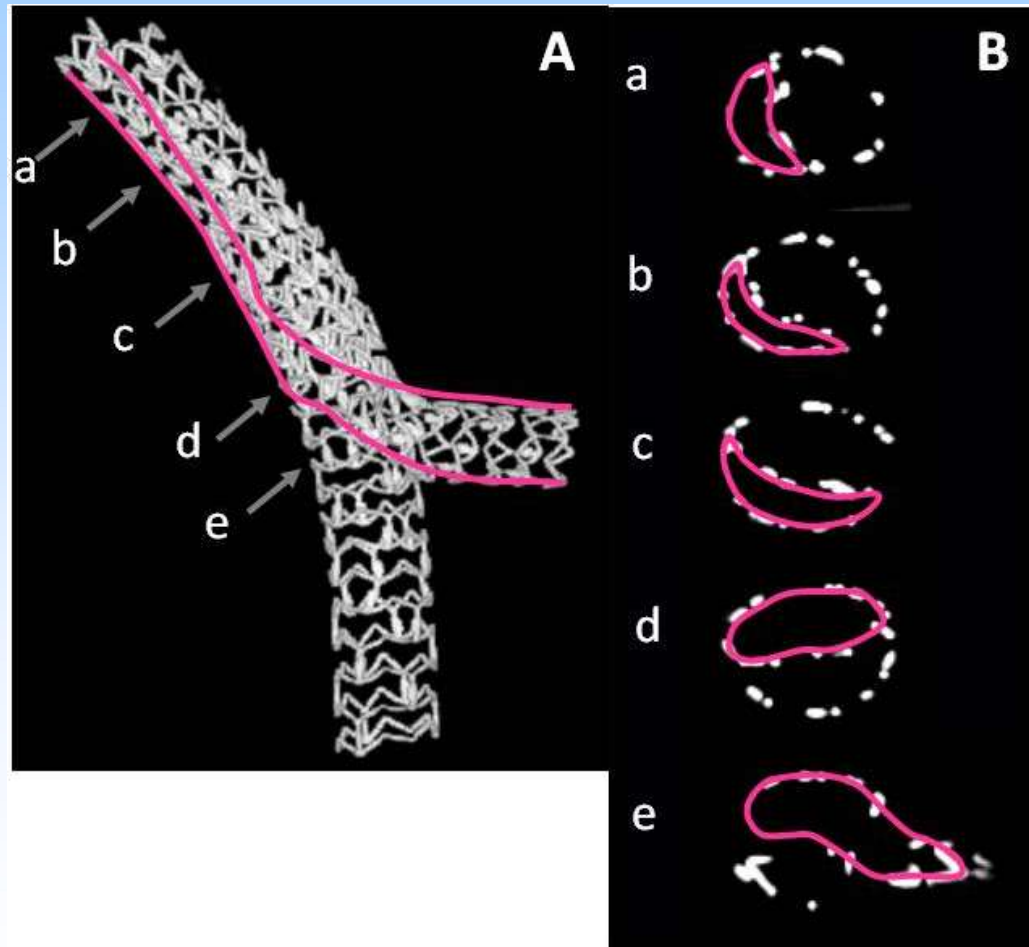
- **Disadvantages**

- Creation of a metallic neo carina (particularly the SKS) in the proximal MB with stent mal-apposition. Theoretically, this technique raises several concerns:
  - The risk of proximal dissection which would require converting the procedure to a crush technique.
  - If re-intervention is necessary at follow-up rewiring the stented vessels may be complicated by wire passage behind stent struts.
  - If restenosis occur in the neo carina or at the proximal stent edge it would require converting to the crush technique for treatment.



# SKS Technique

## Insights from the Bench



*Courtesy of Yoshinobu Murasato, MD.*

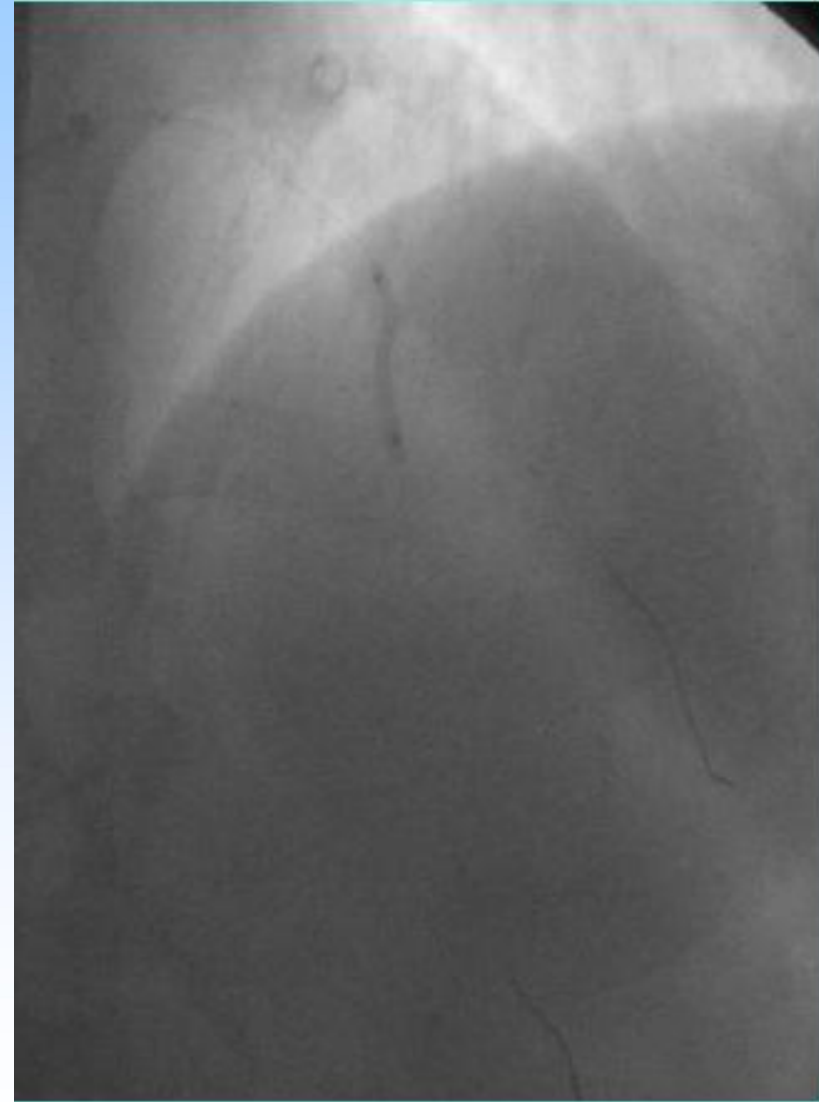




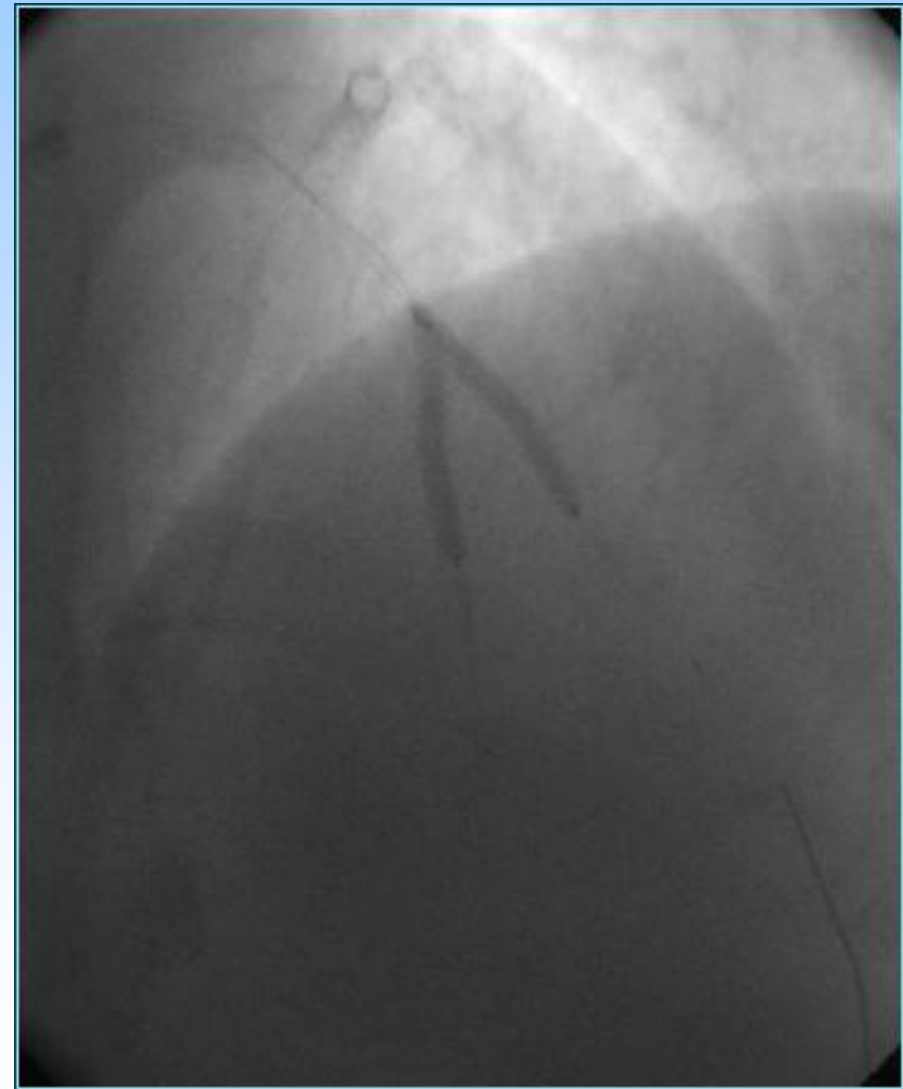
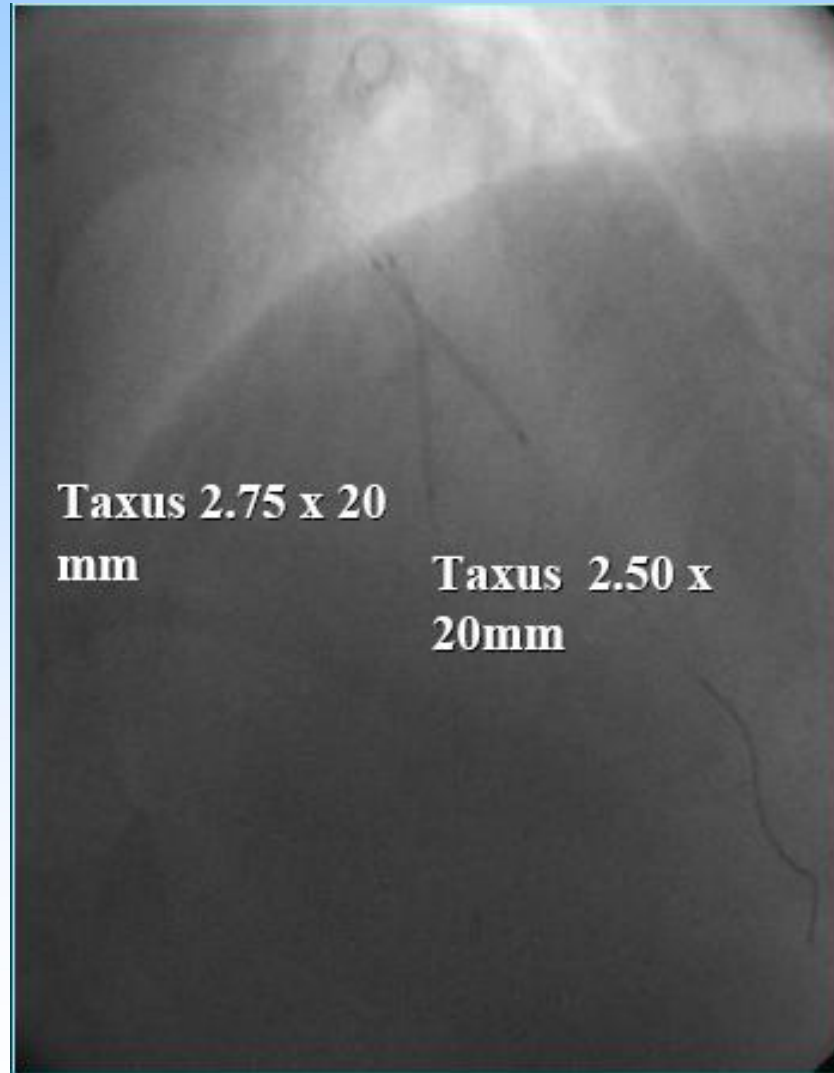
# SKS Technique



Baseline



# SKS Technique



Simultaneous stent insertion and deployment



# Need for a proximal stent after distal V stenting : conversion to CRUSH stenting

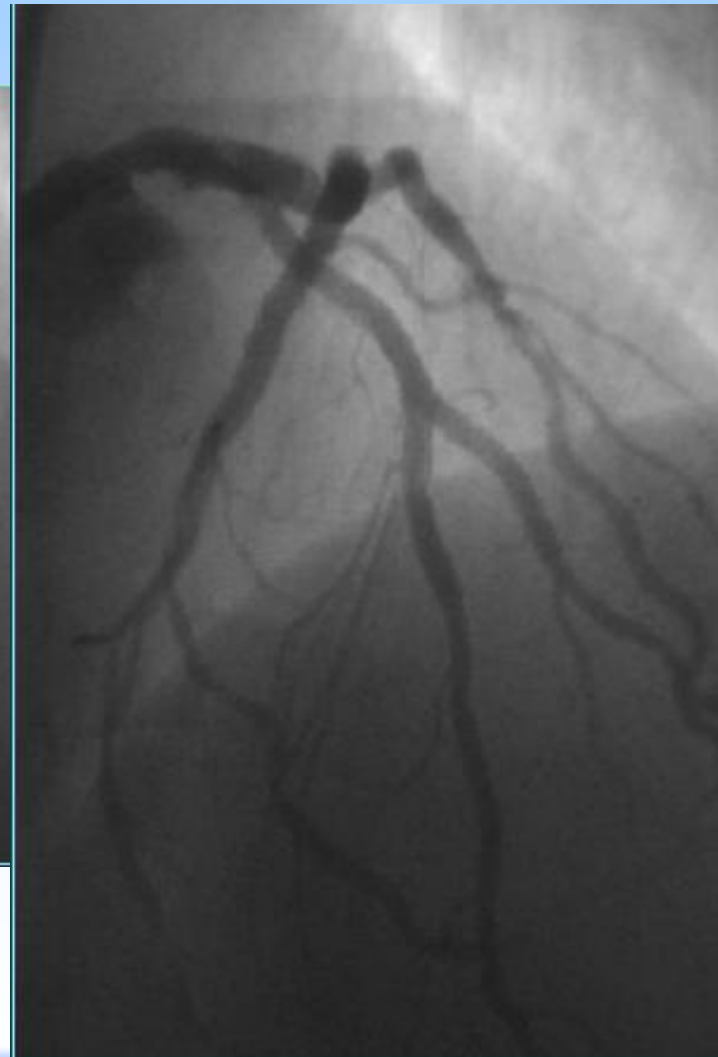


After SKS



Taxus 3.0 x 16  
mm

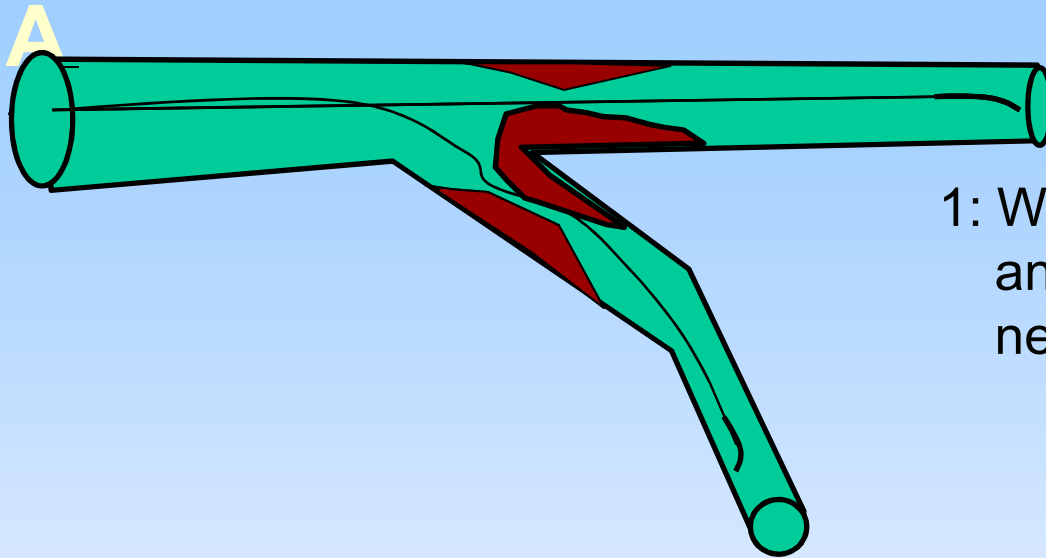
stent  
deployment  
with crush of  
diagonal stent



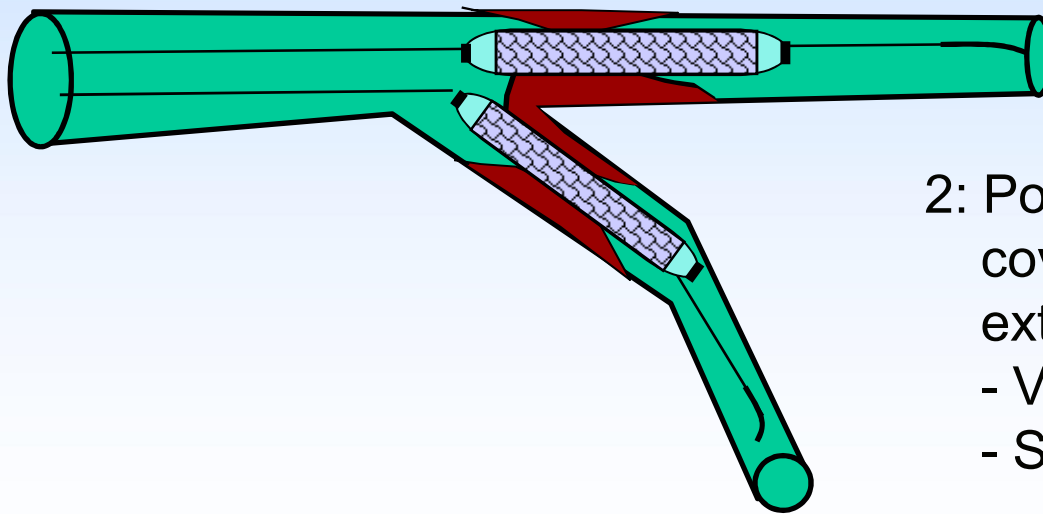
Final result



# V stenting



1: Wire both branches  
and predilate if  
needed

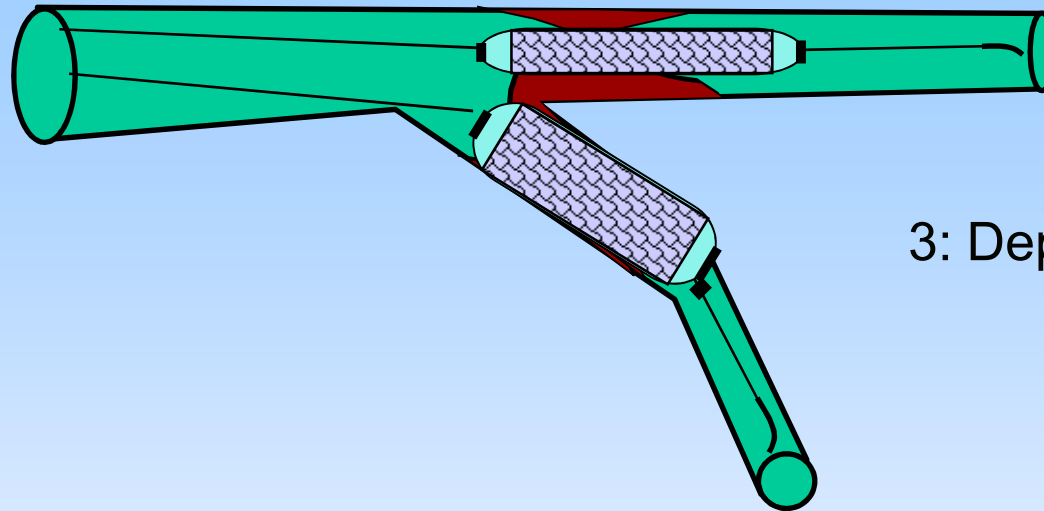


2: Position two parallel stents  
covering both branches and  
extending into the MB  
- V: minimal protrusion into MB  
- SKS: double barrel into the MB

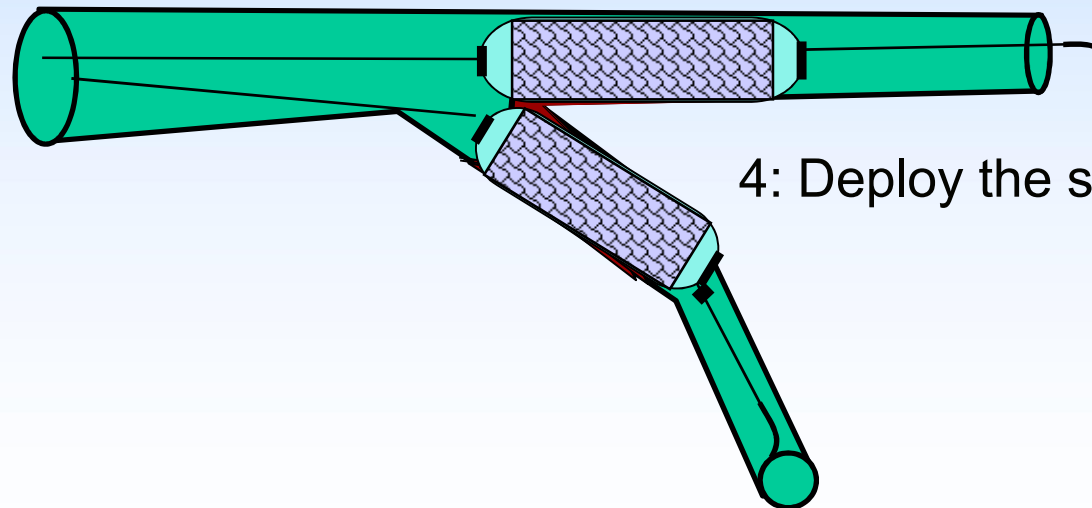


# V stenting

B



3: Deploy one stent

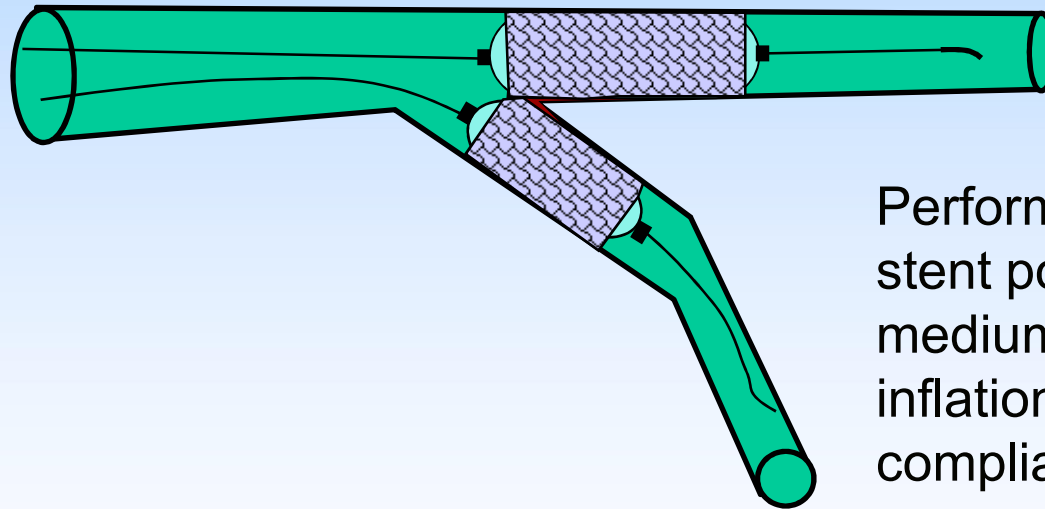


4: Deploy the second stent

*Some operators deploy the two stents simultaneously*



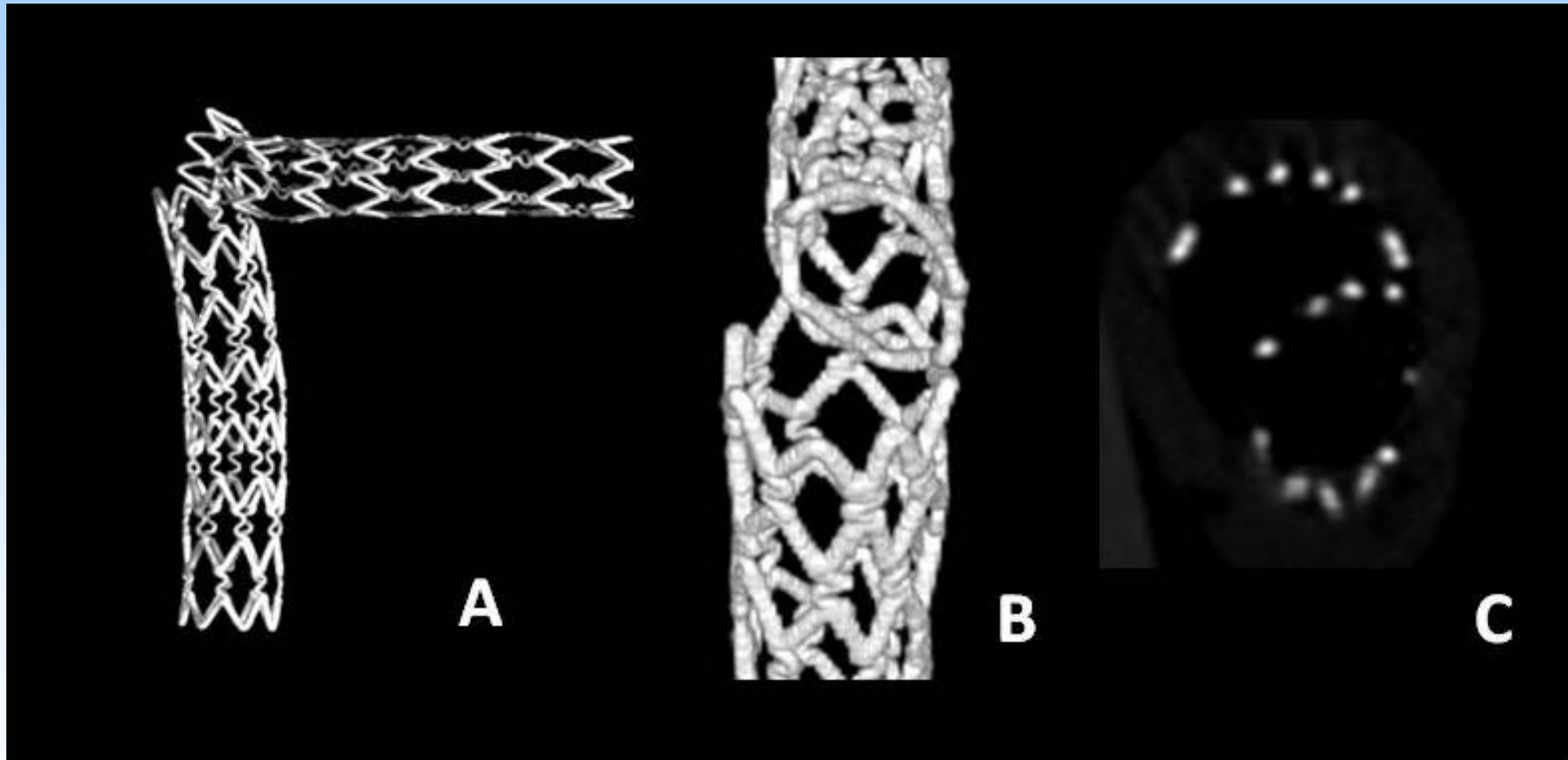
# V stenting



Perform high pressure single stent postdilatation and medium pressure kissing inflation with short and non-compliant balloons



# V Stenting

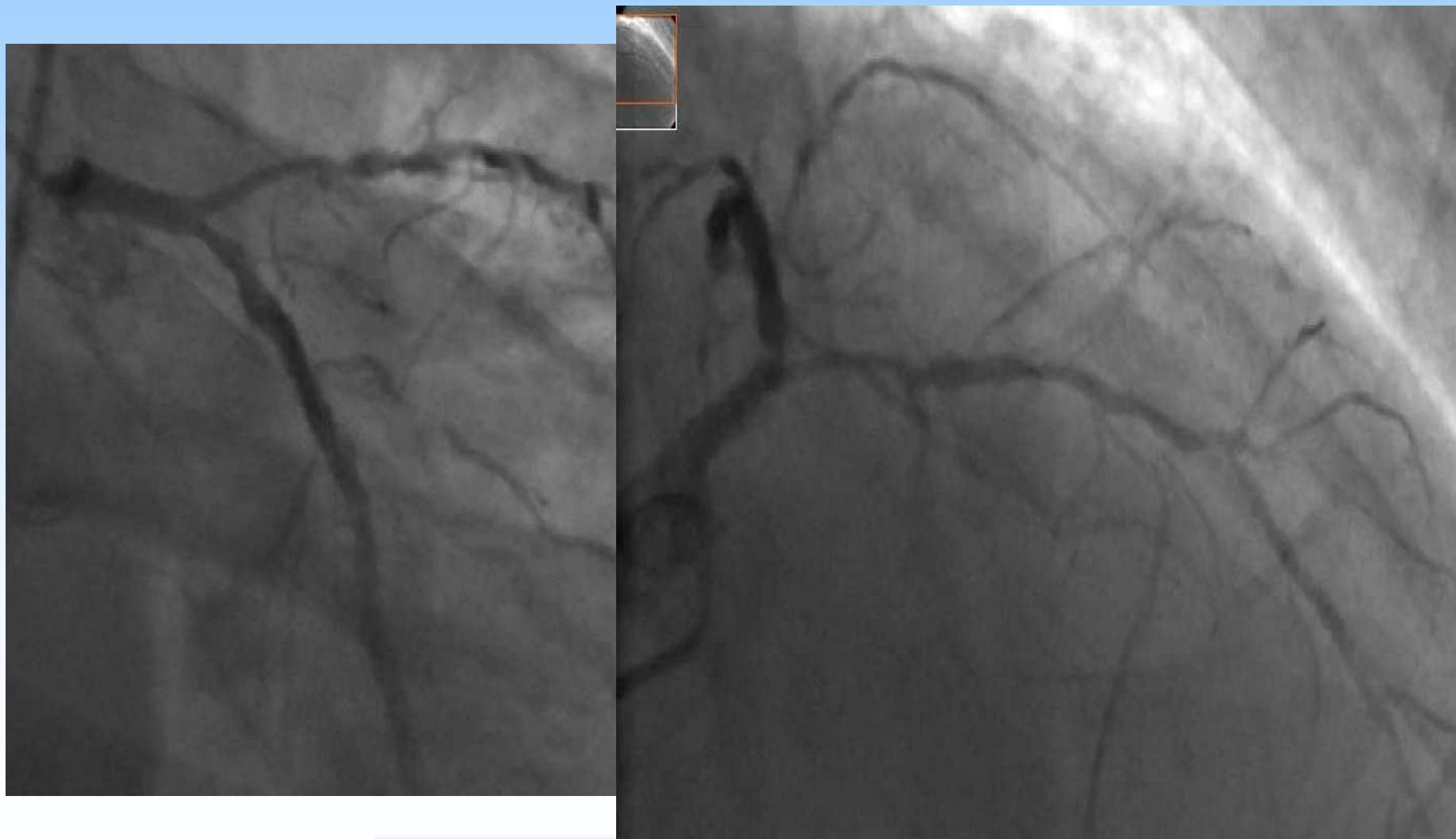


*Courtesy of Yoshinobu Murasato, MD.*



# V Stenting

## Ostial LAD and LCX Disease



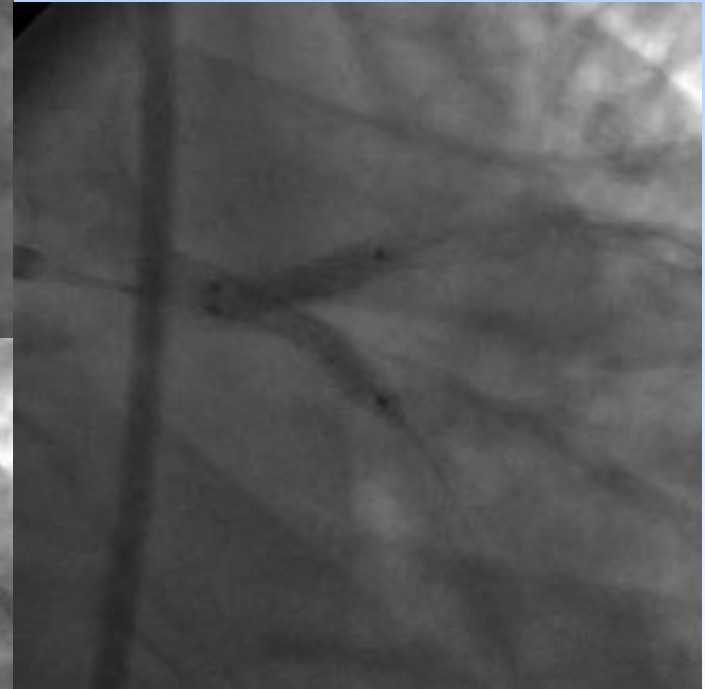
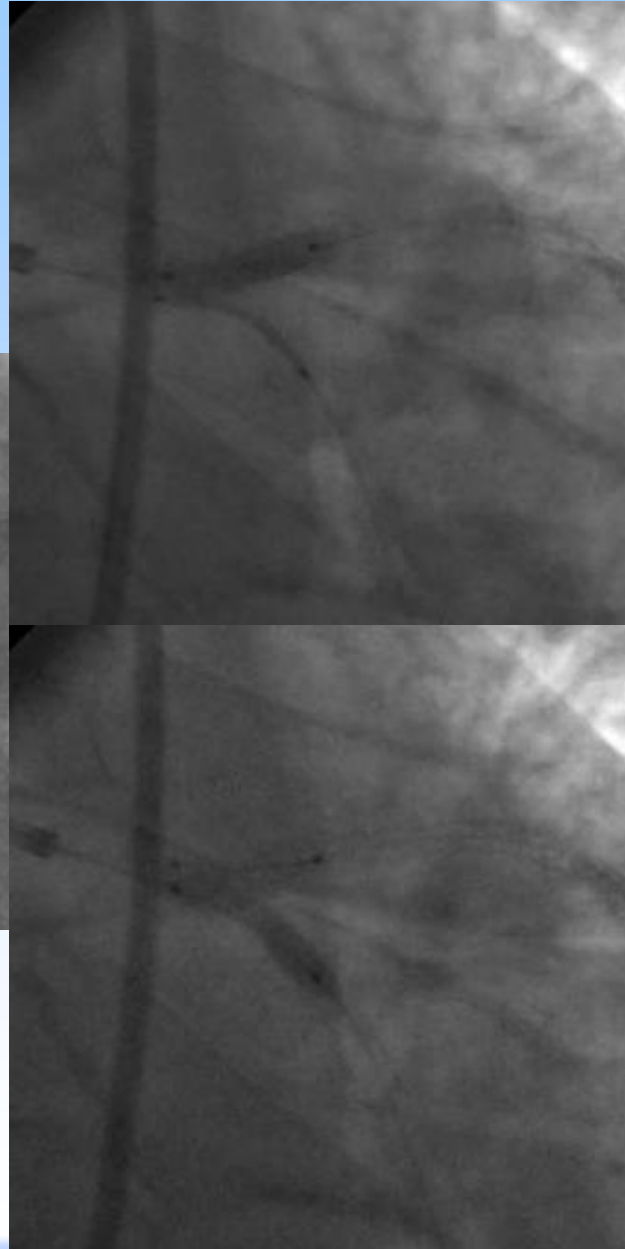
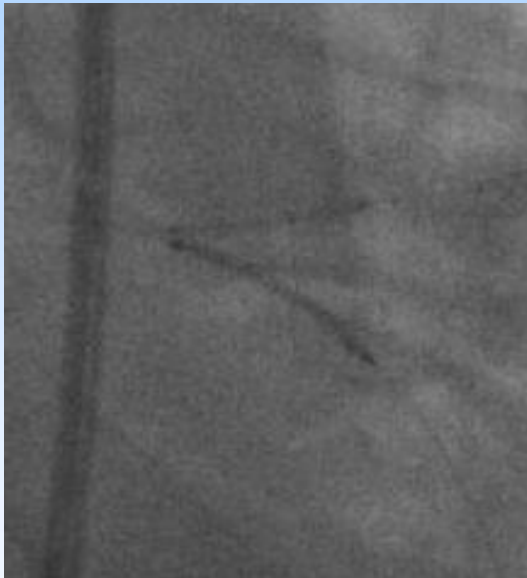
Baseline



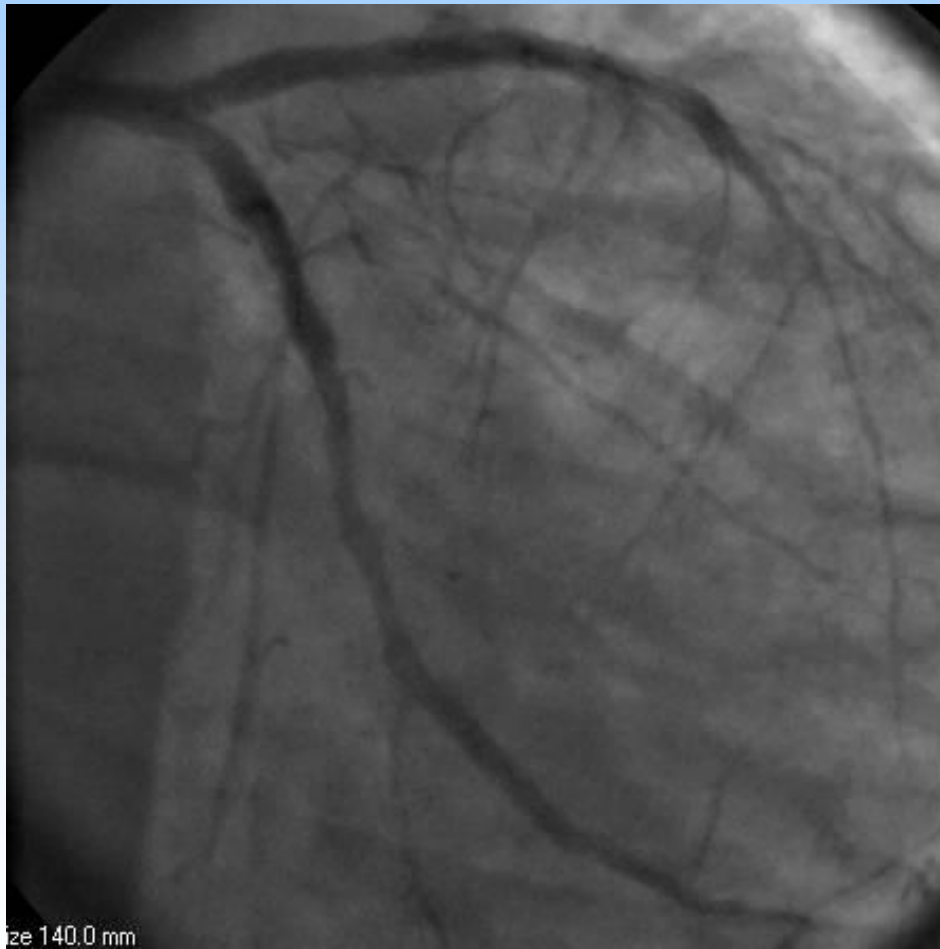


# Sequential Deployment

FKI



# V Stenting



# Summary

- Largely, evidence is lacking as to the superiority of one EDS technique versus others
- The decision as to what technique to use should be driven by bifurcation morphology and operator experience
- Although conclusive evidence is lacking, FKI should be attempted in all patients
- IVUS can help optimize the results and should be used more liberally



# Summary

- Variants of the traditional double stenting techniques have impacted ease of performance and bifurcation stent geometry. Its impact on clinical outcome is yet to be proven.
- At the end, final results optimization rather than technique variant is the most likely factor to impact clinical outcome.

