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Sidebranch Compromise:
Mechanism and Implication

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Overview:

- What causes sidebranch “jailing” after PCI?
- How does FFR help us address bifurcation disease?
- How does IVUS help us address bifurcation disease?

Causes of Sidebranch Compromise

- **Angulation, branch overlap and imaging artifact hamper angiographic determination of sidebranch lesion significance.**

- **Mechanical Causes**
  - **Plaque Shift**
  - **Carina Shift**

Mechanical Causes of Sidebranch Compromise

Anatomic and Functional Evaluation of Bifurcation Lesions Undergoing Percutaneous Coronary Intervention

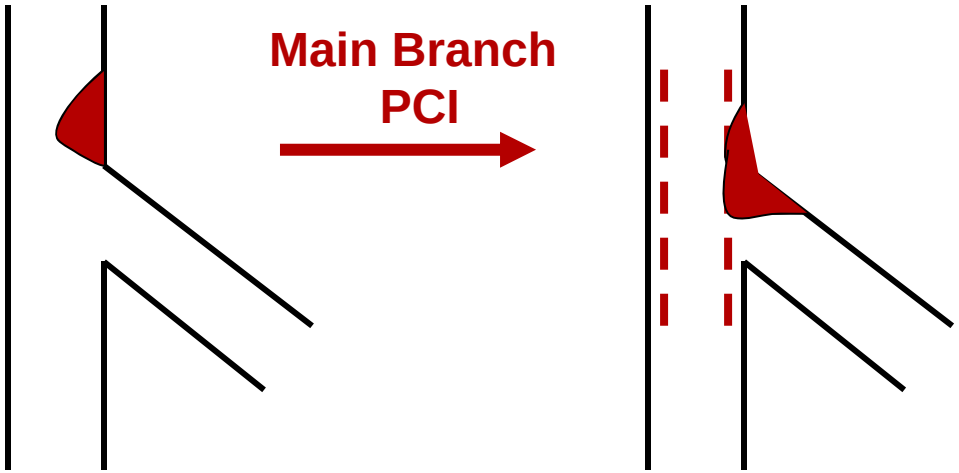
Bon-Kwon Koo, MD, PhD; Katsuhisa Waseda, MD, PhD; Hyun-Jae Kang, MD, PhD; Hyo-Soo Kim, MD, PhD; Chang-Wook Nam, MD, PhD; Seung-Ho Hur, MD, PhD; Jung-Sun Kim, MD, PhD; Donghoon Choi, MD, PhD; Yangsoo Jang, MD, PhD; Joo-Yong Hahn, MD, PhD; Hyeon-Cheol Gwon, MD, PhD; Myeong-Ho Yoon, MD, PhD; Seung-Jea Tahk, MD, PhD; Woo-Young Chung, MD, PhD; Young-Seok Cho, MD, PhD; Dong-Ju Choi, MD, PhD; Takao Hasegawa, MD; Toru Kataoka, MD; Sung Jin Oh, MD; Yasuhiro Honda, MD; Peter J. Fitzgerald, MD, PhD; William F. Fearon, MD

77 patients with bifurcation disease had IVUS of the main branch before and after PCI, and FFR of the "jailed" sidebranch

Circ Cardiovasc Interv 2010;3:113-119

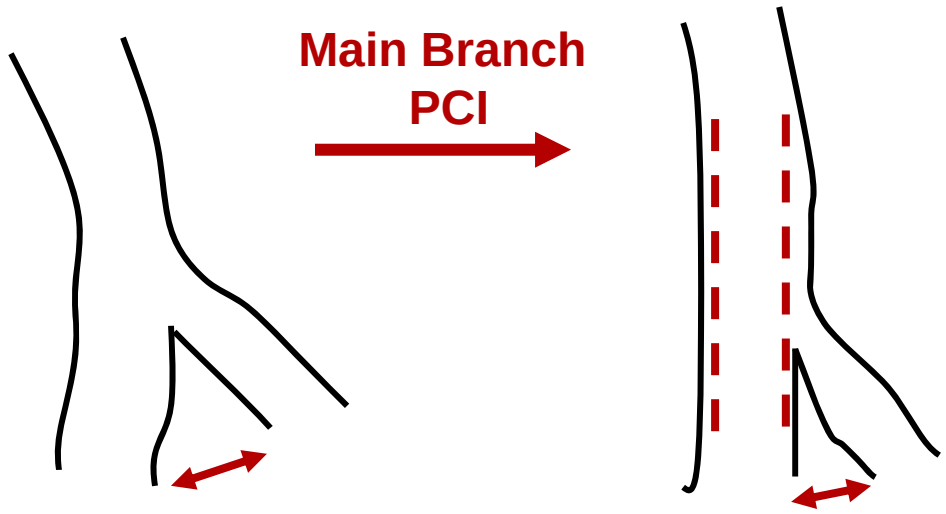
Causes of Sidebranch “Jailing”

- Plaque shift



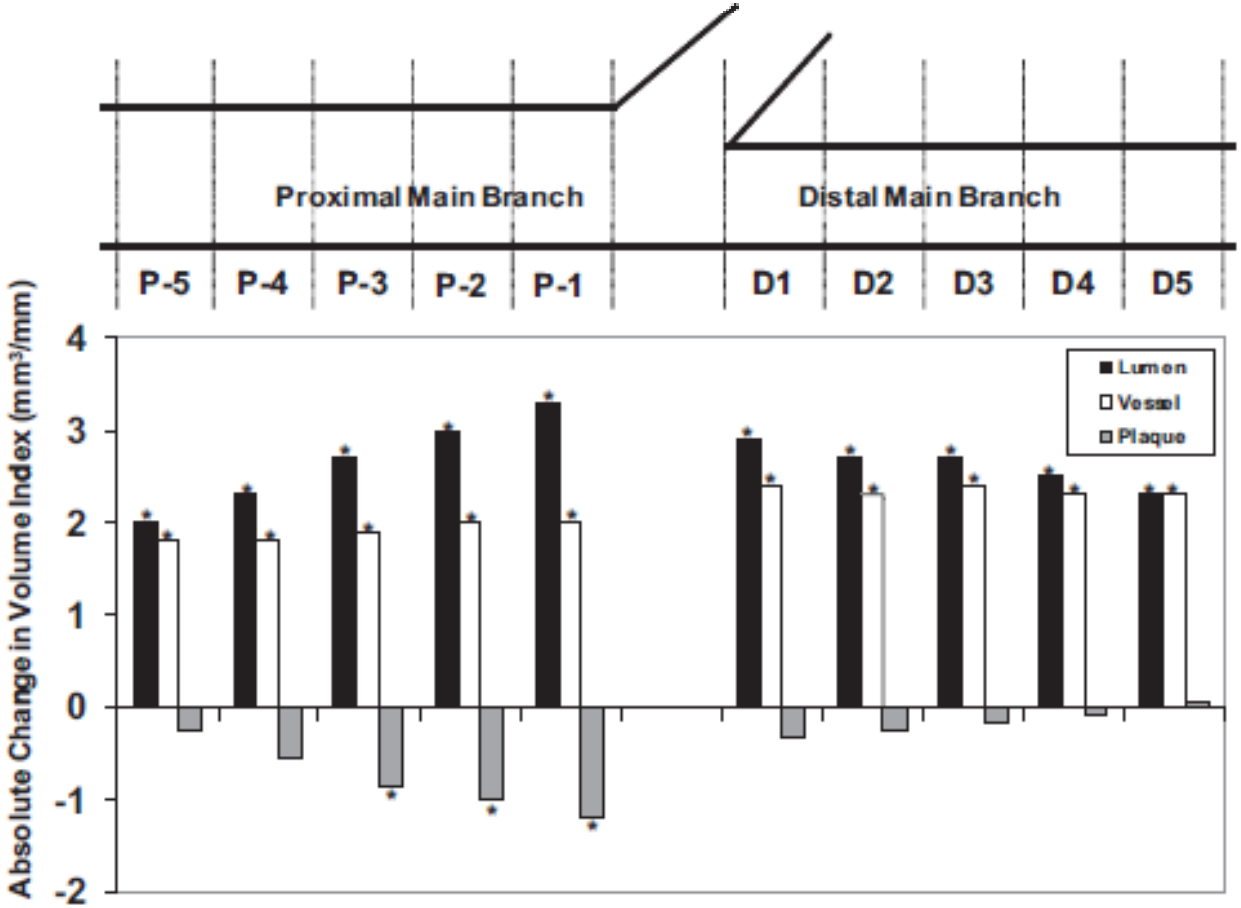
Causes of Sidebranch “Jailing”

- Carina Shift



Anatomic Changes in Main Branch after PCI

IVUS performed before and after PCI in 77 bifurcation lesions



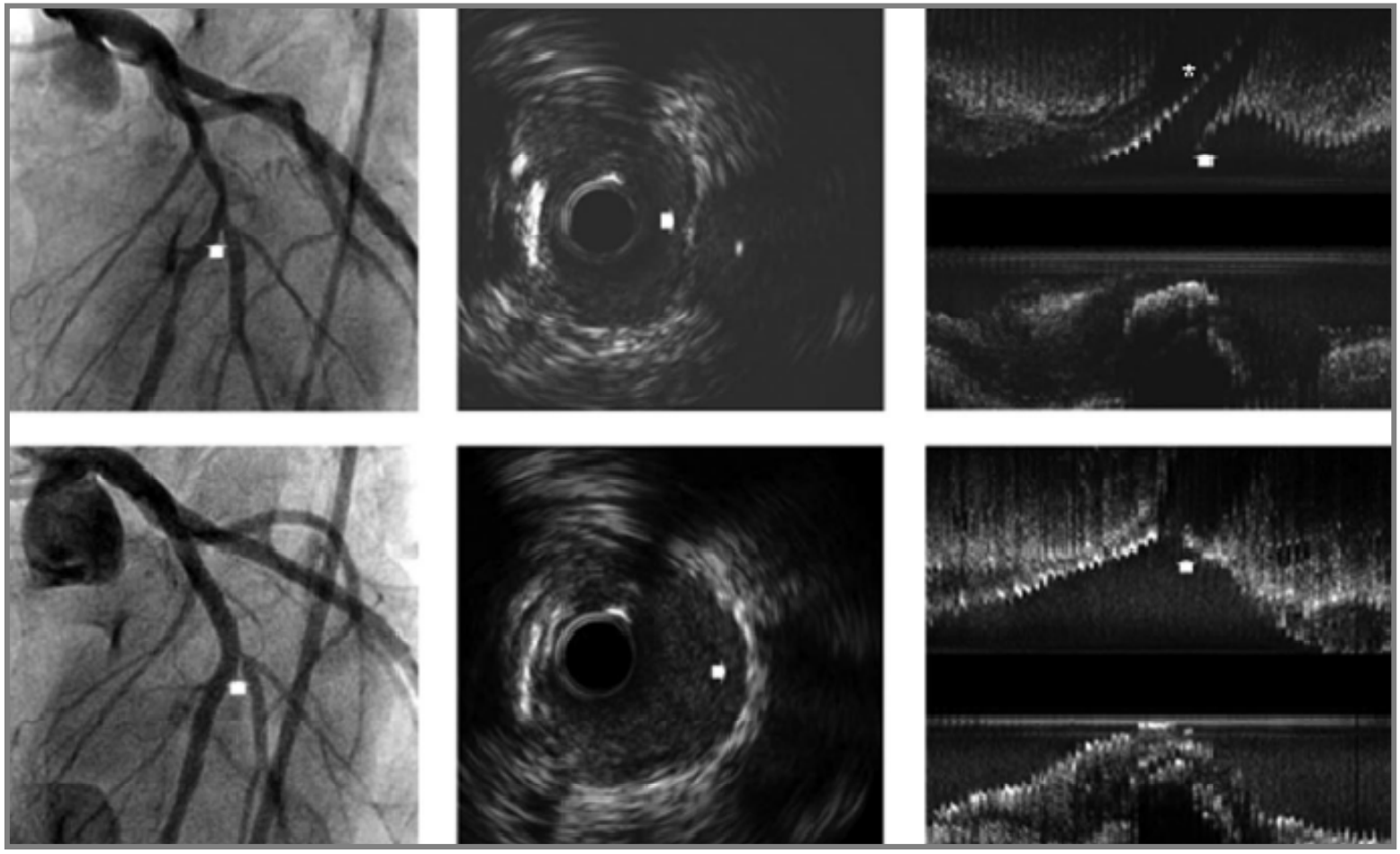
Circ Cardiovasc Interv 2010;3:113-119

Anatomic Changes in Main Branch after PCI

Side Branch "jailing" also can occur due to carina shift

Pre-PCI

Post-PCI



Circ Cardiovasc Interv 2010;3:113-119

Can we predict which side branches will have an abnormal FFR after MB stenting?

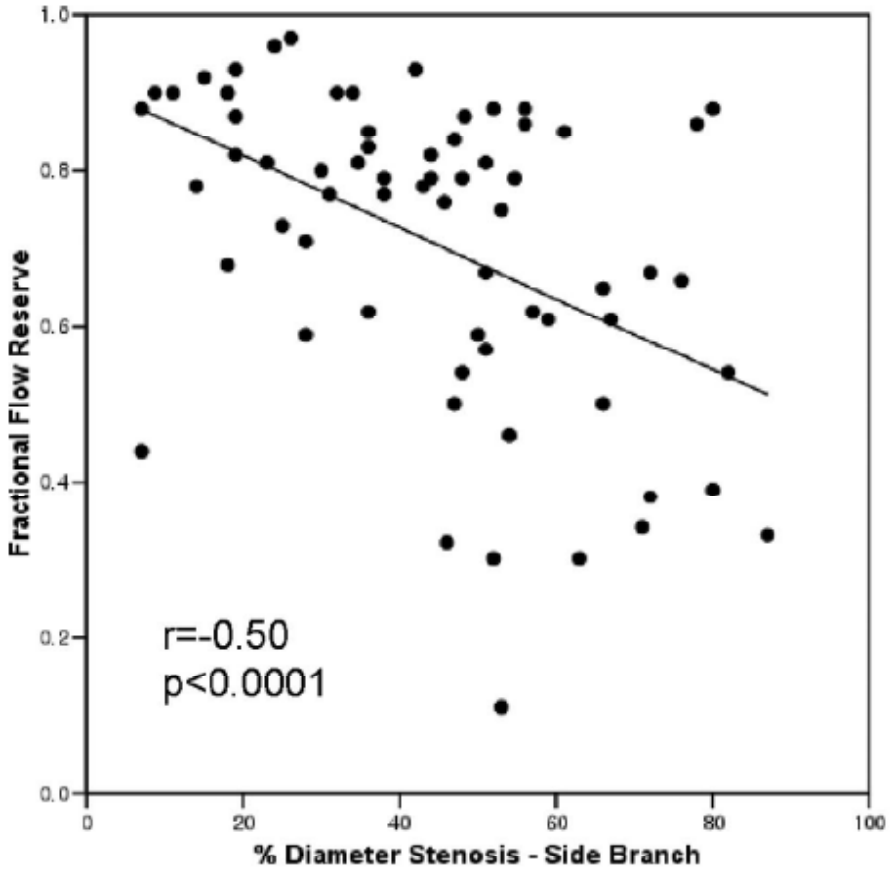
Pre-Intervention Angiographic Parameters

Angiographic Parameters	FFR<0.75 (N=28)	FFR≥0.75 (N=39)	*P*
Main branch			
Reference diameter, mm	3.0±0.6	3.0±0.4	1
Minimal lumen diameter, mm	1.0±0.4	1.2±0.4	0.15
% diameter stenosis	65±13	61±14	0.27
Side branch			
Reference diameter, mm	2.1±0.5	2.2±0.4	0.33
Minimal lumen diameter, mm	0.9±0.4	1.4±0.4	<0.001
% diameter stenosis	54±20	37±18	<0.001
Type B lesion	19 (56)	15 (44)	0.04
Bifurcation angle, degrees	44±19	46±11	0.62

Circ Cardiovasc Intervent 2010;3:113-9.

Can we predict which side branches will have an abnormal FFR after MB stenting?

Correlation between Pre PCI Angiographic DS and Post PCI SB FFR



Circ Cardiovasc Intervent 2010;3:113-9.

Can we predict which side branches will have an abnormal FFR after MB stenting?

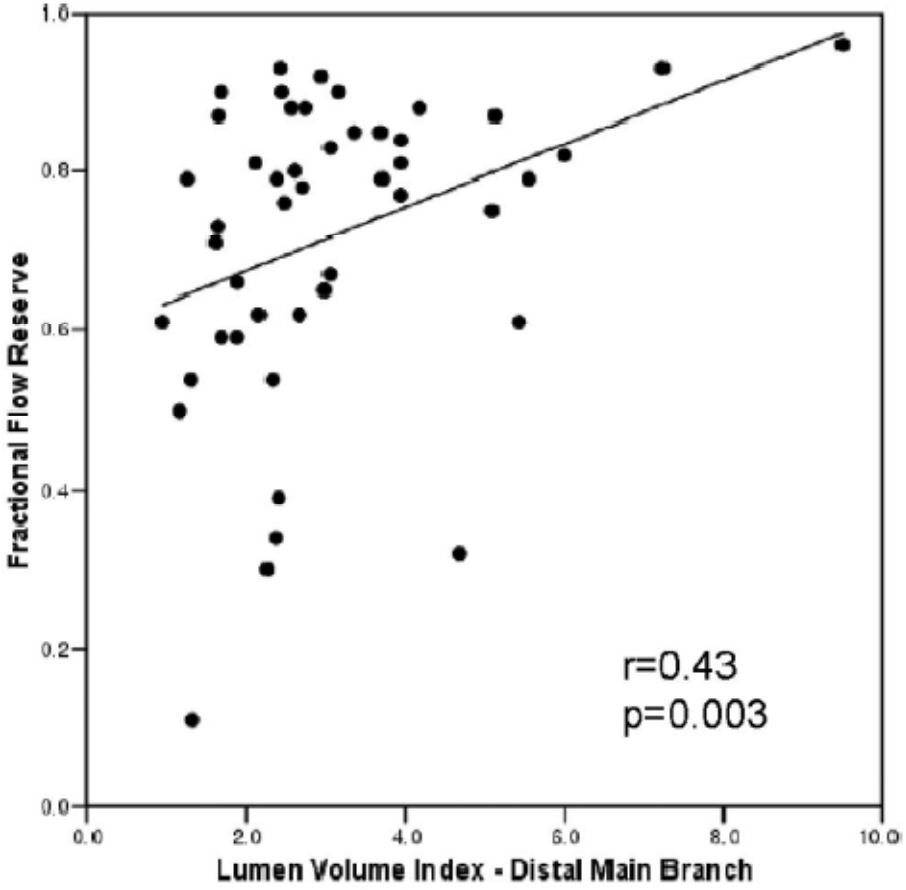
Pre-Intervention IVUS Parameters

IVUS parameters	FFR<0.75 (N=22)	FFR≥0.75 (N=30)	*P*
Proximal MB			
Lumen volume index, mm^3/mm	2.6±1.1	3.4±1.5	0.08
Vessel volume index, mm^3/mm	13.2±3.5	12.7±3.5	0.67
Plaque volume index, mm^3/mm	10.6±3.1	9.4±3.1	0.21
Plaque burden, %	80±8	73±10	0.03
Distal MB			
Lumen volume index, mm^3/mm	2.3±1.1	3.6±1.8	0.01
Vessel volume index, mm^3/mm	8.3±2.0	9.4±2.7	0.14
Plaque volume index, mm^3/mm	6.0±1.5	5.8±2.0	0.69
Plaque burden, %	73±10	61±12	0.002

Circ Cardiovasc Intervent 2010;3:113-9.

Can we predict which side branches will have an abnormal FFR after MB stenting?

Correlation between Pre PCI MB IVUS and Post PCI SB FFR



Circ Cardiovasc Intervent 2010;3:113-9.

What we have learned about PCI and sidebranch “jailing”?

- Both plaque shift and carina shift contribute to sidebranch “jailing” after main branch PCI.

- Unfortunately, anatomic evaluation does not reliably predict the functional significance of sidebranch “jailing”.

Overview:

- What causes sidebranch “jailing” after PCI?
- **How does FFR help us address bifurcation disease?**
- How does IVUS help us address bifurcation disease?

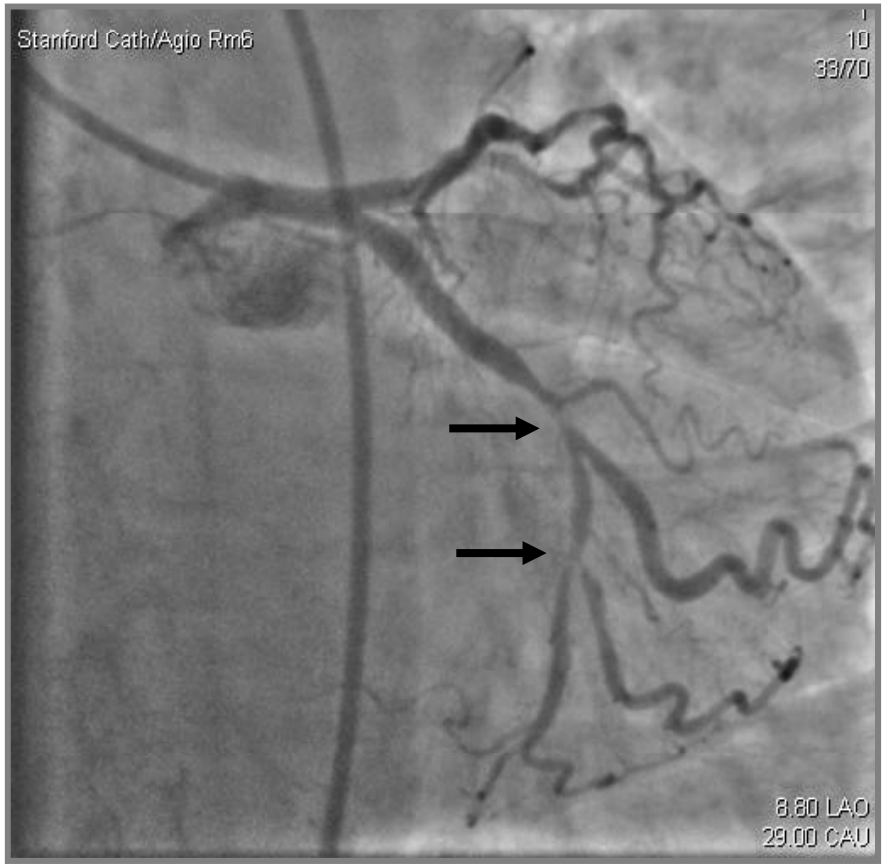
Why do we need FFR for bifurcation lesions?

- Angiographic evaluation is difficult due to vessel overlap, angulation, foreshortening, and stent strut artifact
- IVUS/OCT criteria for a significant sidebranch lesion are unknown and it is technically difficult to perform in some cases (particularly after stenting)
- The amount of myocardium supplied by a sidebranch is relatively small and highly variable
- PCI outcomes of bifurcation lesions are historically poor

Koo and De Bruyne. Eurointervention 2010;6:J94-J98.

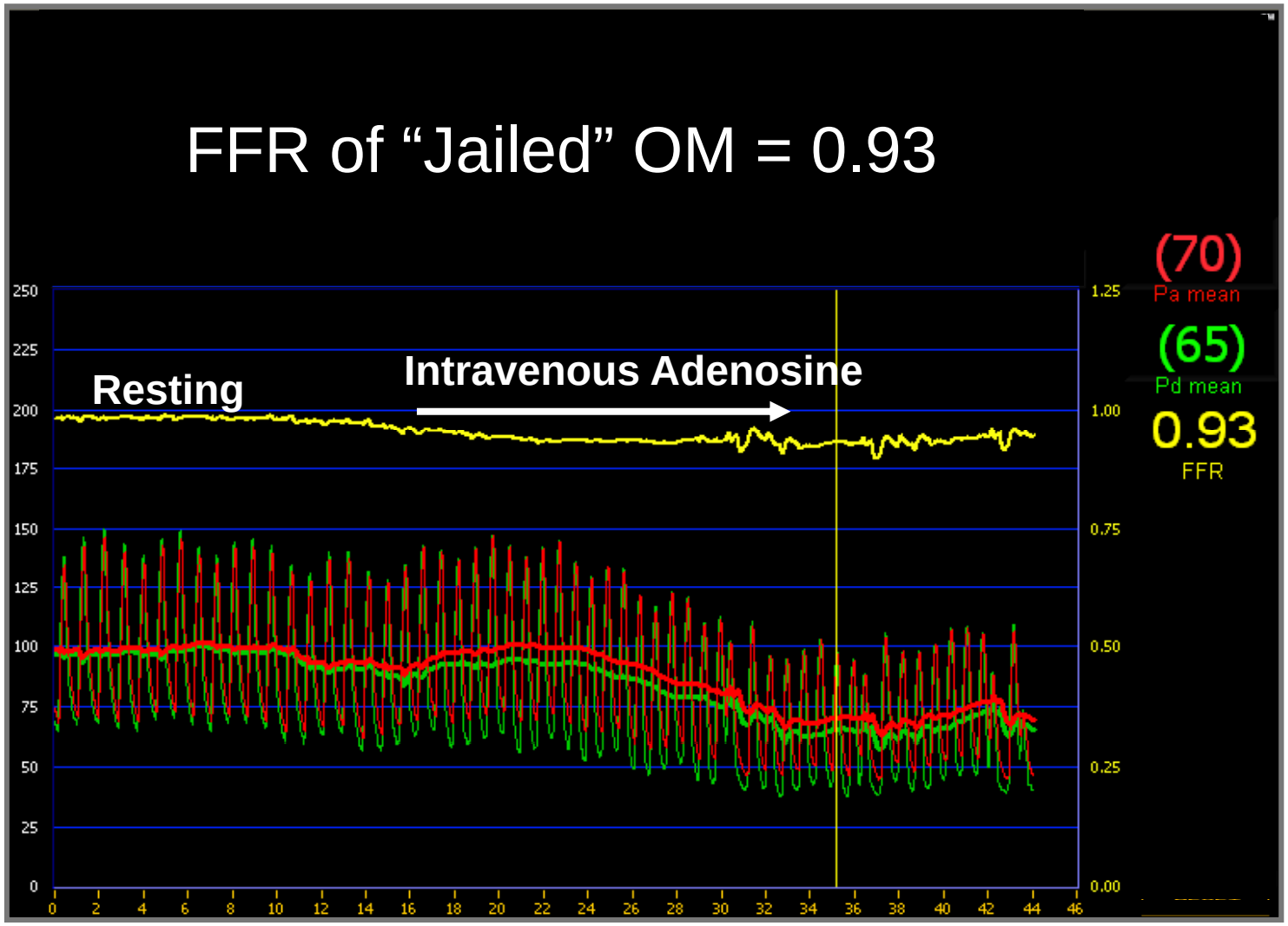
FFR and Bifurcation Disease

Before PCI



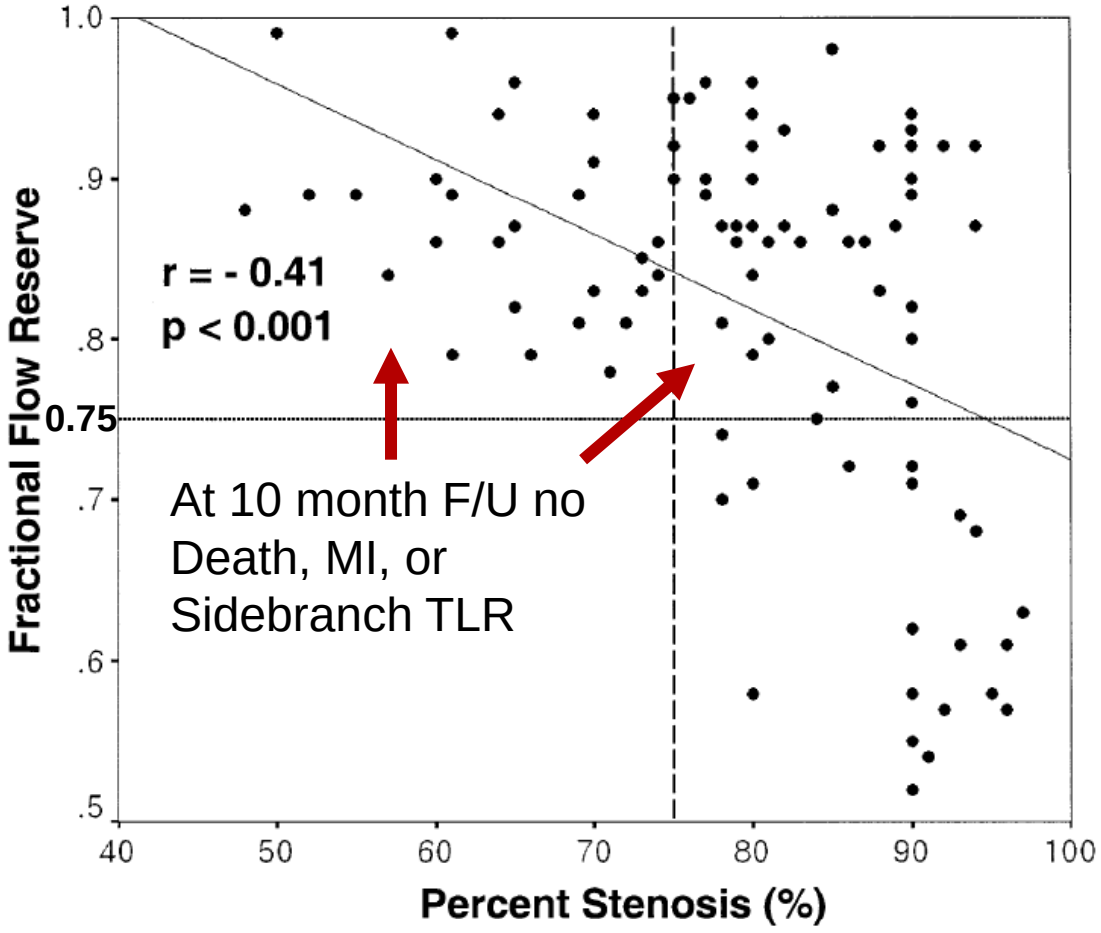
After PCI

FFR and Bifurcation Disease



Jailed Side Branches and FFR

FFR in 97 "Jailed" Side Branches



Koo et al. J Am Coll Cardiol 2005;46:633-7.

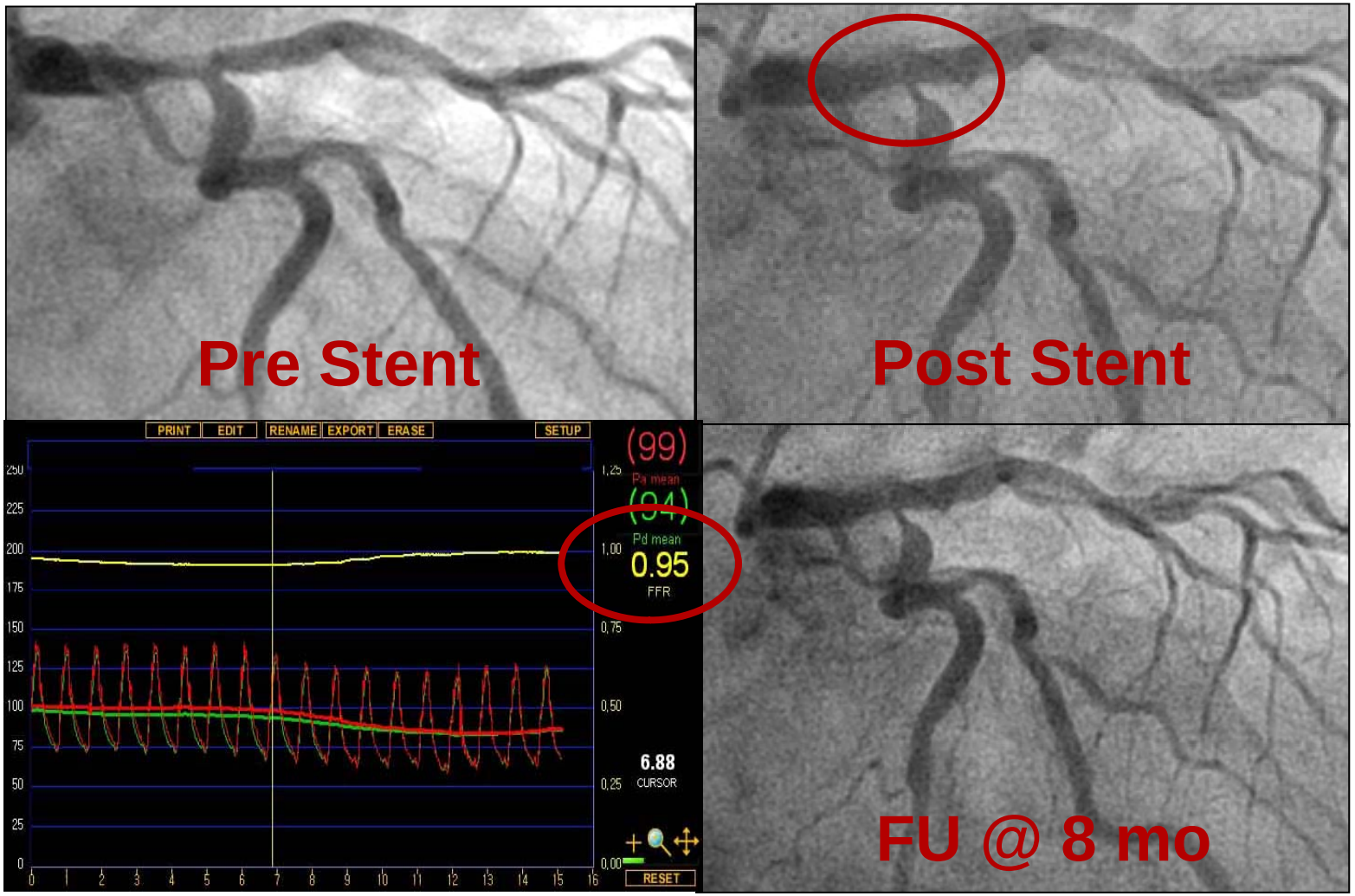
Jailed Side Branches and FFR

FFR in 91 "Jailed" Side Branches, Repeated at 6 Months

	Post-intervention	Follow-up	*P*-value[a]
Main branch	0.96 ± 0.04	0.96 ± 0.04	0.9
Jailed side branch	0.87 ± 0.06	0.87 ± 0.09	0.7
KB group	0.86 ± 0.05	0.84 ± 0.11	0.4
Non-KB group	0.87 ± 0.06	0.89 ± 0.07	0.1

Koo et al. Eur Heart J 2008;29:726-32.

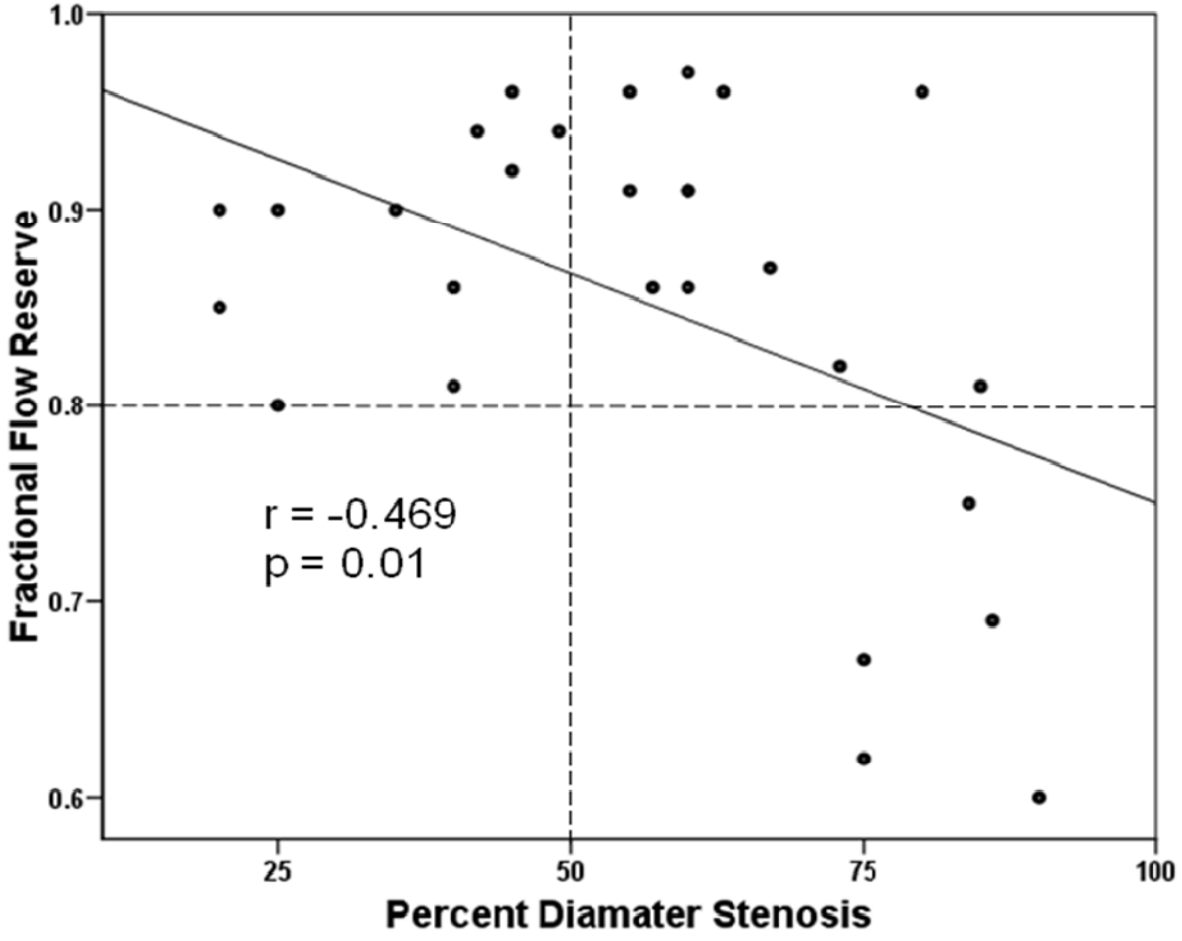
FFR of “jailed” Circumflex



Courtesy of Chang-Wook Nam, MD

FFR of “jailed” Circumflex

FFR measured down “jailed” circumflex in 29 patients after LM PCI



Nam CW, et al. Korean Circ J 2011;41:304-7.

FFR of “jailed” Circumflex

	Defer group n = 24	PCI group n = 5
Death, n	0	1
Myocardial Infarction, n	0	0
TLR, n	3	1
Stent Thrombosis, n	0	0
Total Events, n	3	2

Nam CW, et al. Korean Circ J 2011;41:304-7.

Practical Considerations:

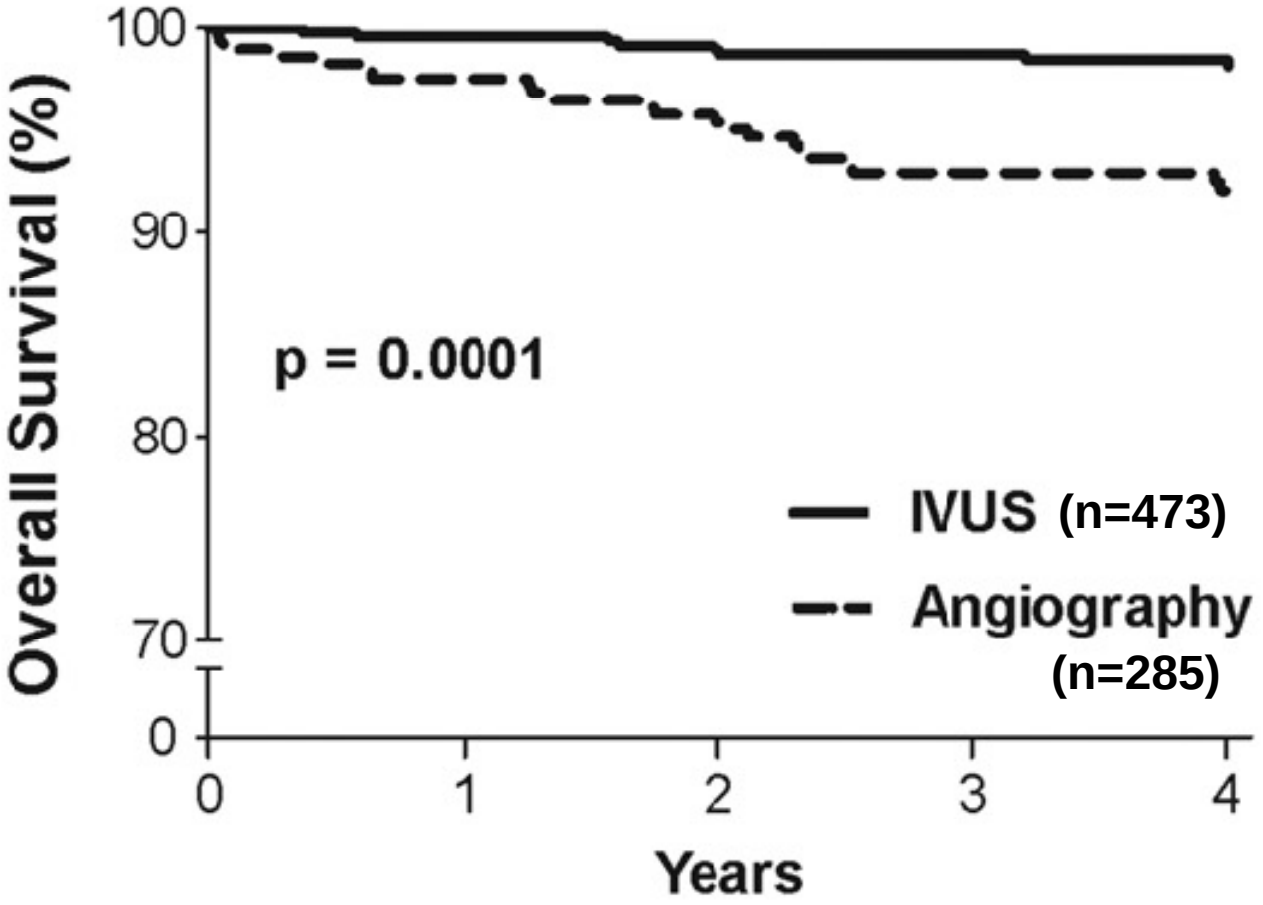
- Do not “jail” the pressure wire behind a stent
- Remember to consider distal side branch disease or proximal main branch disease when assessing FFR of a sidebranch ostium
- If you are intent on measuring the FFR of a “jailed” side branch, but cannot wire the vessel with a pressure wire, can wire with another wire and exchange over a transit catheter

Overview:

- What causes sidebranch “jailing” after PCI?
- How does FFR help us address bifurcation disease?
- **How does IVUS help us address bifurcation disease?**

IVUS Guidance and Bifurcation Lesions

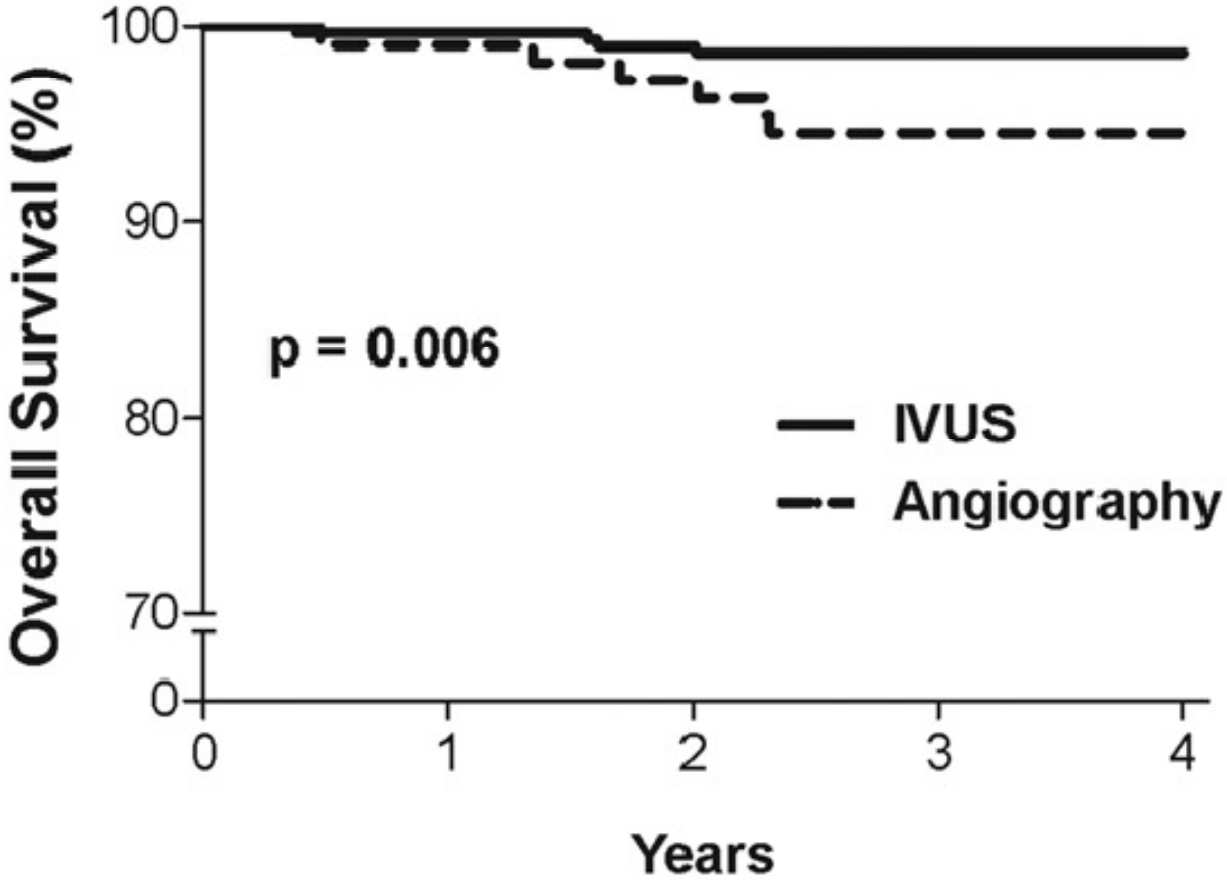
758 non-Left Main bifurcation lesions treated at Asan Medical Center



Kim, et al. Am J Cardiol 2010;106:612-18

IVUS Guidance and Bifurcation Lesions

*420 non-Left Main bifurcation lesions treated with **DES** at Asan Medical Center*



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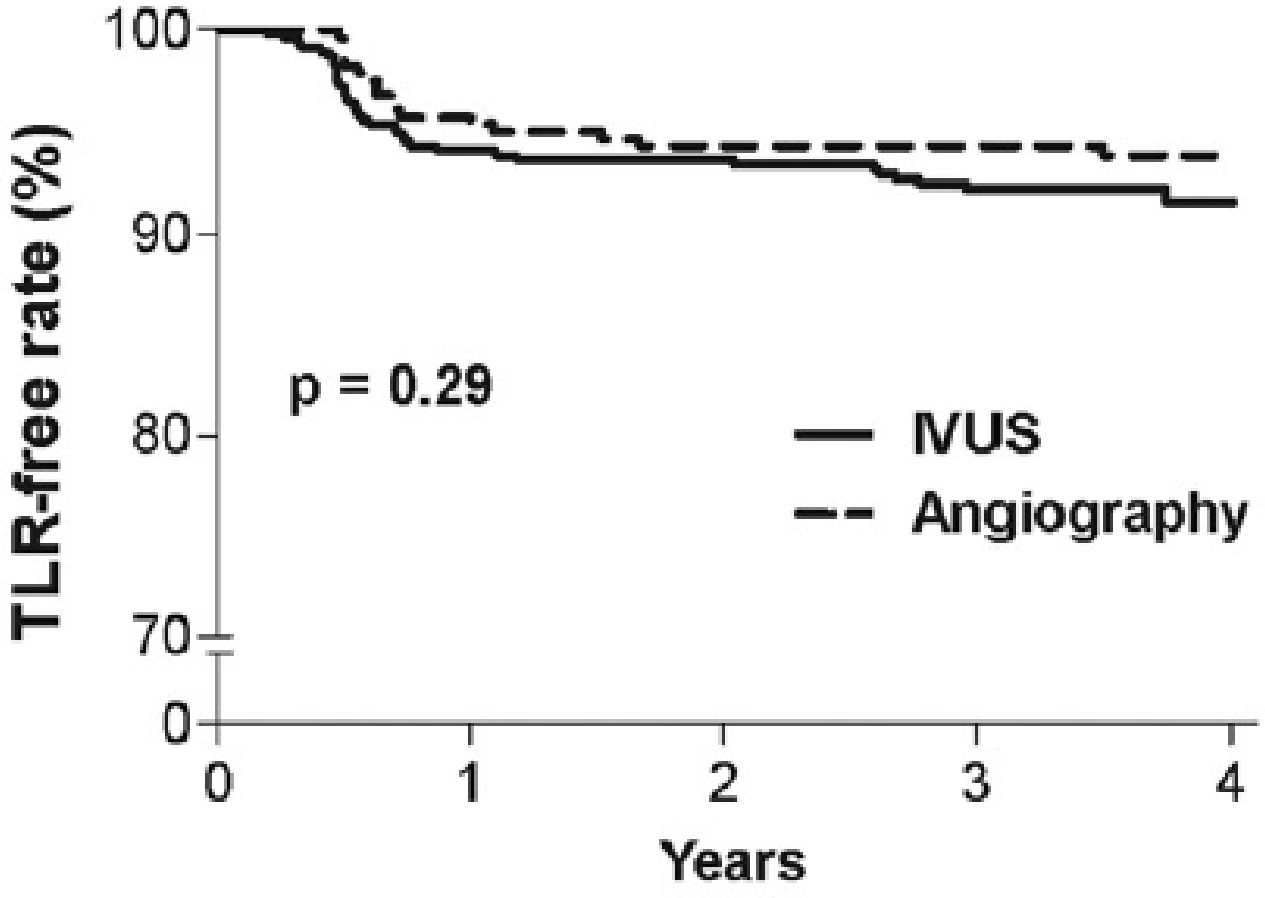
IVUS Guidance and Bifurcation Lesions

758 non-Left Main bifurcation lesions treated at Asan Medical Center



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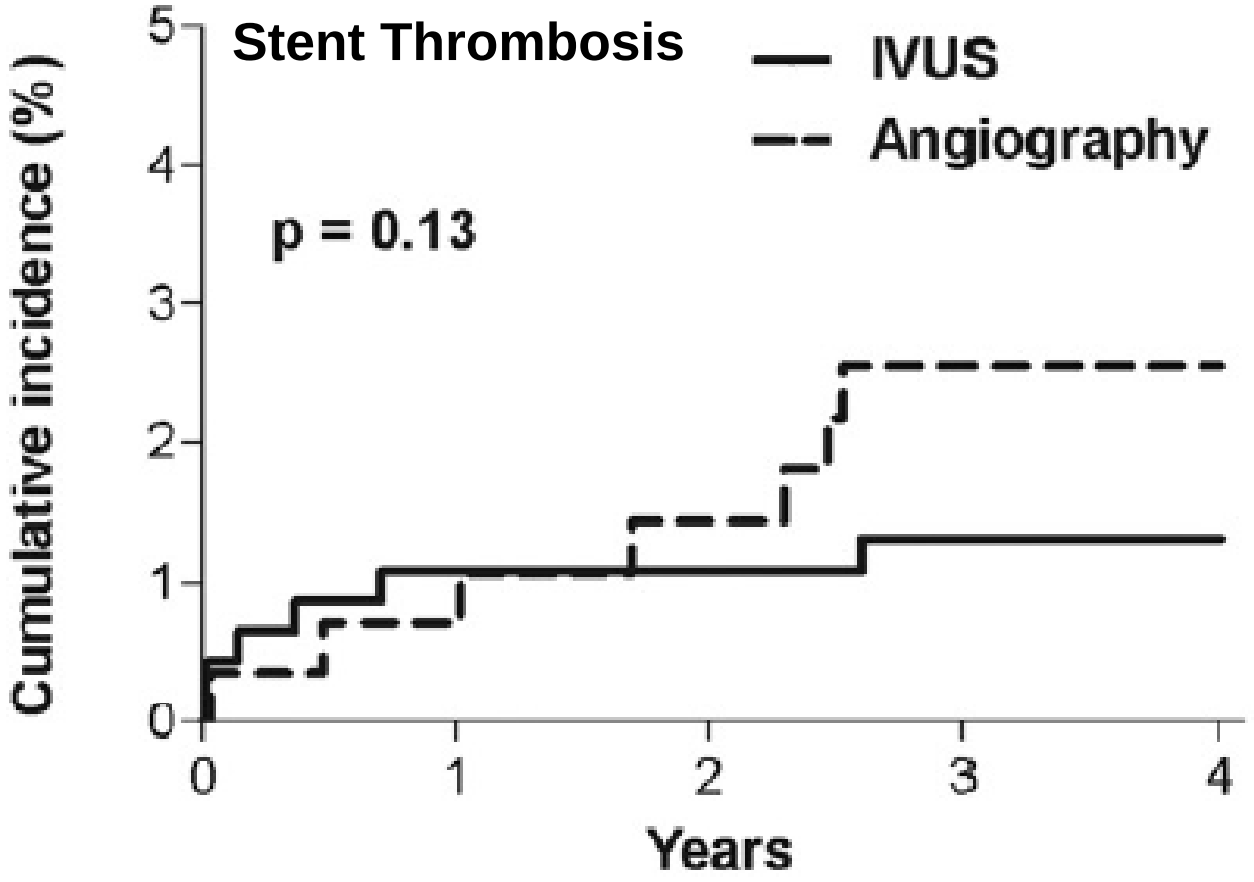

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IVUS Guidance and Bifurcation Lesions

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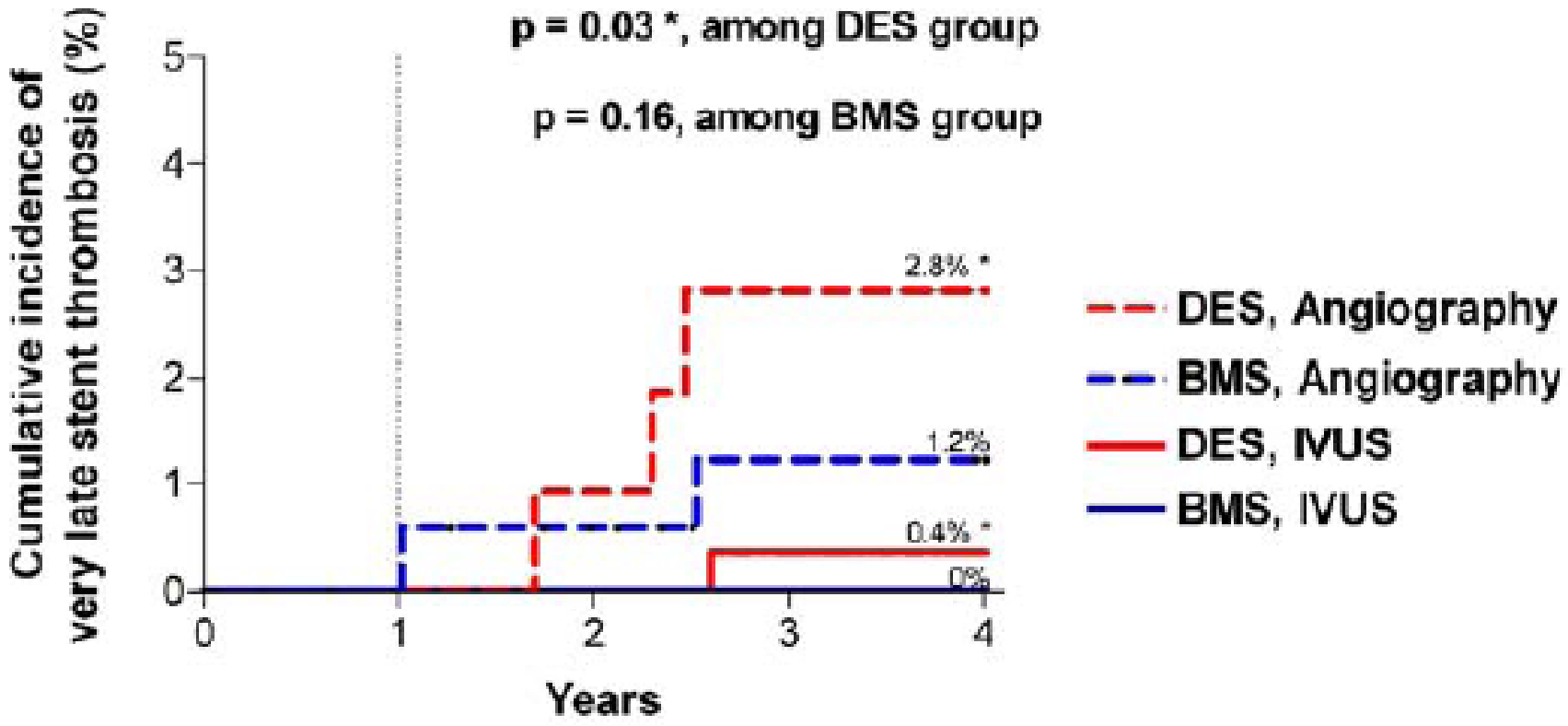
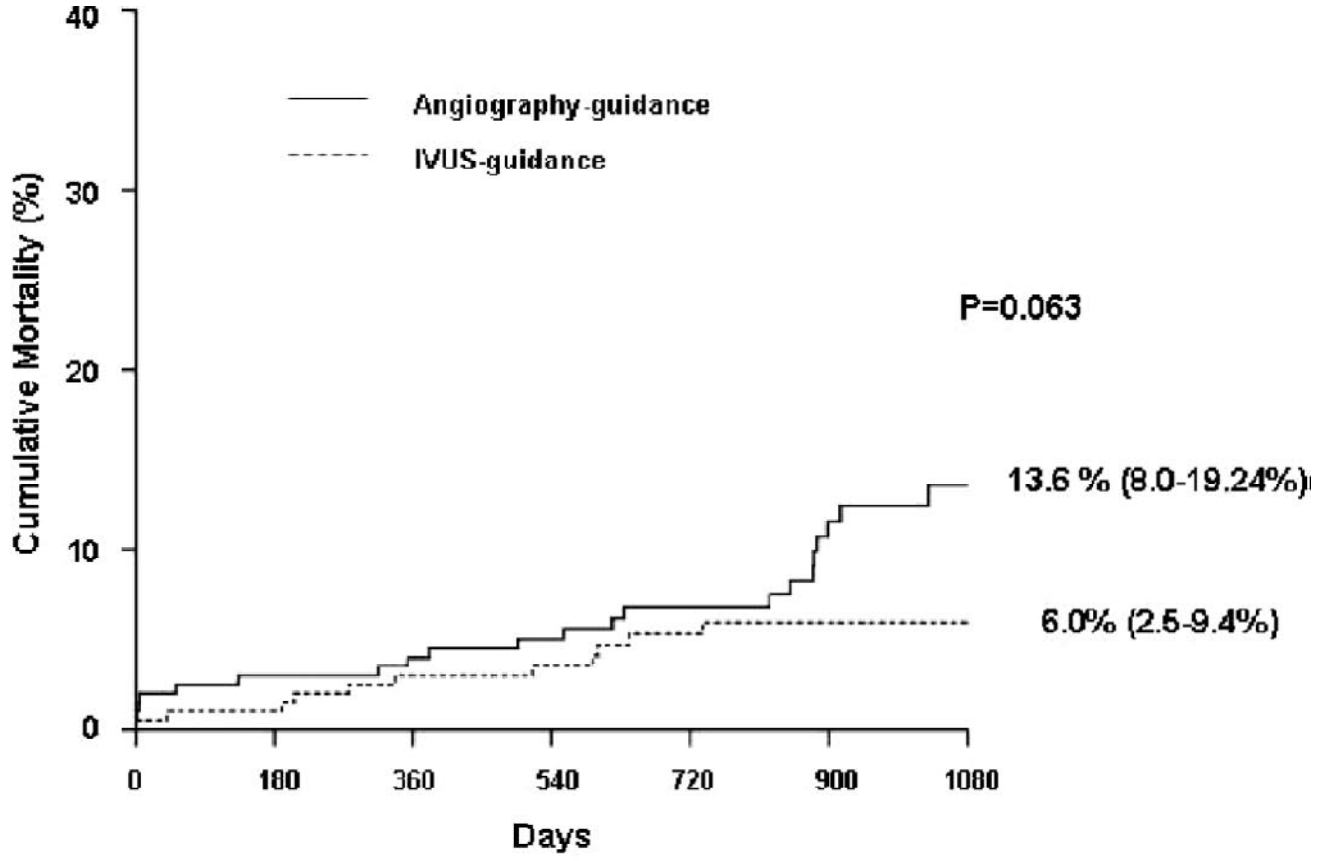


Kim, et al. Am J Cardiol 2010;106:612-18

IVUS Guidance and Bifurcation Lesions

201 propensity matched Left Main lesions treated at Asan Medical Center (>50% were bifurcation lesions)



Park, et al. Circ Cardiovasc Interv 2009;2:167-177

Summary:

- Sidebranch “jailing” occurs because of both plaque shift and carina shift.
- Anatomic assessment does not accurately predict which sidebranch lesions are functionally significant.
- FFR measurement identifies functionally insignificant “jailed” sidebranches which do not require further treatment.

Summary:

- Intravascular ultrasound guidance during bifurcation PCI appears to improve outcomes by optimizing stent deployment.

Functional Angioplasty

FFR-Guided Decision Making,
IVUS-Guided Optimization