What really matters in bifurcation PCI:

Technique or Concept?

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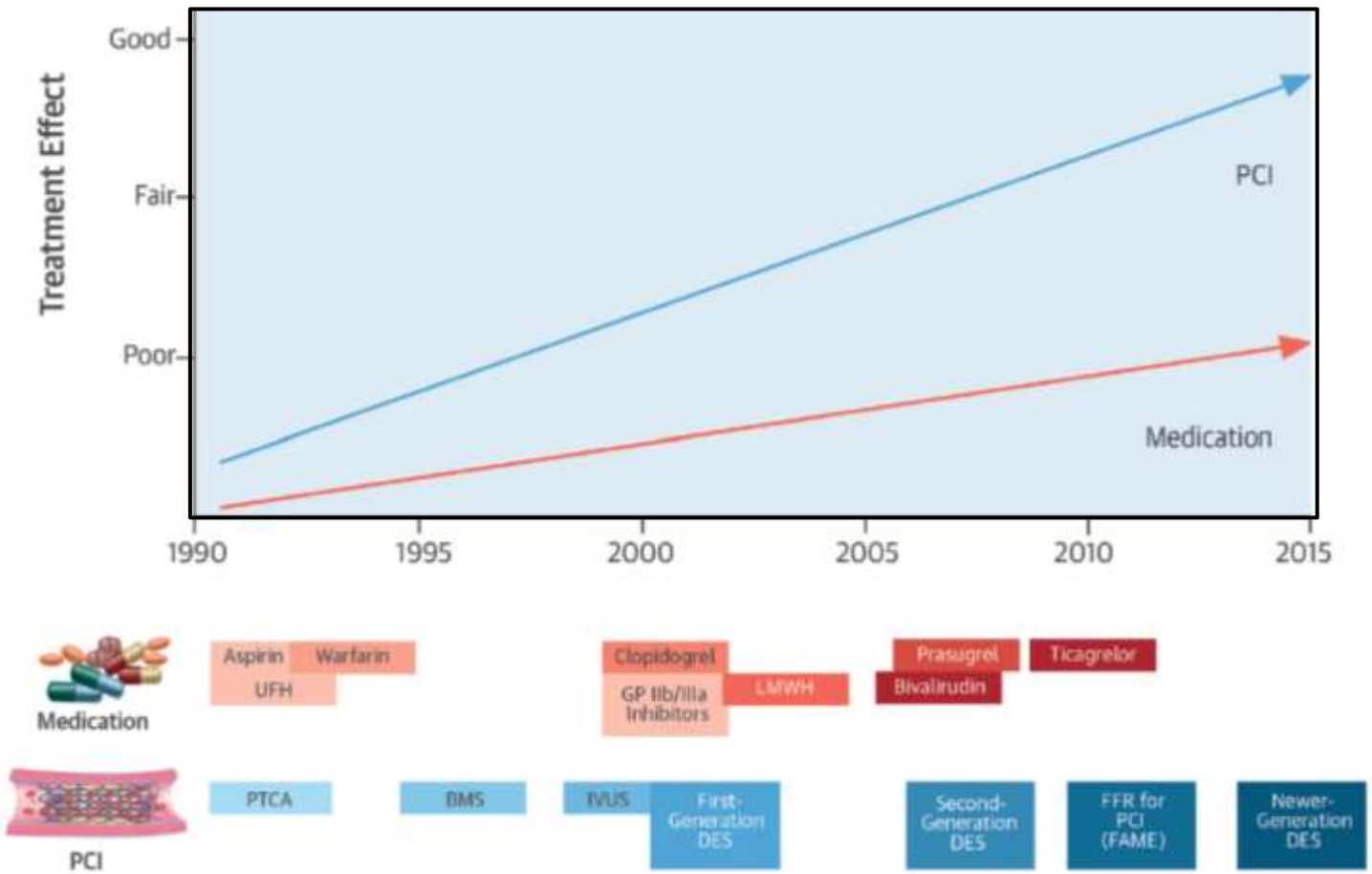
Technical Evolution of PCI



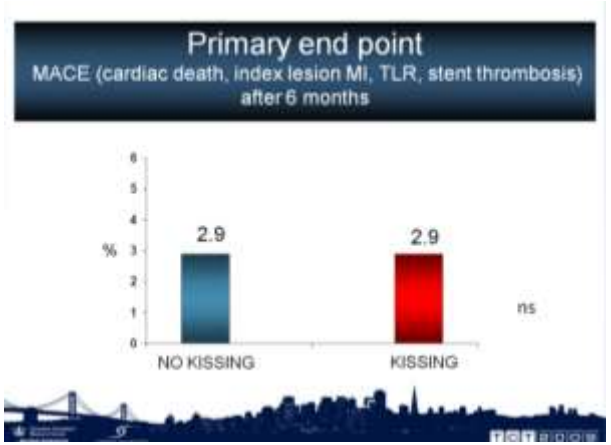
Modified from Lee PH, et al. J Am Coll Cardiol 2016

Does technique matter in bifurcation PCI?

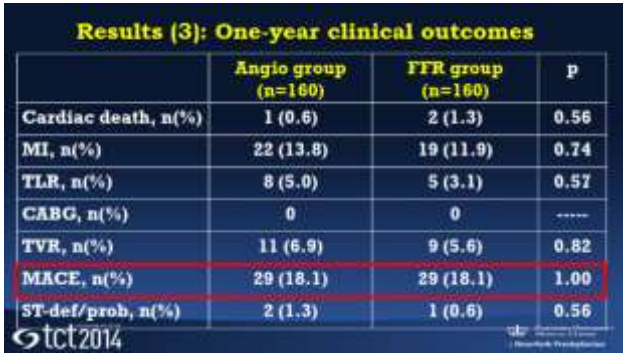
No intervention = *Balloon angioplasty* = *Stenting*

Most Conservative → **Most Aggressive**

No PCI	**Angioplasty in <TIMI 3 flow**	**FFR-guided PCI**	**Angioplasty**	**SB stent**
NORDIC III	NORDIC I	DK-CRUSH VI	CACTUS	CACTUS



NORDIC III: Leave it alone vs. Kissing

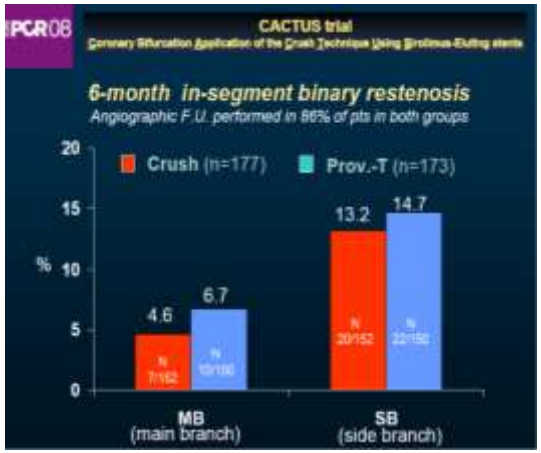


Results (3): One-year clinical outcomes

	Angio group (n=160)	FFR group (n=160)	p
Cardiac death, n(%)	1 (0.6)	2 (1.3)	0.56
MI, n(%)	22 (13.8)	19 (11.9)	0.74
TLR, n(%)	8 (5.0)	5 (3.1)	0.57
CABG, n(%)	0	0	-----
TVR, n(%)	11 (6.9)	9 (5.6)	0.82
MACE, n(%)	29 (18.1)	29 (18.1)	1.00
ST-def/prob, n(%)	2 (1.3)	1 (0.6)	0.56

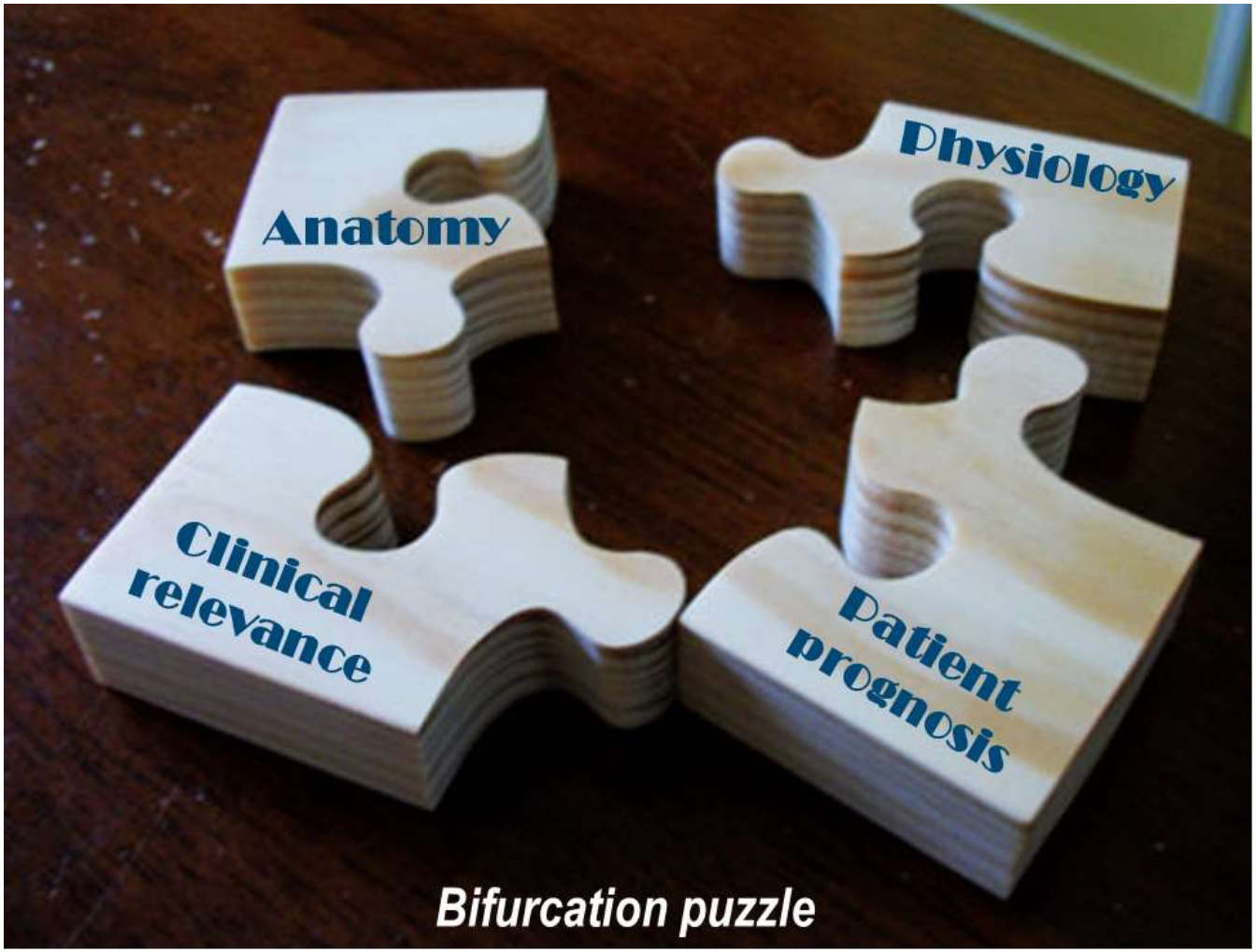
tct2014

DK-CRUSH VI: Angio- vs. FFR-guided



CACTUS: Crush vs. Provisional

Why “technique (or technology)” doesn’t matter?

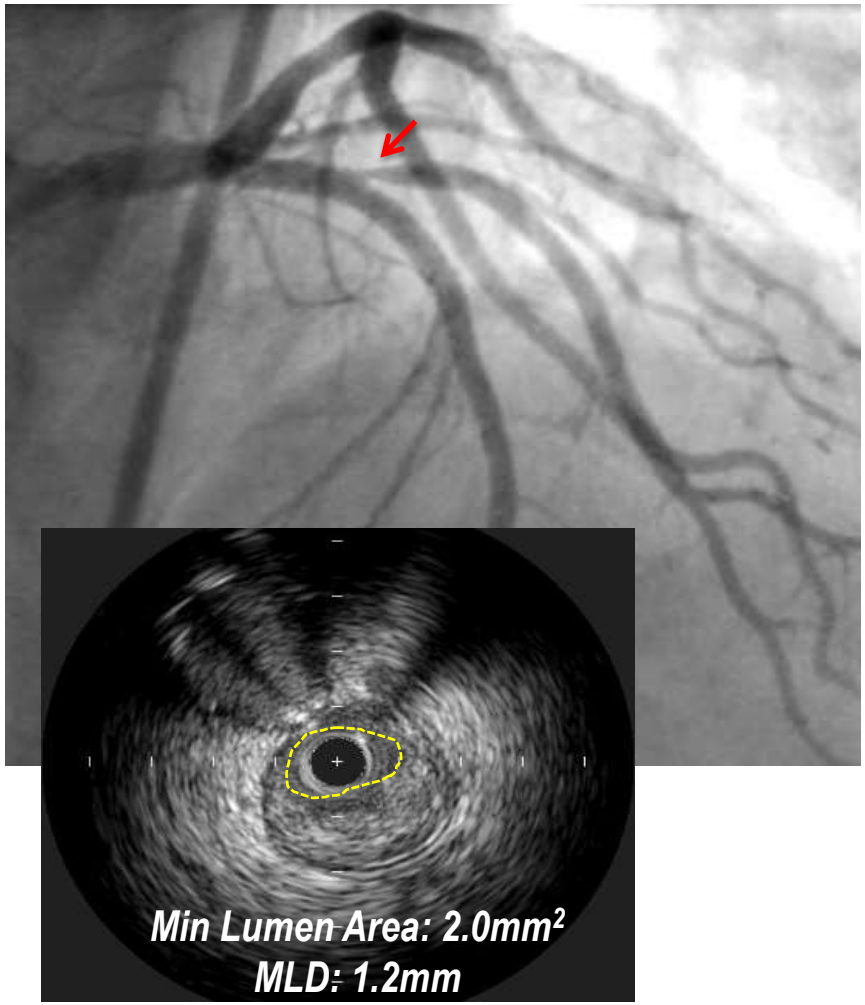


Significant stenosis?

- Anatomically!
- Physiologically!
- Clinically!
- Prognostically!

Stenosis → Ischemia → Clinical relevance → Revascularization → Prognosis

Significant stenosis?

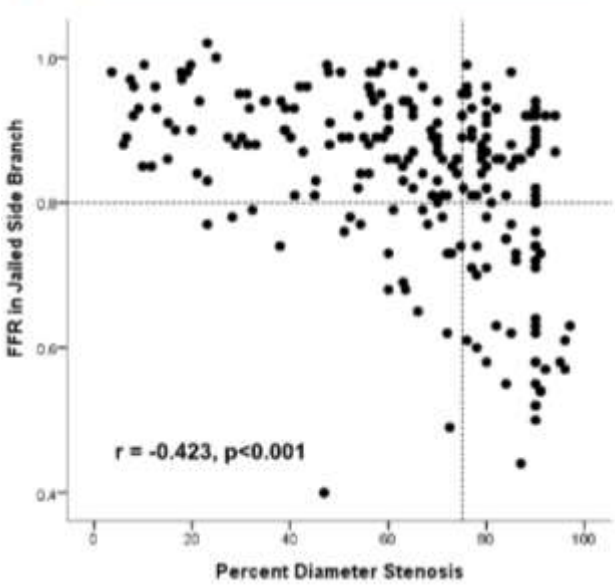


- **Anatomically!**
- Physiologically
- Clinically
- Prognostically

Anatomical severity ≠ Physiological significance

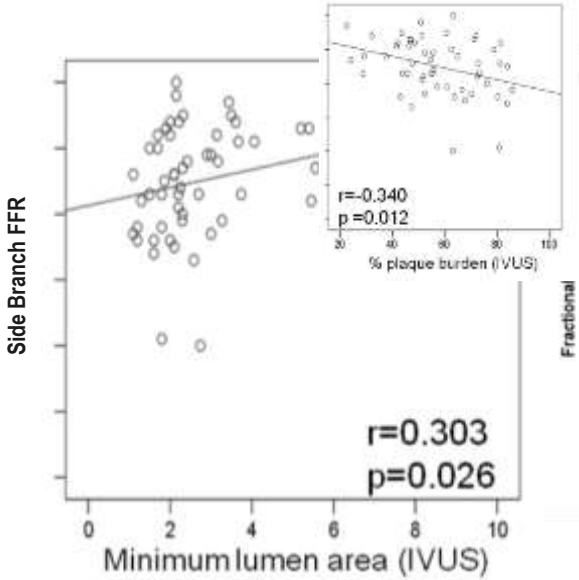
Technique doesn't matter!

Angiography



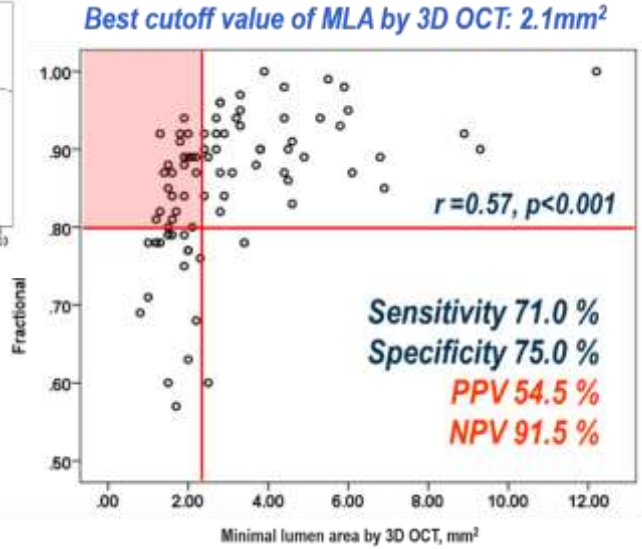
Lee JM, Koo BK, et al., Eurointervention 2015

IVUS



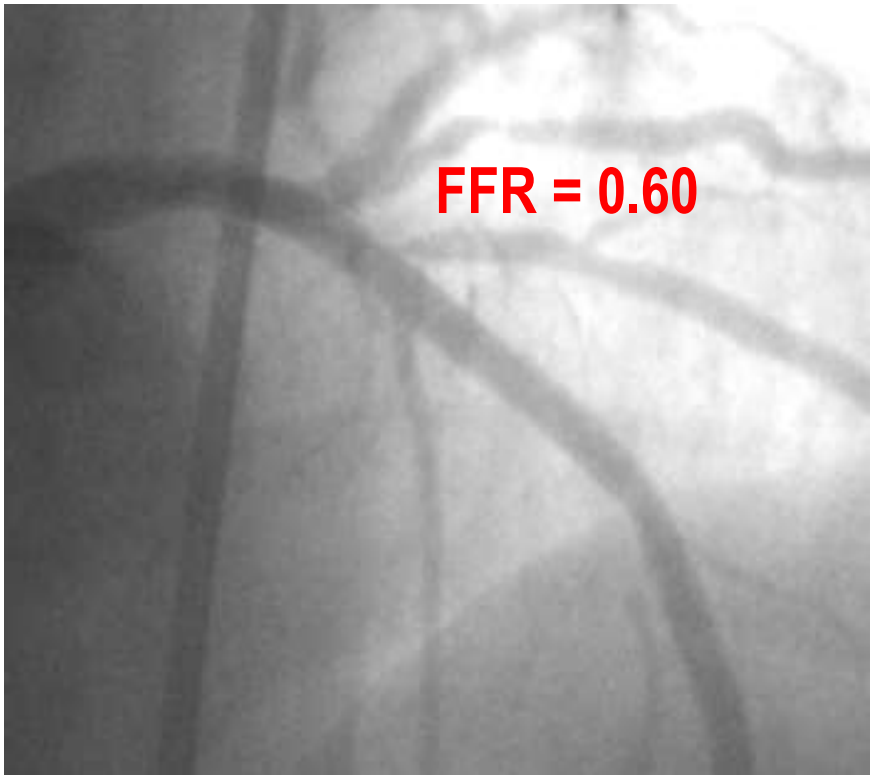
Koh JS, Koo BK, et al., JACC Intv, 2012

OCT



Ha J, Kim JS, et al. JACC Img 2014

Significant stenosis?



- **Anatomically!**
- **Physiologically** (by FFR)**!**
- Clinically?
- Prognostically?

Can FFR-guided approach improve the out mes?

- *FFR-guided SB intervention strategy failed t y over angiography-guided intervention for bif hes).*

Technique still doesn't matter, WHY?

	FFR-guided group		
	N		
Side branch PCI			0.02
TVR		(3.7%)	0.7
MI		0	1
Cardiac death	0	0	1

Koo BK, et al. Eur Heart J 2008

Results (3): One-year clinical outcomes

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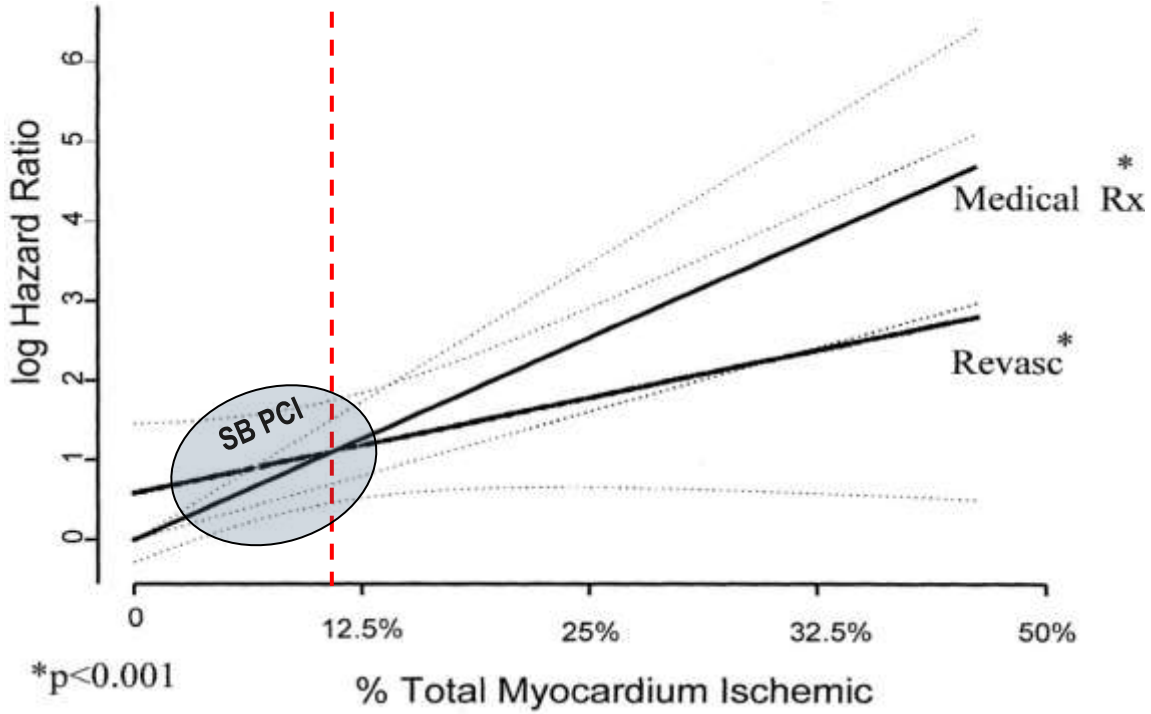
tct2014

Chen SL, et al. JACC Cardiovasc Interv 2015

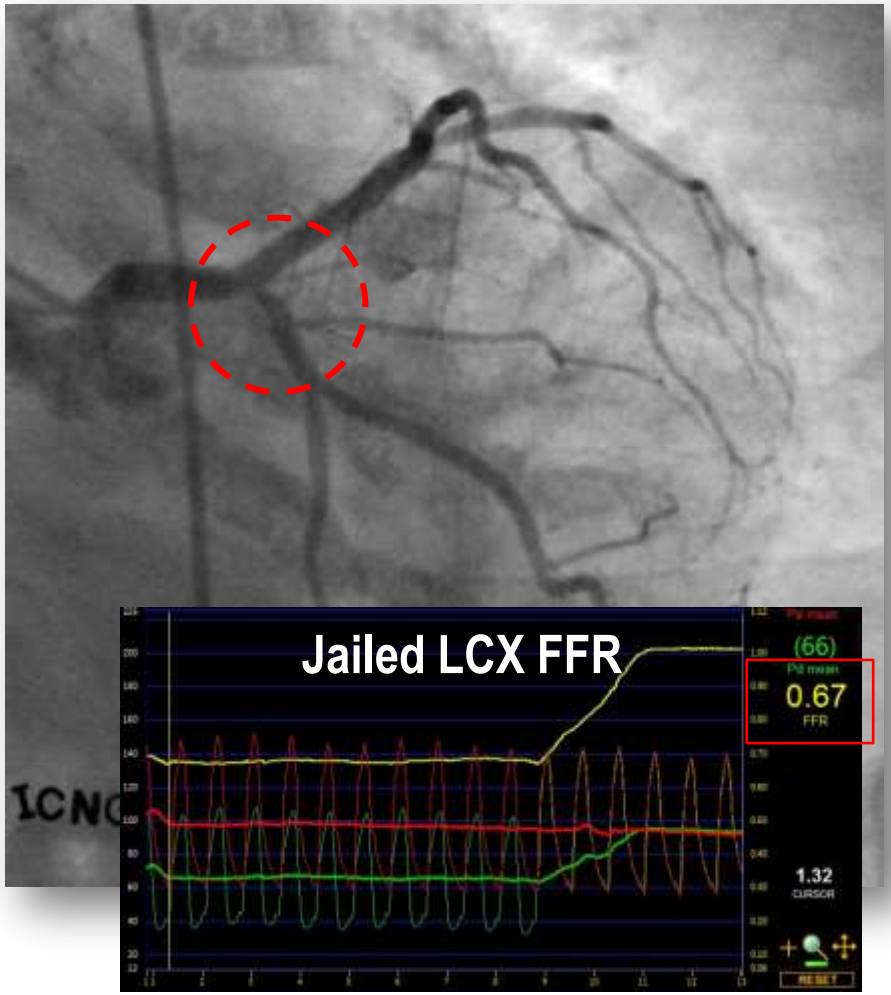
Which side branch deserves revascularization?

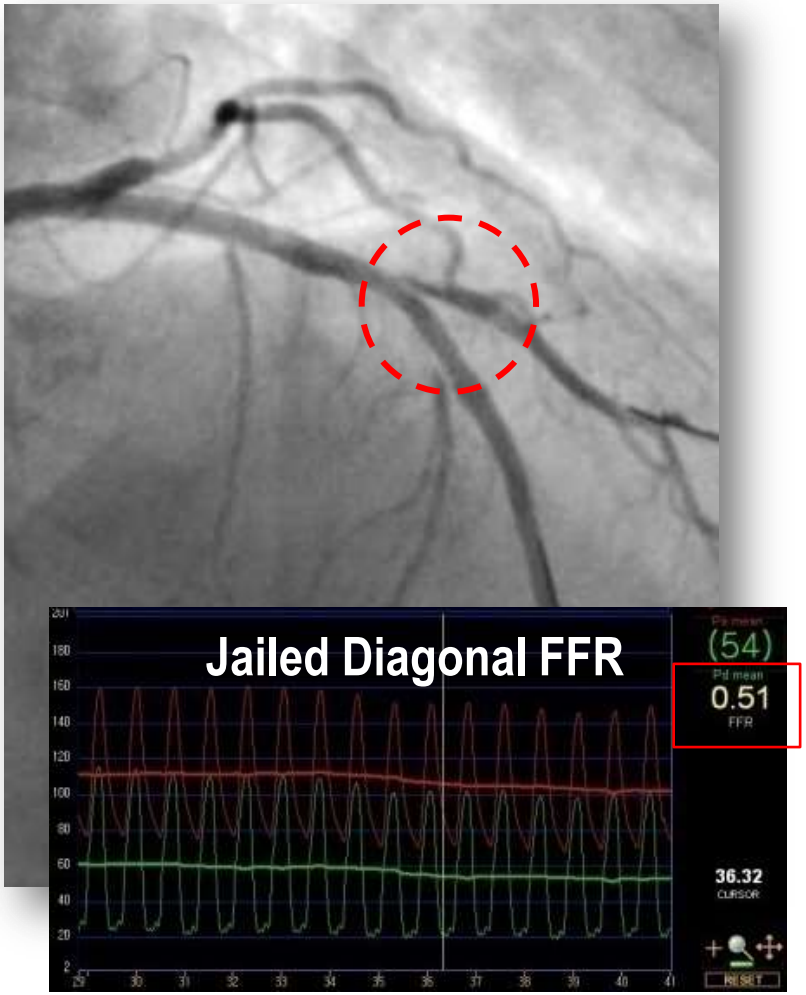
- In terms of ischemia at risk, revascularization is better than medical treatment when moderate to severe ischemia exists. Therefore, it is important to define the side branches that can cause ≥10% ischemia.



Hachamovitch, Circulation 2003

Which is worse?





Clinical significance: Main vs. Side branch

- Responses to 1-minute balloon occlusion -

	LAD	Diagonal	P value
Chest pain (VAS score)	5	2	<0.0001
ST elevation ≥ 1mm	92.3%	35.4%	0.001
QTc interval, msec	454.0±45.4	440.4±35.7	0.07
QTc dispersion, msec	83.8±39.2	70.7±28.5	<0.0001

Side branch has much less clinical relevance in terms of symptom, ischemia and arrhythmic potentials

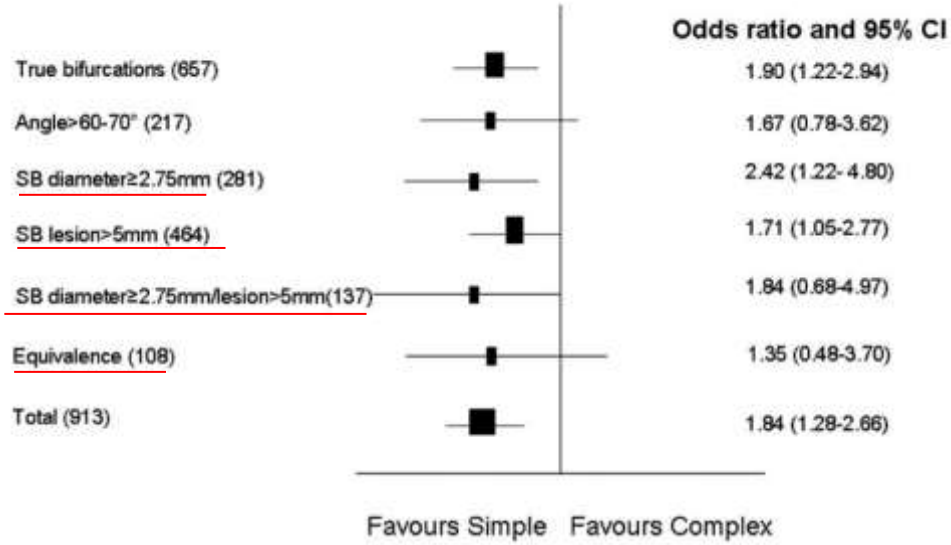
Koo BK, et al., JACC Intv, 2012

Which side branch deserves stent implantation?

- Previous studies focused on angiographic findings failed to define the side branch characteristics which favor side branch stenting.

BBC+NORDIC study

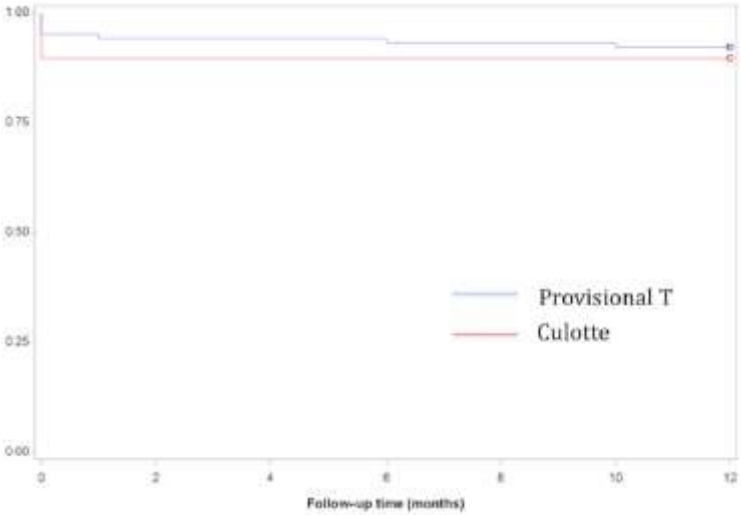
: provisional better, at any discrimination parameter



Behan, et al. Circ Cardiovasc Interv 2011

EBC Two study

: Provisional T vs. Culotte in large side branch (≥2.5mm) with significant ostial disease length (≥ 5mm)



Hildick-Smith, et al. Circ Cardiovasc Interv 2016

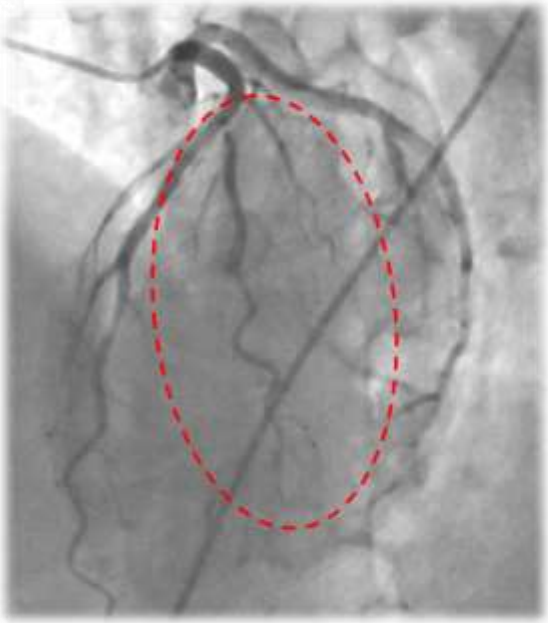
Angiographic and flow characteristics to define ≥10% ischemia by MPI

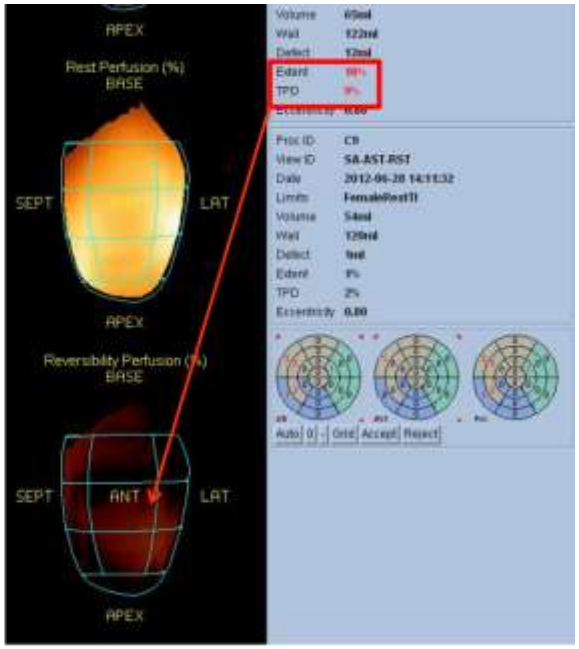
	Ischemia ≥10% (n=11)	Ischemia <10% (n=41)	*P*
Total occlusion	9 (81.8%)	15 (36.6%)	0.008
Size ≥ 2.5mm	10 (90.9%)	23 (56.1%)	0.040
Number = 2	4 (36.4%)	24 (58.5%)	0.012
Number = 1	6 (54.5%)	5 (12.2%)	
Apical area reaching other SB	3 (27.3%)	30 (73.2%)	0.011
Highest in prox-mid LAD	10 (90.9%)	20 (48.8%)	0.016
Flow data from PET			
Stress myocardial blood flow	1.44±0.34	1.74±0.32	0.033
Coronary flow reserve	1.55±0.45	1.91±0.49	0.068
Relative flow reserve	0.59±0.07	0.68±0.09	0.015

Jeon WK. KCS meeting 2016

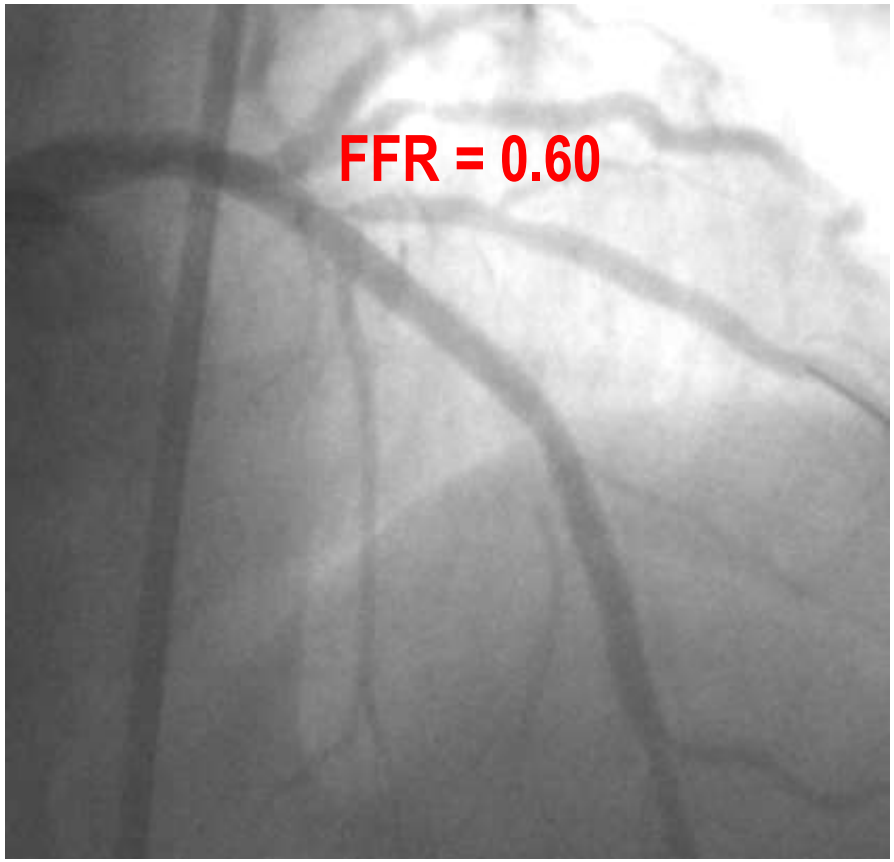
Which side branch deserves stent implantation?

- Don't forget to assess myocardial mass at risk before you do anything (IVUS, FFR, ballooning, stenting…) for side branches.
- Estimate the size, location and influence of other branches (mSNuH score).
- Remind that only a few side (diagonal) branches can cause moderate to severe ischemia.





Significant stenosis?

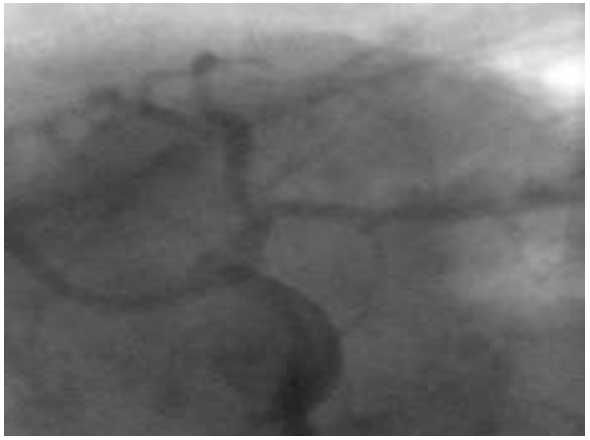


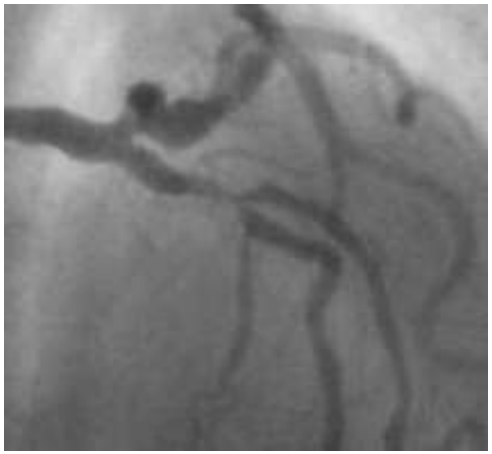
- Anatomically!
- Physiologically!
- Clinically!
- Prognostically?

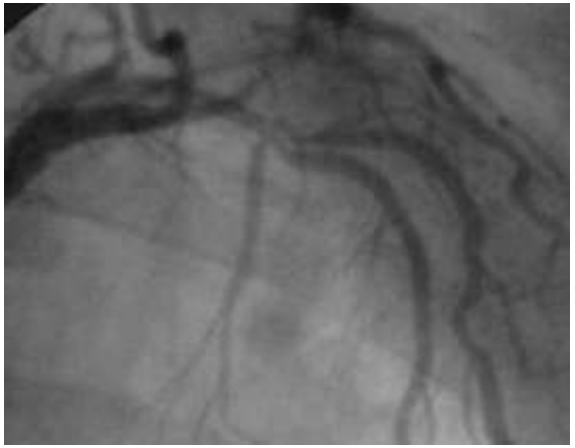
Determinants of prognosis

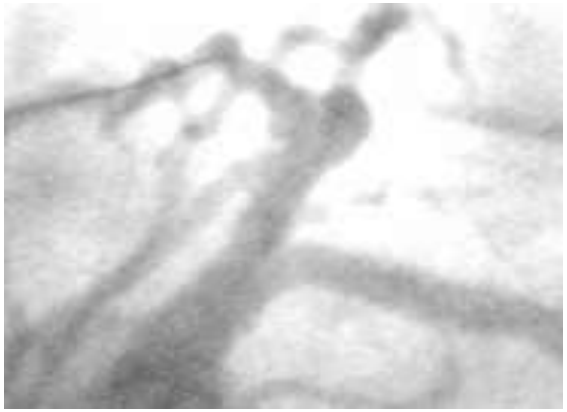
: Ischemic burden, collateral recruitability and **treatment strategy**

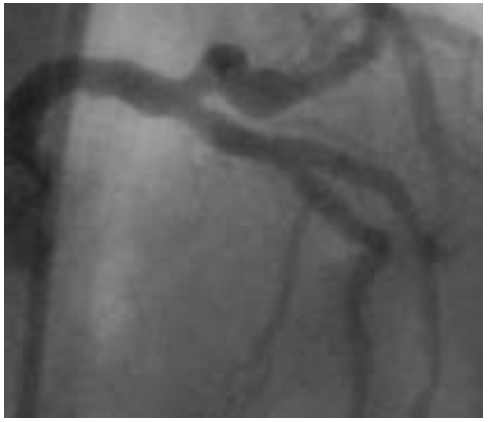
Does technique matter?

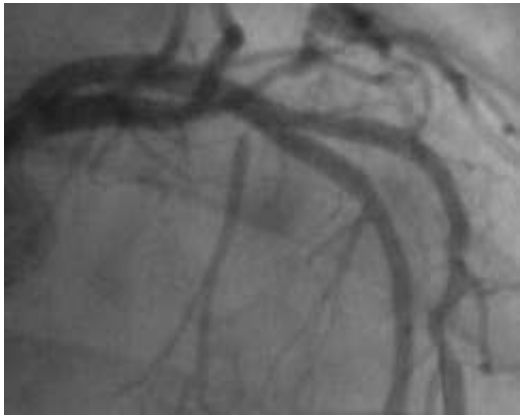












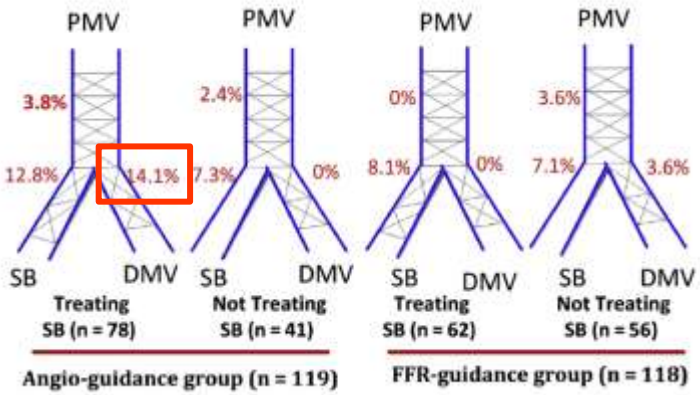
Modified T

Kissing

Crush
(mini, micro, DK, reverse…)

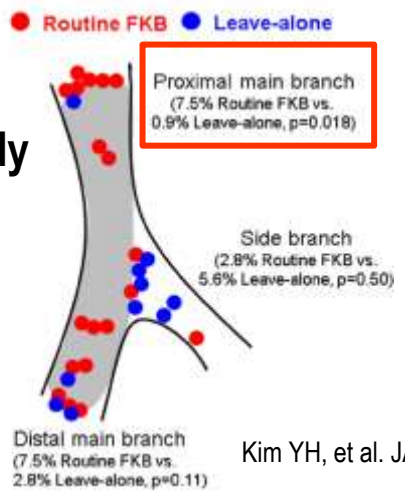
More intervention for SB may cause more events at MB!

DK-CRUSH VI trial



Chen SL, et al. JACC interv 2015

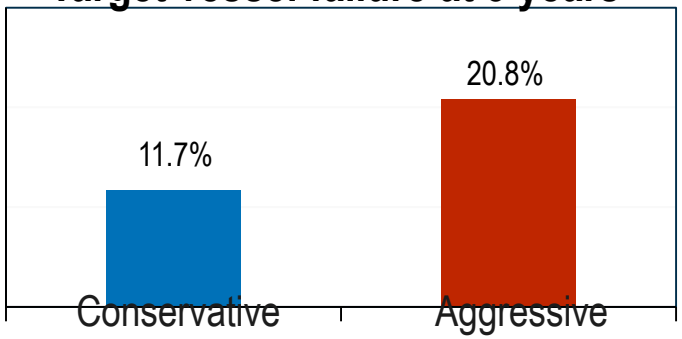
CROSS study



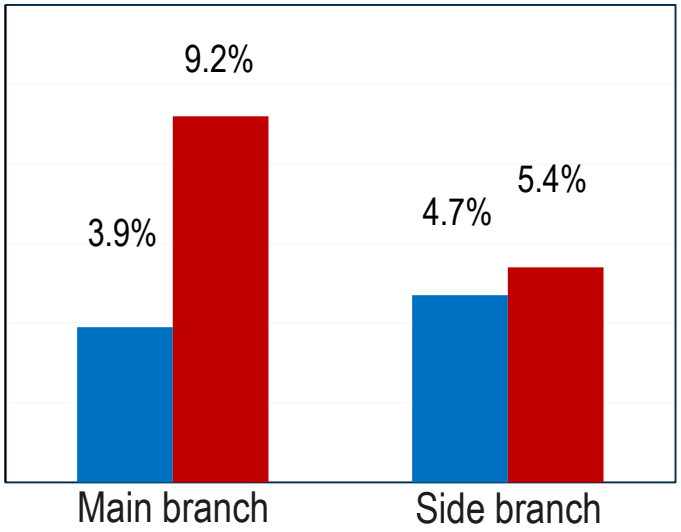
Kim YH, et al. JACC interv 2015

SMART STRATEGY
(IVUS-guided PCI in 98%)

Target vessel failure at 3 years

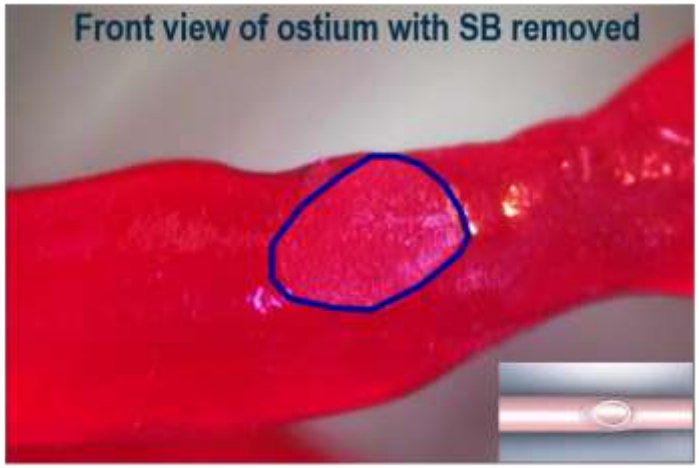


Target lesion failure at 3 years

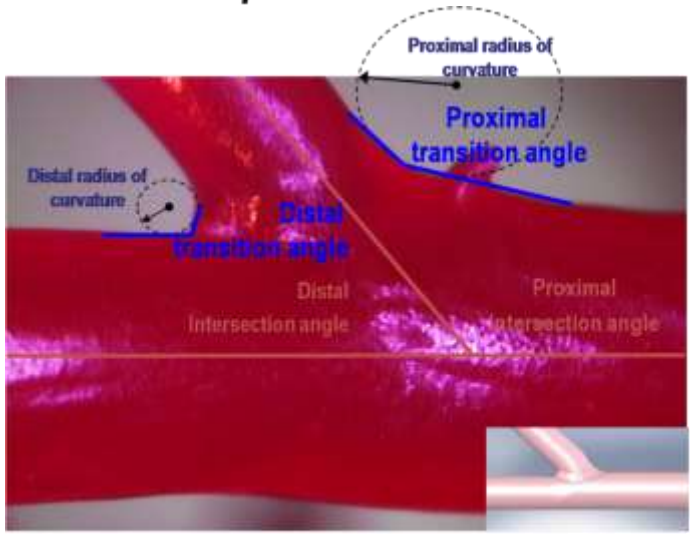


Song YB, et al. JACC interv 2016

Pitfalls of current PCI for bifurcation lesions

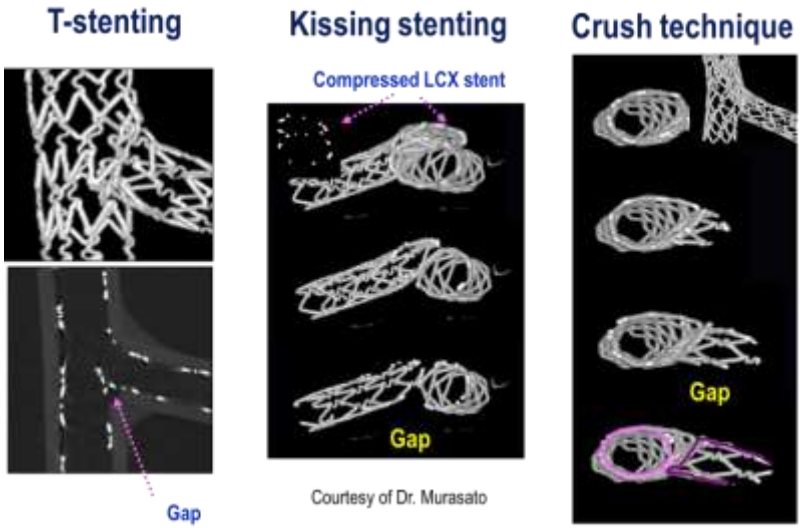


Elliptical SB ostium

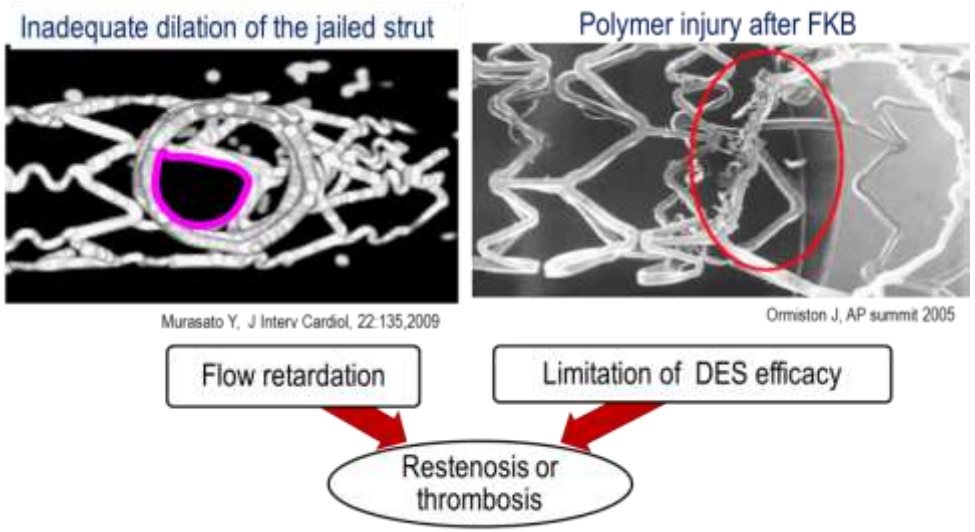


Conical taper

Russell, EuroIntervention 2009

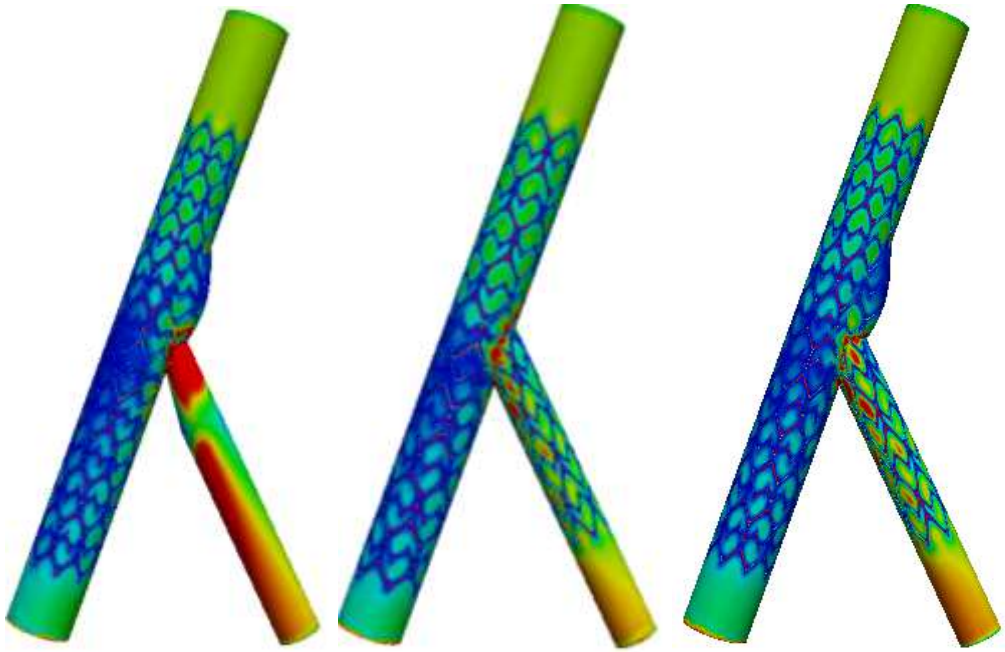


Courtesy of Dr. Murasato

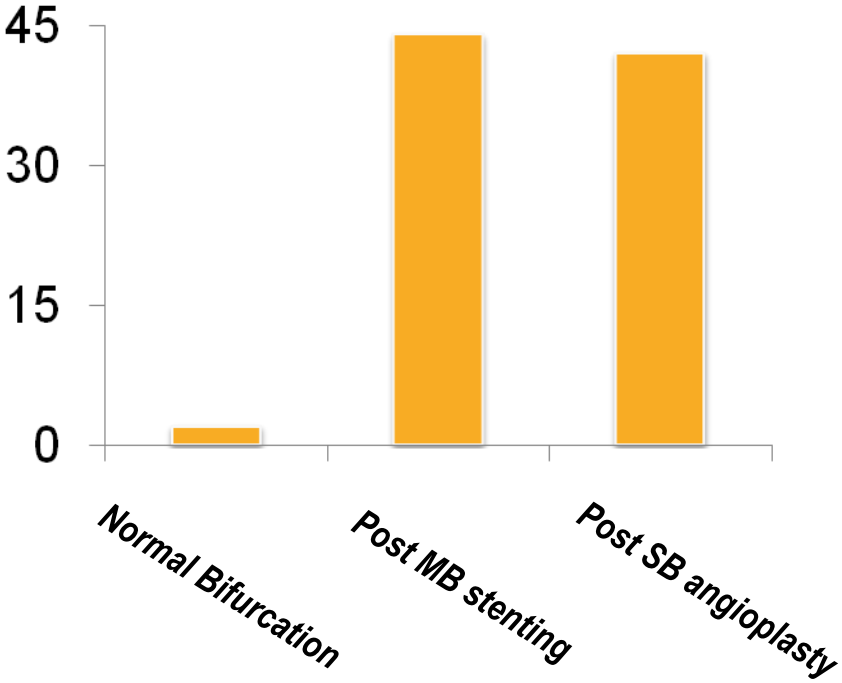


Keep the fractal ratio: Once you break, you'll never recover it!

Shear stress distribution



% area of low WSS *(< 4dyne/cm²)*



Williams & Koo, et al. J Appl Physiol 2010

Simple concepts for complex bifurcation lesions

- Beware that main branch and side
- Before side branch inter
  - Is this branc
  - Is
  - ardial ischemia?
  - outcomes of this patient, not this lesion?

The patient may suffer a big loss when the operator goes after a small gain.

Koo BK. JACC interv 2016