FFR in bifurcation lesions/stenting

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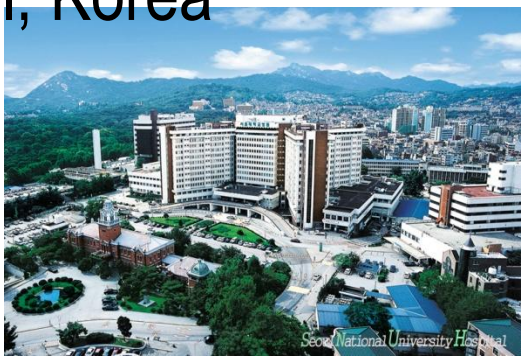


Why "functional evaluation" in bifurcation PCI?

Pitfalls of anatomical evaluation

- **Angiography**
  - Single directional assessment
  - Variability in stenosis assessment
  - No validated criteria for intervention
  - Not physiologic
- **IVUS/OCT**
  - Difficult to perform in tight stenosis
  - No validated criteria for intervention
  - Not physiologic

Uniqueness of side branch lesions

- Various size, various amount of myocardium
- Side branch stenosis is **unique and complex**
  - Underlying plaque → **Eccentric**
  - Remodeling → **Negative remodeling**
  - Complex mechanisms of side branch jailing

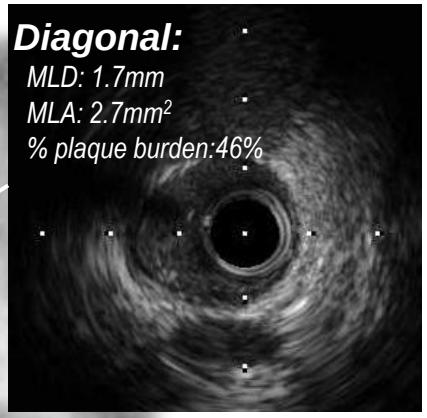
    Carina shift, plaque shift, stent struts, thrombus.....

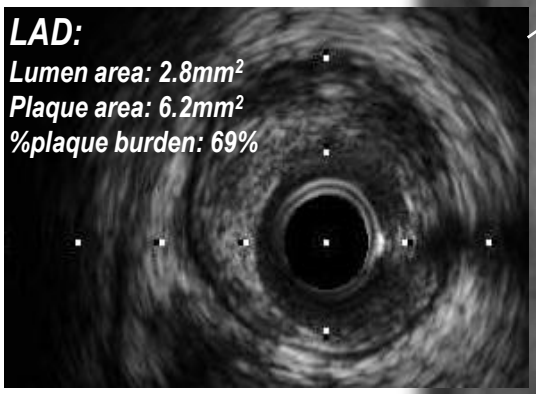
Koo BK & de Bruyne B, Eurointervention 2010

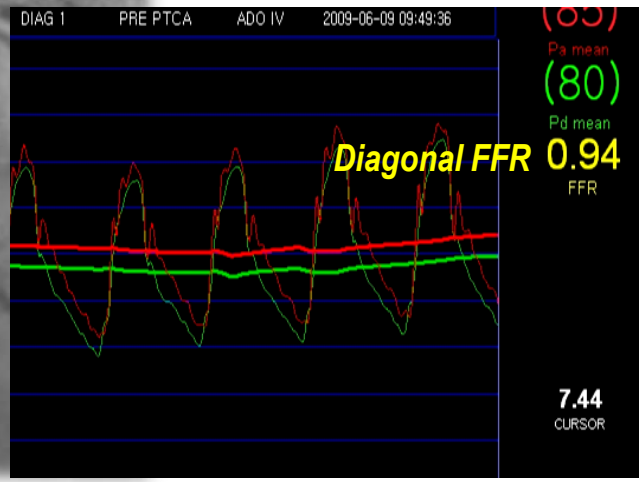
FFR: When and How in Bifurcation PCI?

- Pre-intervention
- After main branch stent implantation
- After side branch balloon angioplasty
- After side branch stenting

Significant bifurcation lesion?

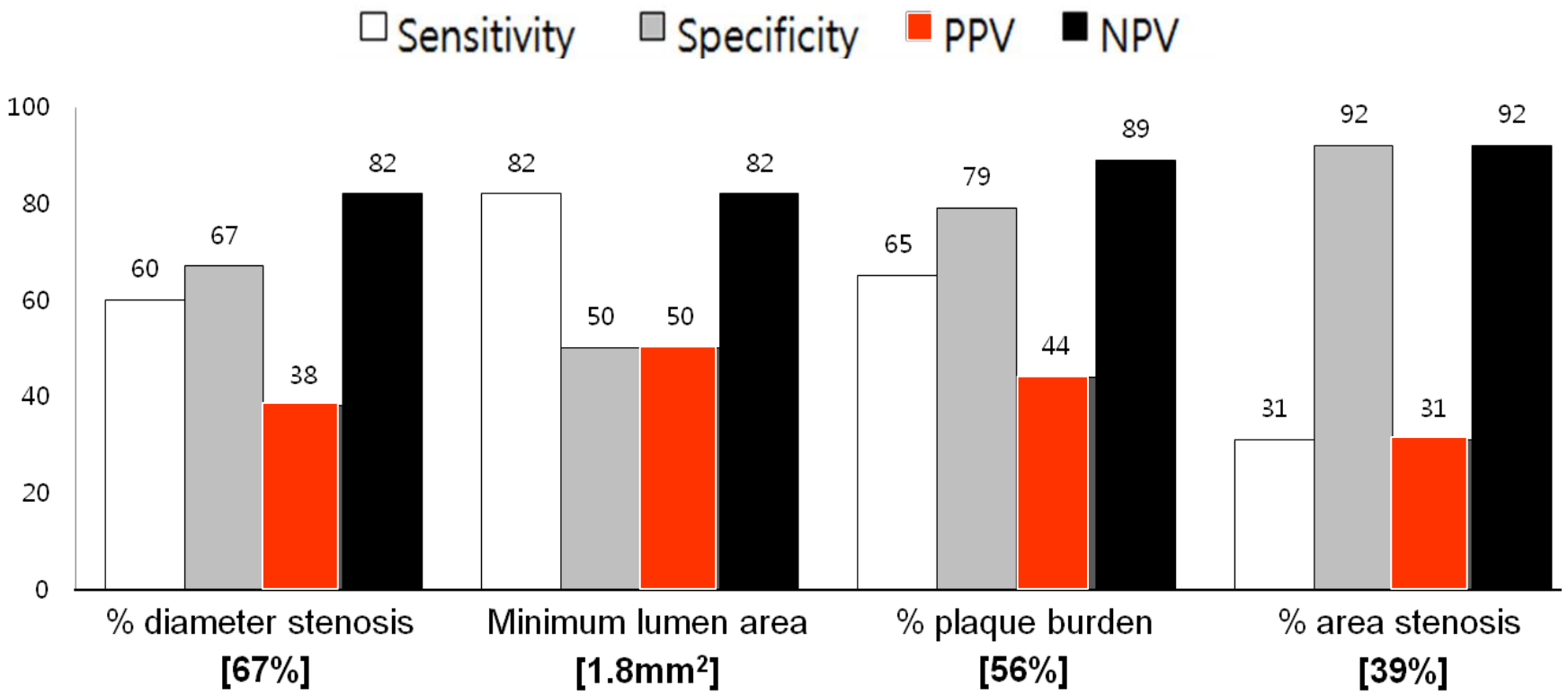






Why FFR?

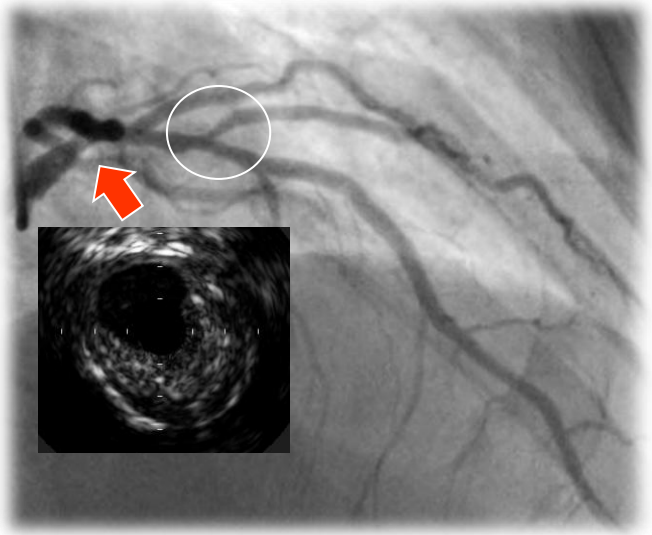
Diagnostic accuracy of anatomic parameters in pure SB ostial lesions



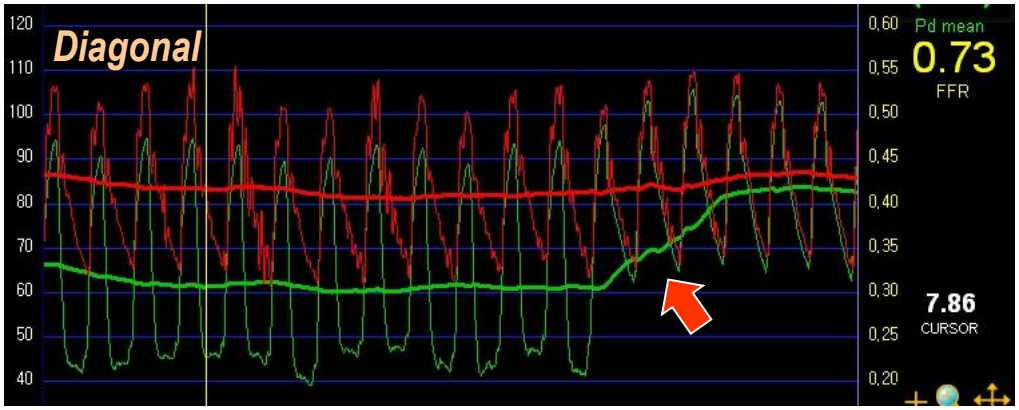
Koh JS, Koo BK, et al., JACC Intv, 2012

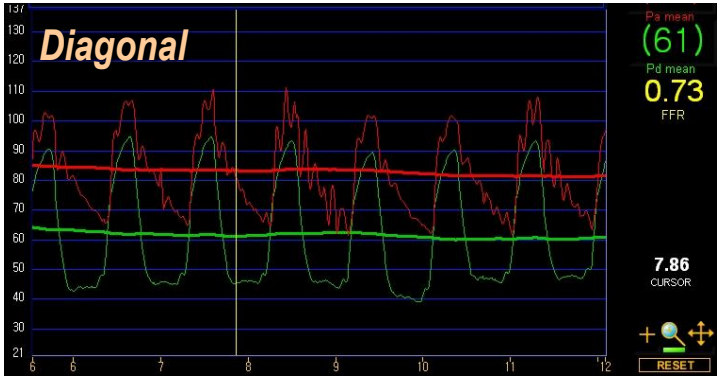
Pitfalls of Side branch FFR: Influence of MB stenosis

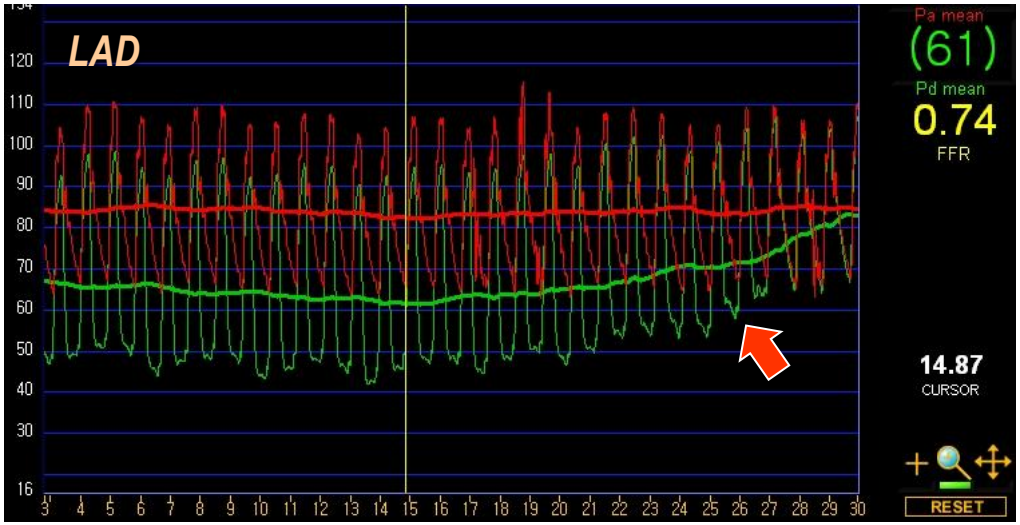
Anatomical & functional Medina 0,0,1 lesion?



Pullback pressure tracing



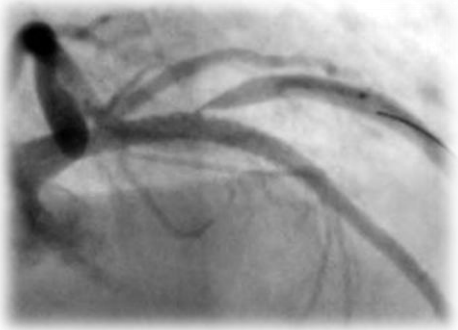




Pre-intervention

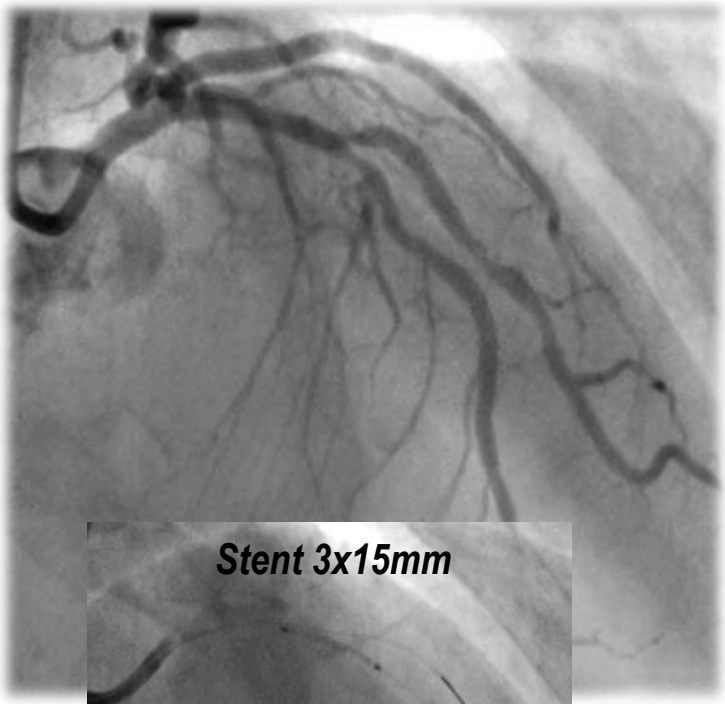
- FFR <0.75 does not always mean the clinical relevance of that SB stenosis. FFR should be measured in large SB.
- When SB FFR is measured, the influence of main branch stenosis should always be considered (Don't forget the pullback pressure tracing!).
- Pre-intervention SB FFR is usually not helpful to predict the jailed SB FFR.

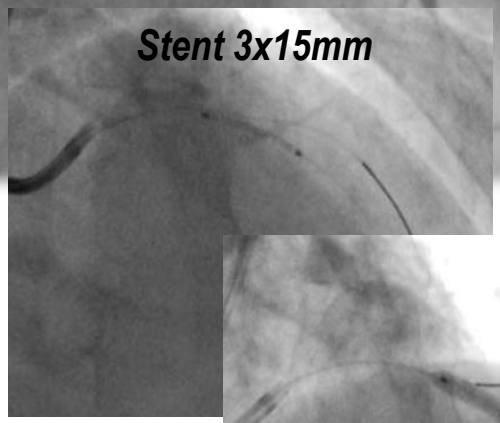
FFR: When and How in Bifurcation PCI?

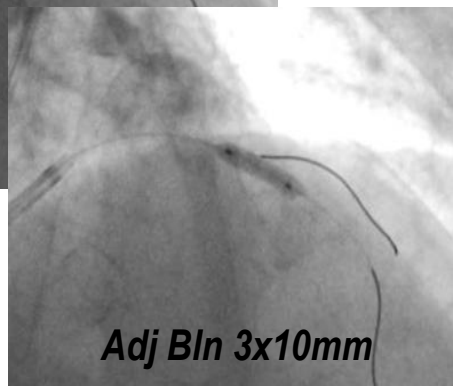


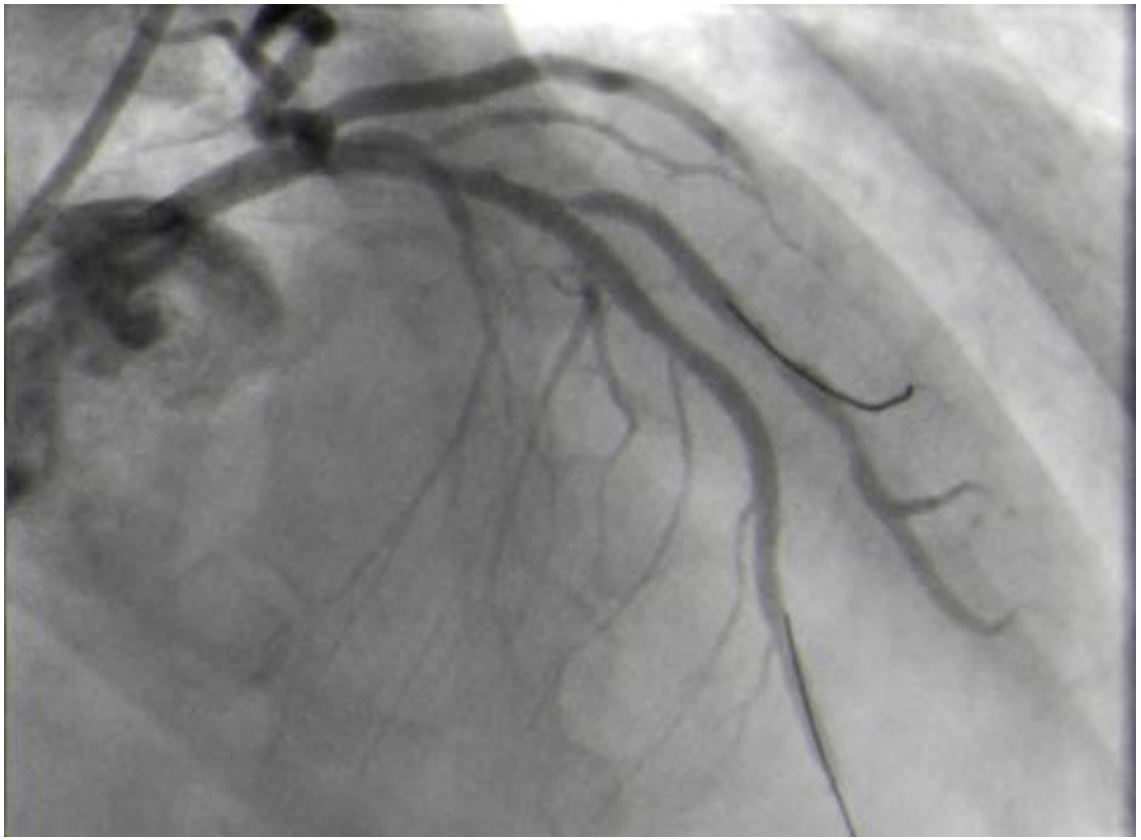
- Pre-intervention
- After main branch stent implantation
- After side branch balloon angioplasty
- After side branch stenting

Side branch angioplasty?



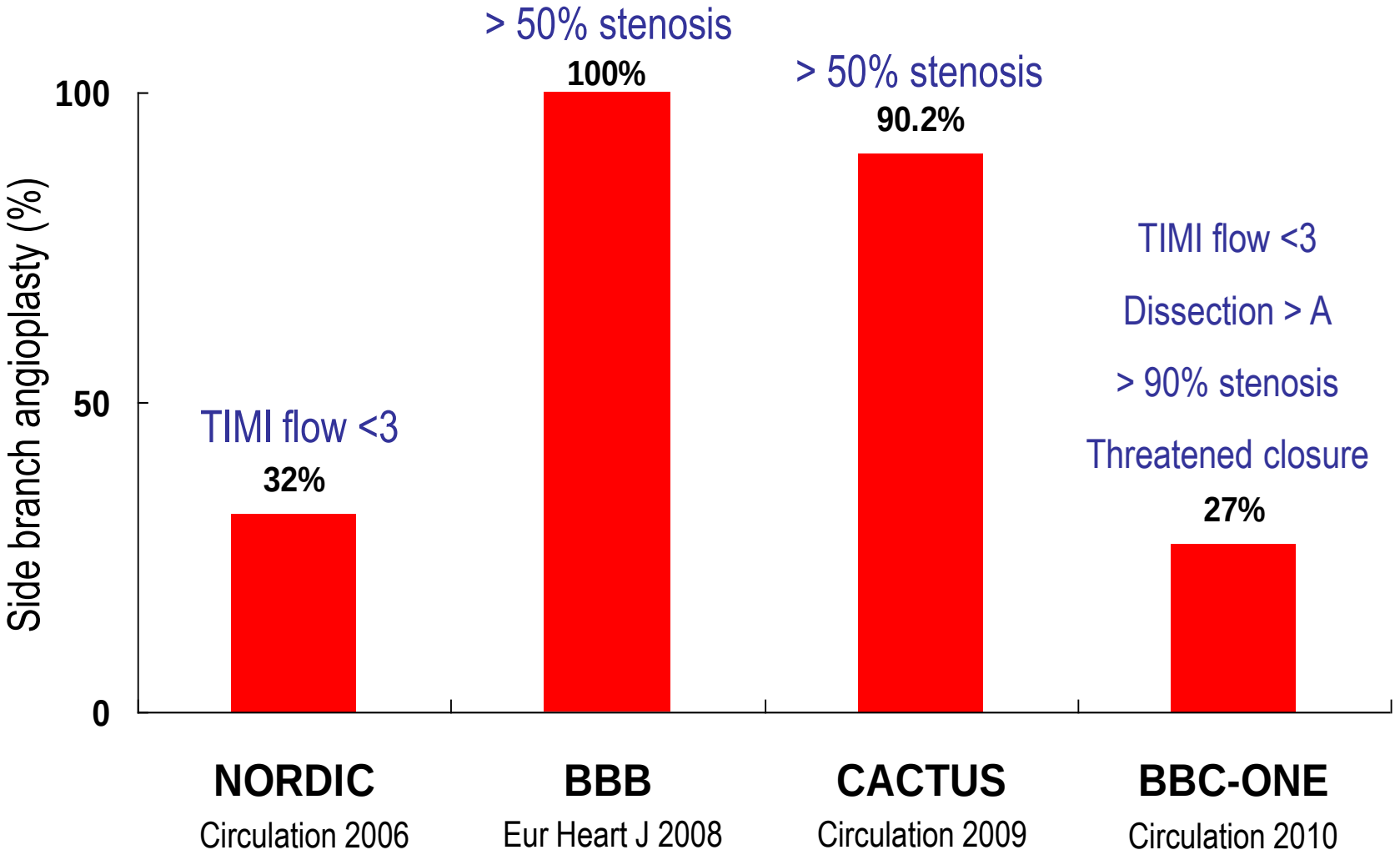




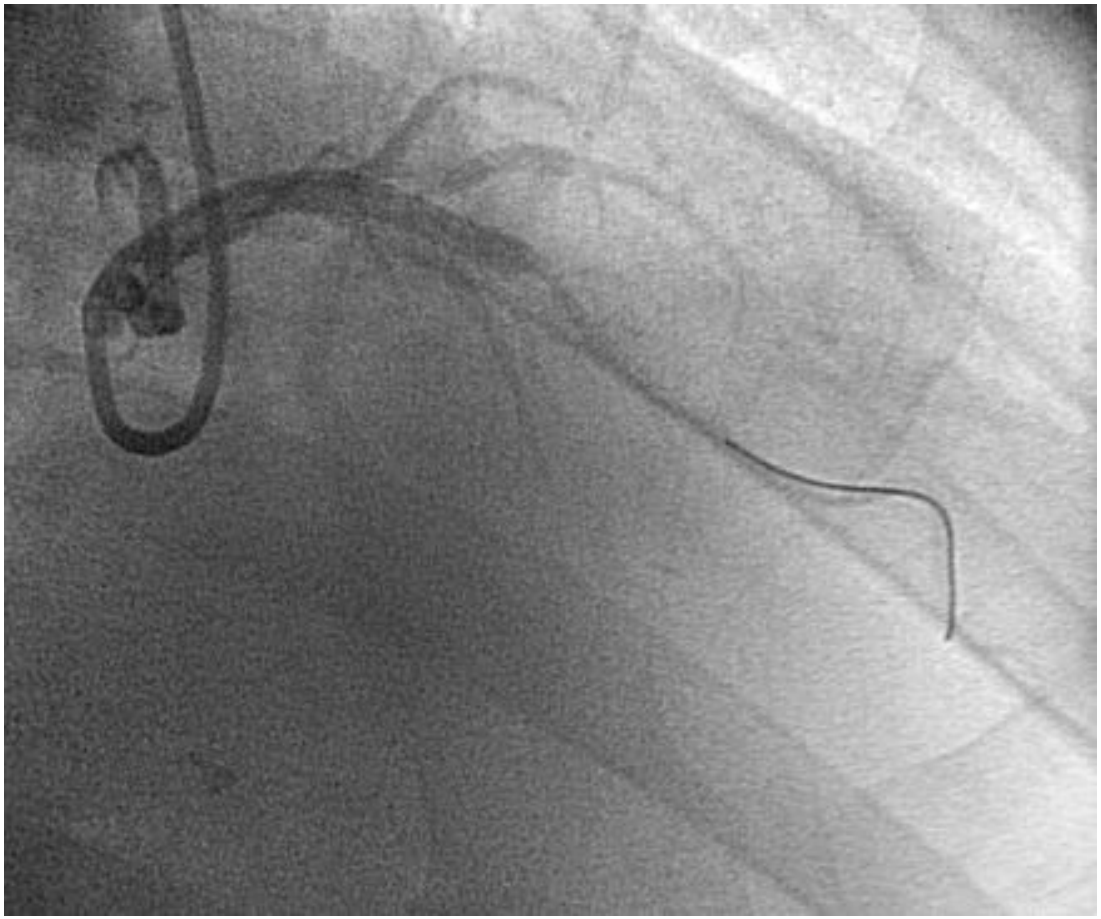


Side branch angioplasty ?

Different criteria from different studies……



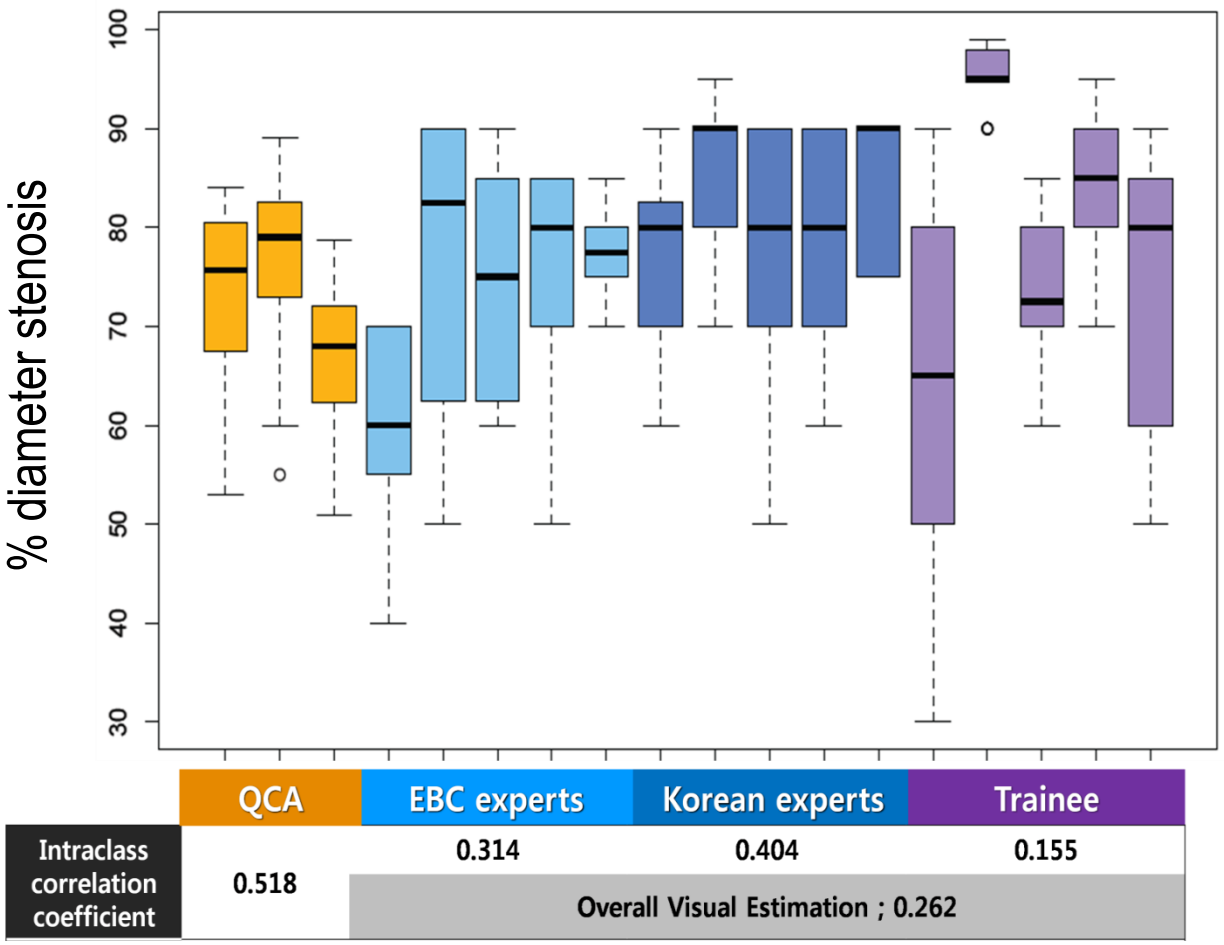
Degree of stenosis?



- Observer 1: 70%
- Observer 2: 90%
- Observer 3: 75%
- QCA system 1: 66%
- QCA system 2: 76%
- QCA system 3: 79%

How accurate is our assessment?

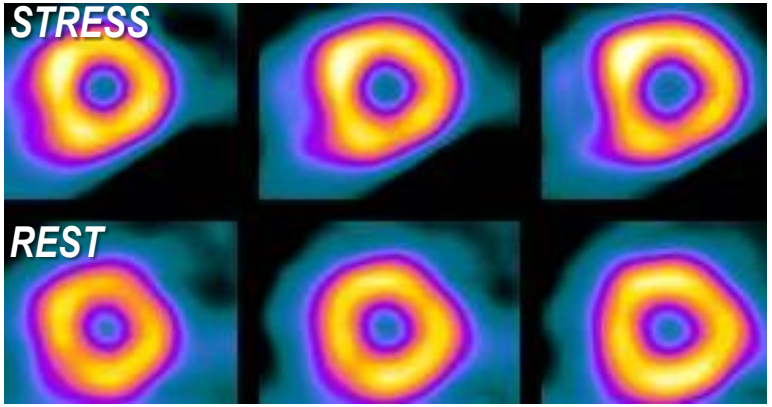
Variability of QCA and visual estimation in jailed SB lesions

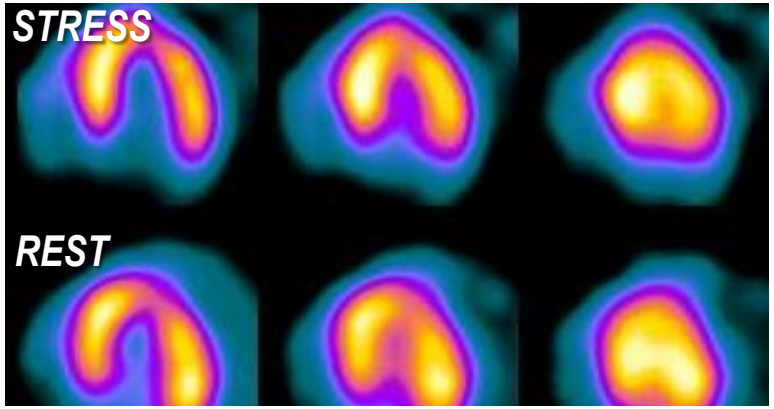


Shin DH, Koo BK, et al. Cath Cardiovasc Interv 2011

In Jailed side branch lesions,

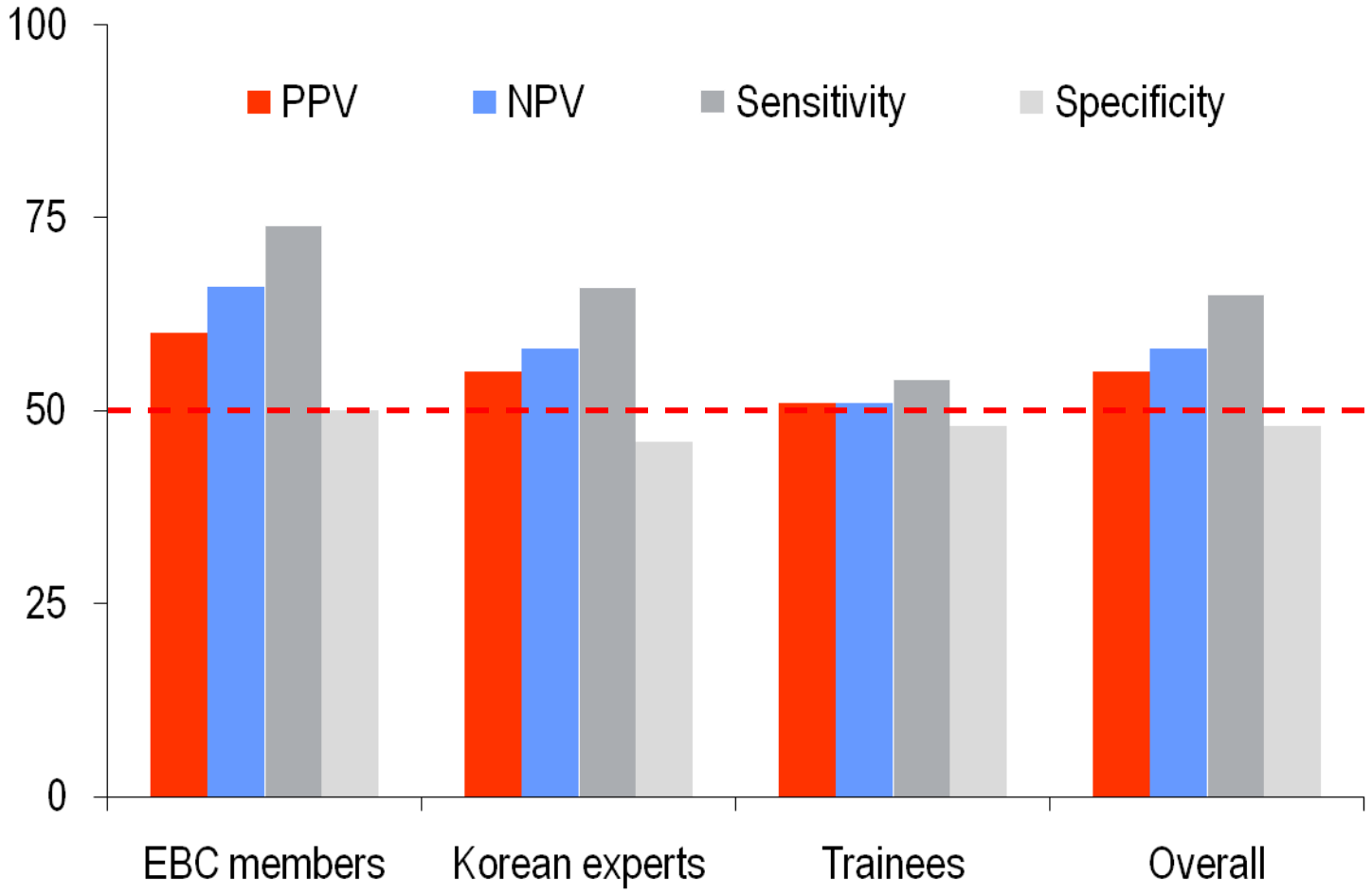
Angiographic severity ≠ Presence of ischemia





No perfusion defect

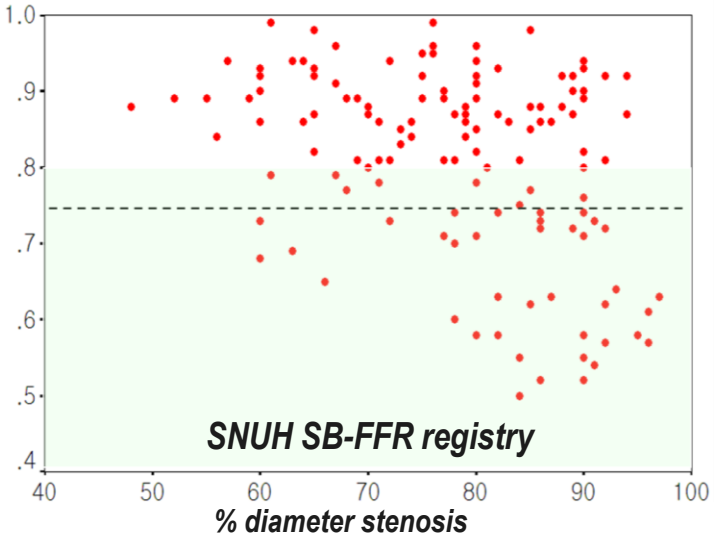
Estimation of "functional significance" in jailed SB lesions

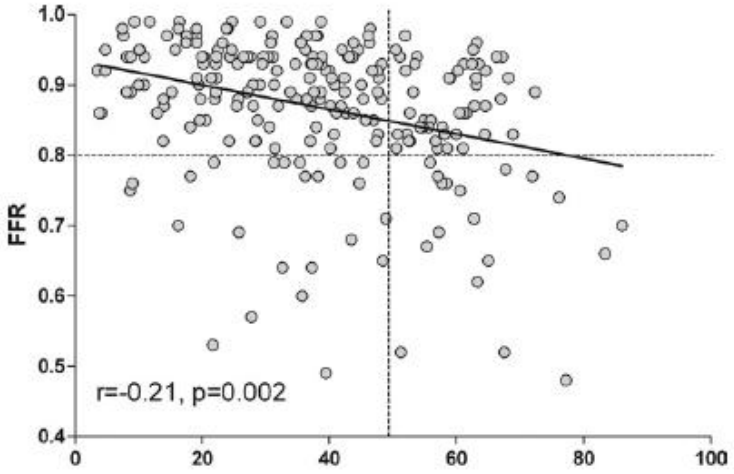


Shin DH, Koo BK, et al. Cath Cardiovasc Interv 2011

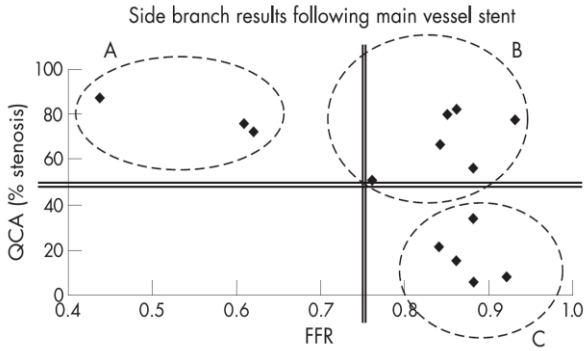
Anatomical severity ≠ Functional significance

FFR vs. % diameter stenosis in Jailed side branches

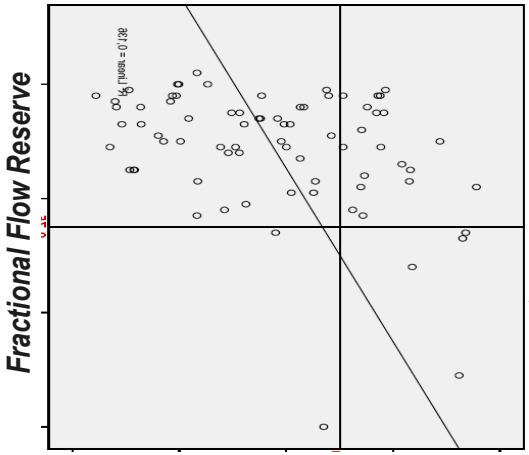




Ahn JM, et al. JACC intv 2012



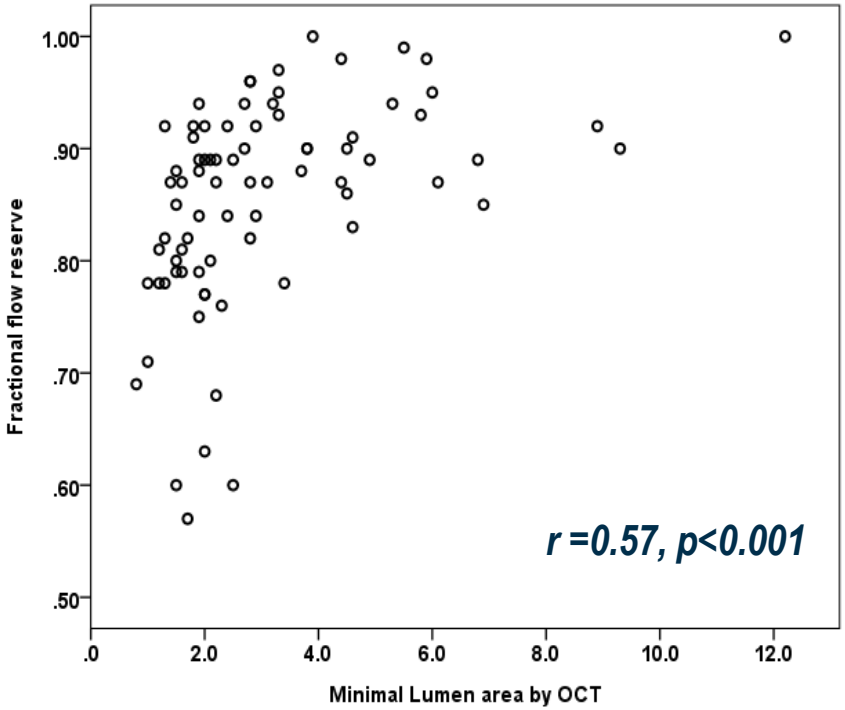
Bellenger, et al. Heart 2007



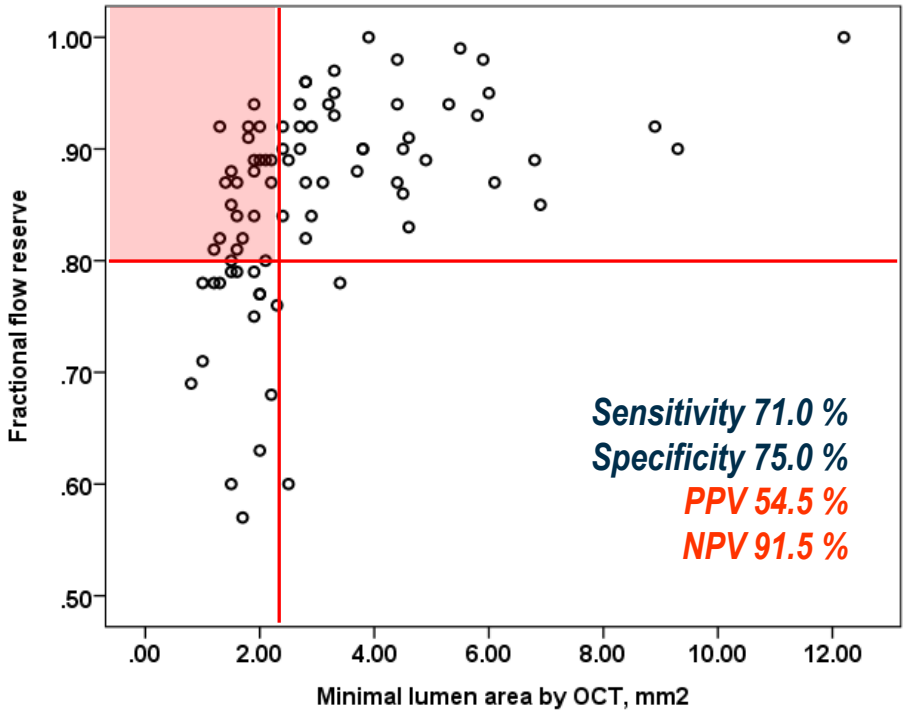
Kumsars I, et al. Eurointervention 2011

Anatomical severity ≠ Functional significance

FFR vs. OCT lumen area in Jailed side branches

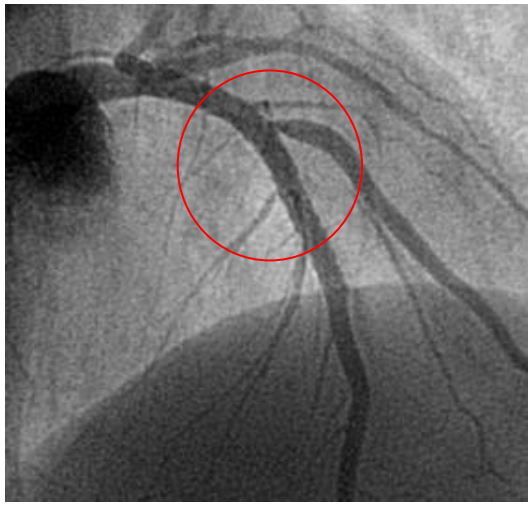


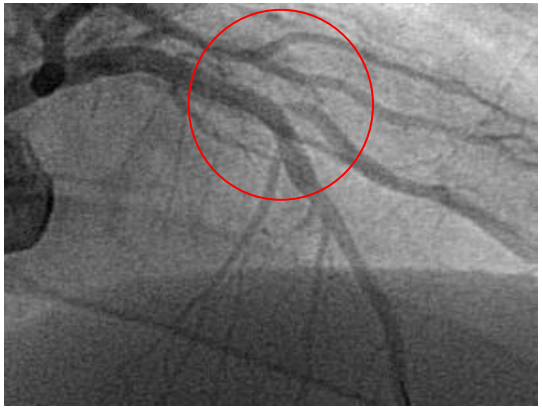
OCT 2.05mm² Vs. FFR 0.80

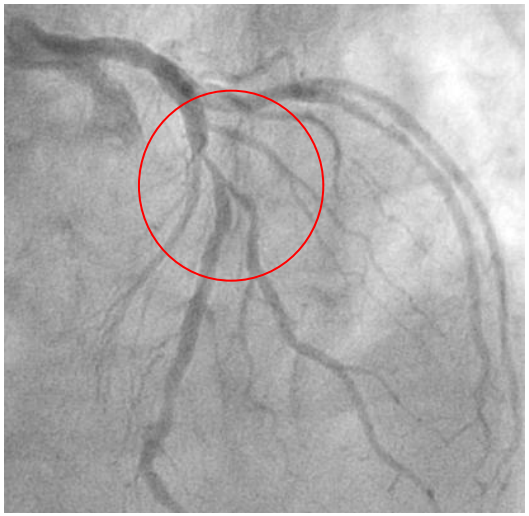


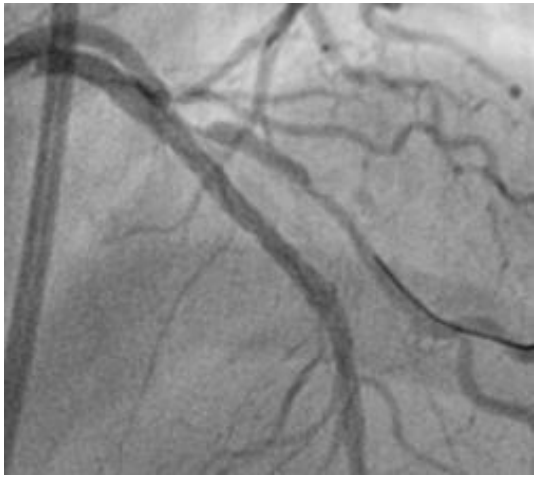
Ha J, Kim JS, et al. JACC Img 2013, in press

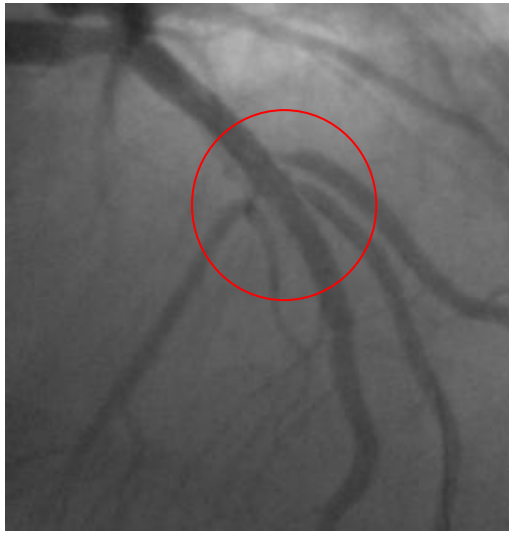
FFR in all jailed side branches?









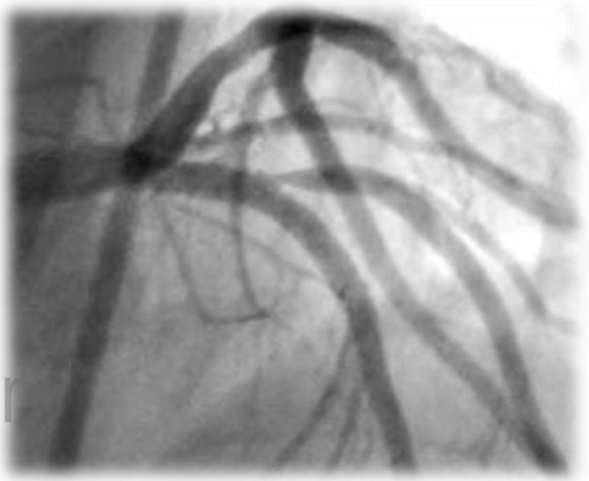


After main branch stent implantation

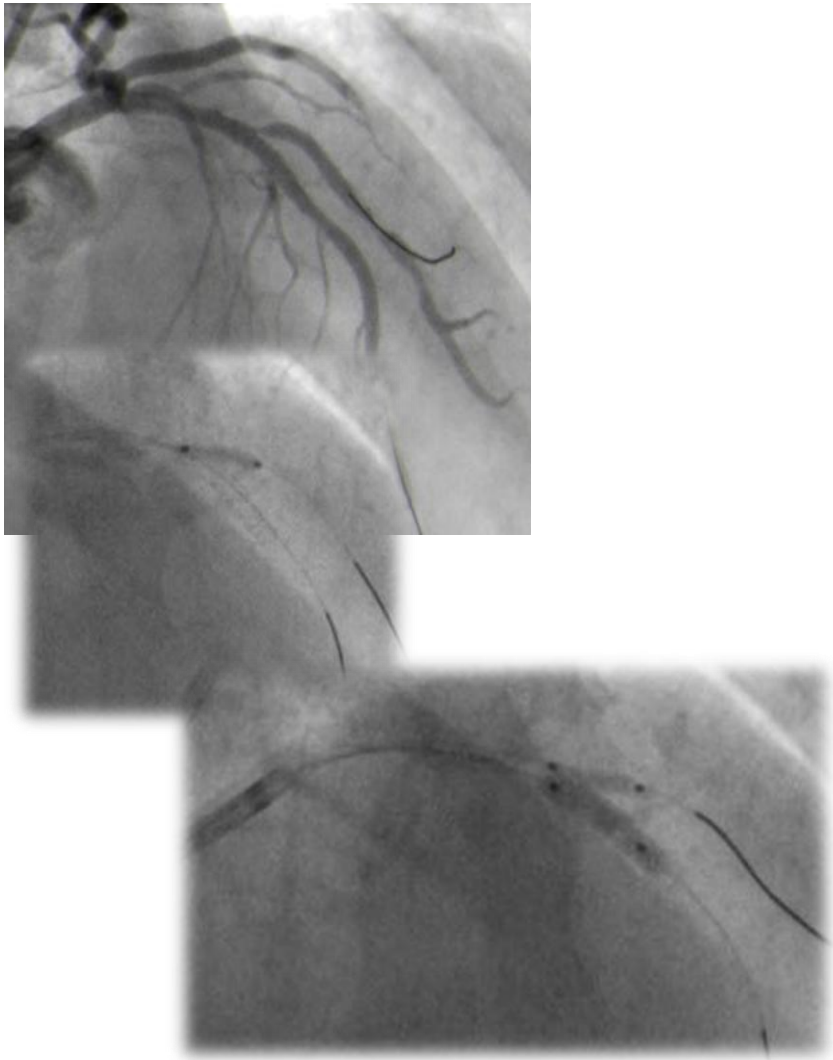
- SB FFR is useful in short ostial SB lesions.
- SB FFR is generally not recommended in very complex SB lesions (severe tortuosity, heavy calcification, diffuse multiple stenosis…..).
- The pressure wire should not be jailed by a MB stent.
- FFR 0.75 seems to be an appropriate criteria for jailed SB intervention considering the clinical relevance of SB and complexity of procedures.

FFR: When and How in Bifurcation PCI?

- Pre-intervention
- After main branch stent i
- After side branch balloon angioplasty
- After side branch stenting



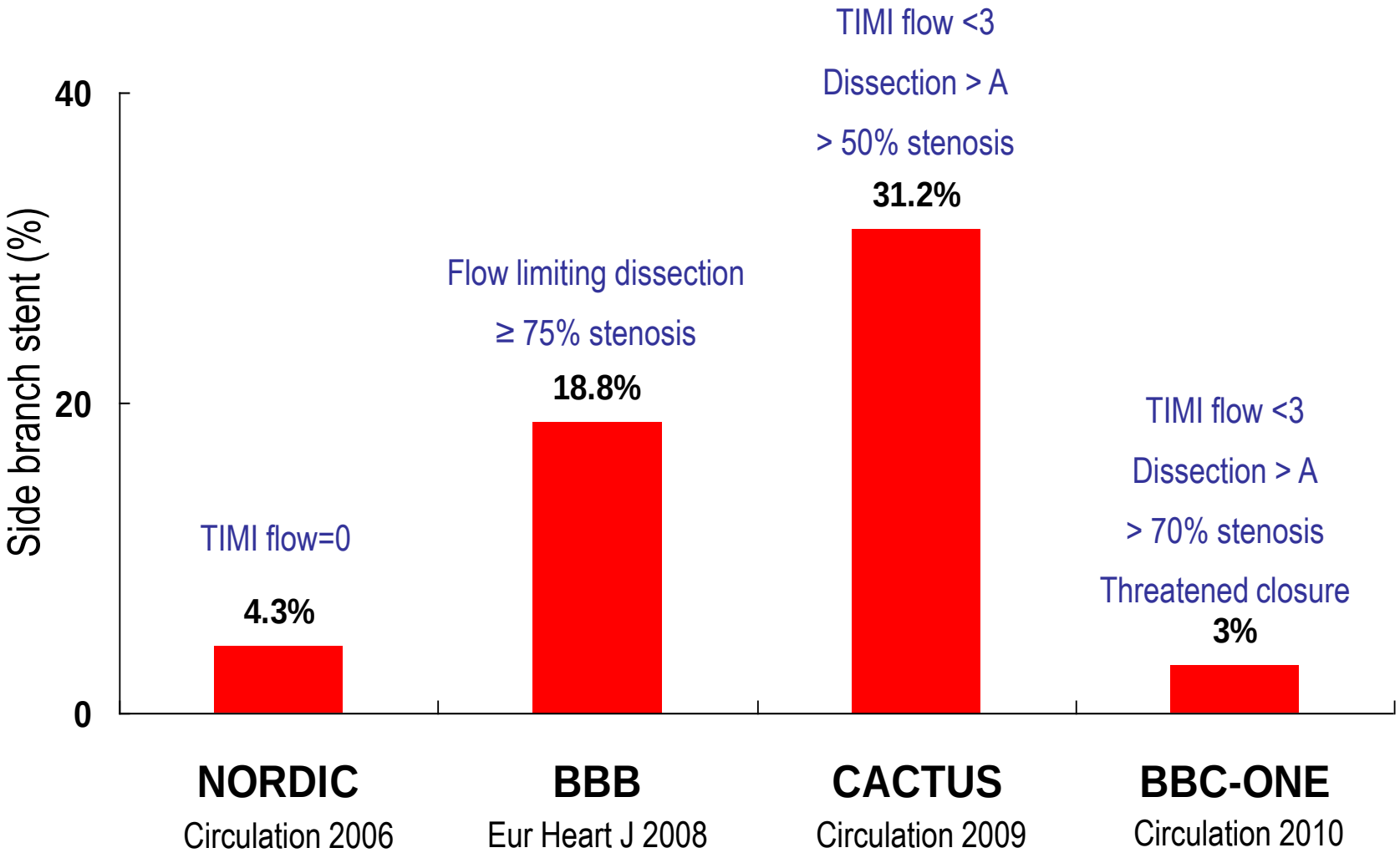
Side branch stenting?



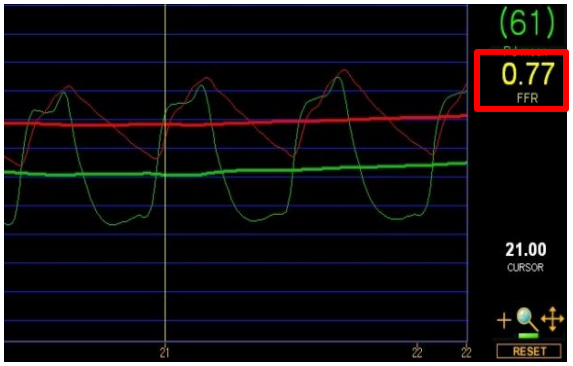
Post-Kissing balloon inflation

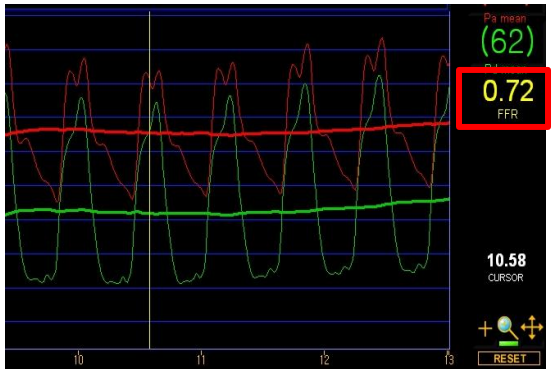
Side branch stenting ?

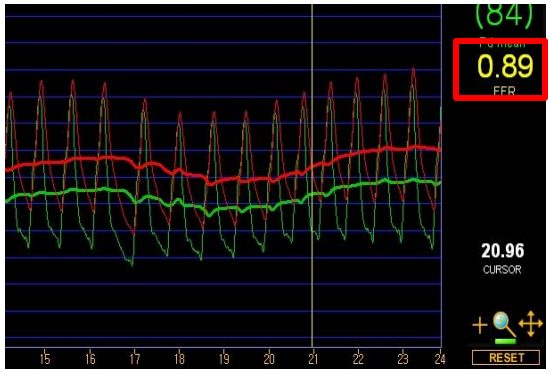
Different criteria from different studies……



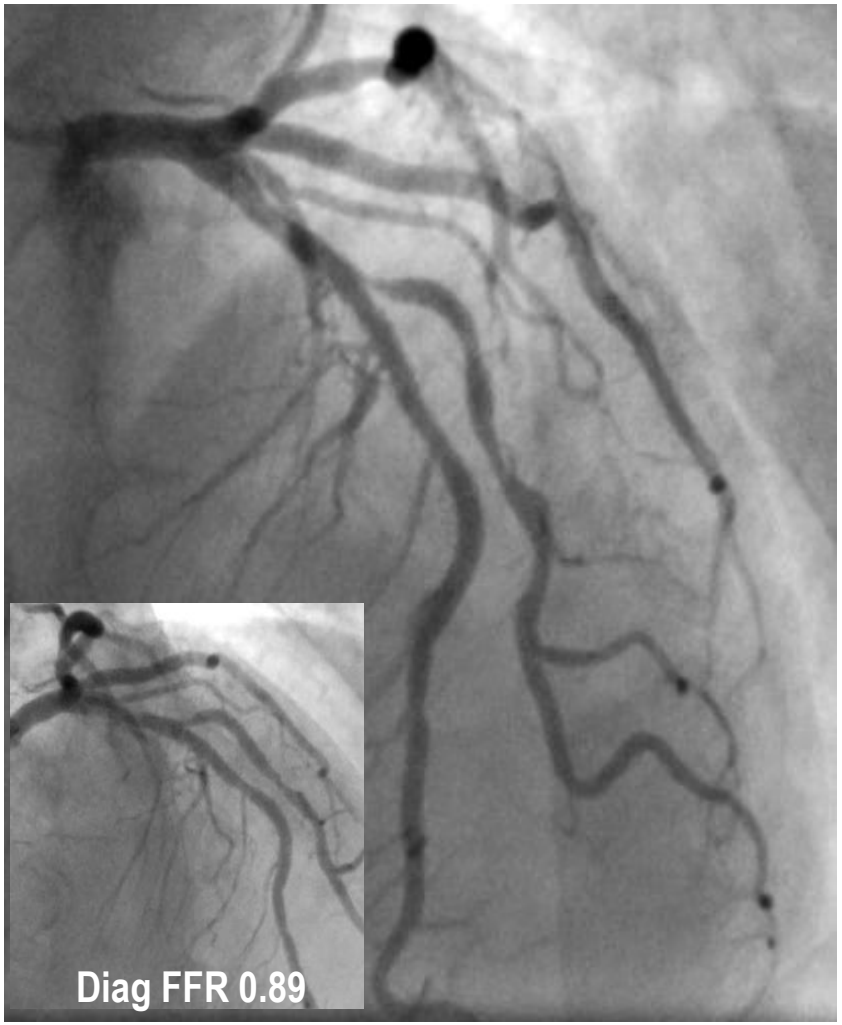
Angiographic vs. FFR changes during PCI

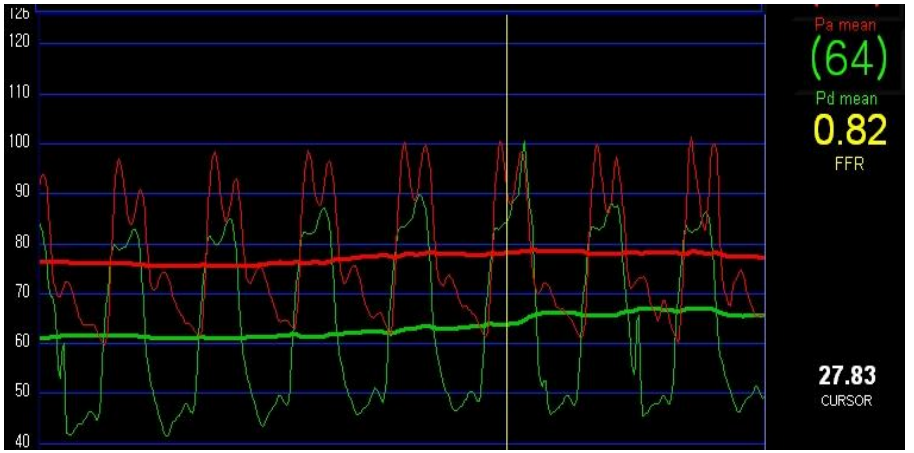






Functional outcome of Jailed side branches

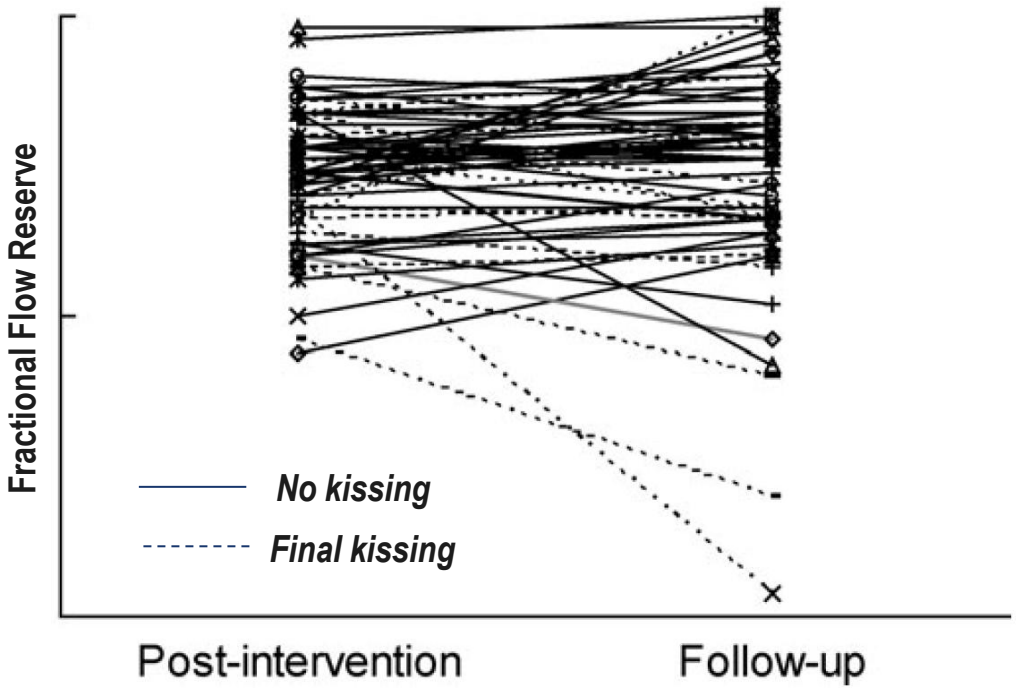




11 month Follow- Up

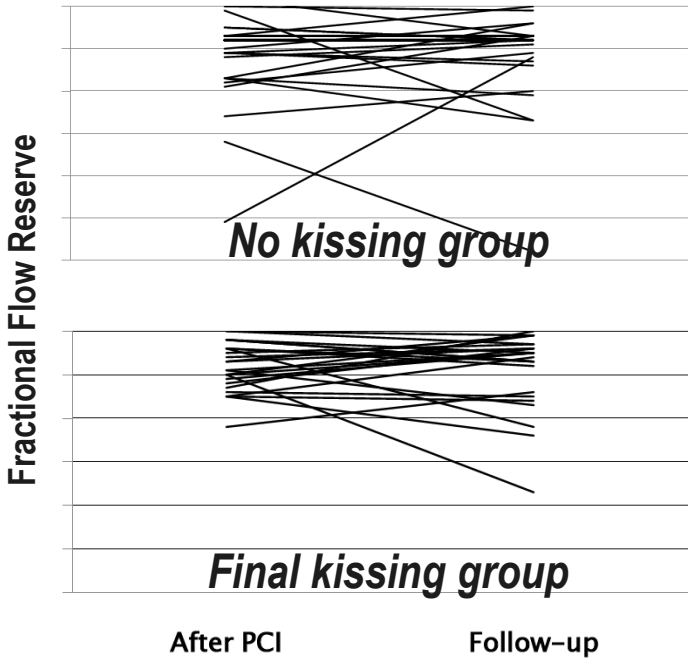
Functional outcome of Jailed side branches

SNUH SB FFR registry



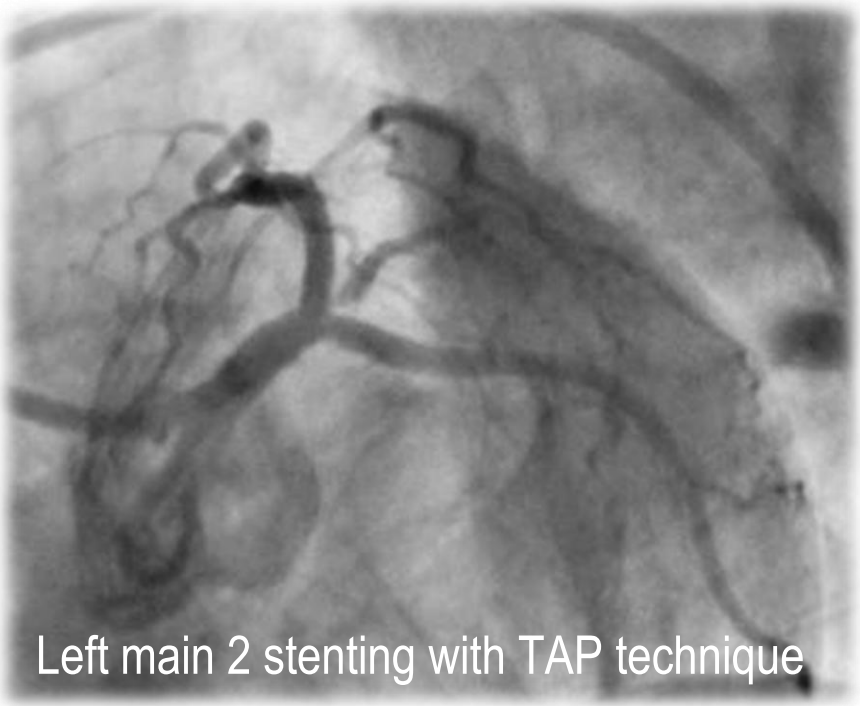
Koo BK, et al Eur Heart J 2009

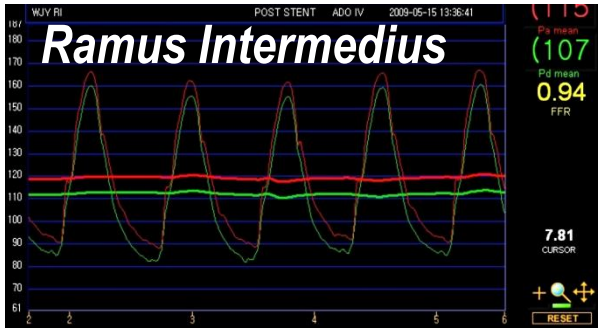
Nordic Baltic Bifurcation III : SB FFR substudy

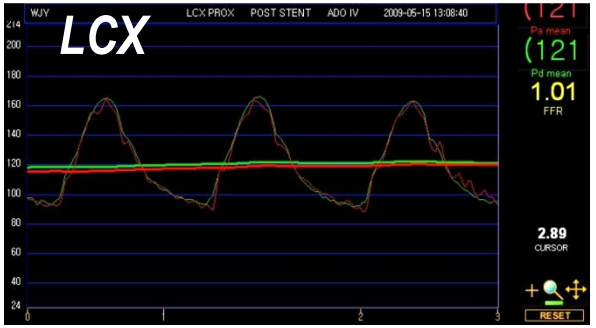


Kumsars I, et al. Eurointervention 2011

FFR after complex Left main stenting







Functionally complete revascularization

FFR after complex side branch stenting

DK crush vs. Provisional

	DK Group	1-Stent Group	P Value
FFR preprocedure			
MB FFR at baseline	0.83 ± 0.15	0.89 ± 0.13	0.109
SB FFR at baseline	0.84 ± 0.15	0.91 ± 0.12	0.100
MB FFR at hyperemia	0.76 ± 0.15	0.83 ± 0.10	0.029
SB FFR at hyperemia	0.76 ± 0.15	0.83 ± 0.16	0.103
FFR postprocedure			
MB FFR at baseline	0.96 ± 0.02	0.95 ± 0.03	0.376
SB FFR at baseline	0.97 ± 0.02	0.96 ± 0.03	0.043
MB FFR at hyperemia	0.92 ± 0.04	0.92 ± 0.05	0.581
SB FFR at hyperemia	0.94 ± 0.03	0.90 ± 0.08	0.028

Ye F, et al. J Interven Cardiol 2010

In cases of crush stenting
Pre- and Post- final kissing balloon

Pre-KBA FFR
0.90
0.96
0.95
0.96
0.92
0.95
0.94
1.00
0.94
0.88
0.88
0.97

0.94 ±0.04

Post-KBA FFR
0.96
1.00
0.95
0.96
1.00
0.98
0.96
1.00
0.94
0.94
0.94
1.00

0.97 ±0.03

Lee BK, et al. Clinical Cardiol 2010

After side branch angioplasty

- Functional outcomes of FFR-guided SB intervention is good regardless of residual stenosis.
- SB FFR is not recommended in case of slow flow or severe dissection.

After side branch stenting

- FFR is useful to detect the residual ischemia.
- However, high FFR does not always guarantee the excellent outcomes of complex intervention for bifurcation lesions.

FFR in Bifurcation lesion

- Bifurcation lesions are unique and different from other stenoses.
- Anatomical evaluations (QCA, IVUS, OCT……) have pitfalls in the evaluation of bifurcation lesions.
- FFR is useful in bifurcation lesions from the beginning till the end of bifurcation PCI and its use can reduce unnecessary complex interventions and their complications.
- However, adequate knowledge on coronary physiology and FFR is required to use FFR properly in complex bifurcation lesions,.