
FFR-guided Jailed Side Branch Intervention

- Pressure wire in Bifurcation lesions -

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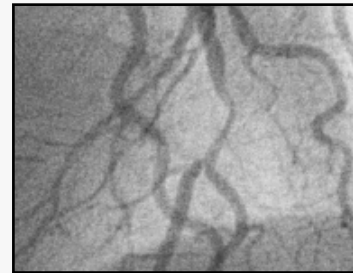
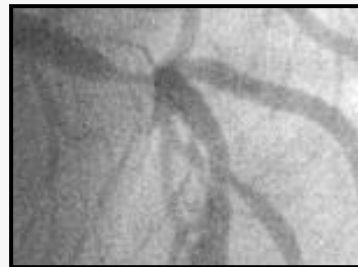
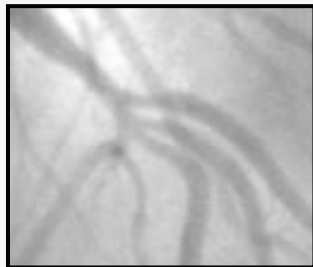
- **Bifurcation Lesions**

Still a challenging lesion subset even in the era of DES

Complex procedure, Low procedural success, High clinical events

Which is the best treatment strategy?

- *Too many variables: type, vessel diameter, vessel length, angulation, plaque location, main branch lesion, side branch stenosis, lesion length, calcification ,,,*



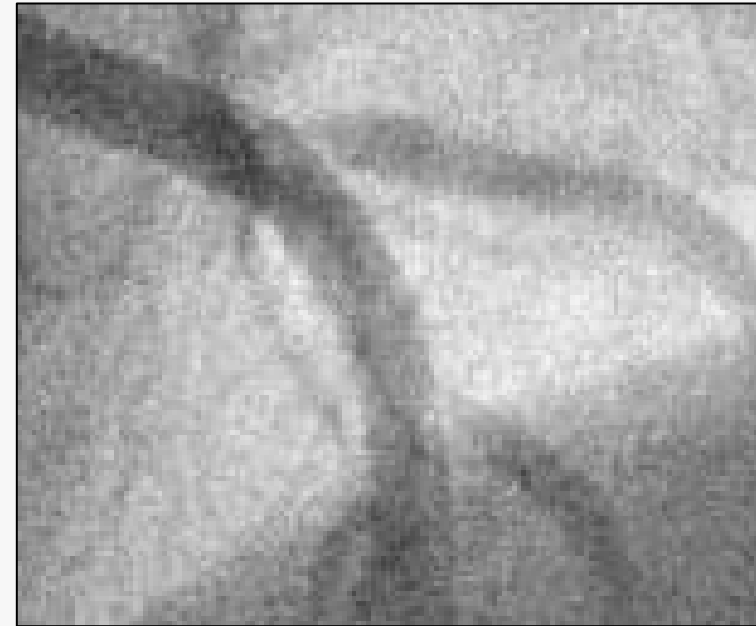
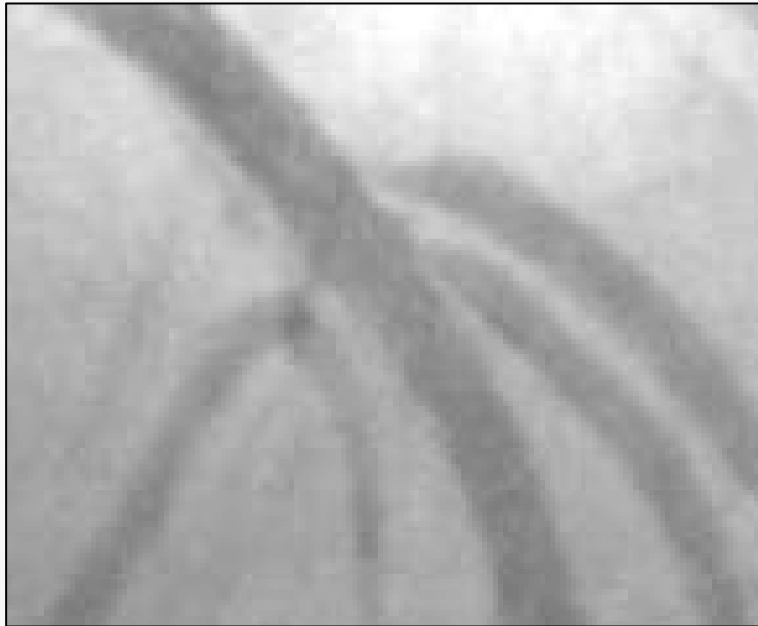
Systemic 2 stenting vs. Provisional side branch intervention in DES era

Author	n	Stent	TLR rate	
			2 stents	1 stent
Colombo, <i>Circulation 2004</i>	85	Cypher	9.5%	4.5%
Ge, <i>AJC 2005</i>	127	Cypher	8.8%	5.4%
Pen, <i>AHJ 2004</i>	91	Cypher	5%	2%

Provisional side branch intervention

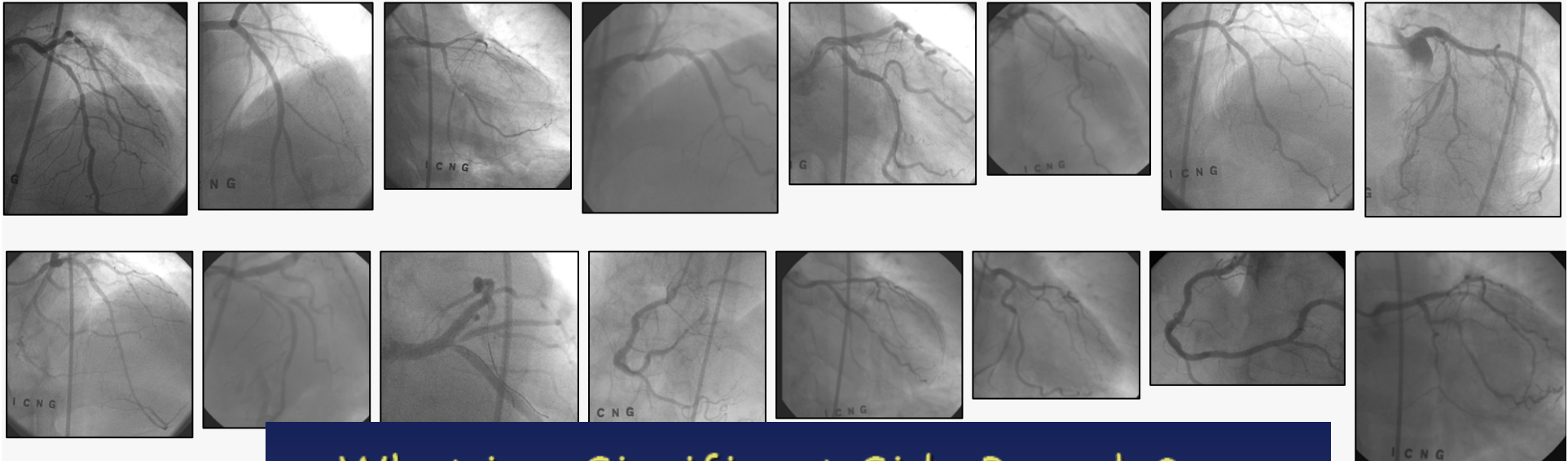
- Which one needs additional complex intervention?
- How to assess?
- How to treat?

To treat ? or Not ?



- Reference vessel diameter $\geq 2\text{mm}$?
- Percent stenosis $\geq 75\%$?
- Significant myocardial territory?

To treat ? or Not ?



What is a Significant Side Branch ?

Fractional Flow Reserve (FFR)

- Easily obtained, Stenosis specific, Simple (<0.75 → ischemia)
- Reflects both degree of stenosis and myocardial territory

Journal of the American College of Cardiology
© 2005 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 46, No. 4, 2005
ISSN 0735-1097/05/\$30.00
doi:10.1016/j.jacc.2005.04.054

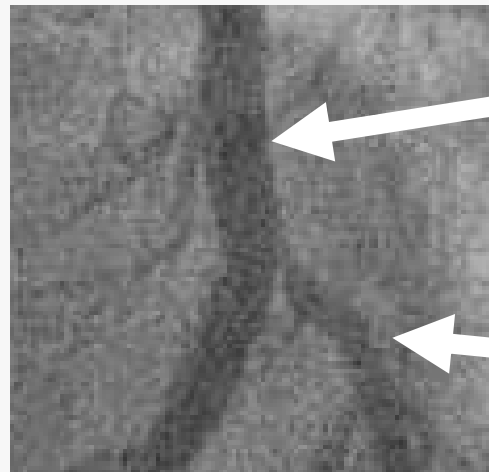
Physiologic Assessment of Jailed Side Branch Lesions Using Fractional Flow Reserve

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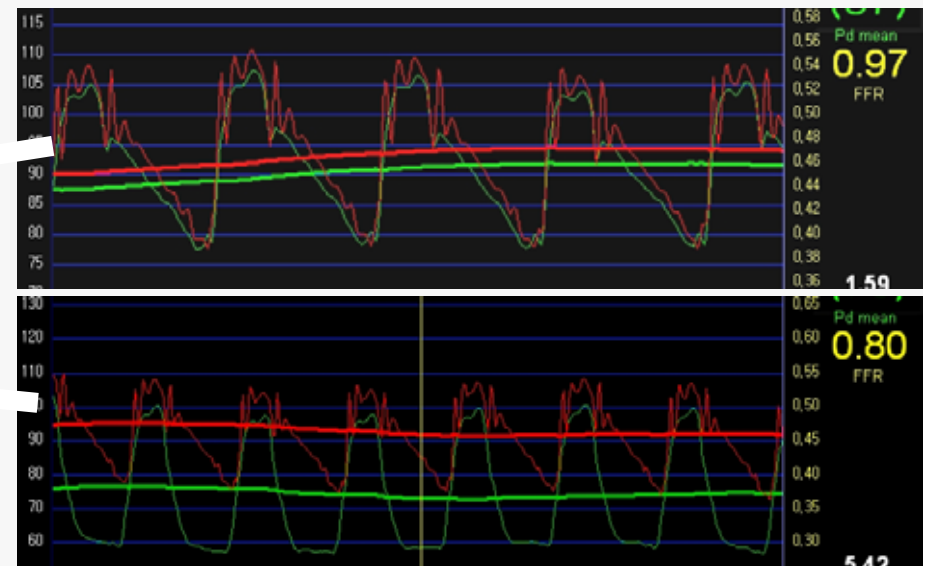
RADI4 pressure wire: Successful FFR measurement: 94/97 lesions (97%)



Initial



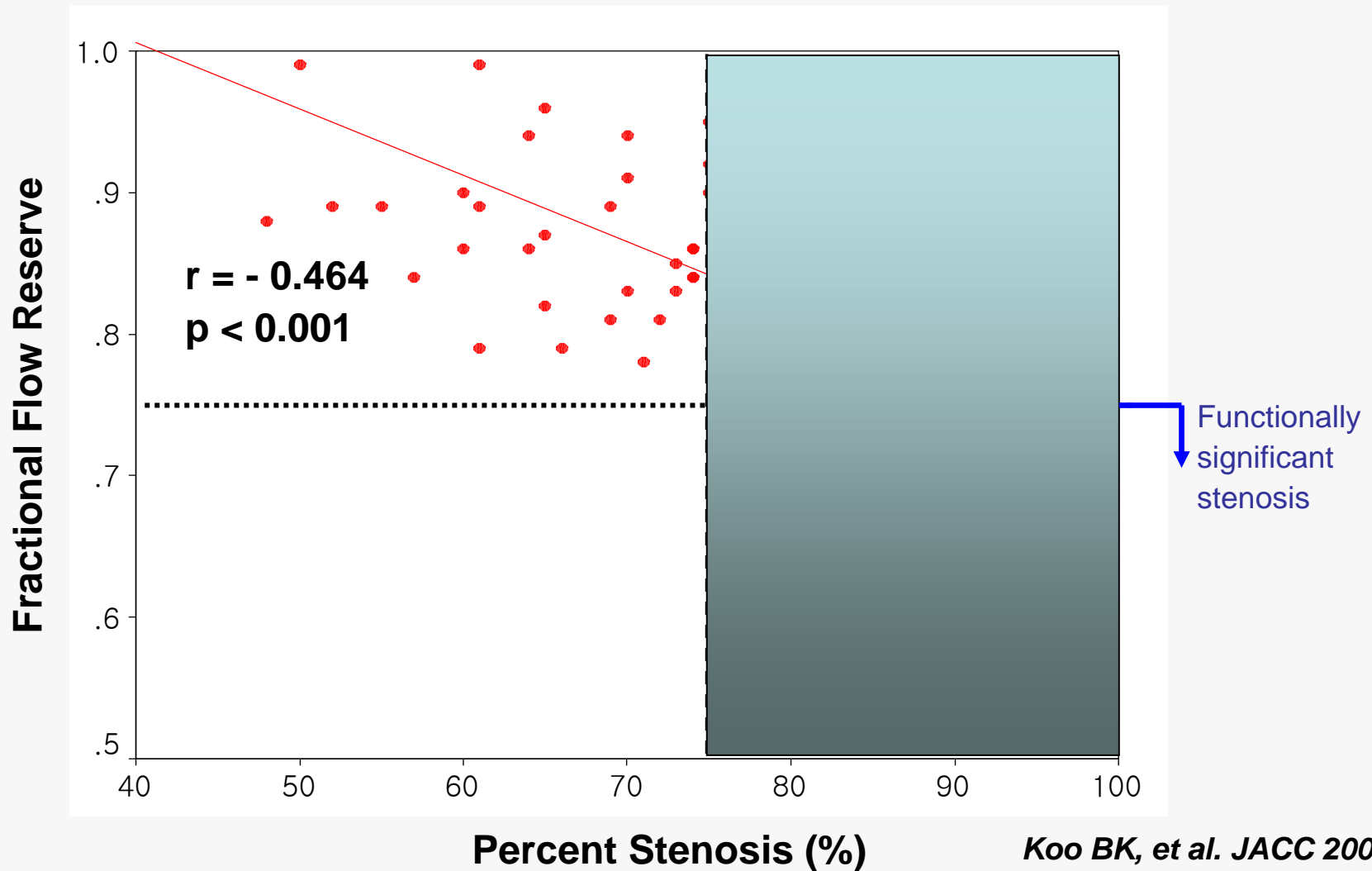
Post-stent



Characteristics of lesions (n=94)

Bifurcation type (ICPS classification)	
Type 1	55 (58%)
Type 2	12 (13%)
Type 3	17 (18%)
Type 4	10 (11%)
QCA of jailed branches	
MLD, mm	0.45 ± 0.25
Reference diameter, mm	2.2 ± 0.5
Percent stenosis, %	79 ± 11
Lesion length, mm	7.0 ± 3.3

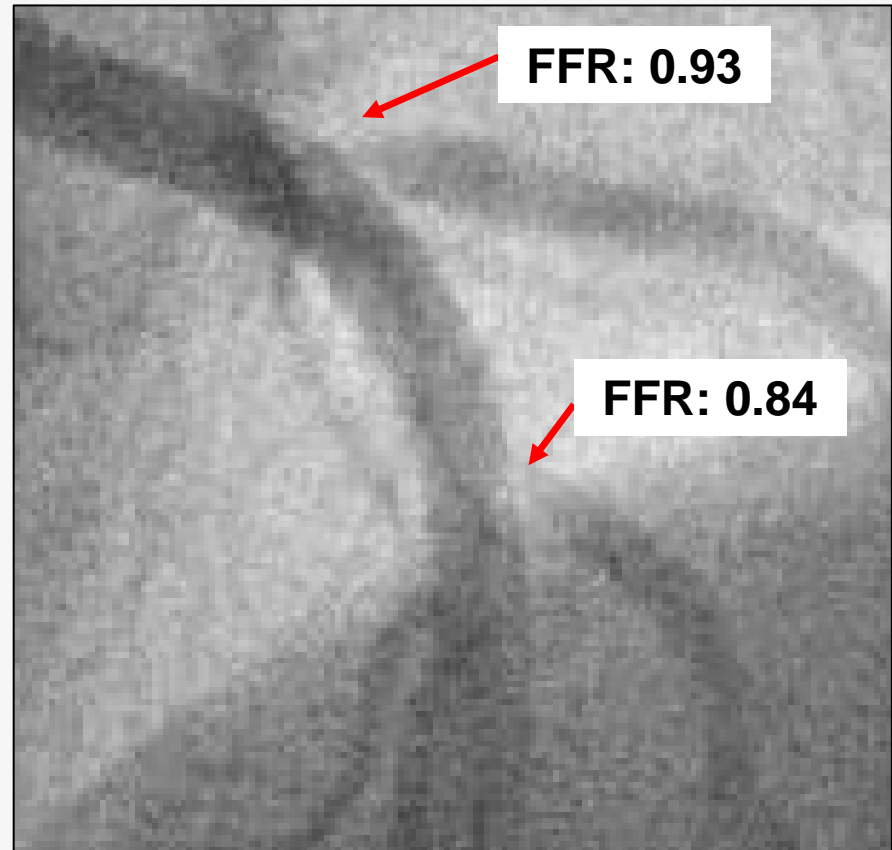
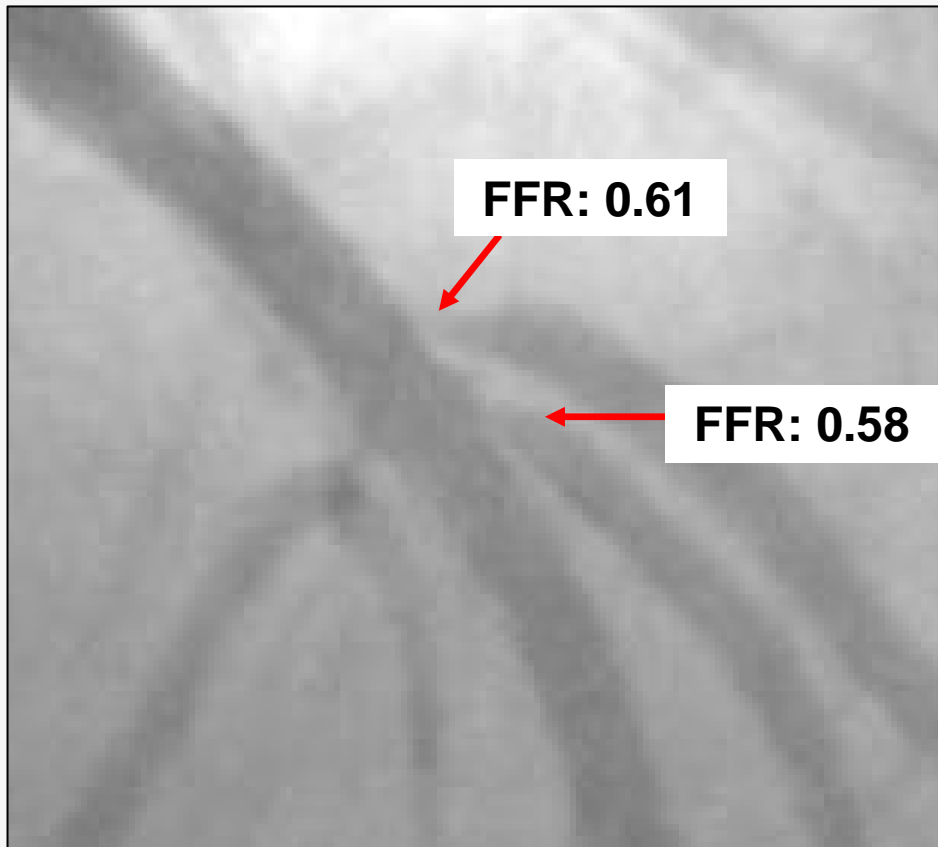
QCA vs. FFR in Jailed side branch lesions (n=94)



FFR vs. Percent stenosis by QCA


	Percent stenosis	
	<75%	≥75%
All lesions (n=94)		
FFR <0.75	0	20(27%)
FFR ≥0.75	20	53
Vessel size ≥2.5mm (n=20)		
FFR <0.75	0	8(38%)
FFR ≥0.75	7	13

How to Assess?



**What if “pressure wire”
is not available?**

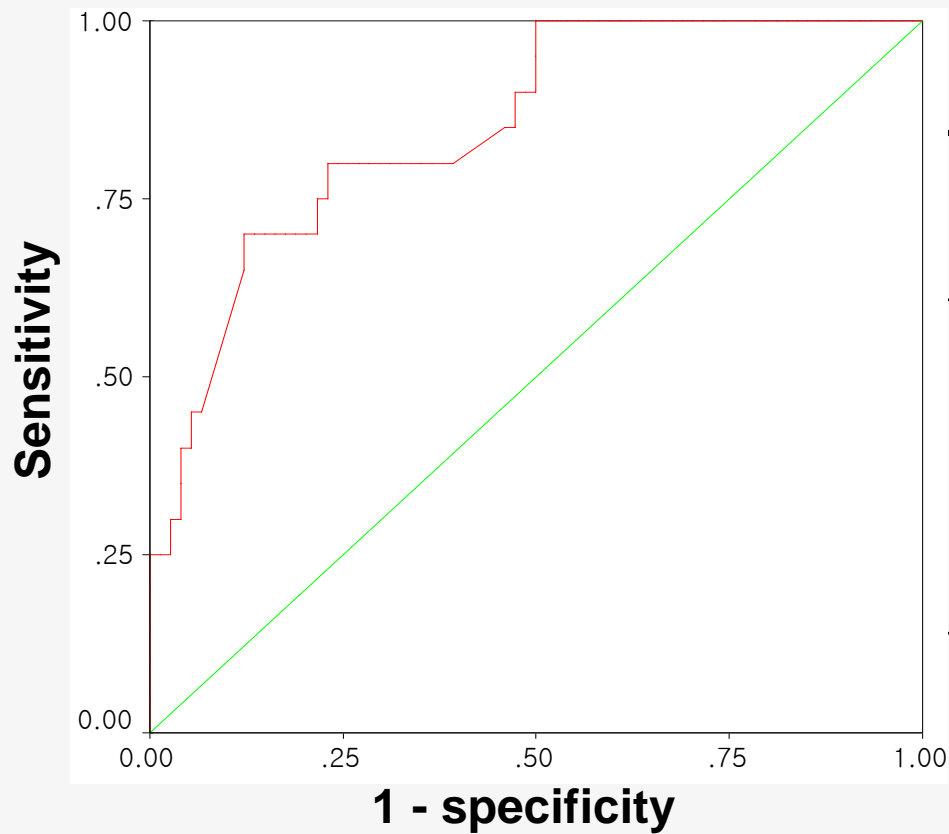
Pre-PCI angiographic differences according to post-PCI SB FFR

	FFR<0.75	FFR≥0.75	P value
Type 1 lesion* 	49%	29%	< 0.001
Angle < 70	89%	78%	NS
Plaque location – contra-lateral	23%	21%	NS
SB reference diameter	2.2 ± 0.3 mm	2.3 ± 0.3 mm	NS
SB percent stenosis	57 ± 18%	46 ± 20%	0.04

* Only angiographic parameter associated with FFR<0.75 after stenting in multivariate analysis

FFR (< 0.75) vs. QCA (% stenosis)

- All Lesions (n=94) -



AUC: 0.85 (95% CI: 0.76 - 0.94)

% stenosis	Sensitivity	Specificity
75%	1.0	0.39
85%	0.8	0.77

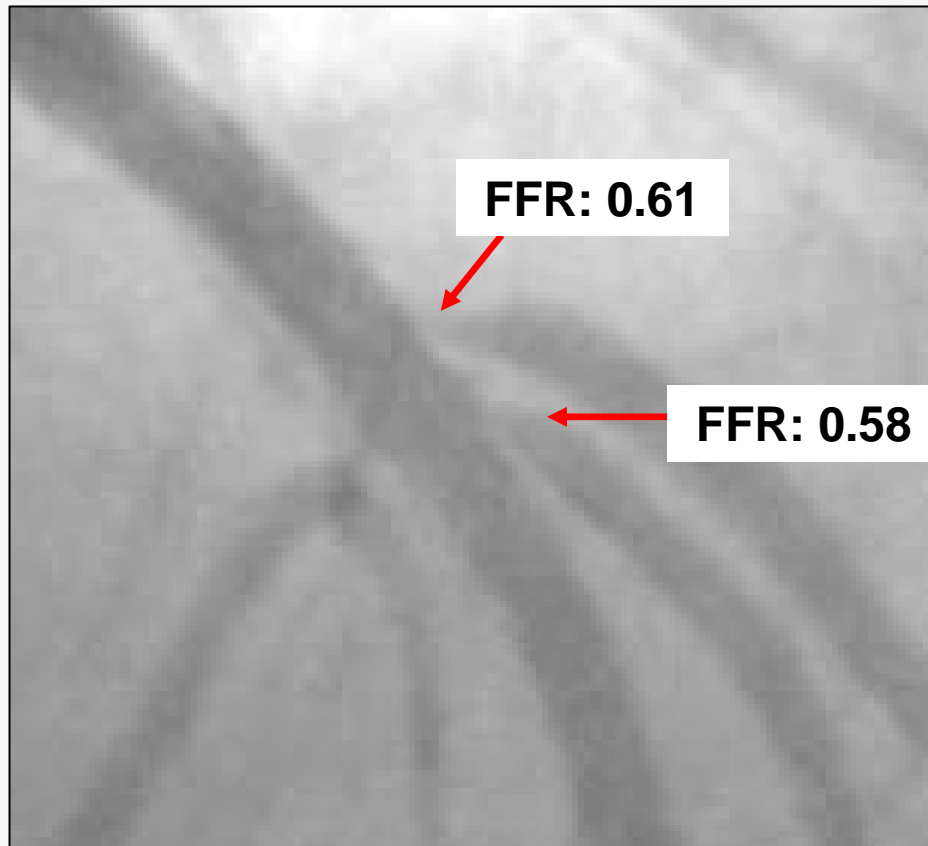
Summary

In bifurcation lesions with relatively short side branch stenosis.....

1. QCA overestimates the functional significance of jailed SB lesions.

Most lesions with tight stenosis don't need further intervention.

How to Treat?



Balloon artery ratio?

Goal of treatment?

My Hypothesis

- The treatment goal of jailed side branch lesion may be to maintain $< 75\%$ stenosis.
- Therefore, balloon inflation with a relatively small size balloon would be enough, if the gain could be maintained.

FFR in Provisional SB intervention

: *preliminary data*

Patient selection

Inclusion criteria

- **De novo, bifurcation lesion**
- **Main branches**
 - Successful DES implantation
 - No significant stenosis proximal to the stented segment
- **Jailed side branches**
 - Stenosis > 50%, diameter > 2 mm
 - Lesion length < 10 mm
 - Side branch length > 30 mm

Exclusion criteria

- Side branch slow flow after stenting
- Left main disease, CTO lesions
- Infarct related artery, thrombus
- Diffuse or distal lesion at SB
- RWMA at stented segments
- Myocardial disease, valvular disease
- Renal insufficiency

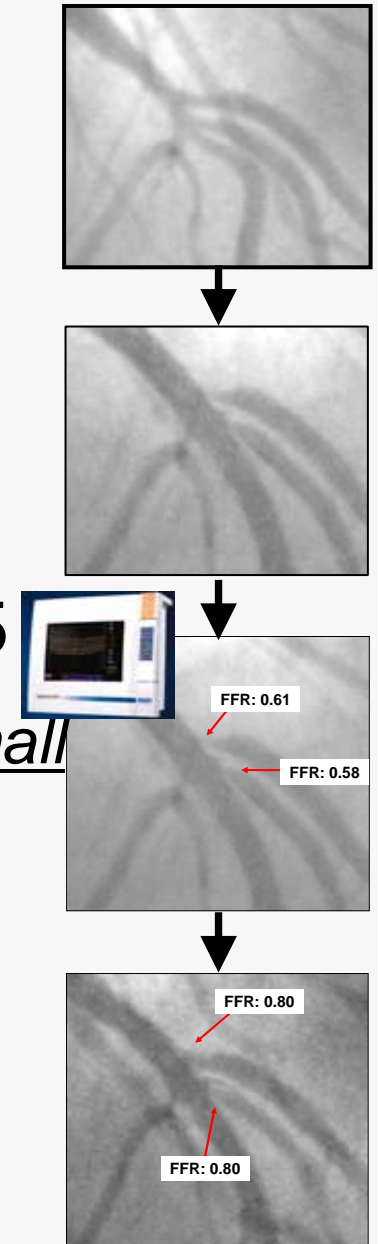
Aims

To assess

- The changes in functional significance of jailed SB after kissing balloon inflation
- The changes in functional significance of jailed SB during follow-up
- Clinical outcomes of FFR-guided jailed SB intervention strategy

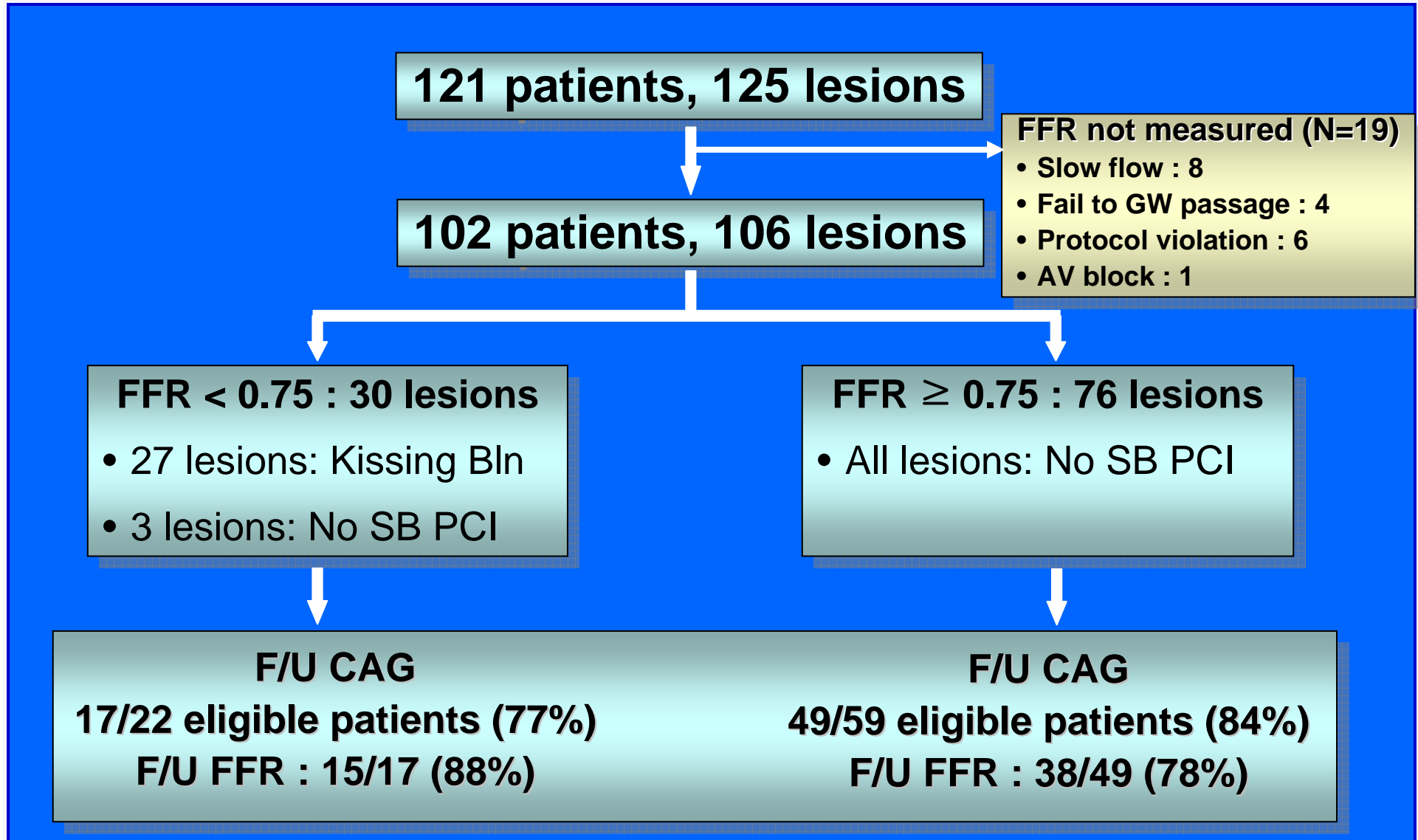
Procedures

- Stenting the main branch with DES
- Measure FFR in jailed SB
- Side branch intervention, when $FFR < 0.75$
 - Kissing balloon technique with a relatively small balloon at side branch
 - If $FFR < 0.75$ after kissing balloon,
→ use larger balloon, or stent implantation



FFR in provisional SB intervention: preliminary data


• Jun, 2004 ~



Baseline characteristics of patients (n=82)

Age, yr	62 ± 9
Male	55 (67%)
Risk factors	
Diabetes Mellitus	22 (27%)
Hypertension	46 (56%)
Hypercholesterolemia	30 (37%)
Current smoker	24 (29%)
Stable angina/Unstable angina	36 (43%) / 27 (33%)
LVEF, %	60 ± 8
Multi-vessel disease	39 (48%)

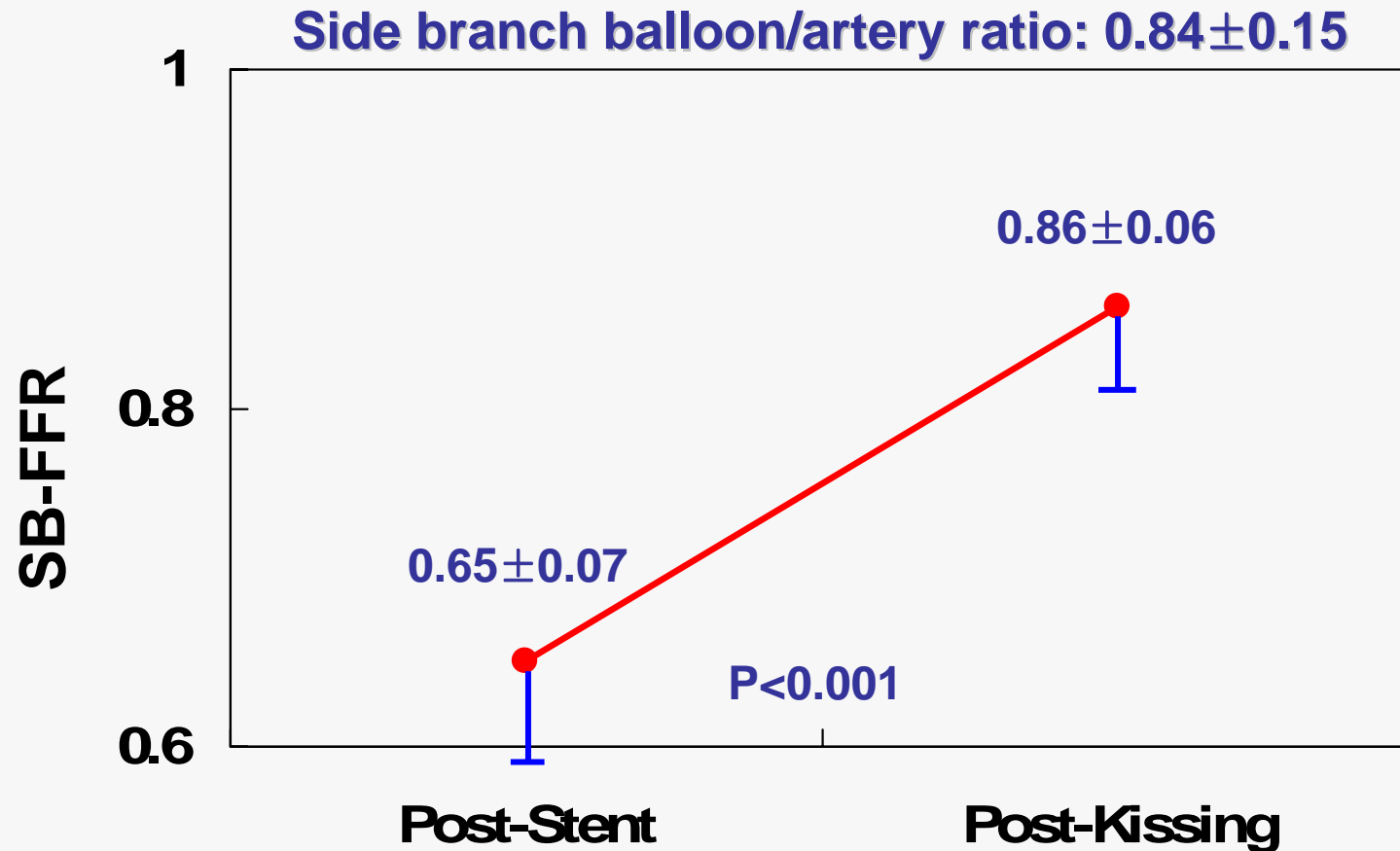
Baseline characteristics of lesions (n=86)



Bifurcation type*	
Type 1	33 (38%)
Type 4	28 (33%)
Used stents (n=95)	
Cypher / TAXUS	64 / 31
Diameter, mm	2.9 ± 0.3
Length, mm	30.1 ± 11.1
Lesion Location	
LAD-Diagonal	64 (74%)
LCX-OM	18 (21%)
RCA-PD/PL	4 (5%)

* ICPS classification

Changes in SB-FFR after Kissing balloon



Achievement of $FFR > 0.75$: 19/20 lesions (95%)

Changes of FFR during 6M follow-up (53 lesions)

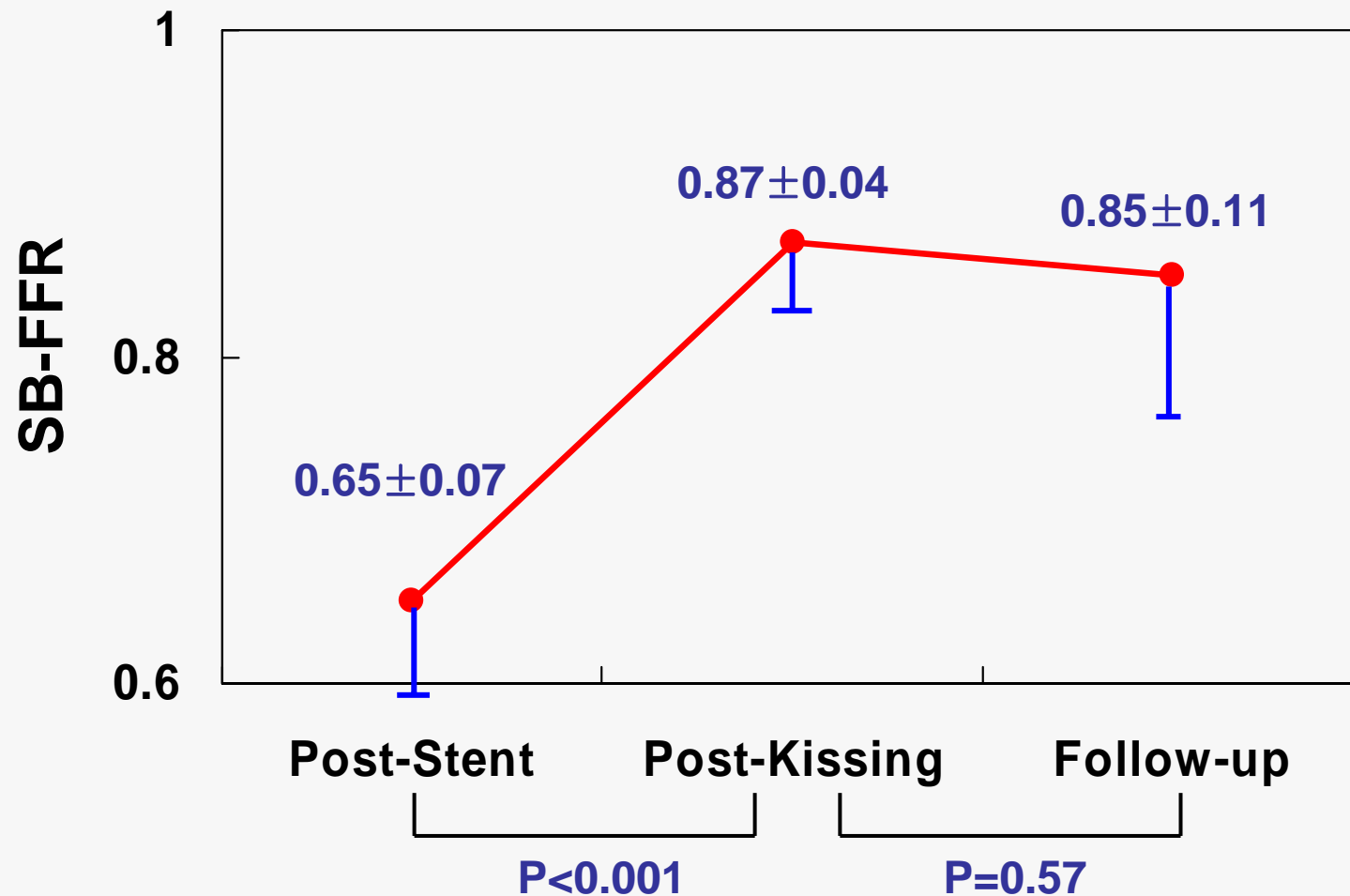
	Post-PCI	6 Mo Follow-up
Main branch	0.96±0.03	0.96±0.04
Jailed SB	0.86±0.05	0.87±0.08
SB-FFRadj*	0.90±0.05	0.91±0.07

P>0.05

*Adjusted side branch FFR; SB-FFRadj = [side branch FFR] / [main branch FFR]
Four main branch TVR lesions were excluded.

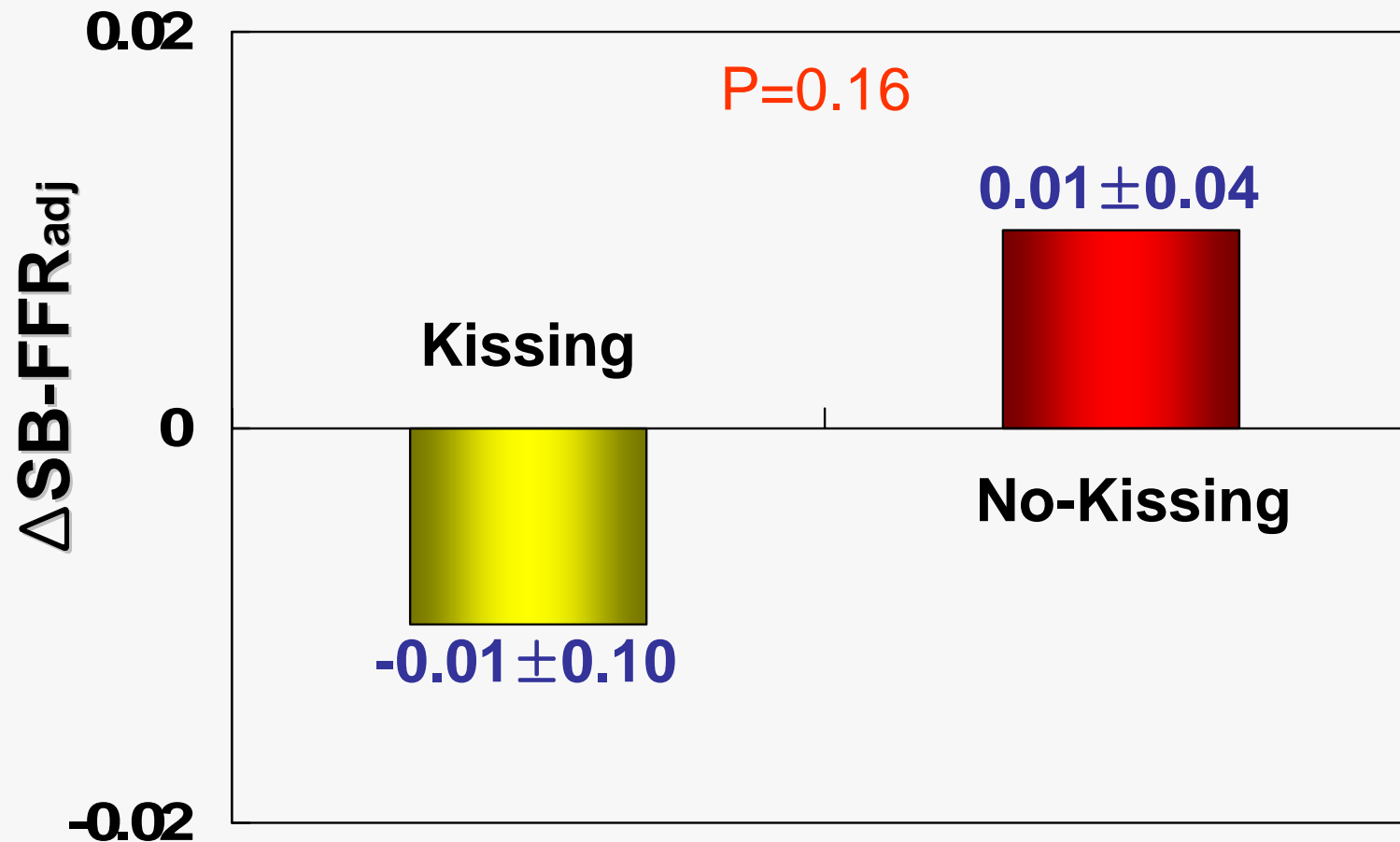
Changes in SB-FFR after Kissing balloon

Side branch balloon/artery ratio: 0.84 ± 0.15



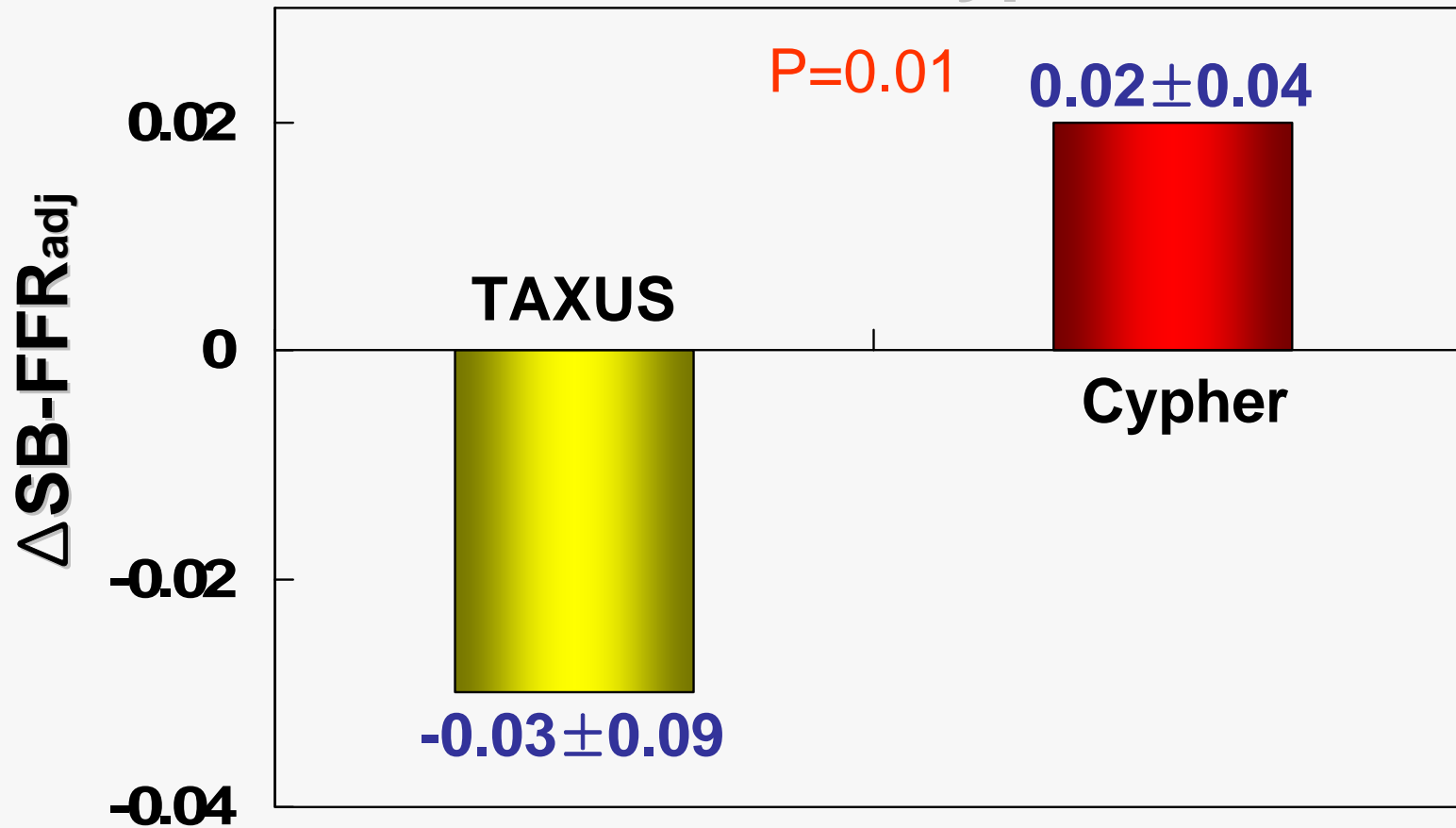
Changes in Functional Stenosis of Jailed SB

Kissing vs. No-Kissing



Changes in Functional Stenosis of Jailed SB

TAXUS vs. Cypher



Summary

In bifurcation lesions with relatively short side branch stenosis.....

1. Quantitative coronary angiography overestimates the functional significance of jailed side branch lesions. Most lesions with tight stenosis don't need further intervention.
2. Kissing balloon inflation with relatively small size balloon in side branch is effective.
3. Functional significance of jailed side branch lesions do not change significantly during follow-up.

Clinical Outcomes

Death: 1 (non-cardiac)

Q wave MI: 0, **Stent thrombosis:** 0

TLR: 4 patients (4.9%)

2 lesions – main branch

1 lesion – side branch

1 lesion –both branches

Side branch TLR: 2.3%

Comparison with other strategies

	<i>Colombo, et al.</i>		<i>Ge, et al</i>		<i>Ge, et al</i>	<i>Koo, et al</i>
Strategy	2Stent	1Stent/ PTCA	2Stent	1Stent/ PTCA	Crush	FFR-guided
N	65	22	117	57	181	82
SB diameter, mm	2.1	2.1	2.3	2.1	2.42	2.3
SB, %stenosis	57	46	62	54	64	48
SB, lesion length, mm	6.1	5.1	10.2	5.7	10.9	6.7
*MACE, %	14.3	13.6	15.5	10.1	18.2	6.1

*Cardiac death, Q MI, TVR

Summary

In bifurcation lesions with relatively short side branch stenosis.....

1. QCA overestimates the functional significance of jailed SB lesions.
Most lesions with tight stenosis don't need further intervention.
2. Kissing balloon inflation with relatively small size balloon in SB is effective.
3. Functional significance of jailed SB lesions do not change significantly during follow-up.
4. **FFR-guided jailed SB intervention strategy seems to be feasible and effective.**

CONCLUSION

In bifurcation lesions with relatively short side branch lesions....

Don't be too aggressive.

If you are in doubt, kissing with a small side branch balloon, or measure “the FFR” !