How to Treat Side Branch with FFR Guidance?

(With Case Examples)

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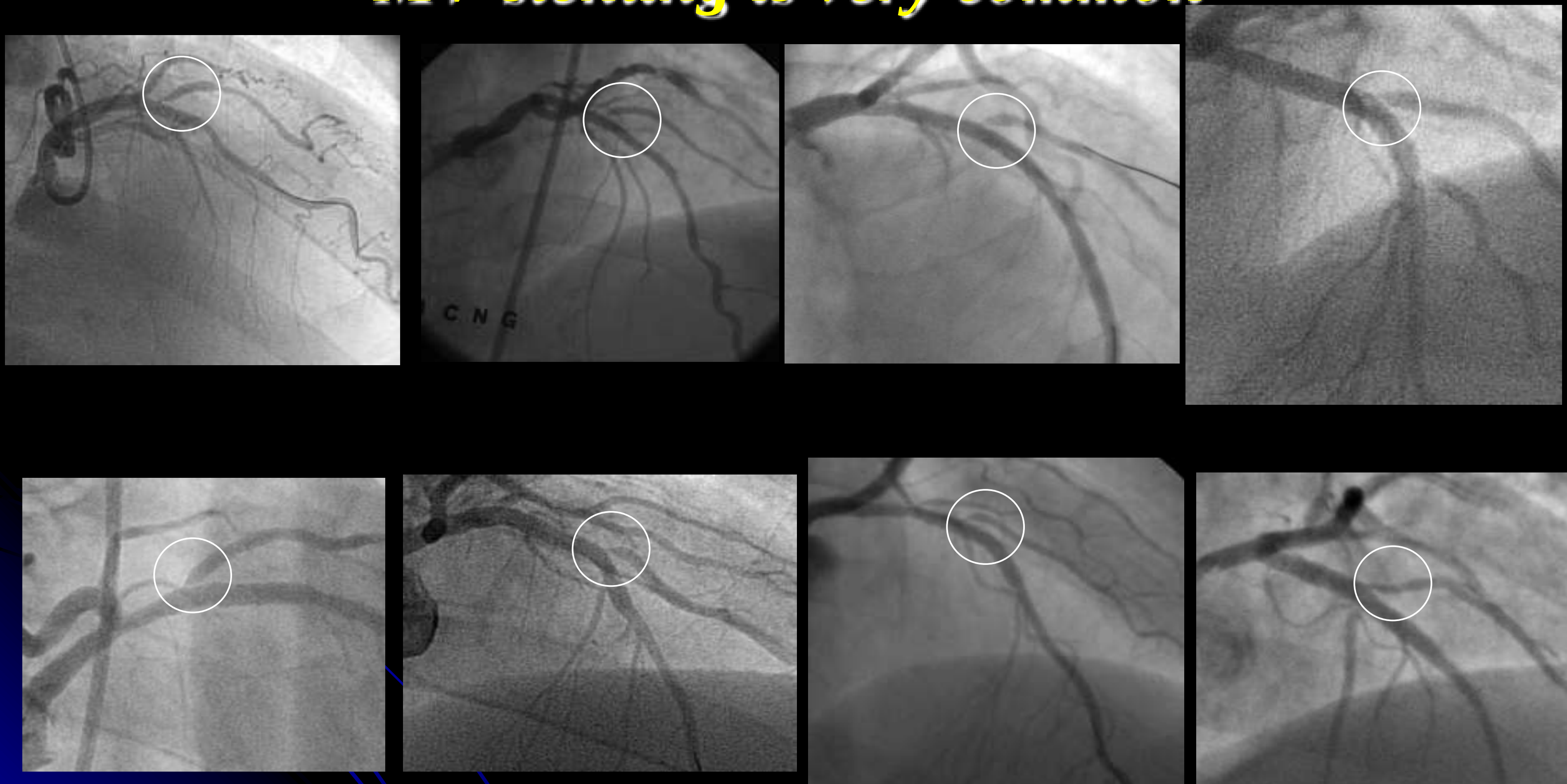
Overview

- Why do we need FFR for side branch treatment?
- How does FFR help us address side branch treatment?
- Limitation of FFR guidance for side branch;

Overview

- **Why do we need FFR for side branch treatment?**
- How does FFR help us address side branch treatment?
- Limitation of FFR guidance for side branch;

The phenomena of SBo been compromised after MV stenting is very common



Why “physiologic evaluation” in bifurcation lesion?

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

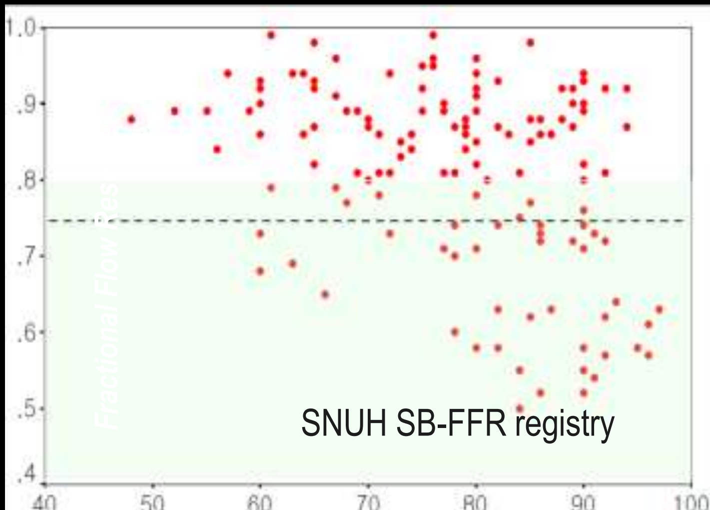
Uniqueness of side branch lesions

- 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

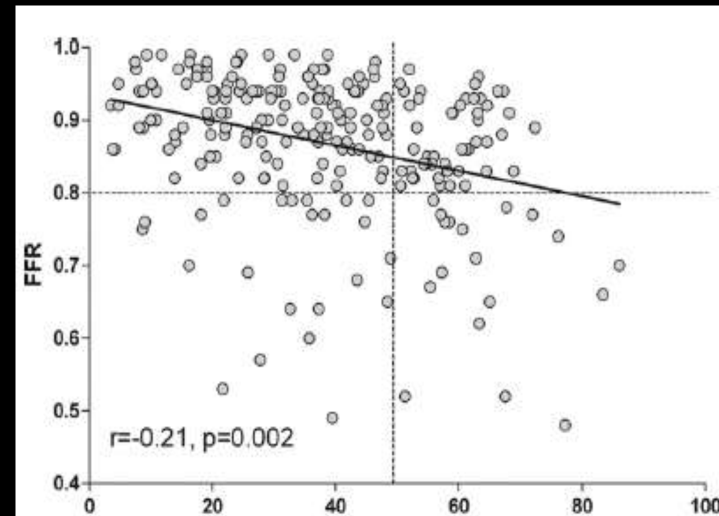
    Carina shift, plaque shift, stent struts, thrombus.....

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

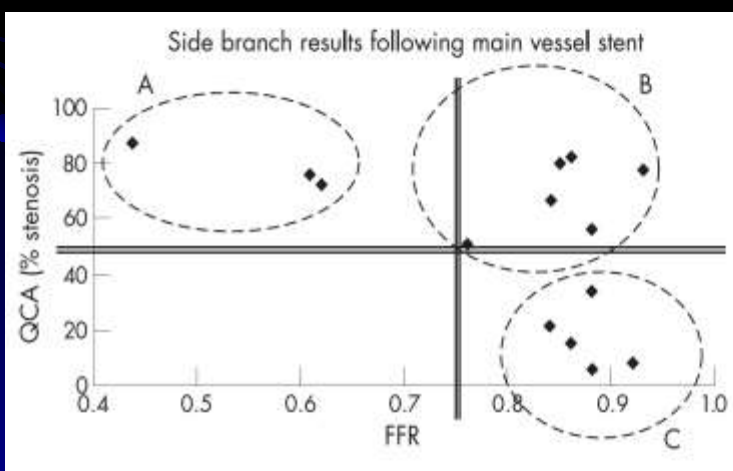
Poor Correlation between Diameter Stenosis and FFR in Jailed Side Branches



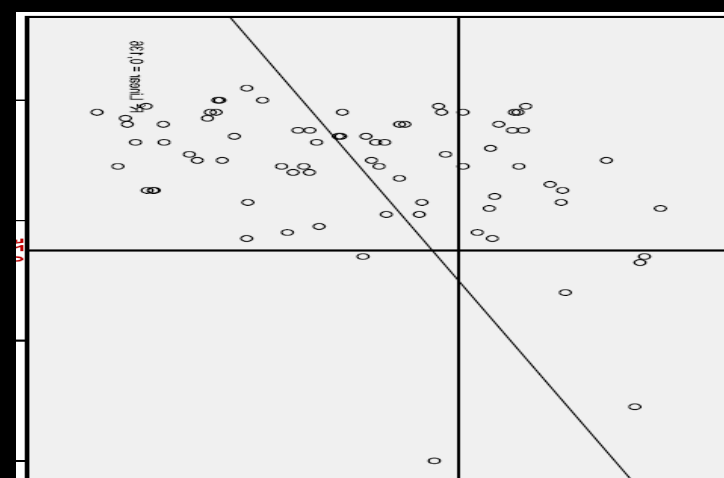
Park SH & Koo BK, J Ger Cardiol 2012



Ahn JM, et al. JACC intv 2012



Bellenger, et al. Heart 2007



Kumsars I, et al. Eurointervention 2011

Jailed Side Branches and FFR

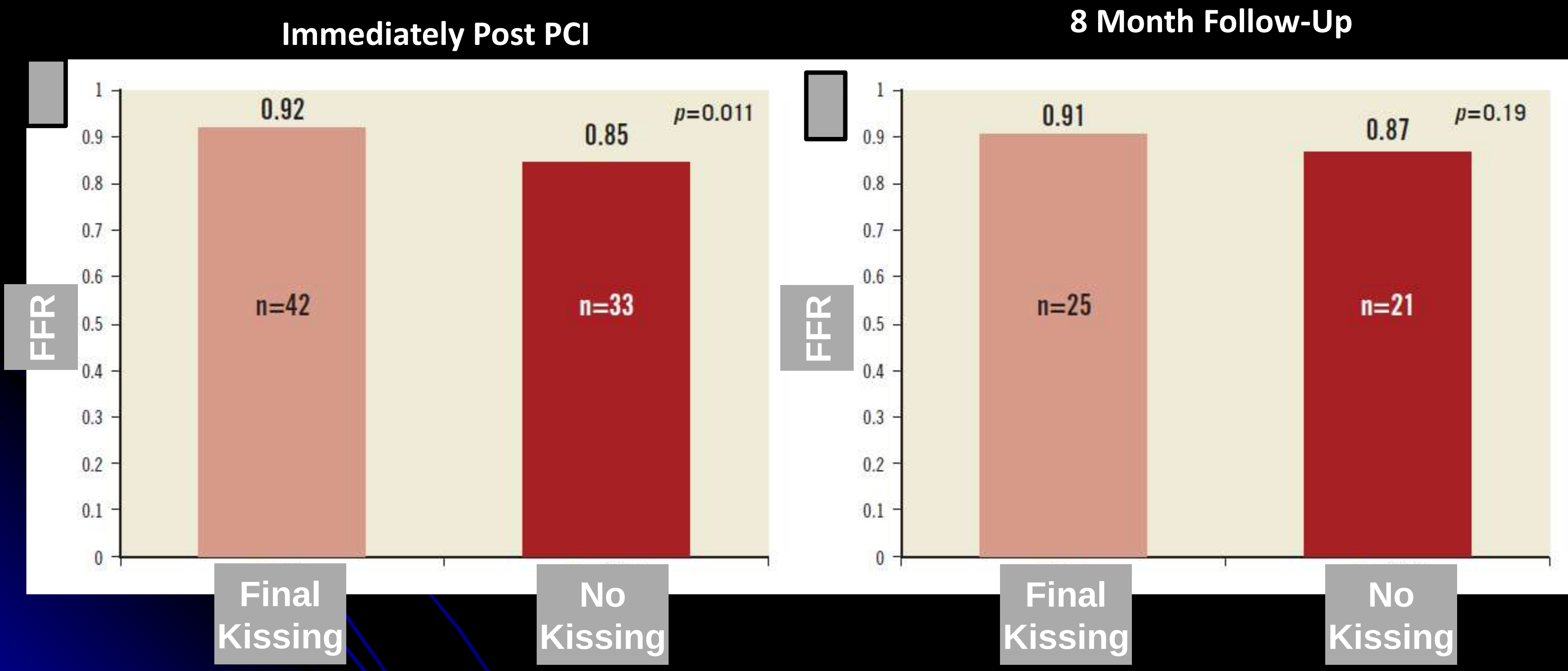
FFR in 91 "Jailed" Side Branches, Repeated at 6 Months

	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.

Jailed Side Branches and FFR

FFR in 75 "Jailed" side branches from Nordic-Baltic Bifurcation III study (42 with final kissing, 32 without)



No difference in clinical outcomes

Kumsars, et al. Eurointervention 2012;7:1155-61.

The Acute Changes of Fractional Flow Reserve in DK (Double Kissing), Crush, and 1-Stent Technique for True Bifurcation Lesions

FEI YE, M.D., JUN-JIE ZHANG, M.D., NAI-LIANG TIAN, M.D., SONG LIN, M.D., ZHI-ZHONG LIU, M.D., JING KAN, M.D., HAI-MEI XU, M.D., ZHONGSHENG ZHU, M.D., and SHAO-LIANG CHEN, M.D., F.S.C.A.I., F.A.C.C.

From the Nanjing First Hospital, Nanjing Medical University, Nanjing, China

FFR before and after PCI (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

J Interven Cardiol 2010

Efficacy of Fractional Flow Reserve Measurements at Side Branch Vessels Treated With the Crush Stenting Technique in True Coronary Bifurcation Lesions

Byoung Kwon Lee, MD; Hyun Hee Choi, MD; Kyung-Soon Hong, MD; Byoung-Keuk Kim, MD; Jaemin Shim, MD; Jung-Sun Kim, MD; Young-Guk Ko, MD; Donghoon Choi, MD; Yangsoo Jang, Myeong-Ki Hong, MD, PhD

	Pre-KBA MLD, MV/SB (mm)	Post-KBA MLD, MV/SB (mm)	Pre-KBA FFR	Post-KBA FFR
1	2.4/2.5	2.6/2.6	0.90	0.96
2	2.9/2.5	2.9/2.4	0.96	1.00
3	3.0/2.3	3.0/2.5	0.95	0.95
4	2.7/2.3	2.8/2.4	0.96	0.96
5	2.9/2.2	2.9/2.4	0.92	1.00
6	3.1/1.8	3.2/2.0	0.95	0.98
7	3.0/2.2	2.9/2.3	0.94	0.96
8	2.8/1.6	2.7/1.8	1.00	1.00
9	3.0/2.8	2.9/2.8	0.94	0.94
10	3.1/2.9	3.0/3.0	0.88	0.94
11	3.4/2.4	3.3/2.3	0.88	0.94
12	3.2/2.1	3.2/2.3	0.97	1.00
			0.94±0.04	0.97±0.03

Clinical Cardiol 2010

DK crush stenting was associated with higher FFR and lower residual diameter stenosis in the SB, as compared with the provisional 1-stent group.

FFR changes between DK and PS after PCI

FFR changes	DK (n=38)	PSBS (n=30)	P values
MV, at hyperemia			
FFR before-PCI	0.76±0.16	0.82±0.13	0.077
<0.80 (n (%))	16 (42.1)	20 (66.7)	0.054
FFR post-PCI	0.92±0.04	0.93±0.04	0.516
>0.94 (n (%))	11 (29.7)	11 (36.7)	0.607
FFR gain	0.16±0.16	0.12±0.13	0.123
SB, at hyperemia			
FFR before-PCI	0.76±0.17	0.79±0.18	0.339
<0.80	19 (50.0)	20 (66.7)	0.219
FFR post-PCI	0.93±0.04	0.91±0.08	0.159
>0.94 (n (%))	17 (45.9)	12 (40.0)	0.804
≥0.90 (n (%))	30 (81.1)	22 (73.3)	0.559
FFR gain	0.18±0.15	0.12±0.18	**0.044**

Ye F, Chen SL, Zhang JJ, et al. Chin Med J (Engl). 2012 Aug;125(15):2658-62.

FFR changes between DK and PS at 8-month follow-up

FFR changes		DK (n=29)	PS (n=23)	P values
MV FFR		0.92±0.05	0.90±0.05	0.297
	>0.94 (n (%))	11 (37.9)	7 (30.4)	0.585
	Loss of FFR_{MV}	0.003±0.07	–0.03±0.06	0.086
SB FFR		0.93±0.05	0.87±0.04	**0.007**
	≥0.90 (n (%))	23(79.3)	13(56.5)	**0.032**
	Loss of FFR_{SB}	–0.002±0.07	–0.06±0.11	**0.037**

Ye F, Chen SL, Zhang JJ, et al. Chin Med J (Engl). 2012 Aug;125(15):2658-62.

Overview

- Why do we need FFR for side branch treatment?
- **How does FFR help us address side branch treatment?**
- Limitation of FFR guidance for side branch;

When should we assess the SB with FFR after MV stenting?

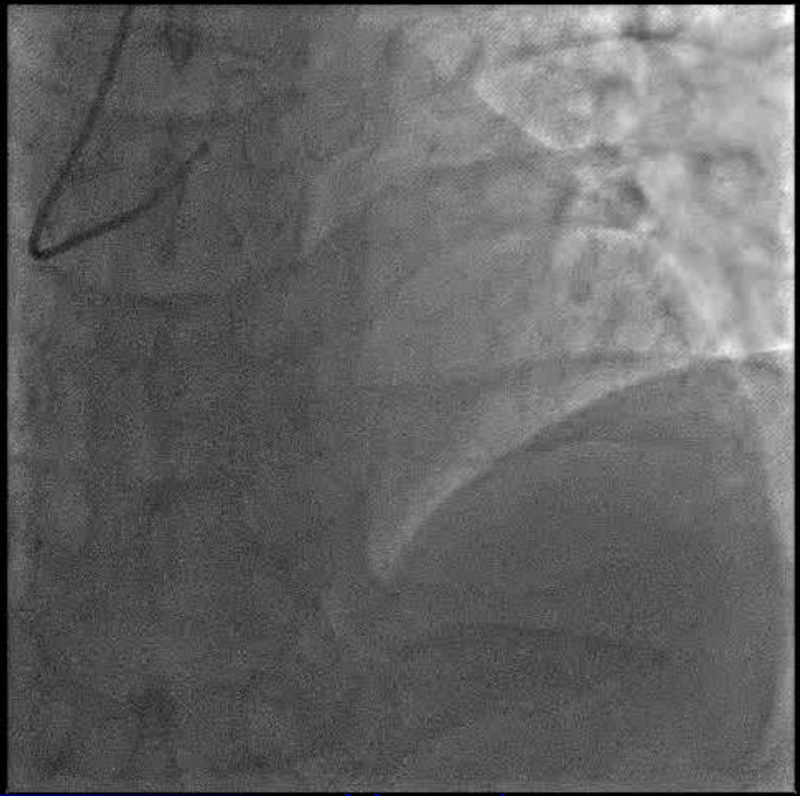
- SB is clinical significant;
- Large SBs with ostial severe stenosis (supplying large amount of myocardium);
- Middle or even small SBs with ostial severe stenosis of patients with lower EF;
- If small SBs with slow/no flow, FFR should not be measured before kissing…

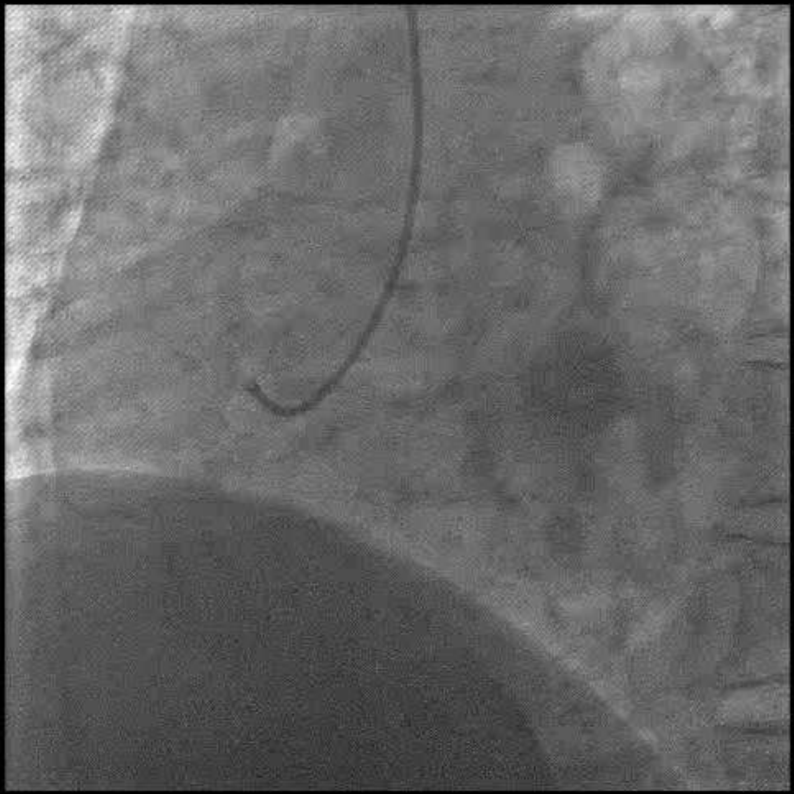
Case 1

Clinical feature

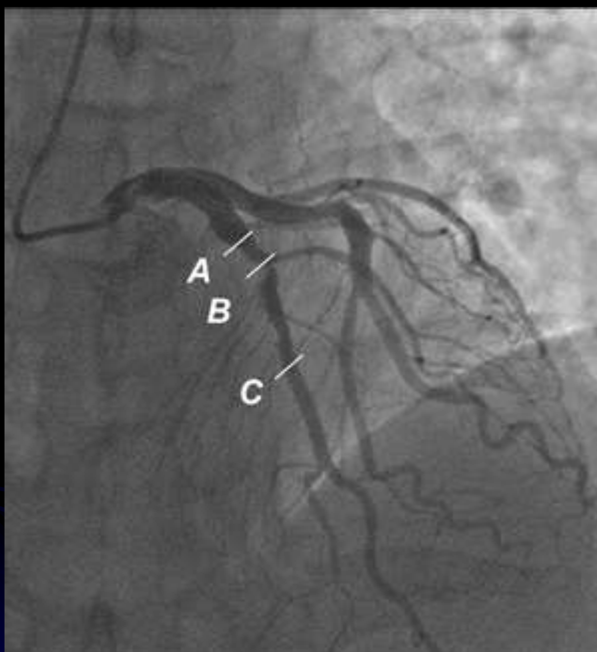
- 57-year-old, Male
- Severe effort angina in the last 2 months (CCS III)
- Risk Factors: Current smoker
- ECG: Lead V1-V4: ST segment depression, T wave inversion
- UCG: LVDd 65mm，EF 48%
- NT-proBNP：105.7pg/ml

Coronary Angiography

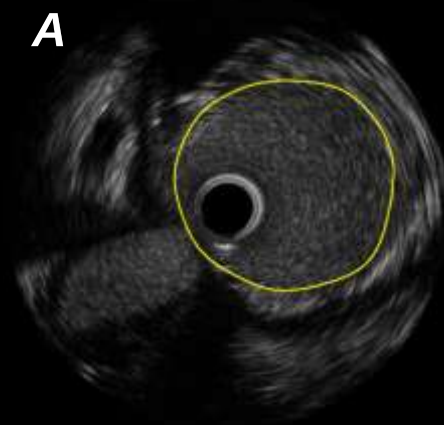




Medina classification: 1,1,0

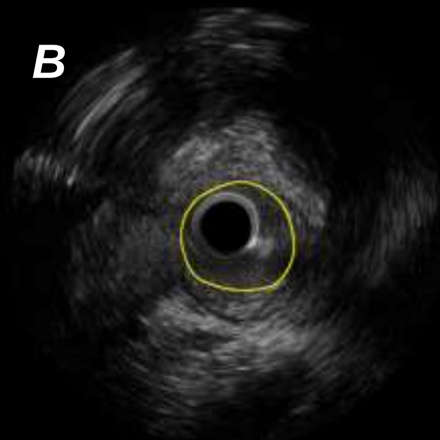


A



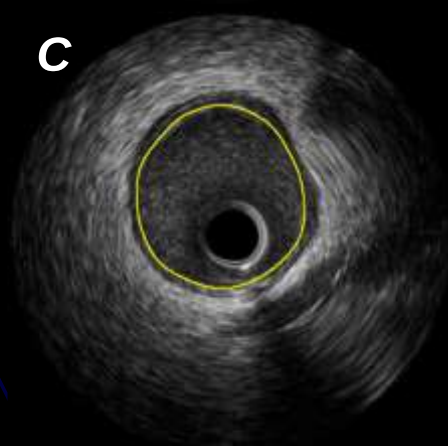
	Area	Diameter (mm)		
	(mm²)	Mean	Min	Max
Lumen	14.67	4.33	4.20	4.47

B



	Area	Diameter (mm)		
	(mm²)	Mean	Min	Max
Lumen	3.88	2.24	2.15	2.33

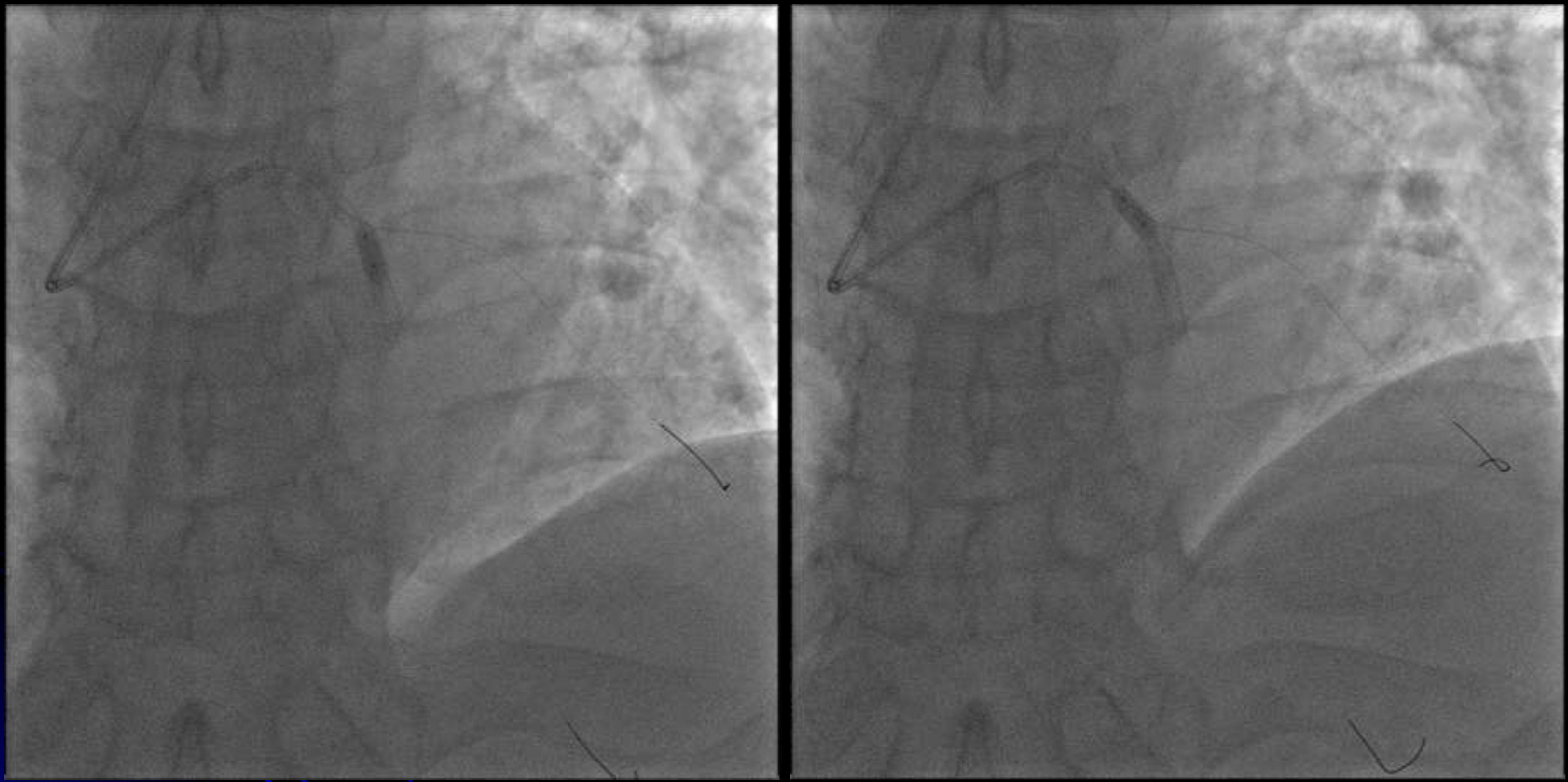
C



	Area	Diameter (mm)		
	(mm²)	Mean	Min	Max
Lumen	9.54	3.50	3.32	3.67

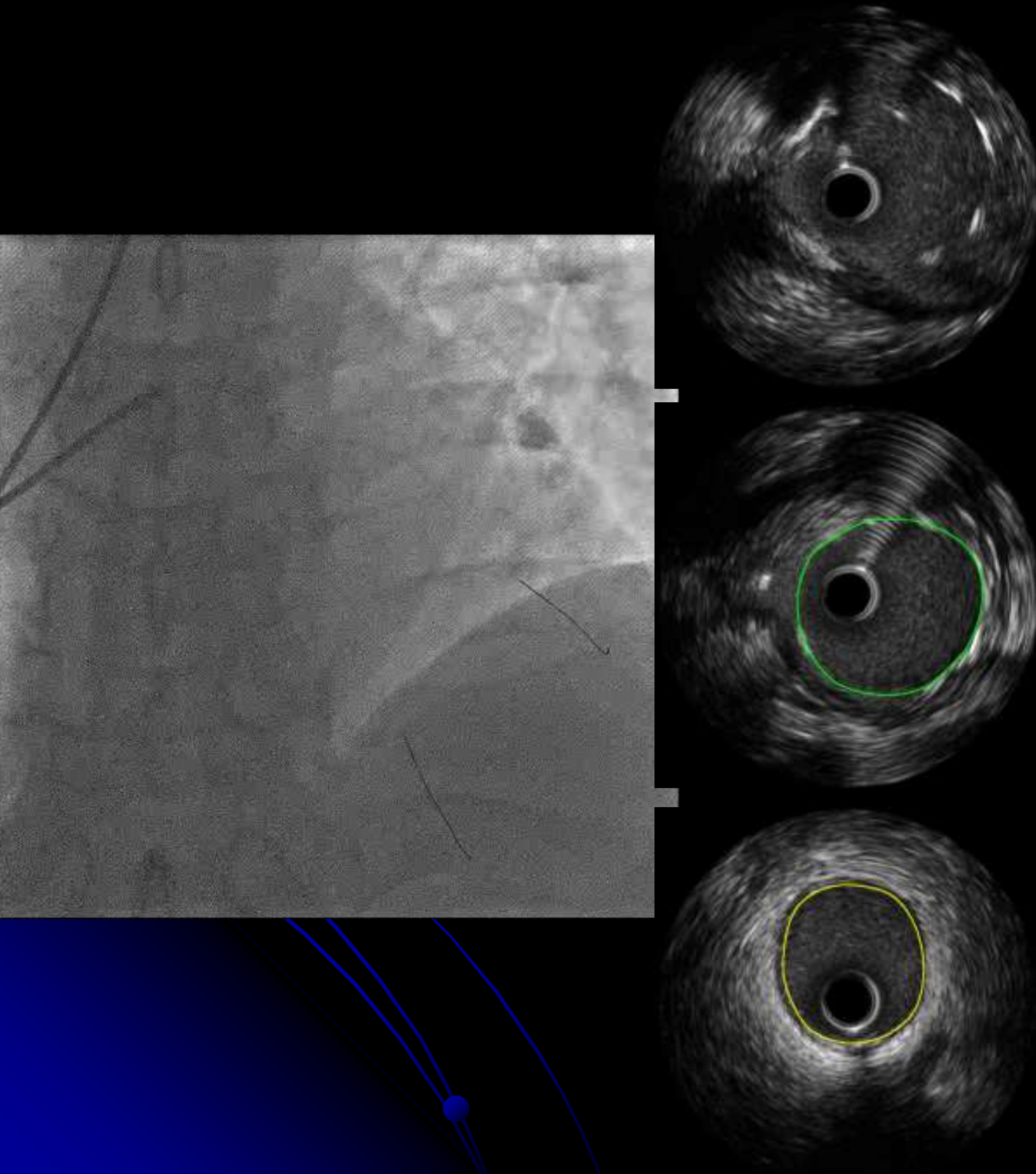
Provisional T Stenting technique

*3.5*28mm XIENCE V 12atm*30s*



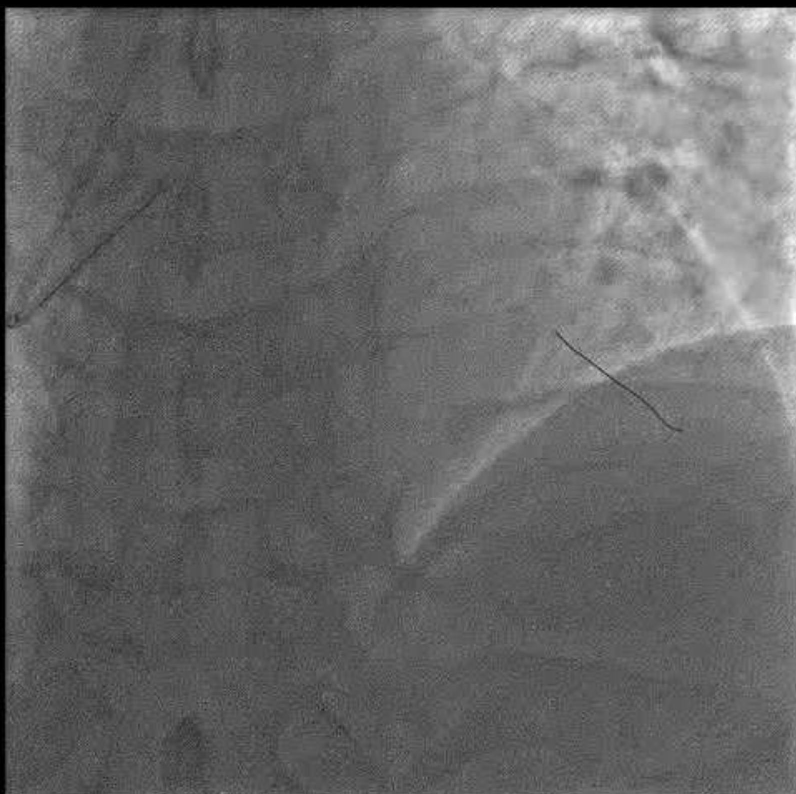
Postdilatation

*4.5*8mm Quantum 20atm*15s*



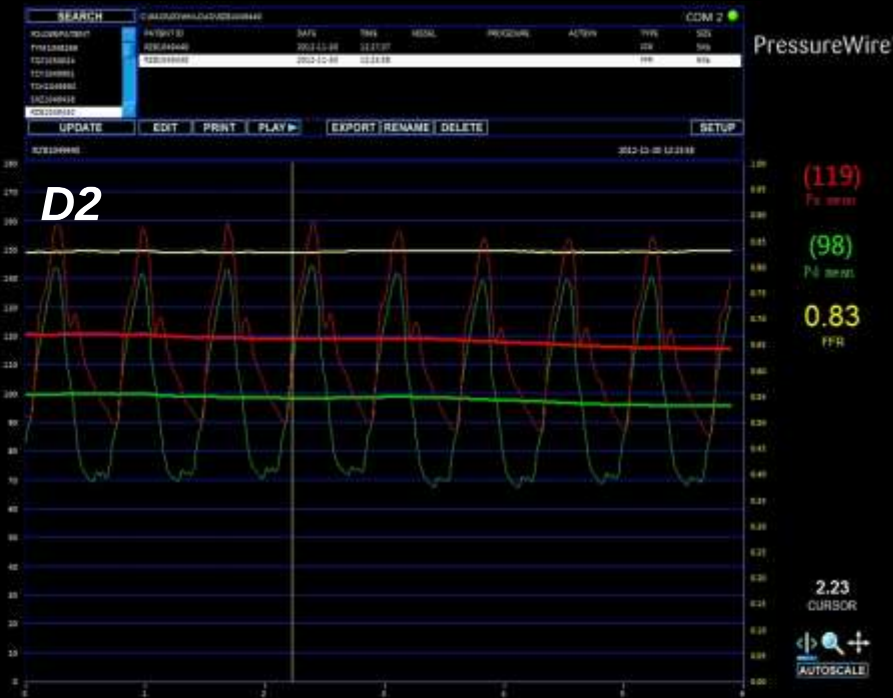
	Area	Diameter (mm)		
	(mm^2)	Mean	Min	Max
Stent	13.85	4.21	4.03	4.39

FFR measurement again after postdilatation for SB



4.5*8mmQuantum with 14atm and 2.0*8mmAPEX with 8atm for kissing inflation

Final Result



Follow-up after 1 year

Overview

- Why do we need FFR for side branch treatment?
- How does FFR help us address side branch treatment?
- **Limitation of FFR guidance for side branch;**

FFR measurement for complex SB after MV 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
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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

In our pilot study of SB FFR comparing DK and Provisional technique, about 3.4% pts were failed in FFR measurement after MV stenting.

Ye F, Chen SL, et al. J Interven Cardiol 2010

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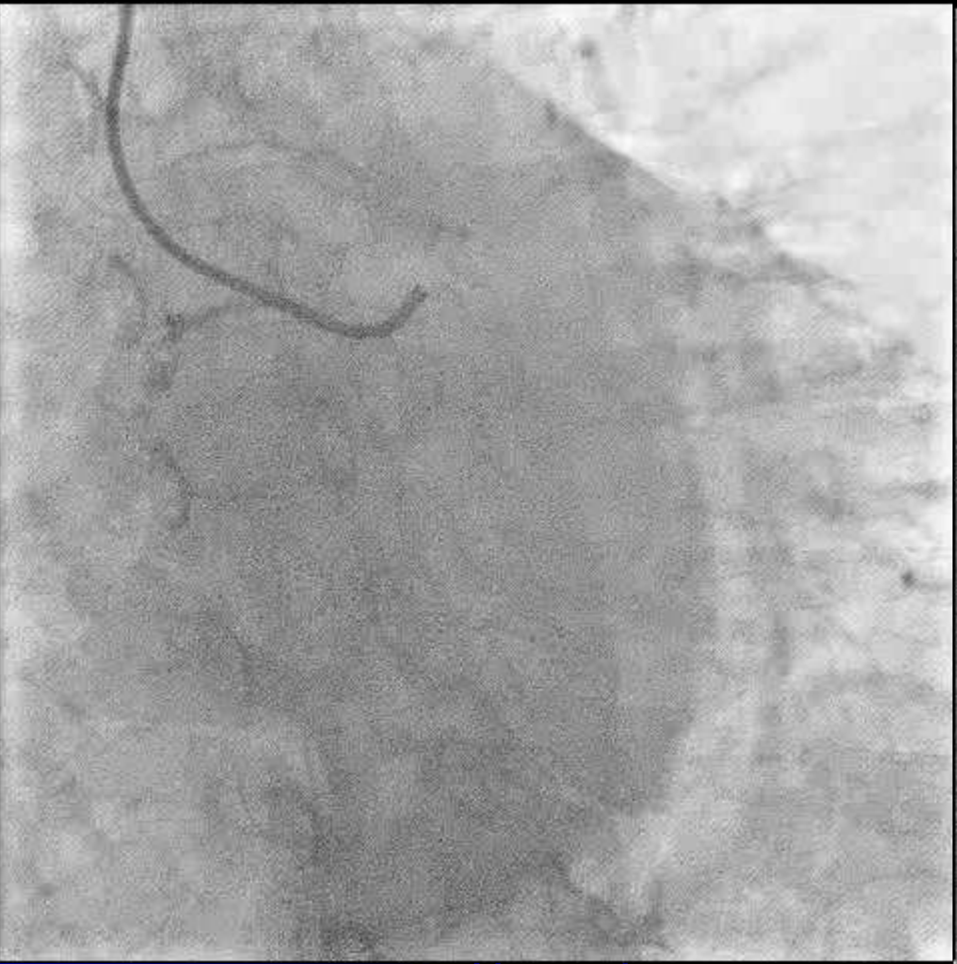
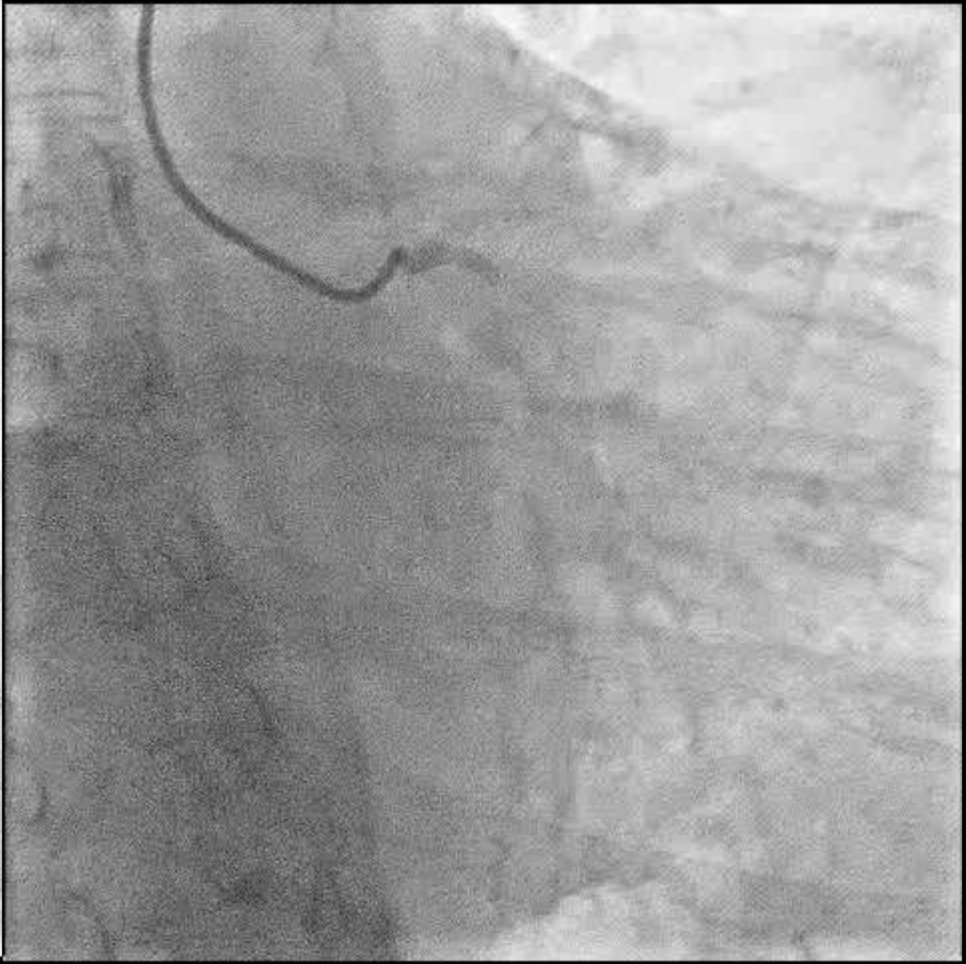
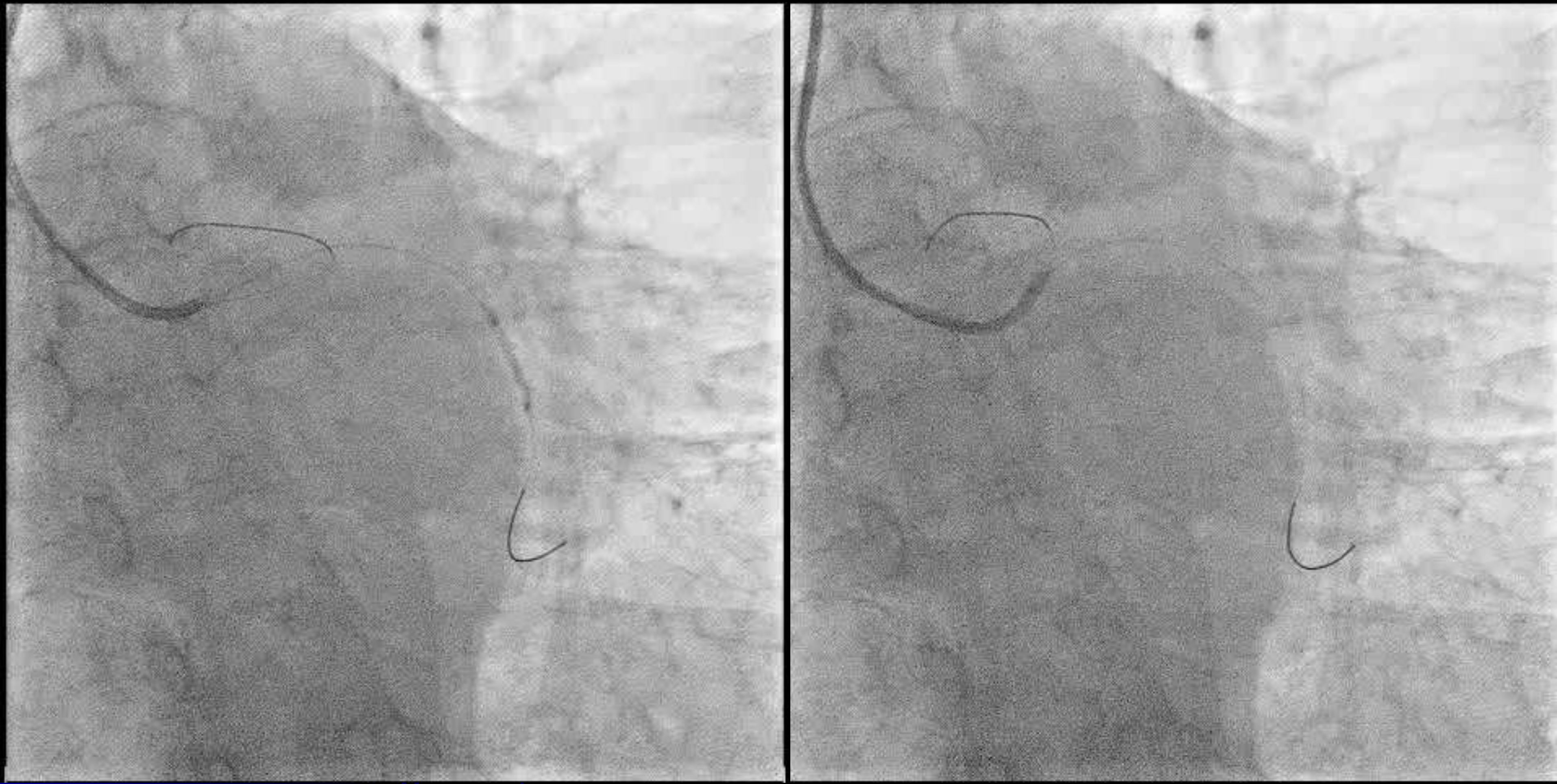
Case presentation: DGY, female, 78y, chest discomfort for 1y, EF 35%





2-vessel disease, for the reason pt refuse to be sent to surgery, stage PCI strategy was performed for LCA lesions.

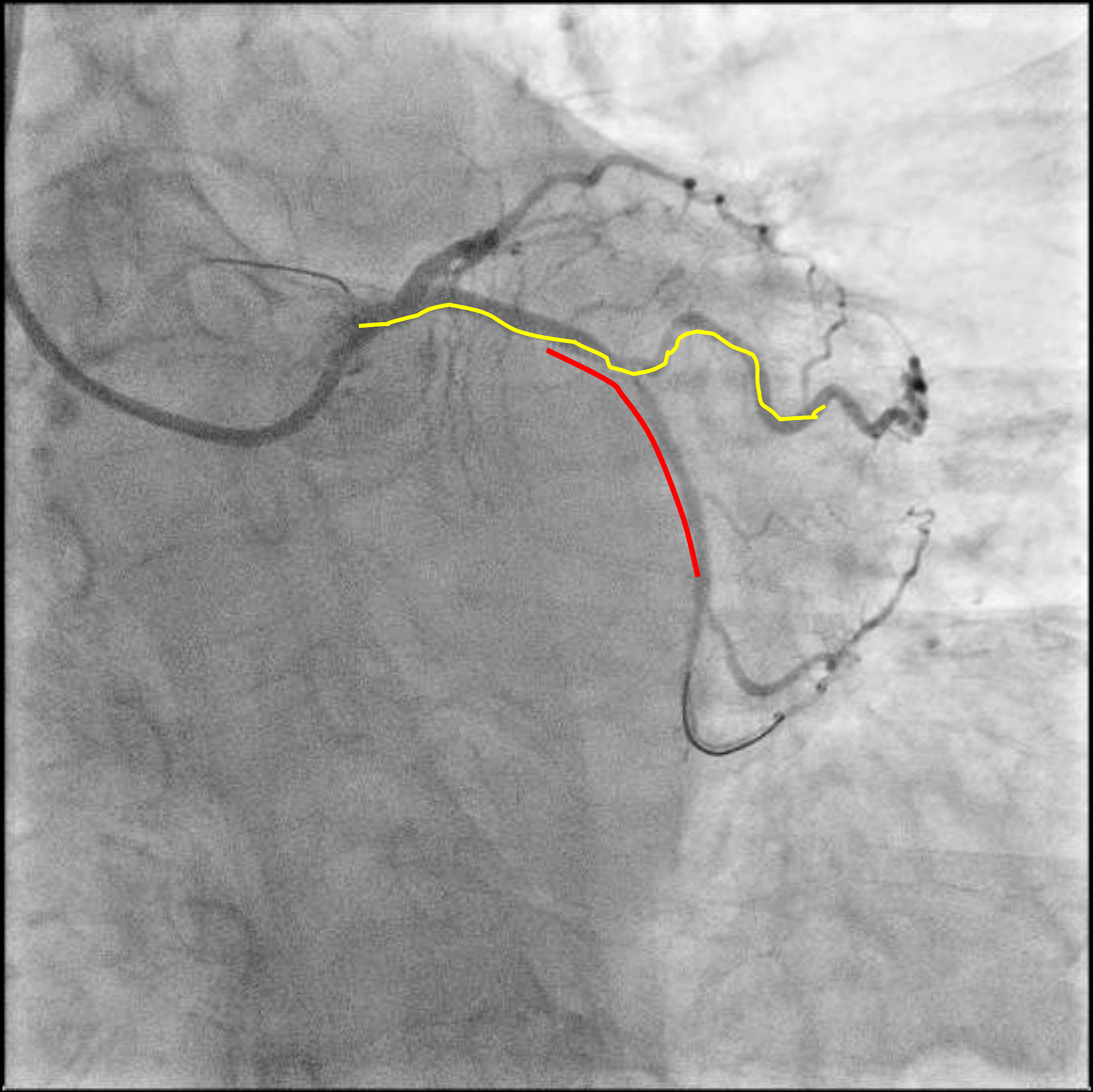
PCI procedure



*Predilation with a 2.0*15mm balloon*

The next strategy…

- *1-stent strategy with a wire jailed in OM;*
- *FFR measuring of OM*
- *Then…*



PCI procedure…

*2.75*36mm DES deployed from proLCX-disLCX*

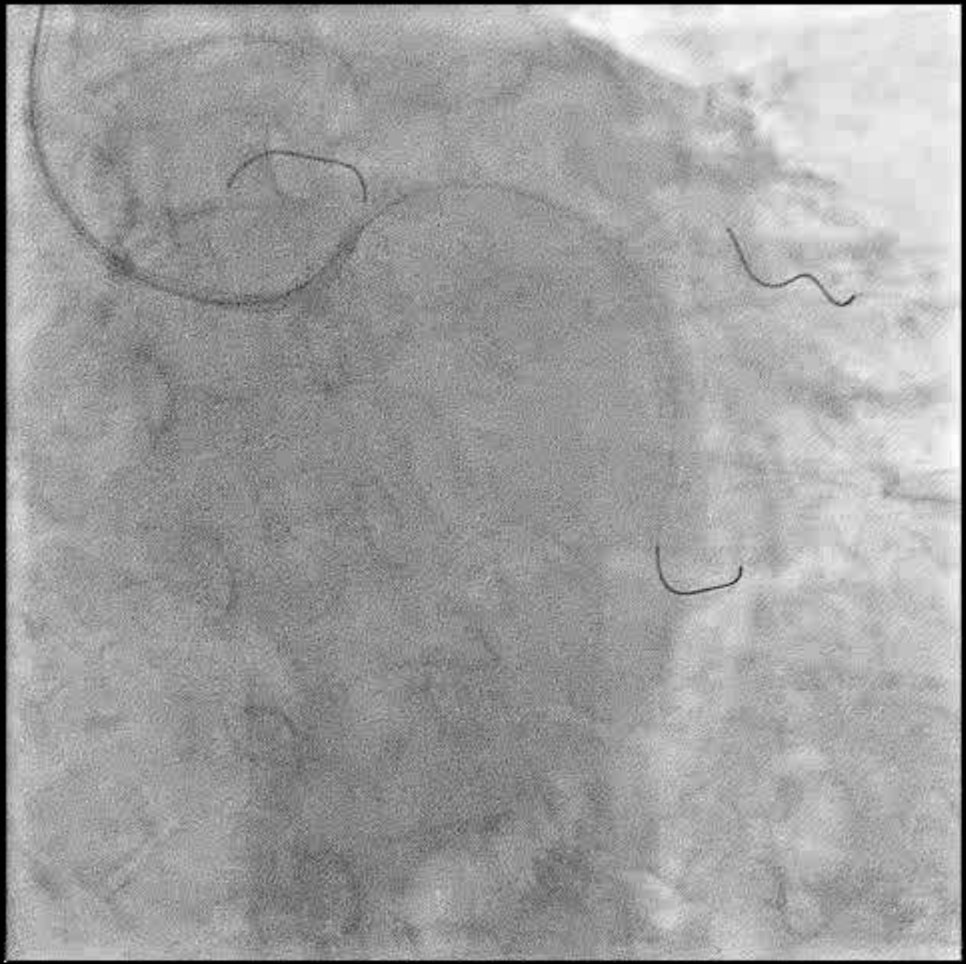
Next strategy…

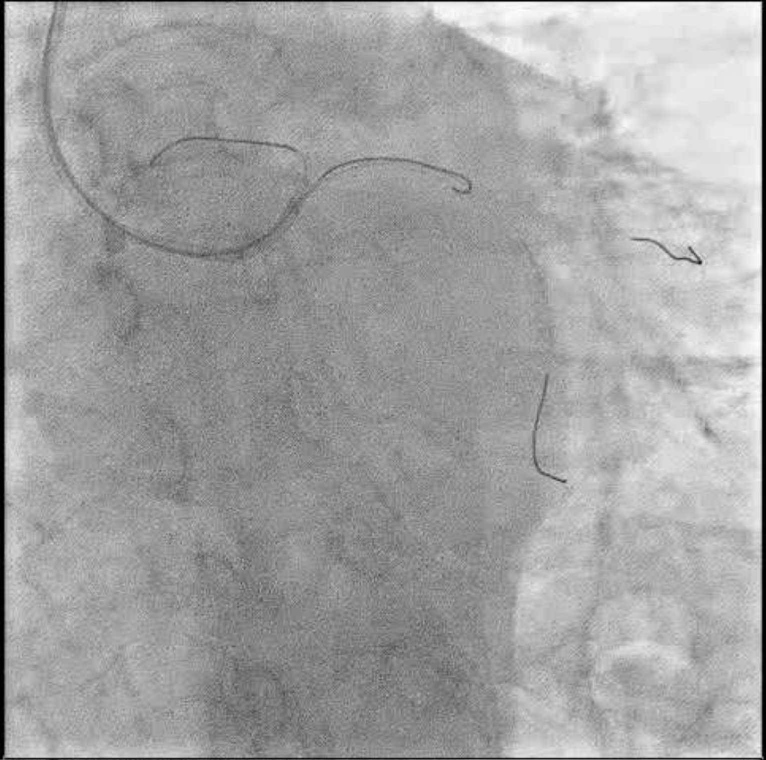
Ostial OM was compressed by carina shift or plaque shift, but flow was good;

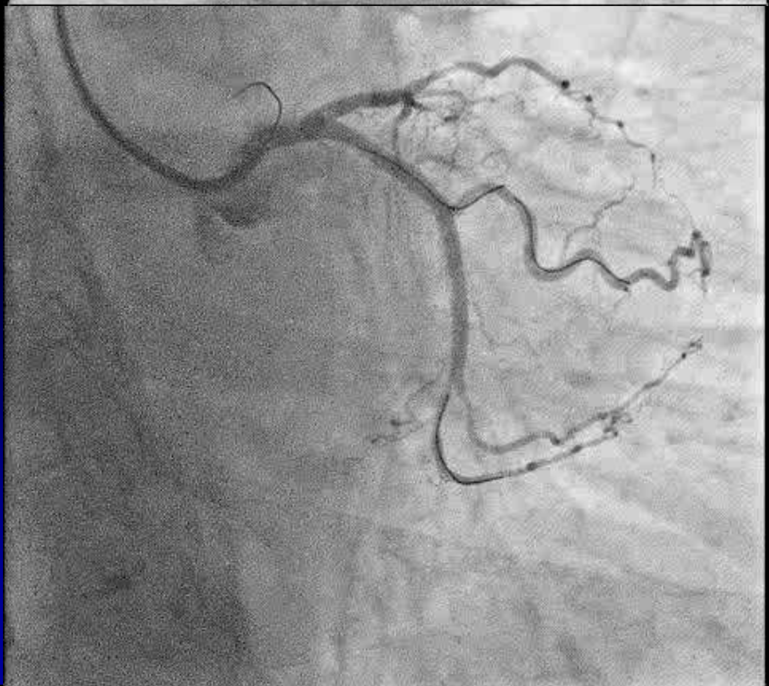
Ostial OM and proximal segment was very tortous;

FFR measure would be difficult;

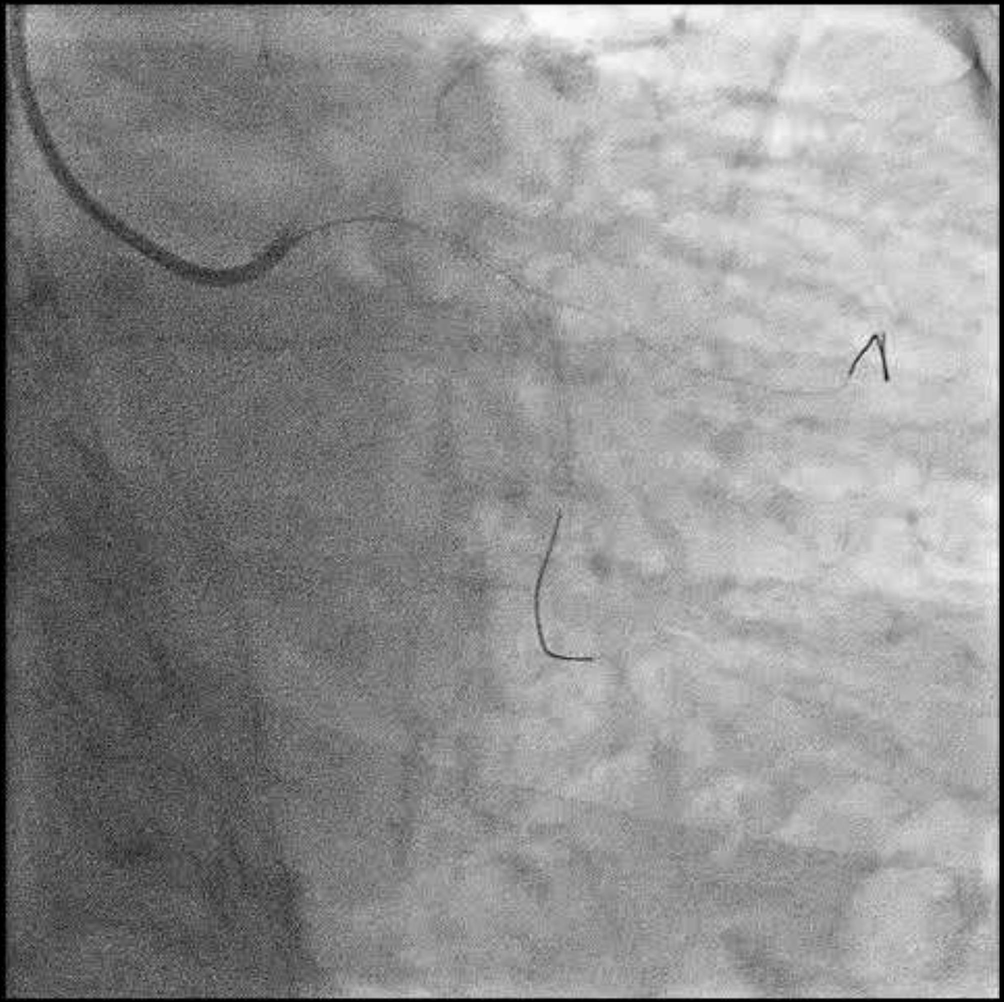
So, we left another wire in the OM…

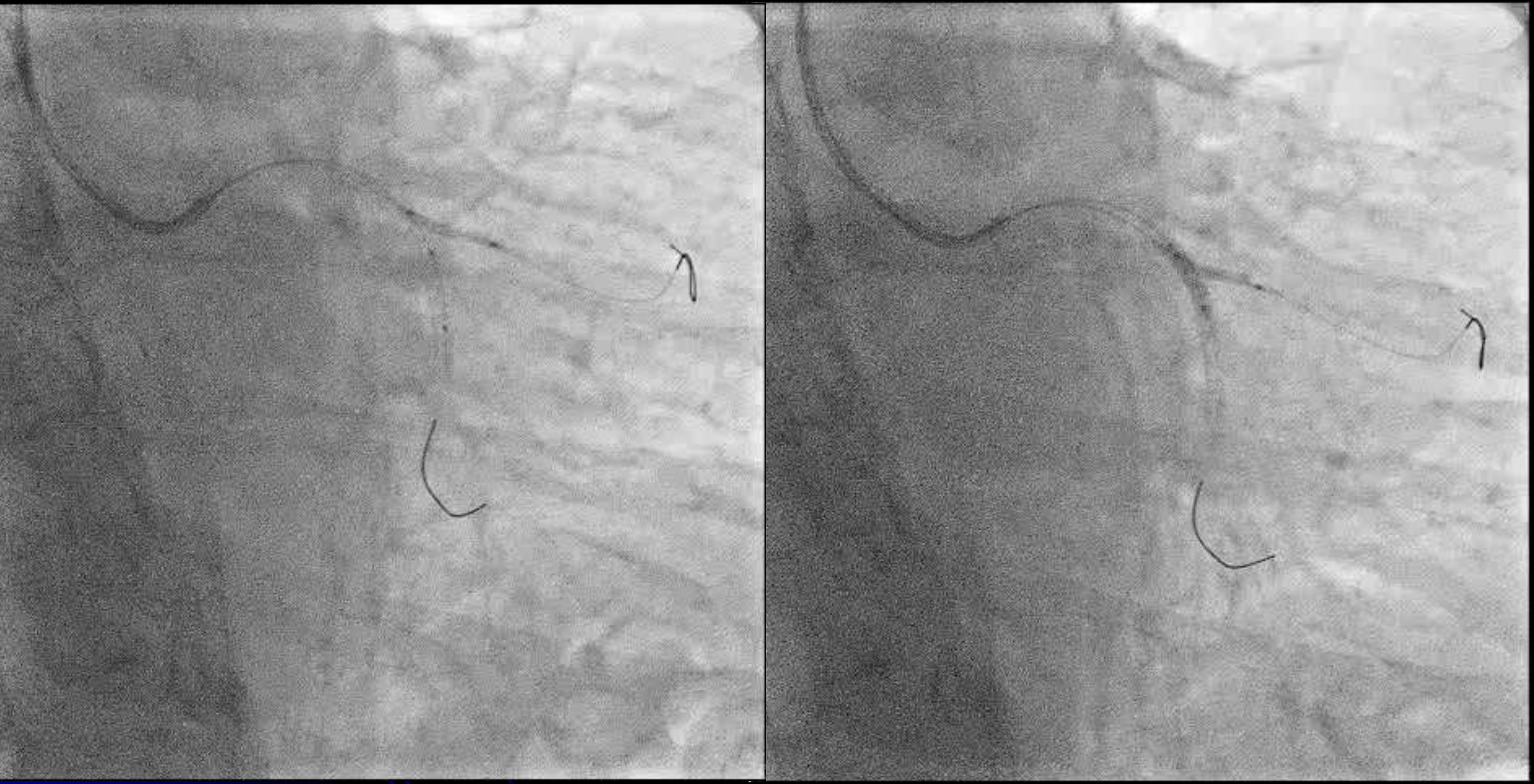






Measuring FFR of OM was very difficult for the pressure wire controlling into OM, and dissection occurring…

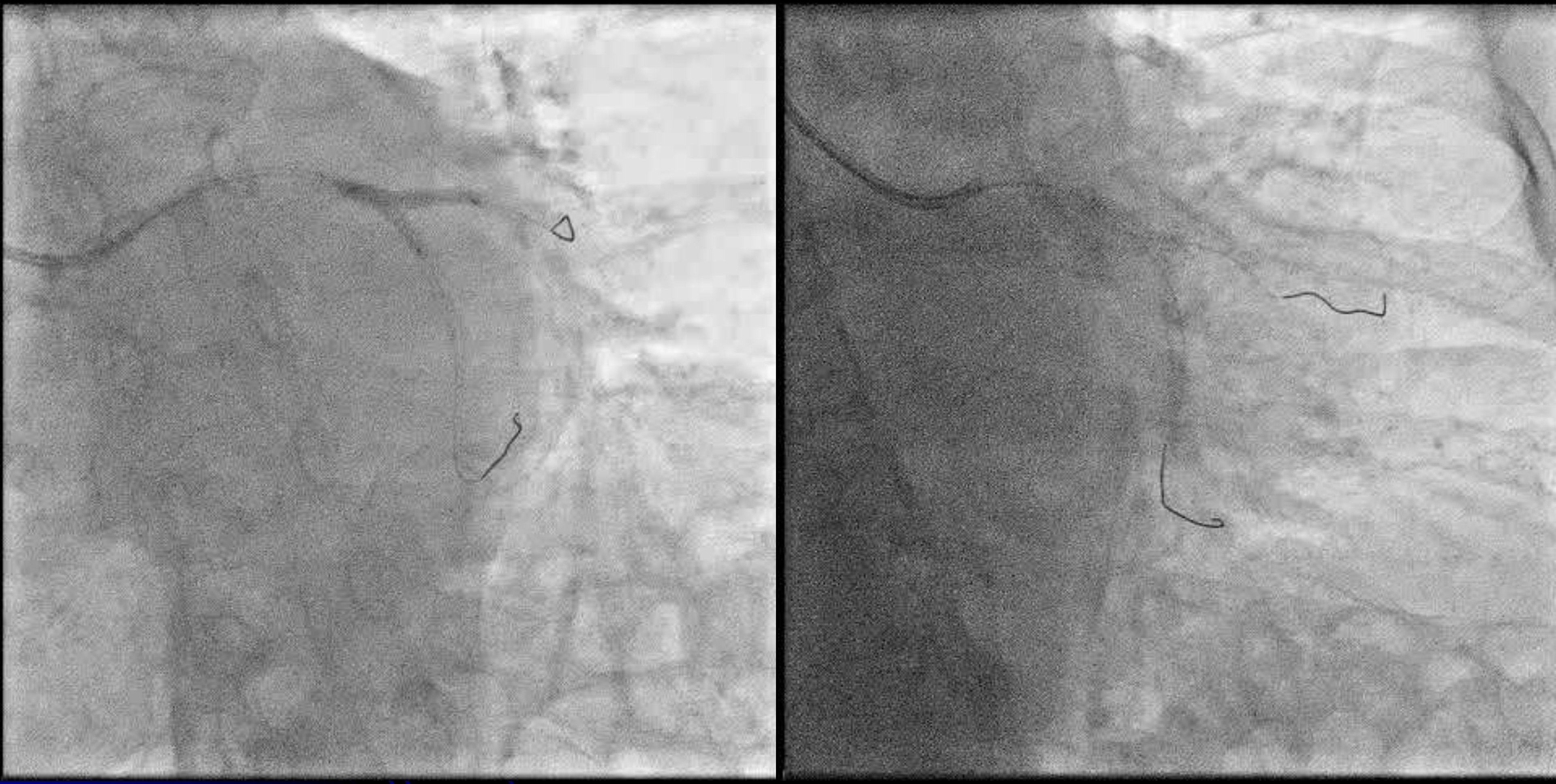




Predilation and kissing balloon inflation at LCX-OM bif

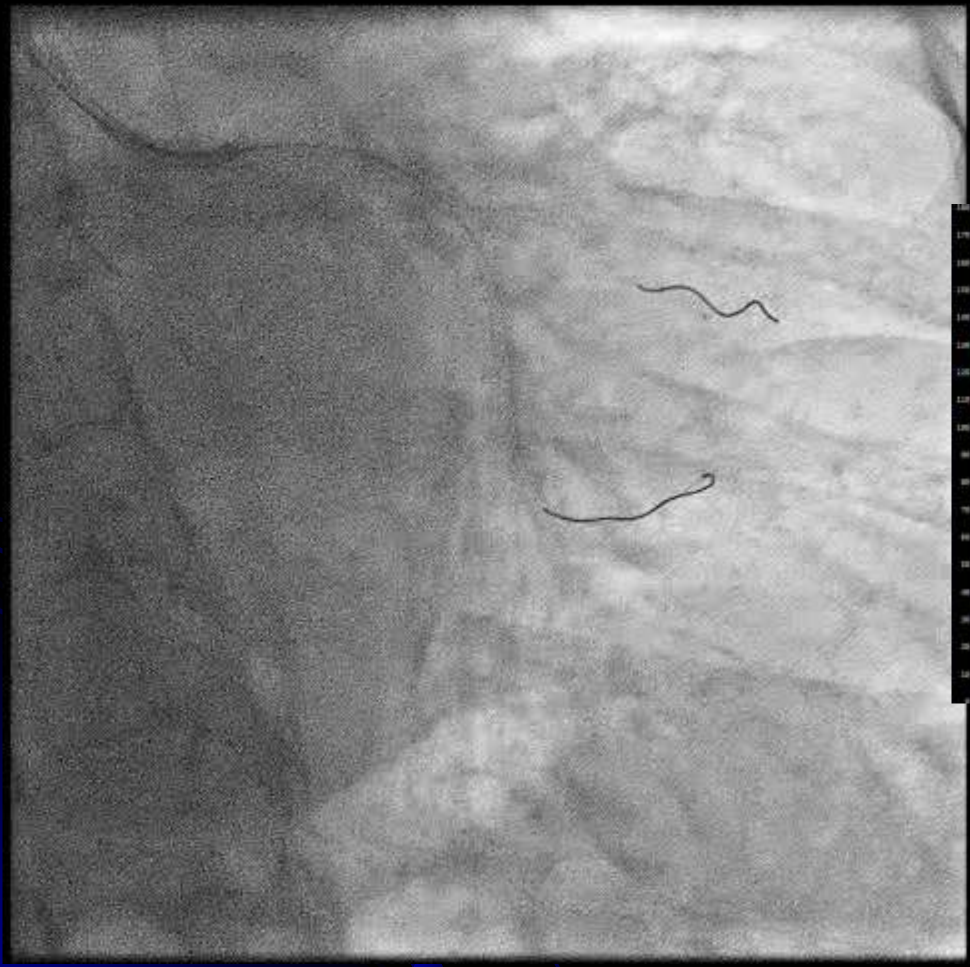
“TAP” technique

*2.5*18mm DES implanted at ostial OM*

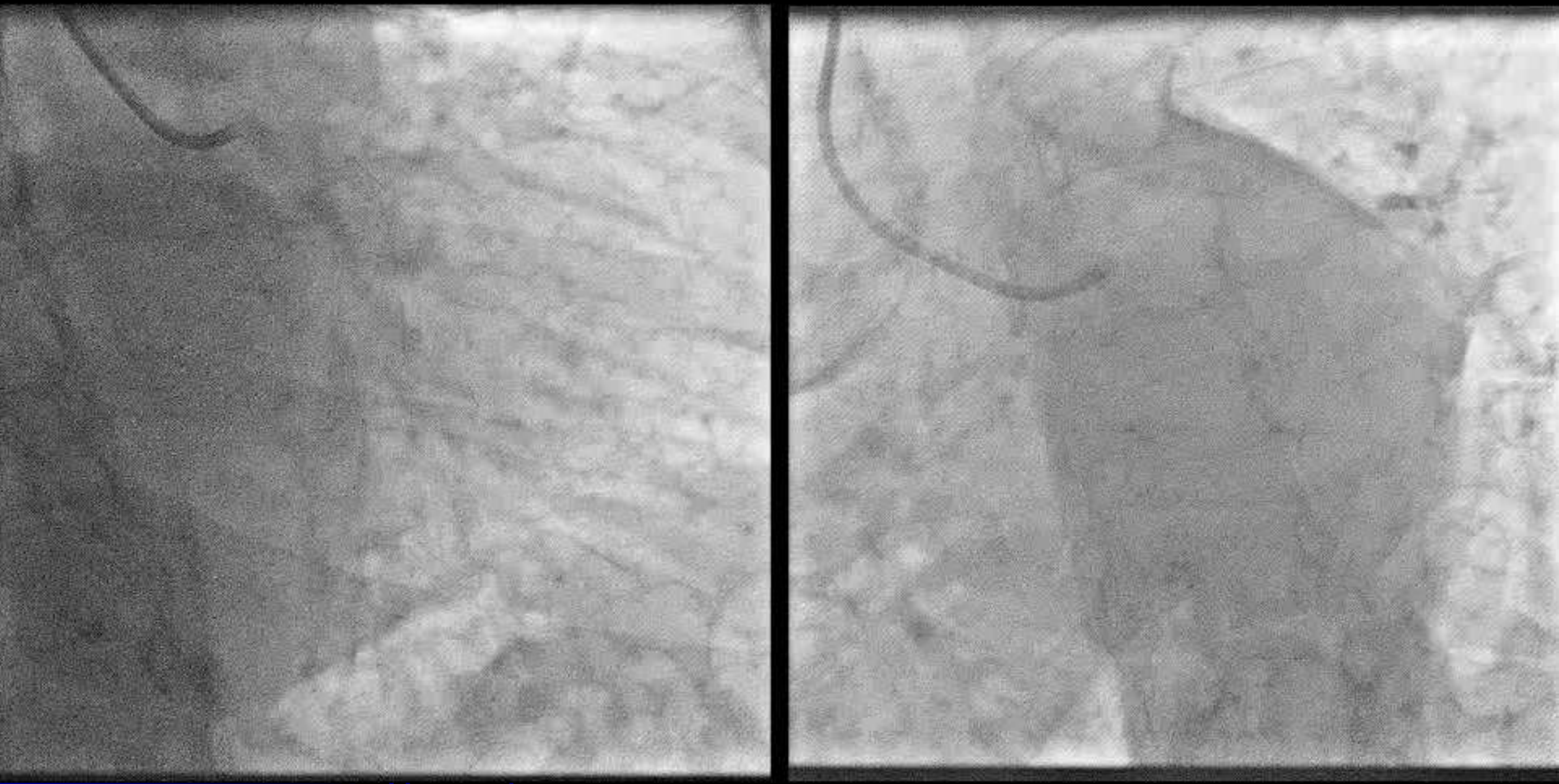


FKI and after kissing

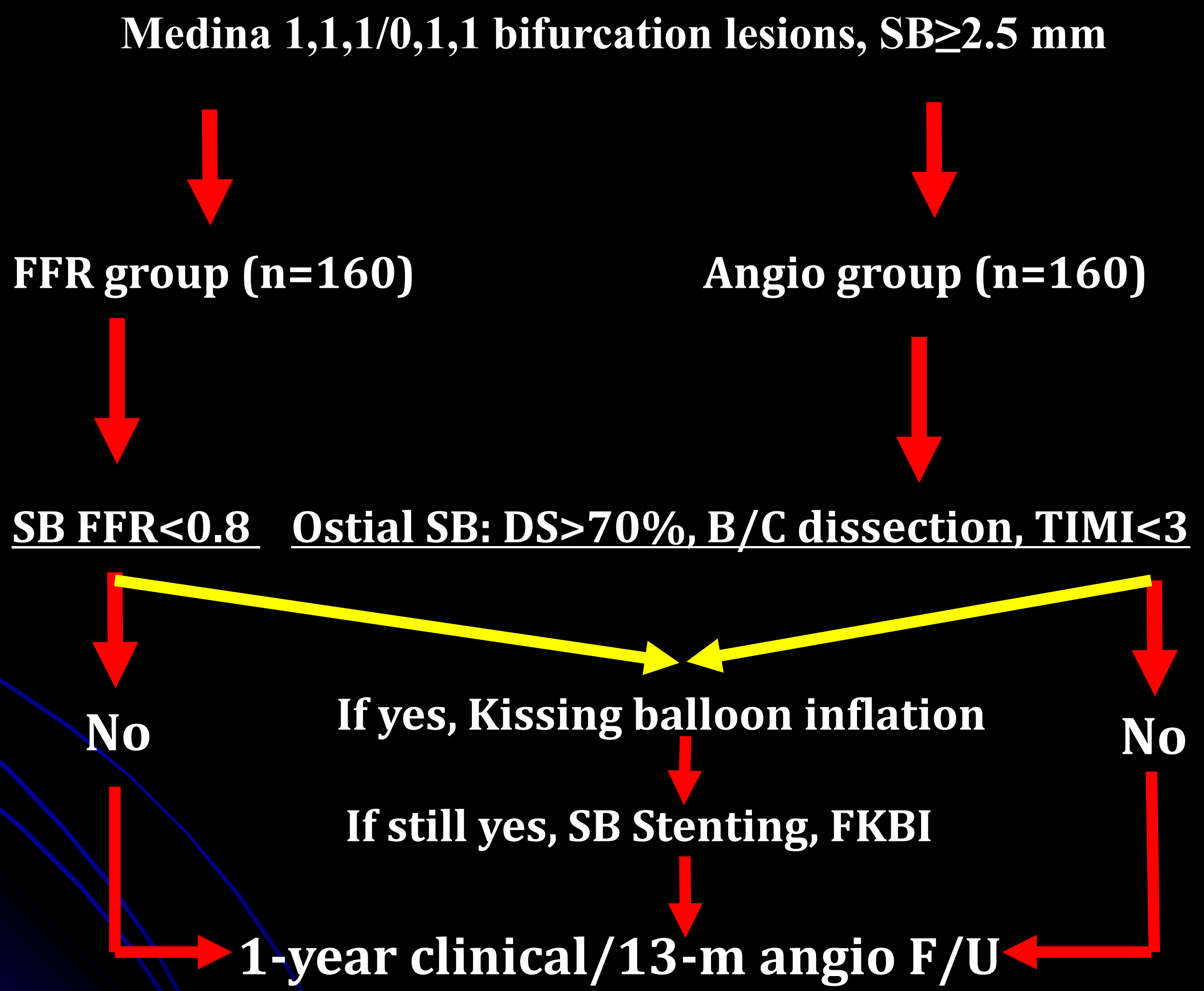
Re-measure FFR of OM



Final result



DKCRUSH-VI Study Design



Chen SL, et al, JACC Cardiovasc Interv 2015

DKCRUSH-VI Study Design

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

Chen SL, et al, JACC Cardiovasc Interv 2015

Conclusions

- Angiographic evaluation of bifurcation lesions always mismatch their functional significance
- FFR measurement is feasible and safe in bifurcation lesions, and can help guide the decision regarding the need for PCI except a little difficult of manipulation

Thanks for your attention