Basics of Angiographic Interpretation

Analysis of Angiography

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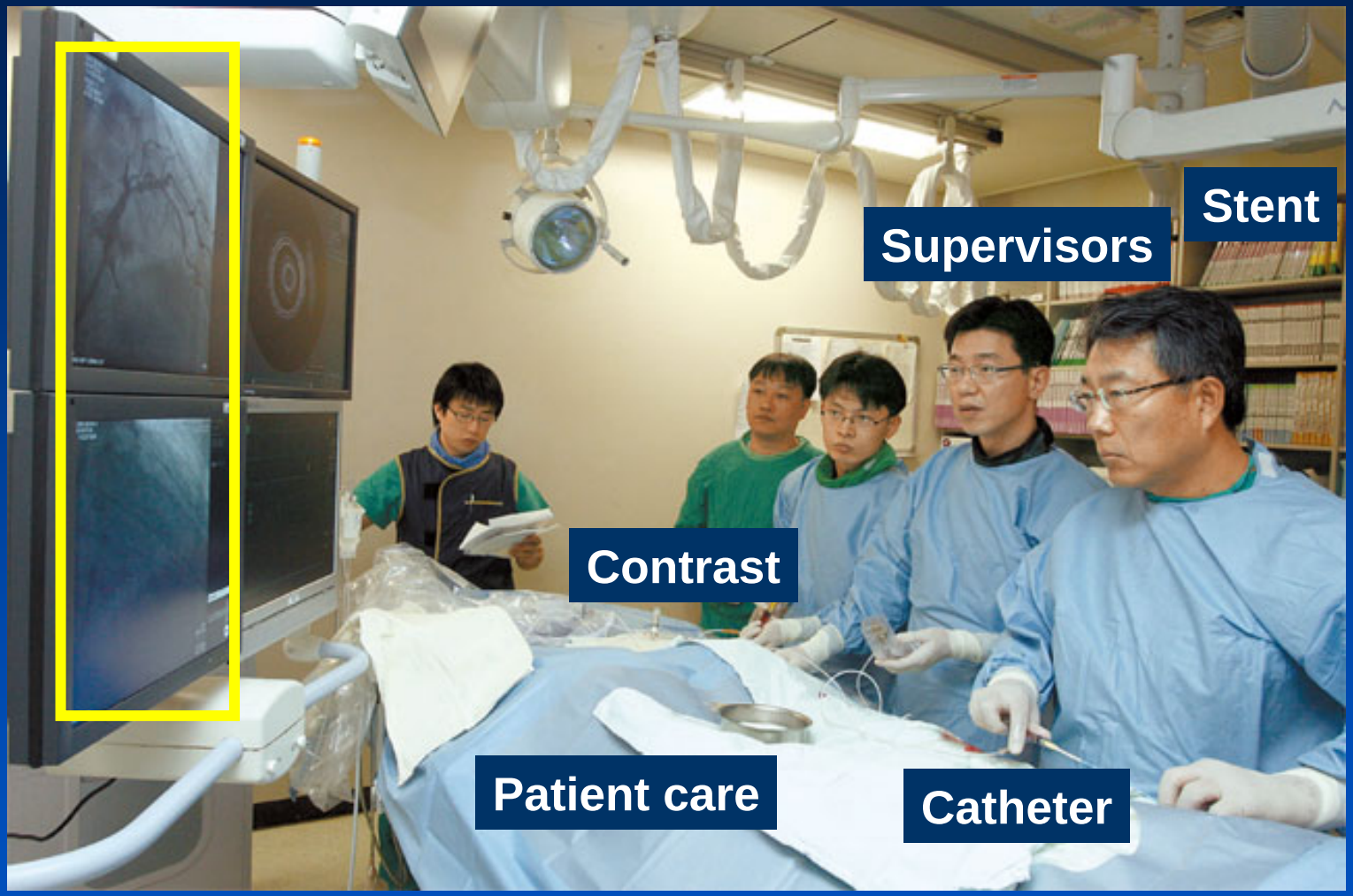
What made us nervous…



What we do in angiographic analysis ?

Qualitative and Quantitative

Measurement of Angiography

taken at preprocedure,

postprocedure and follow-up

Good Angiography

The first for good analysis and technique dependent

- Angiography is only as good as the quality of the images taken
- Comprehensive diagnostic - no omissions
- Multiple views - foreshortening and overlap
- Catheter caliber - contrast streaming
- IC Nitroglycerin - vasospasm

Case Report Form of Angiographic Analysis
in CardioVascular Research Foundation, Seoul

CARDIOVASCULAR RESEARCH FOUNDATION

Study name: _____
Site : _____
Patient ID: _____
Cath date: _____

Image

Catheter frame # _____ Arterial frame # _____

_____ _____ 1
Director / Fellow / Technician Date

CARDIOVASCULAR RESEARCH FOUNDATION

Study name: _____
Site : _____
Patient ID: _____
Cath date: _____

Site: [ ] CASS 1=Prox; 2=Mid 3=Distal; 4=Ostial
Location: [ ]
Frame: [ ]
Projection: [ ]
Catheter size: [ ] Fr

Qualitative measurement

OCEDURE

Morphology

Eccentric	[ ]	0=Conc 1=Ecc
Bend	[ ]	0-180
Thrombus	[ ]	0=Absent; 1=Pres
Tortuosity	[ ]	0=None; 1=Mod; 2=severe
Calcification	[ ]	0=None/mild; 1=Mod; 2=severe
Ulceration	[ ]	0=Absent; 1=Pres
Aneurysm	[ ]	0=Absent; 1=Pres
Intimal flap	[ ]	0=Absent; 1=Pres
Ectasia	[ ]	0=Absent; 1=Pres
Pre-TIMI	[ ]	TIMI 0-3
Frames	[ ]	0 ---- 200
Frames (corr)	[ ]	0 ---- 200
Bifurcation	[ ]	0, A-> F
Side branch	[ ]	CASS
SBPreDS	[ ]	%

QCA

Prox Normal	[ ]
Distal Normal	[ ]
Inter normal	[ ]
MLD	[ ]
Lesion length	[ ]

_____ _____ 2
Director / Fellow / Technician Date

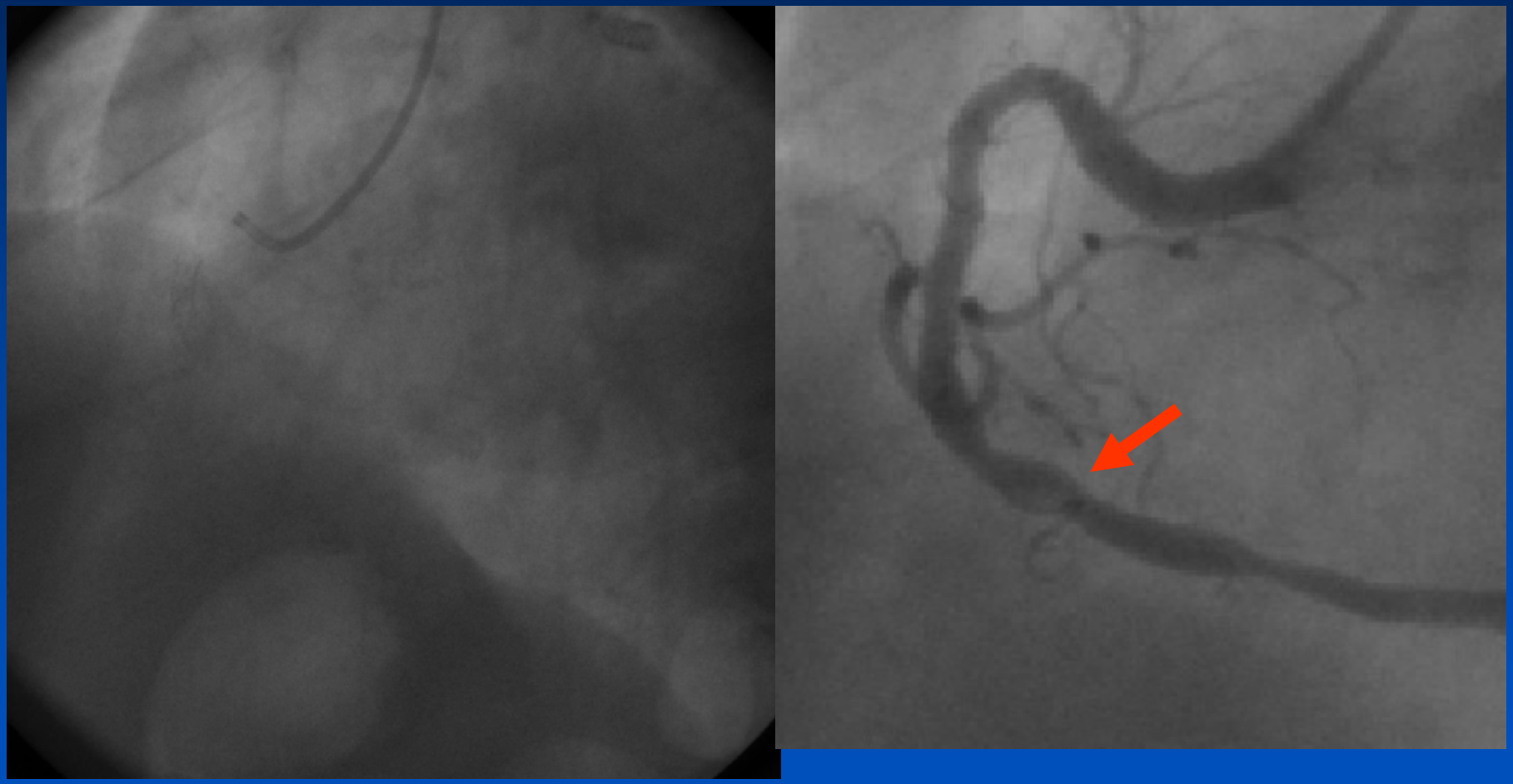
Angiography remains a gold standard

- Identifies lesion characters and complications of PCI
- TIMI flow
- Collateral circulation
- Distal embolization
- Vasospasm
- Dissections
- Slow/No reflow
- Perforations

Angiography: limitations are real

- Thrombus
- Extent of Calcium
- Severity of Intermediate Lesions
- Unstable/vulnerable plaque
- Bifurcation Lesions
- Can not provides functional data

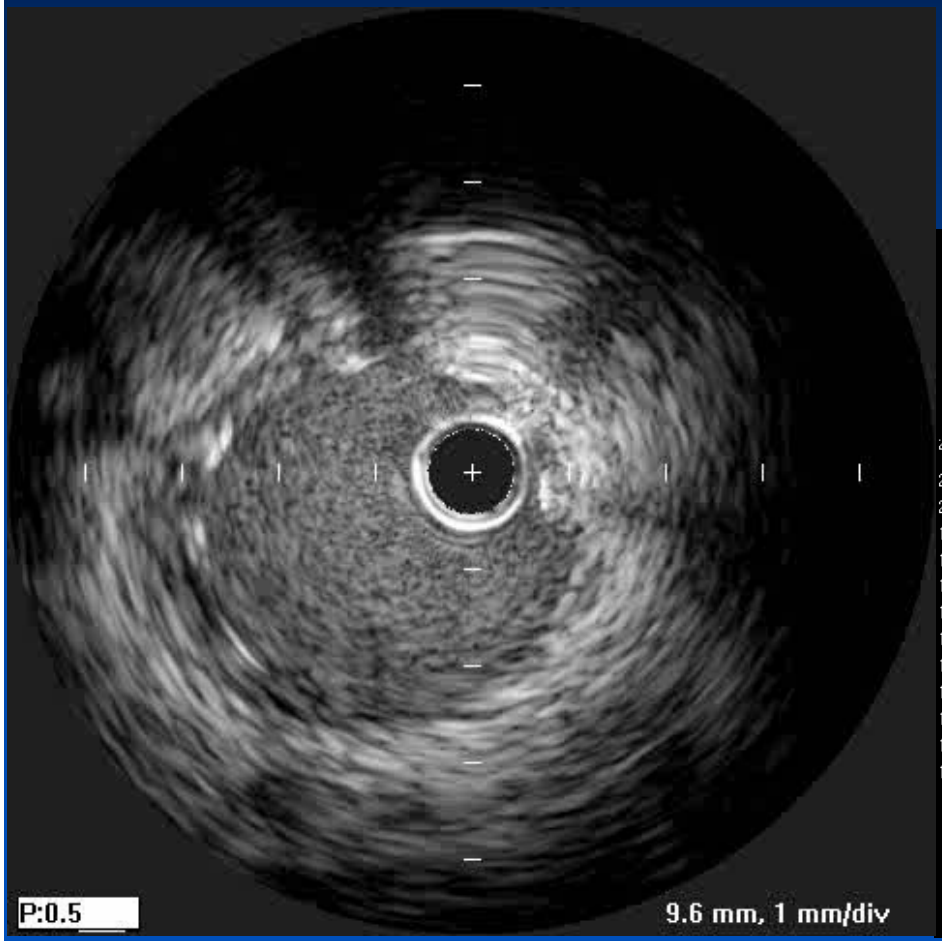
Thrombus
Visualization with a Freeze-frame

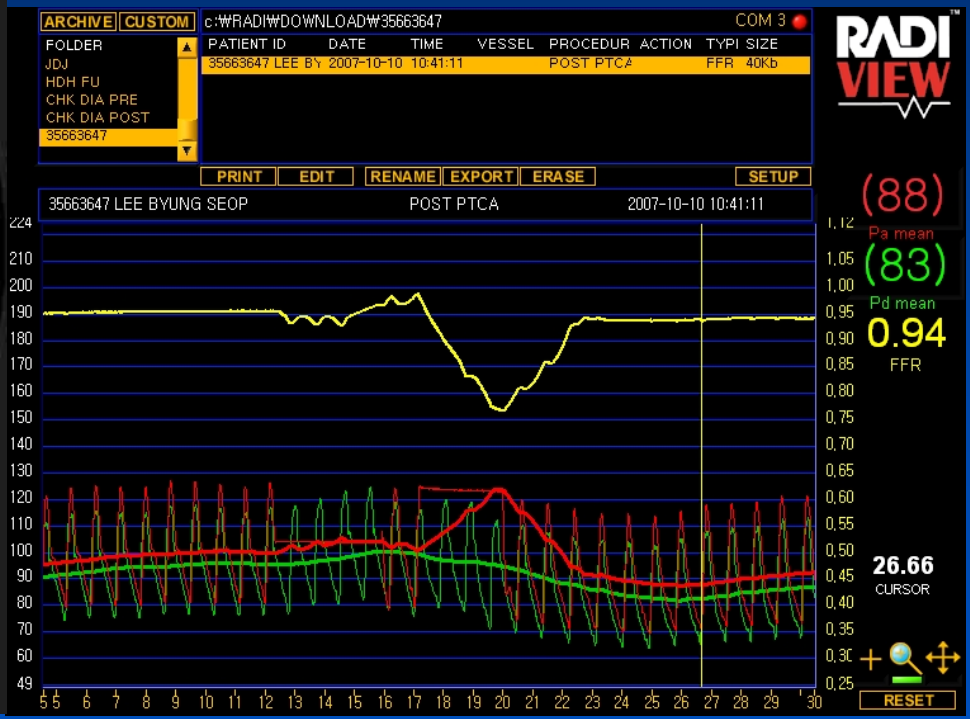


Thrombus and Calcium Diagnostic Considerations

- Thrombus
  - Angiography: low sensitivity, high specificity
  - Angioscopy is best diagnostic tool
- Calcium
  - Angiography: low sensitivity for mild/moderate Ca, Moderate sensitivity for severe Ca
  - IVUS is best diagnostic tool

Stenosis or Not at Ostial LCX ?





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Catheter size: [ ] Fr

PRE-PROCEDU

Quantitative measurement

Morphology

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QCA

Prox Normal	[ ]
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Inter normal	[ ]
MLD	[ ]
Lesion length	[ ]

_____ _____ 2
Director / Fellow / Technician Date

Surrogate End Points
As Quantitative Angiographic Measurements

- Minimal luminal diameter (MLD)
- Late loss
- Diameter stenosis
- Binary angiographic restenosis

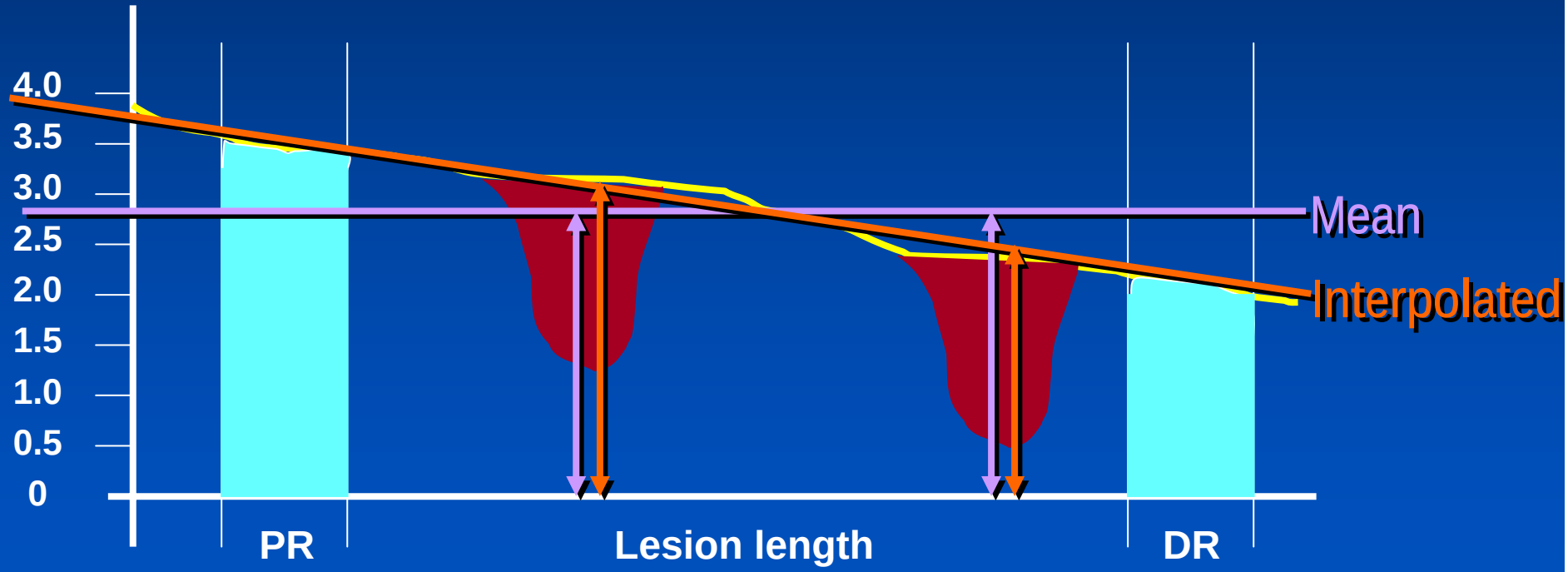
- A reliable substitute for clinical end points in smaller studies
- To speed up trial progress

Interpolated Reference

standard to assess the degree of stenosis

- MLD = 1.3
- Mean reference: (3.5+2.2) / 2 = 2.85
  DS = (2.85-1.3) / 2.85 X 100 = 54.4%
- Interpolated reference: 3.2
  DS = (3.2-1.3) / 3.2 X 100 = 59.4%

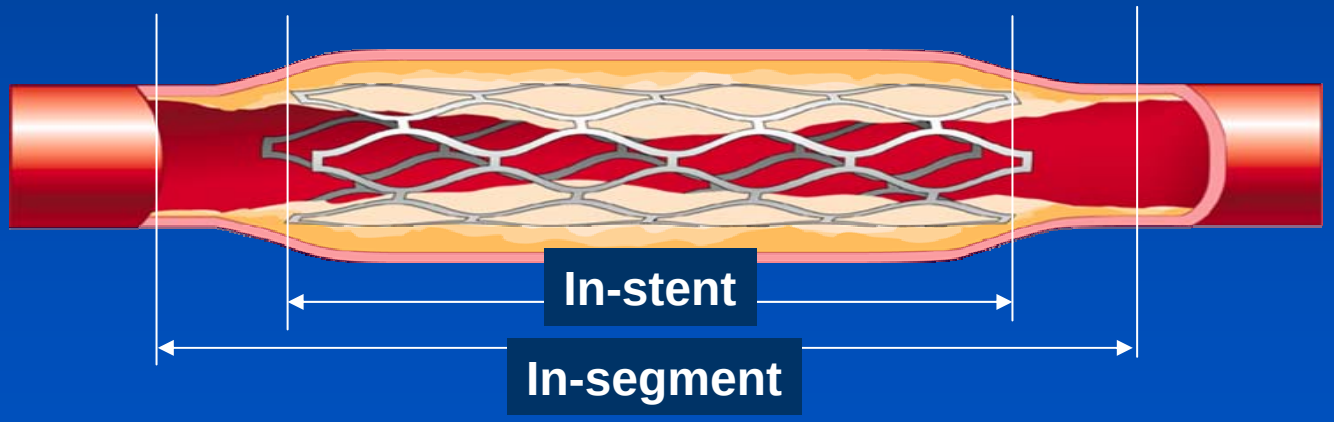
- MLD = 0.5
- Mean reference: (3.5+2.2) / 2 = 2.85
  DS = (2.85-0.5) / 2.85 X 100 = 82.5%
- Interpolated reference: 2.5
  DS = (2.5-0.5) / 2.5 X 100 = 80.0%



Courtesy of YH Kim

Definition of Late Loss
Post-procedure MLD – F/U MLD

- Within the stent (**in-stent**)
- Within the analysis segment (**in-segment**)
- Within the segment, but separately considering the stented segment, proximal and distal edges and taking the maximum change in MLD within those 3 segments and applying it to this segment as a whole (**maximal regional late loss**)



Ellis SG et al. J Am Coll Cardiol 2005;45:1193

Late Loss

	Proximal edge	In-stent	Distal edge
Post-procedure MLD, mm	2.7	3.0	3.1
F/U MLD, mm	2.4	2.2	1.8
Difference, mm	0.3	0.8	1.3

- **In-stent late loss : 3.0 – 2.2 = 0.8**
- **In-segment late loss : 2.7 – 1.8 = 0.9 mm**
- **Maximal regional late loss : 1.3 mm**

Advantage of Late Loss

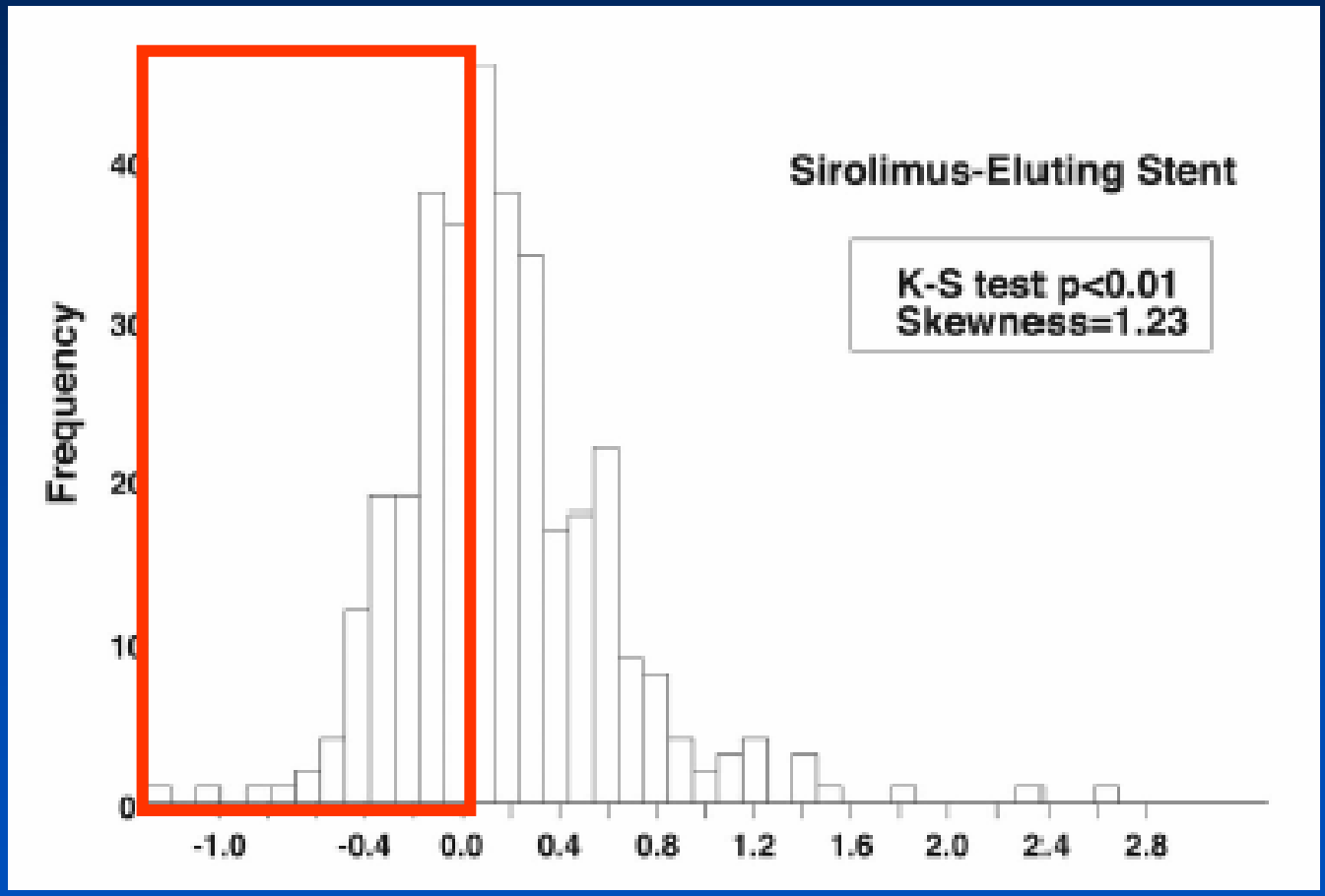
- Useful indirect measurement of intimal growth
- No dependency of reference diameter
- Less patients to demonstrate the efficacy of device than restenosis or clinical outcomes

In-Segment vs. In-Stent Late Loss

- **In-stent late loss**
  - Reflect only the pure biologic potency of an antirestenotic device

- **In-segment late loss**
  - Potency of an antirestenotic device
  - Effect of margins of stents due to balloon injury and drug diffusion effects, etc

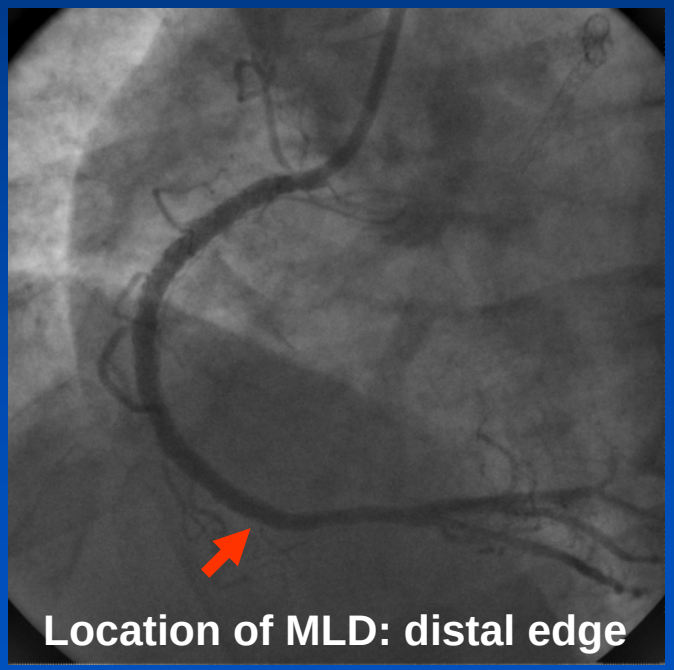
Negative Late Loss
What does it mean?

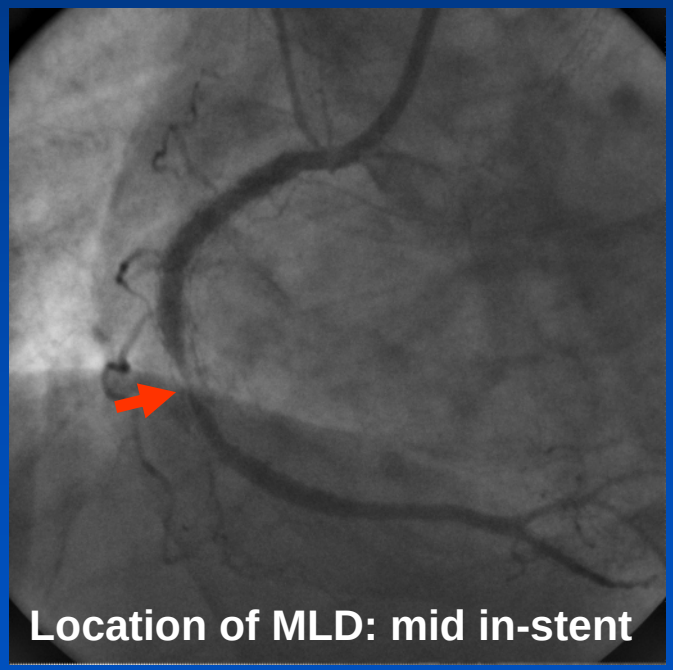


Mauri L et al. Circulation. 2005;111:321

Potential Limitation of LL Indicating Intimal Growth

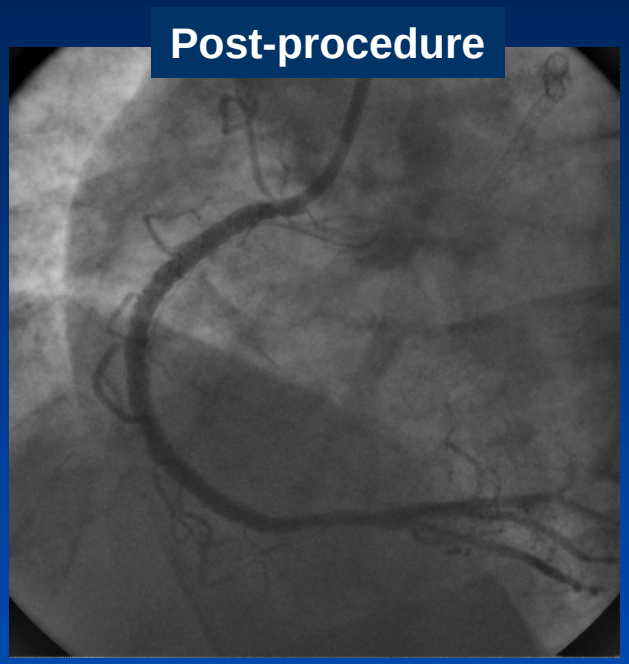
- LL does not indicate the intimal growth at the same site.
- Practically, standard techniques of measuring late loss have compared MLDs from a specified zone in in-stent, edge, or in-segment.

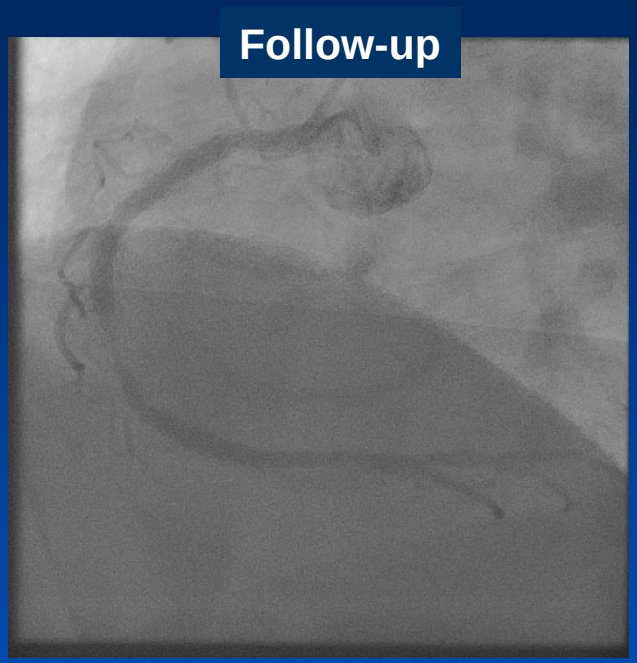

Location of MLD: distal edge


Location of MLD: mid in-stent

Measurement Error of LL

due to 2 measures from 2 different angiograms



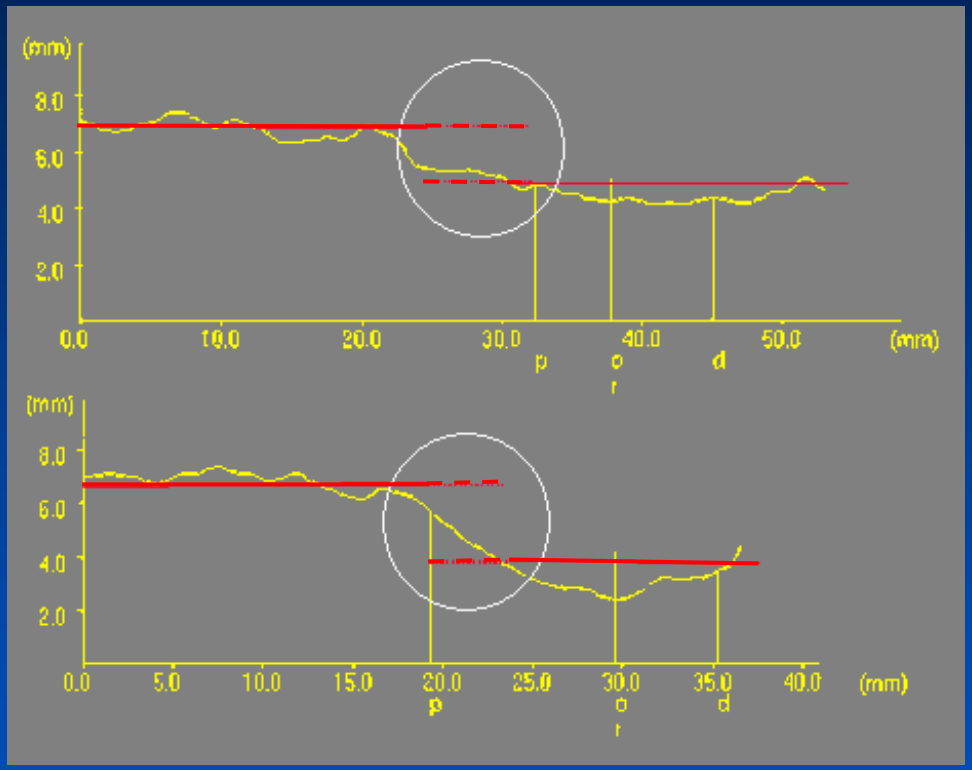


- Different guiding catheters: 7Fr vs. 5Fr
- Not same projections

We need well-trained personnel, well-developed protocol, and monitoring program in measurement...

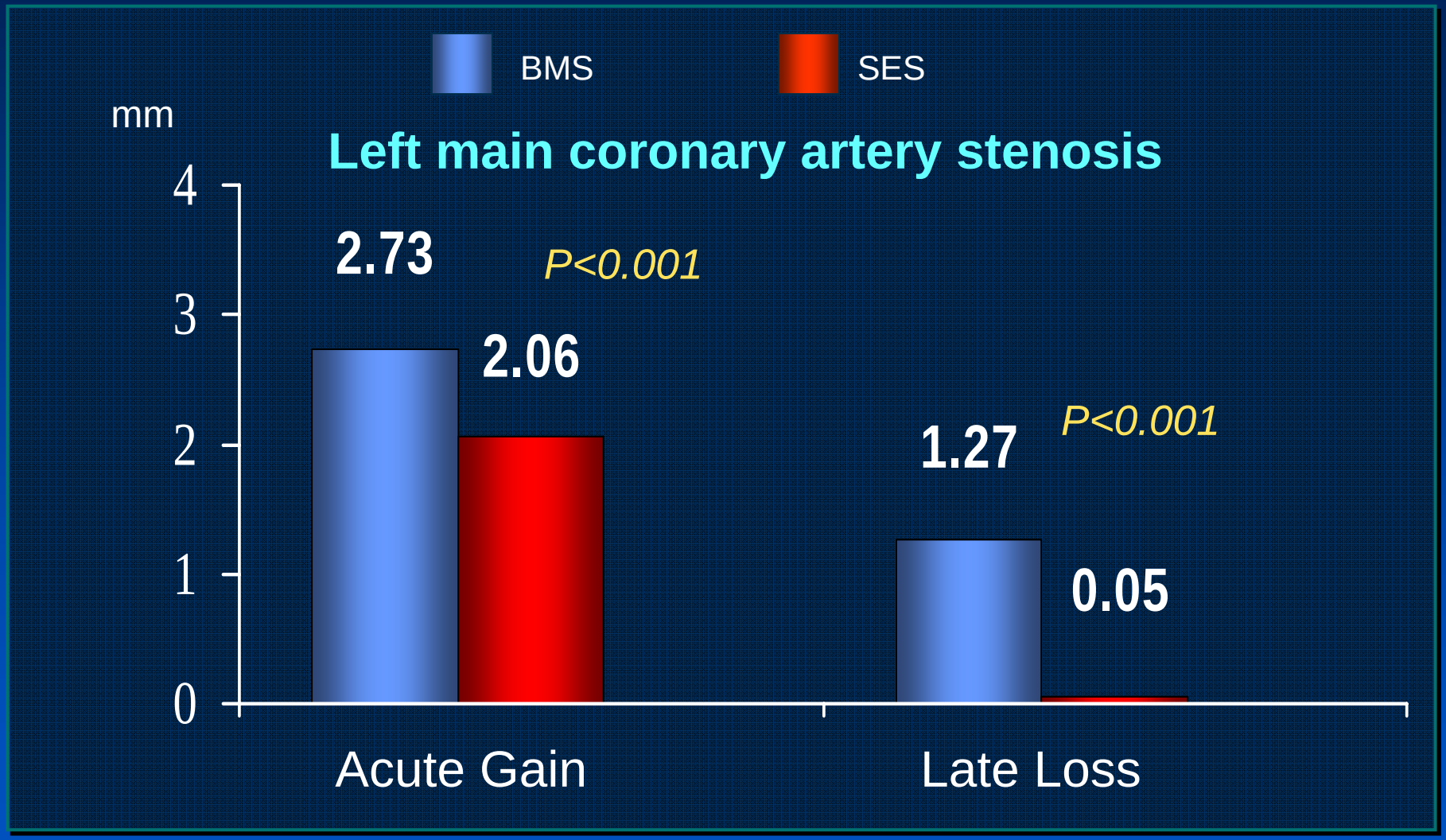
limitations of Bifurcation QCA

Method to determine the proper reference diameter for each individual segment

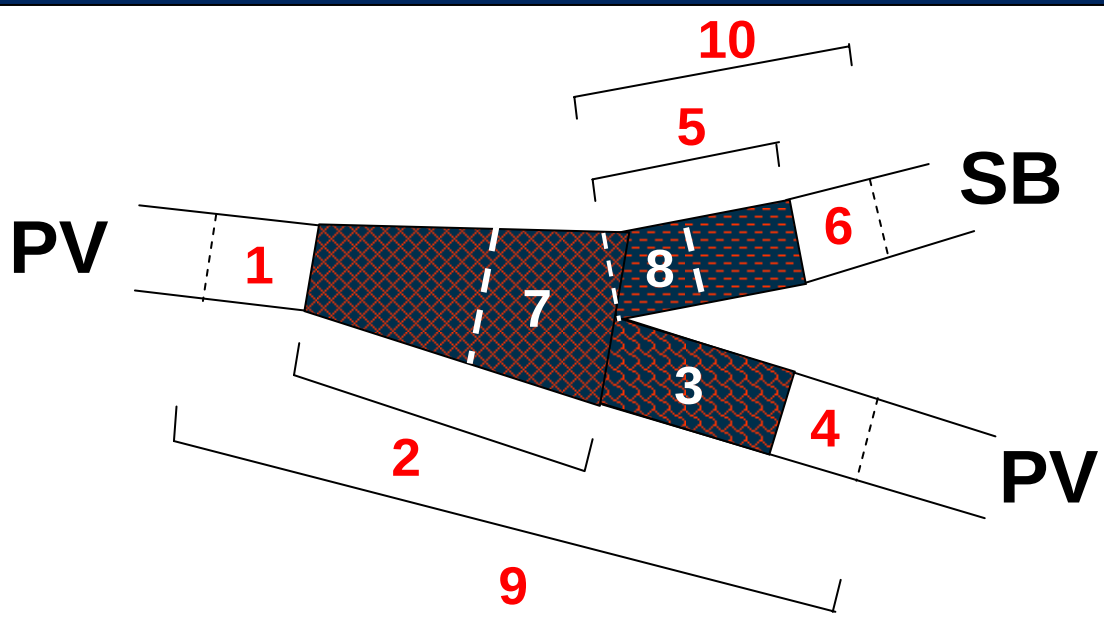


The “Step down” phenomenon is a major limitations of Standard QCA when applied to bifurcation analyses

What does the late loss mean in bifurcation ?
Is it the LM, LAD, or LCX ?



Late loss is only meaningful if the segment analyzed is specified



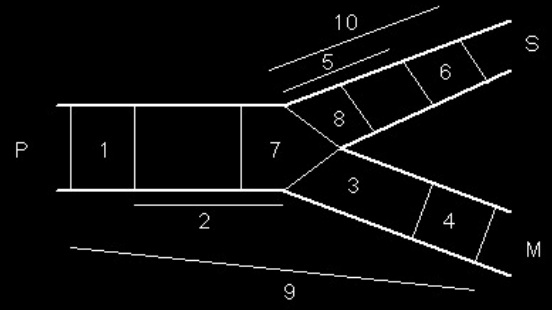
1 – Proximal Edge of the Prox PV Stent
2 – Prox PV Stent
3 – Distal PV Stent*
4 – Distal Edge of the PV Stent
5 – SB Stent*
6 – Distal Edge of the SB Stent*
7 – Carina
8 – Ostium of the SB (5mm)
9 – PV In-Lesion
10 – SB In-Lesion

**if additional stent(s) placed*

Gorktekin O et al. Catheter Cardiovasc Interv 2007;69:172

Dedicated Bifurcation QCA Software

Bifurcation Segment Model



JEONG HYEONG JIN
ID 27258695

Birthdate 1931-4-8
Physician
Hospital Asan Medical Center/4411...
Acquisition Date 2006-9-7

Patient Orientation L\F
II Size 16.00 cm

Segment
Trial Name
Intervention
Analysis type Nonostial

Cal. Factor 0.1339 mm/pix
Cal. Object 7.00 French Catheter

Car
Rat
Mur
Fin

1
2
3
4
5
6
7 M
7 S
8
9
10

	Ref A (mm²)	Plaque A (mm²)	%A (%)
Carina	4.55	0.53	12

Ratio Dist/Prox at Ostium	Luminal	Reference
Murray	-	-
Finet	-	-

	Prox pos (mm)	Length (mm)	%D (%)	Min D (mm)	Max D (mm)	Mean D (mm)	Ref D (mm)
1	0.00	4.97	7.16	1.88	2.46	2.21	2.03
2	4.97	2.59	4.56	1.40	2.39	2.07	1.46
3	7.56	8.23	38.29	0.83	1.40	1.08	1.34
4	15.80	4.98	16.54	1.24	1.75	1.54	1.48
5	7.67	5.91	19.84	1.03	1.46	1.28	1.28
6	13.58	5.00	11.07	1.20	1.37	1.29	1.35
7 Main	5.13	2.43	4.56	1.40	-	-	1.46
7 Side	5.13	2.54	4.56	1.40	-	-	1.46
8	7.67	2.03	19.84	1.03	1.36	1.20	1.28
9	0.00	20.78	38.29	0.83	2.46	1.57	1.34
10	7.67	10.91	19.84	1.03	1.46	1.28	1.28

Page 1/3

Page 1/3

Why do we need Core Lab?

- Scientific support
- Technical support
- Standard guideline
- Research resources
- Training
- Etc.