

Left Main & Bifurcation PCI I
Left Main PCI

Assessing Left Main Bifurcation: What to Know before PCI

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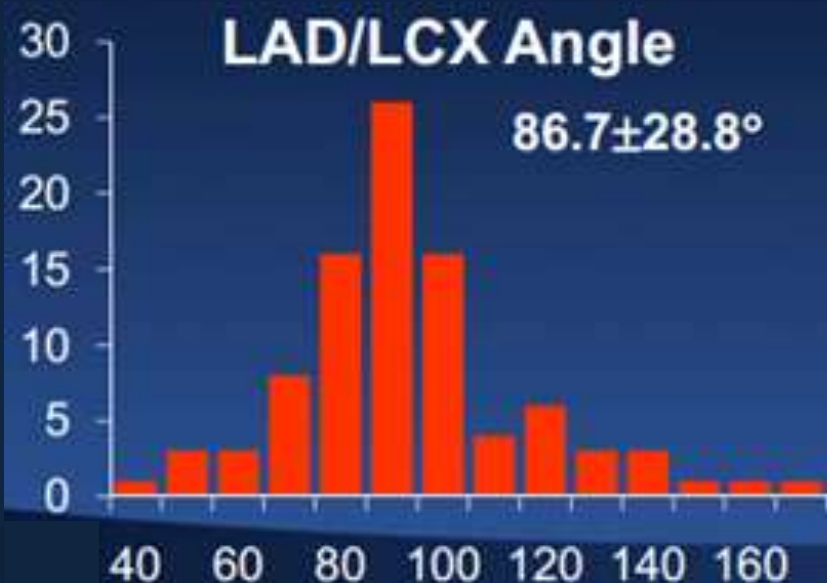
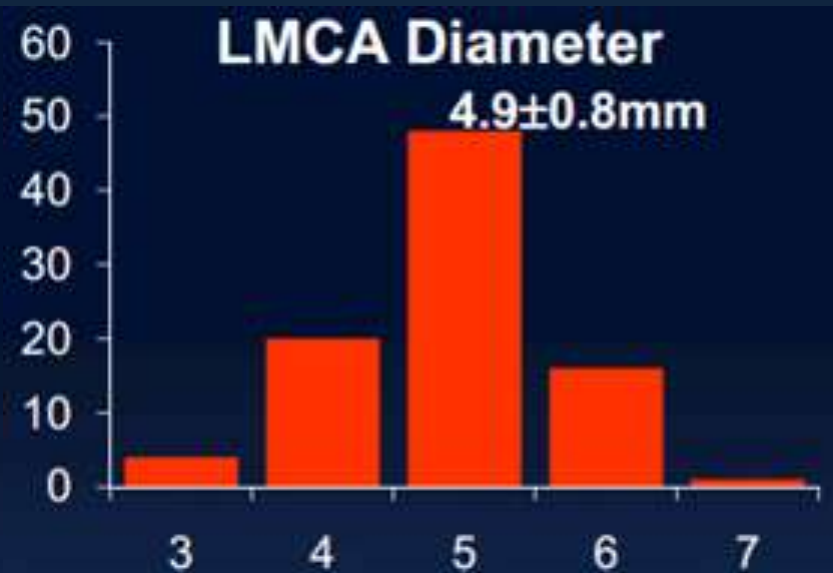
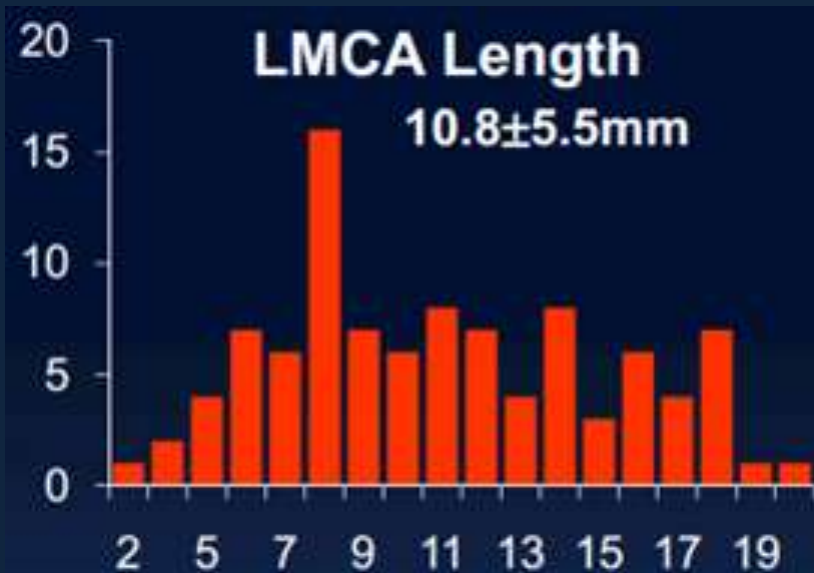


TCTAP 2015, April 28 – May 1,
Seoul

Conflict of Interest

- I, Yoshinobu Murasato, do not have any conflict of interest.

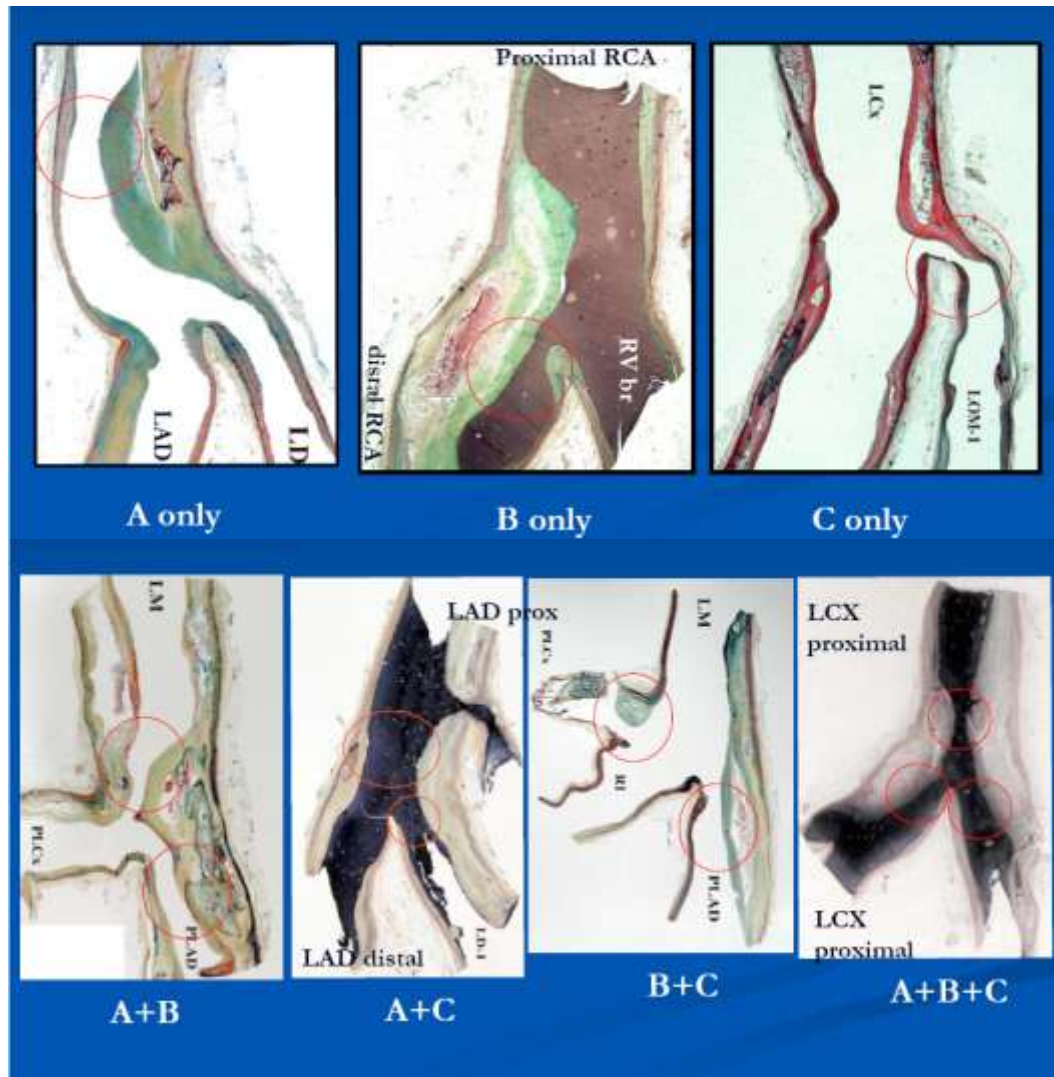
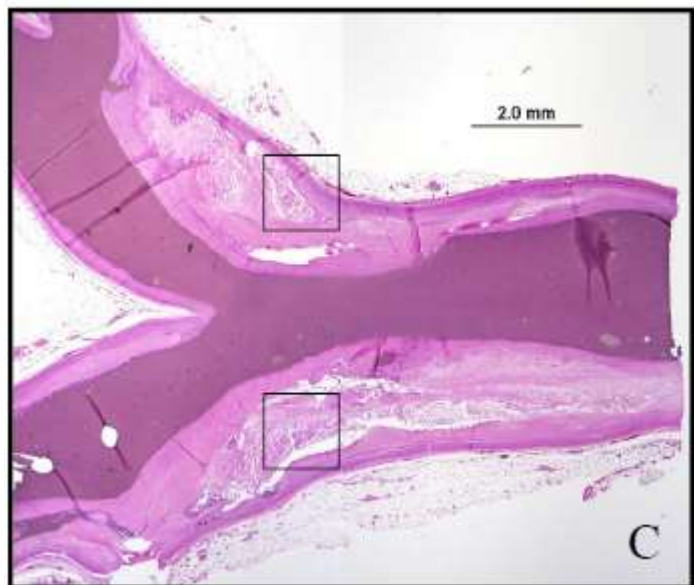
Anatomical parameter in LMCA



Positive correlation
between length and angle
($r=0.32$)

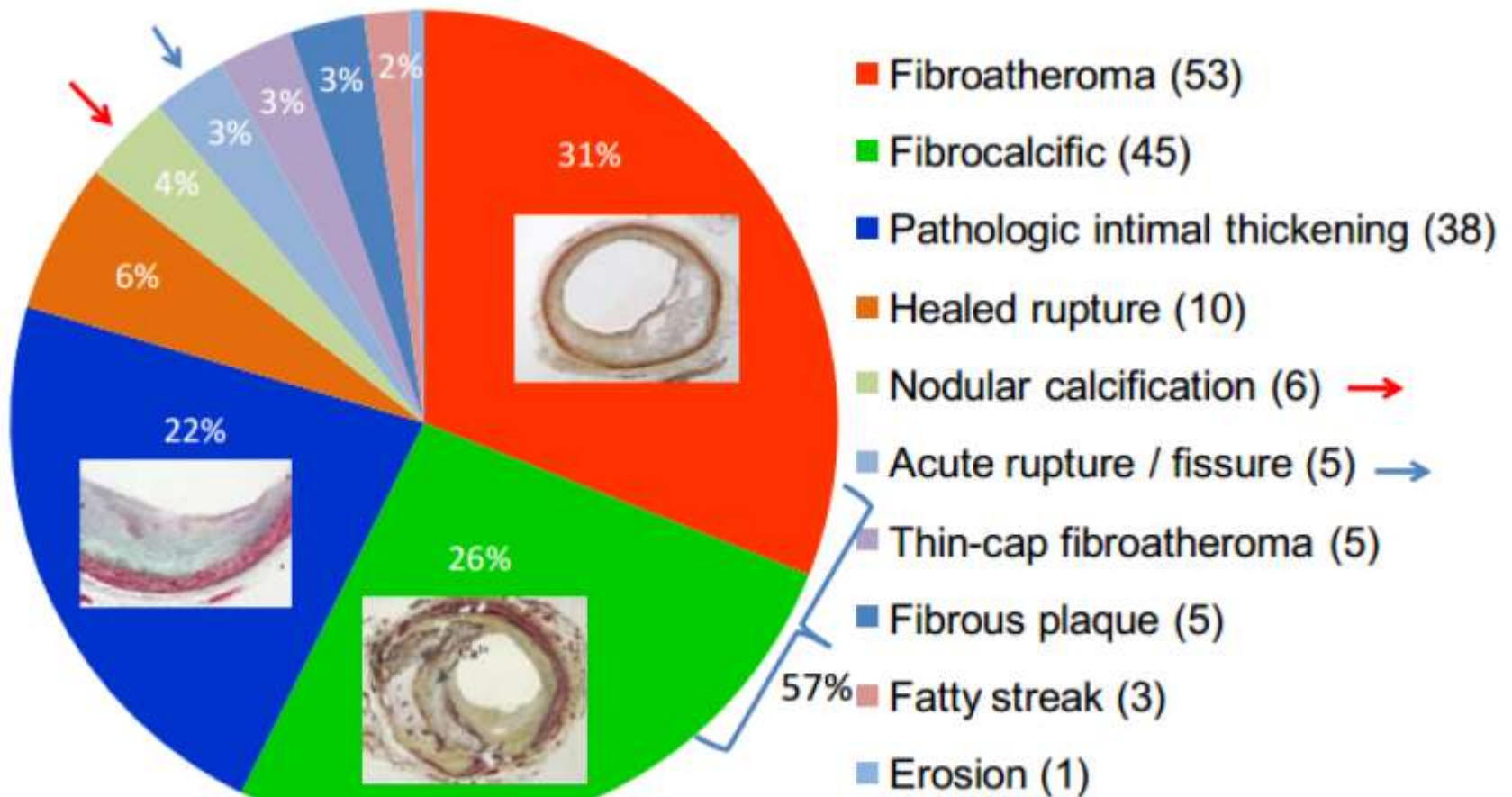
Types of Involvement of Coronary Bifurcations by Atherosclerosis

- Atherosclerosis occur predominantly close to bifurcation.
- Carinal involvement by atherosclerosis is extremely unusual.



Types of plaque in LMCA in sudden cardiac death cases with stenosis $\geq 50\%$

171cases

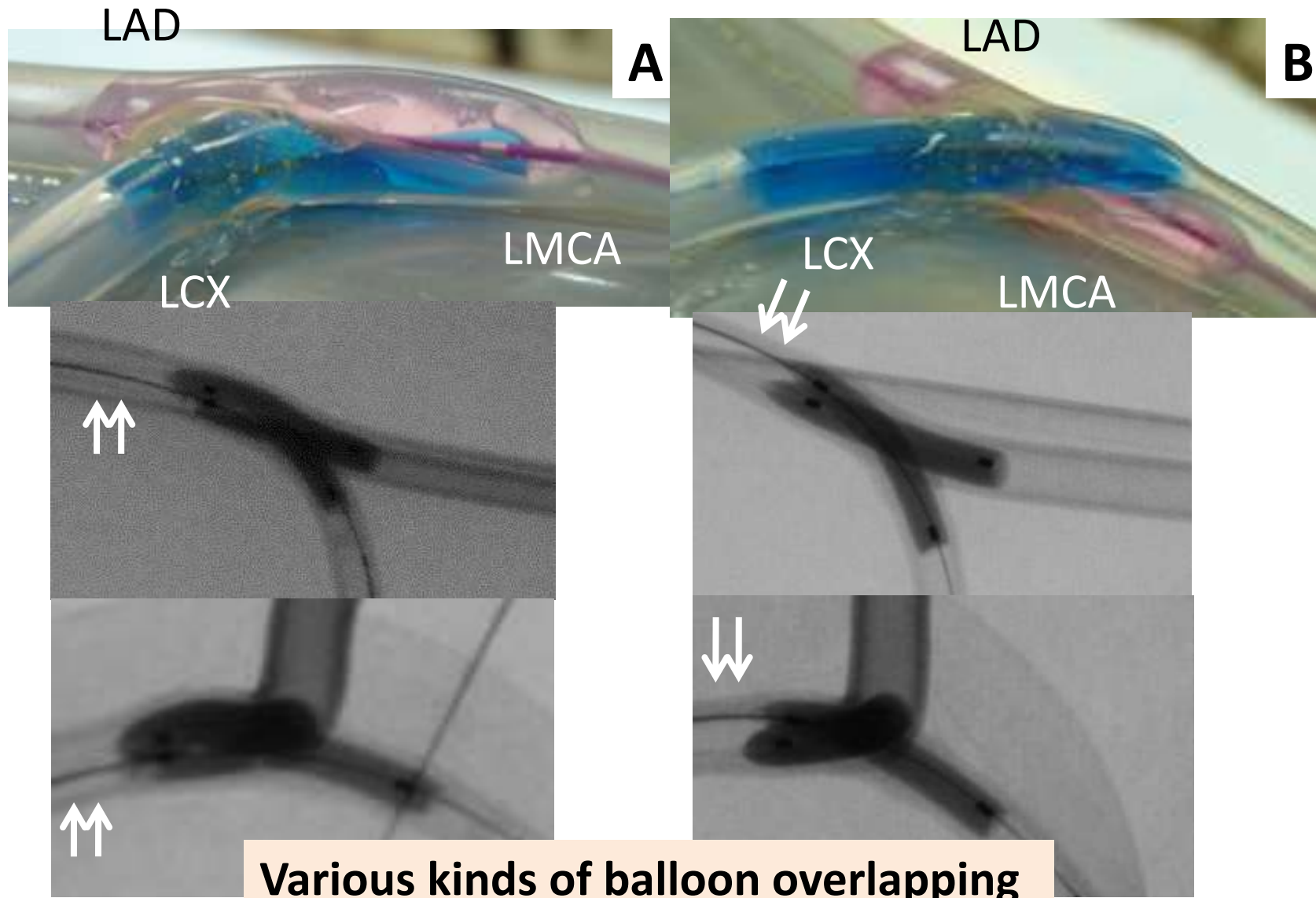


Vascular Branching Laws

Bifurcation diameter models	Relationship	Physical mechanisms
HK	$D_m^{\frac{7}{3}} = D_l^{\frac{7}{3}} + D_s^{\frac{7}{3}}$	Minimum Energy
Finet	$D_m = 0.678 \times (D_l + D_s)$	"Fractal"-type relation
Murray	$D_m^3 = D_l^3 + D_s^3$	Minimum Energy & WSS ~ Constant
Mitsudo	$D_m^2 = D_l^2 + D_s^2$	Velocity ~ Constant
where D_m , D_l , and D_s are the diameters of mother, larger and smaller daughter vessels, respectively.		

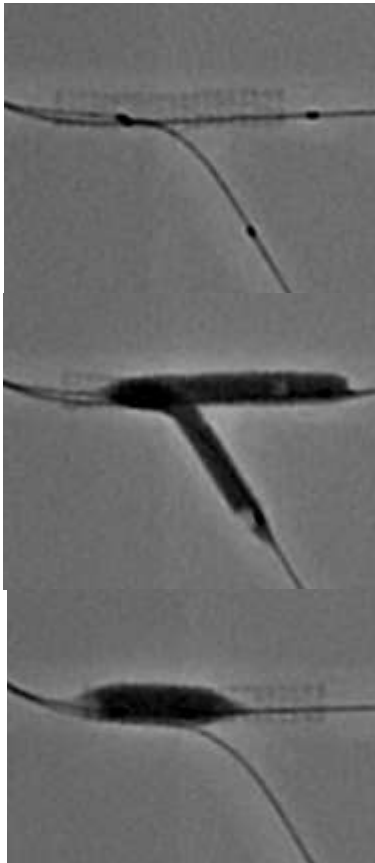
Area-preservation and Finet models are empirical and do not have a physical basis.

Effect of 3-D structure of LMCA on kissing balloon



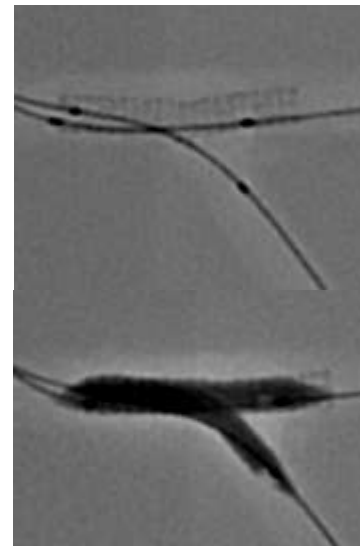
Two overlapping styles in KBT

Minimal overlapping + Proximal optimization



- ML Vision 3.5/28, 14atm
- SB Ryujin 3.0/20, 12atm
- KBT (6atm)
MV Ryujin 3.5/20
SB Ryujin 3.0/20
- prox MV
Quntum Maverick II
4.5/8, 12atm

Long overlapping



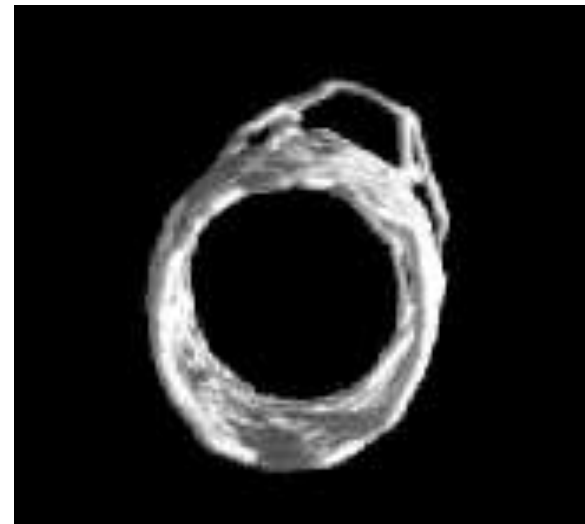
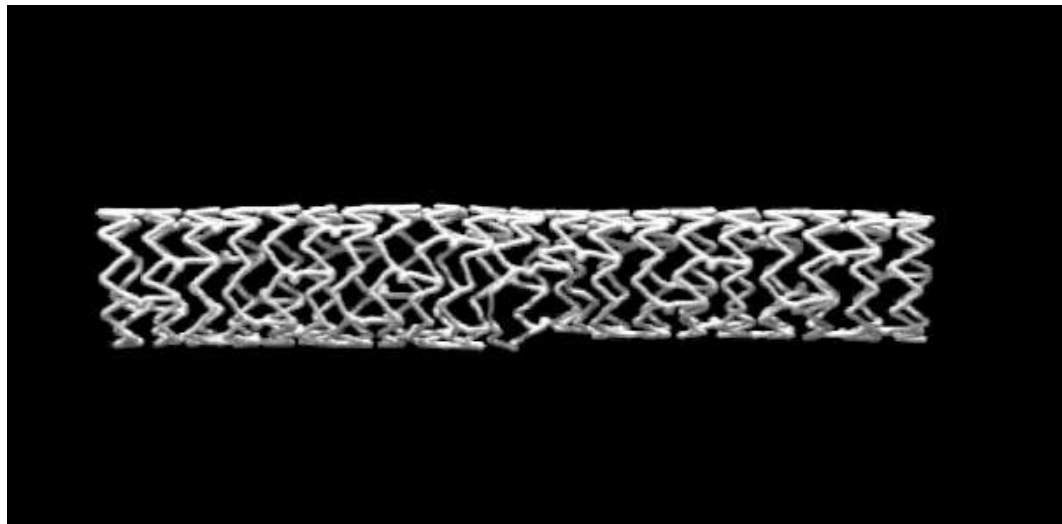
- ML Vision 3.5/28, 14atm
- SB Ryujin 3.0/20, 12atm
- KBT (6atm)
MV Ryujin 3.5/20
SB Ryujin 3.0/20

Mitsudo's law

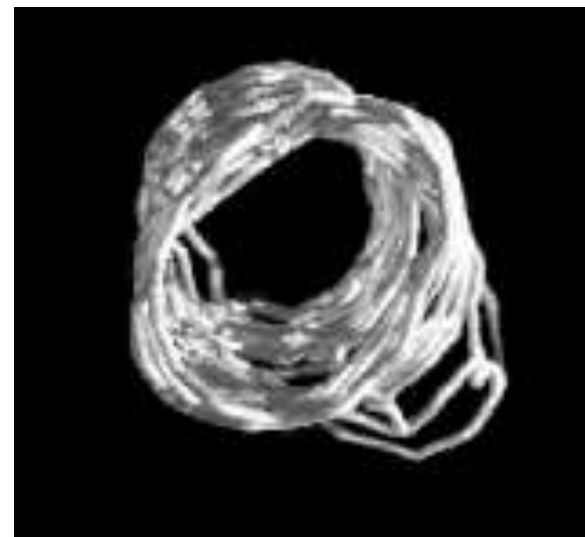
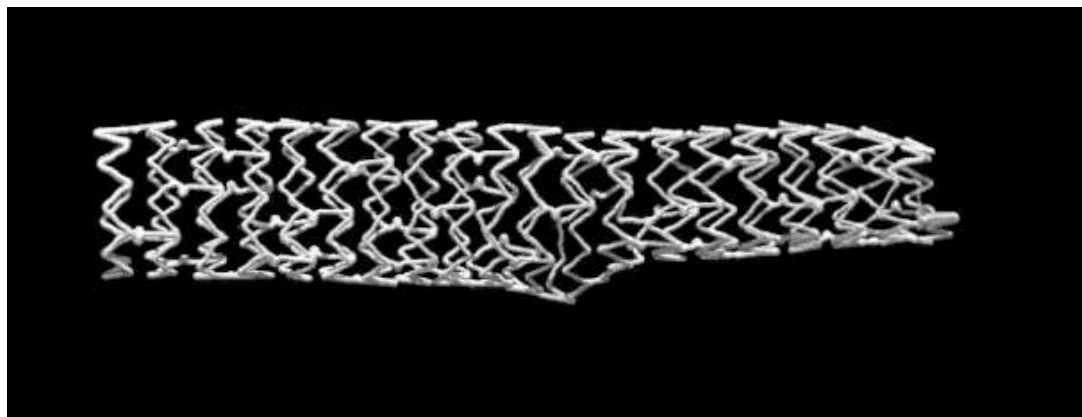
$$3.5^2 + 3.0^2 = 4.6^2$$

Suboptimal KBT has a potential of changing LMCA geometry.

Minimal overlapping + POT

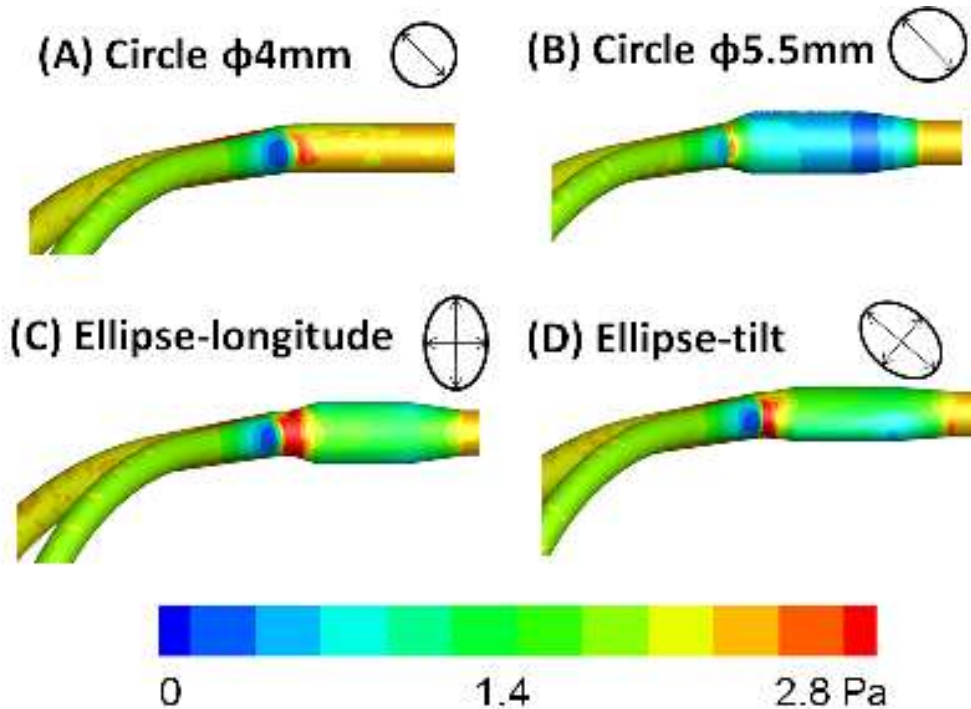


Long overlapping

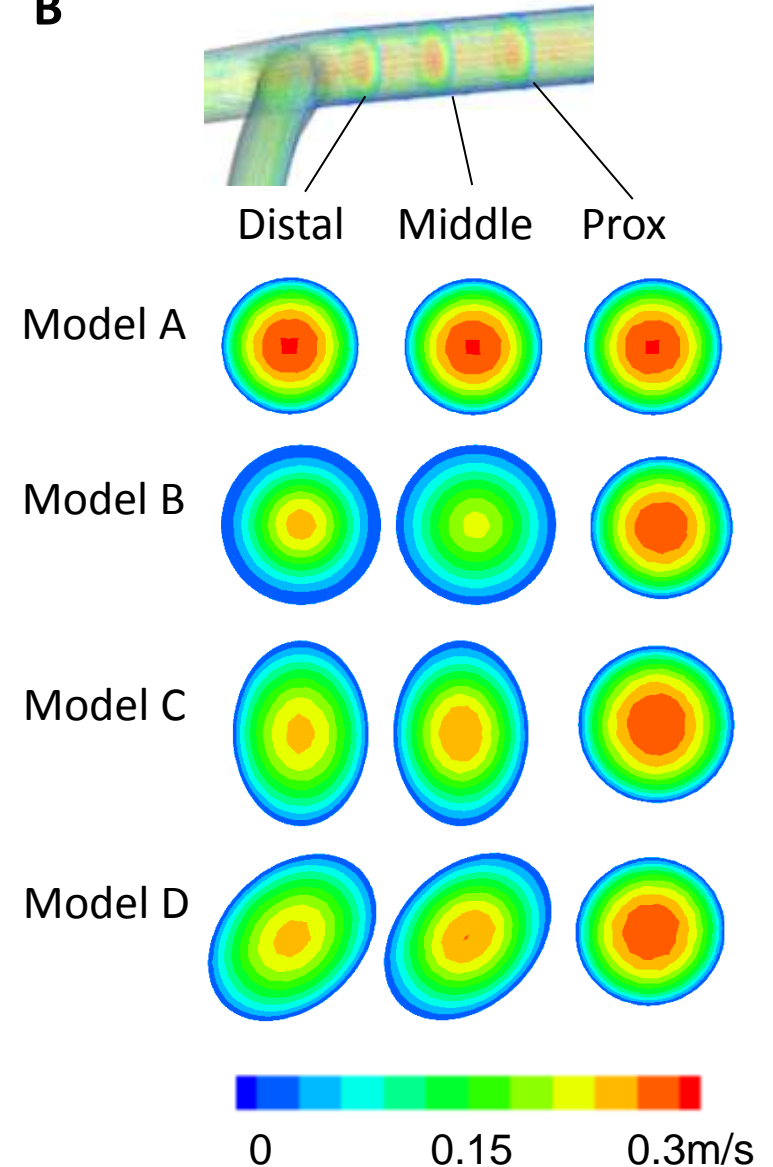


Complete revascularization should be performed according to vascular branching law.

A



B

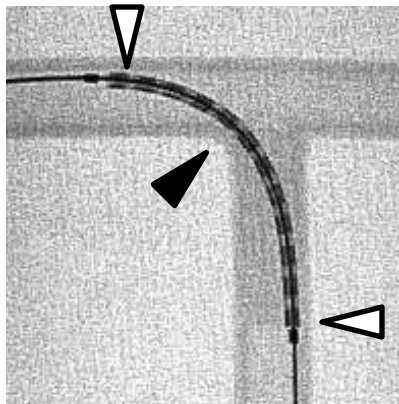


Overdilation in the LMCA produces the low shear stress area in the overdilated area, even when it is a round shape. It may lead to atherosclerosis or thrombosis in the future.

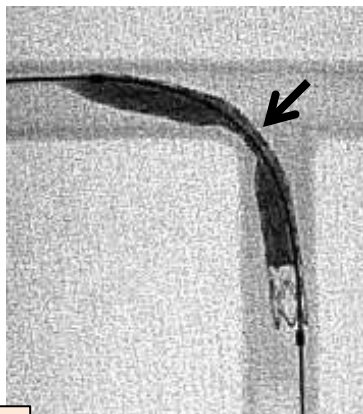
Effect of bifurcation angle on stent expansion

Right angle

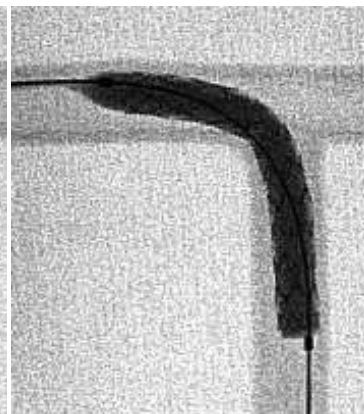
a



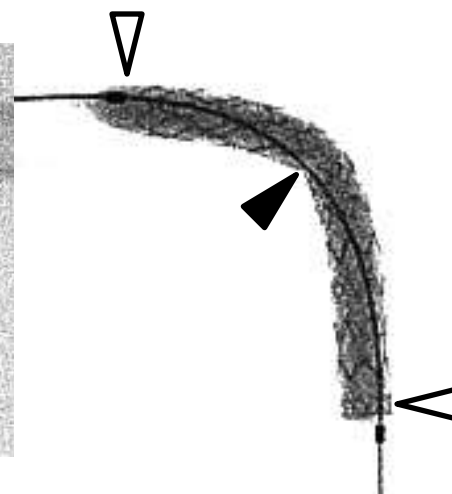
b



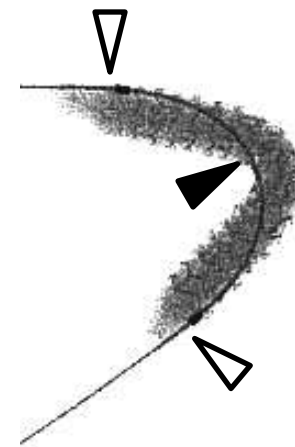
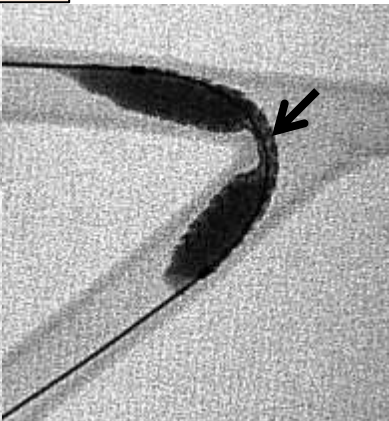
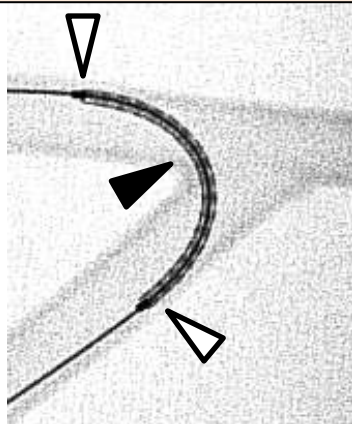
c



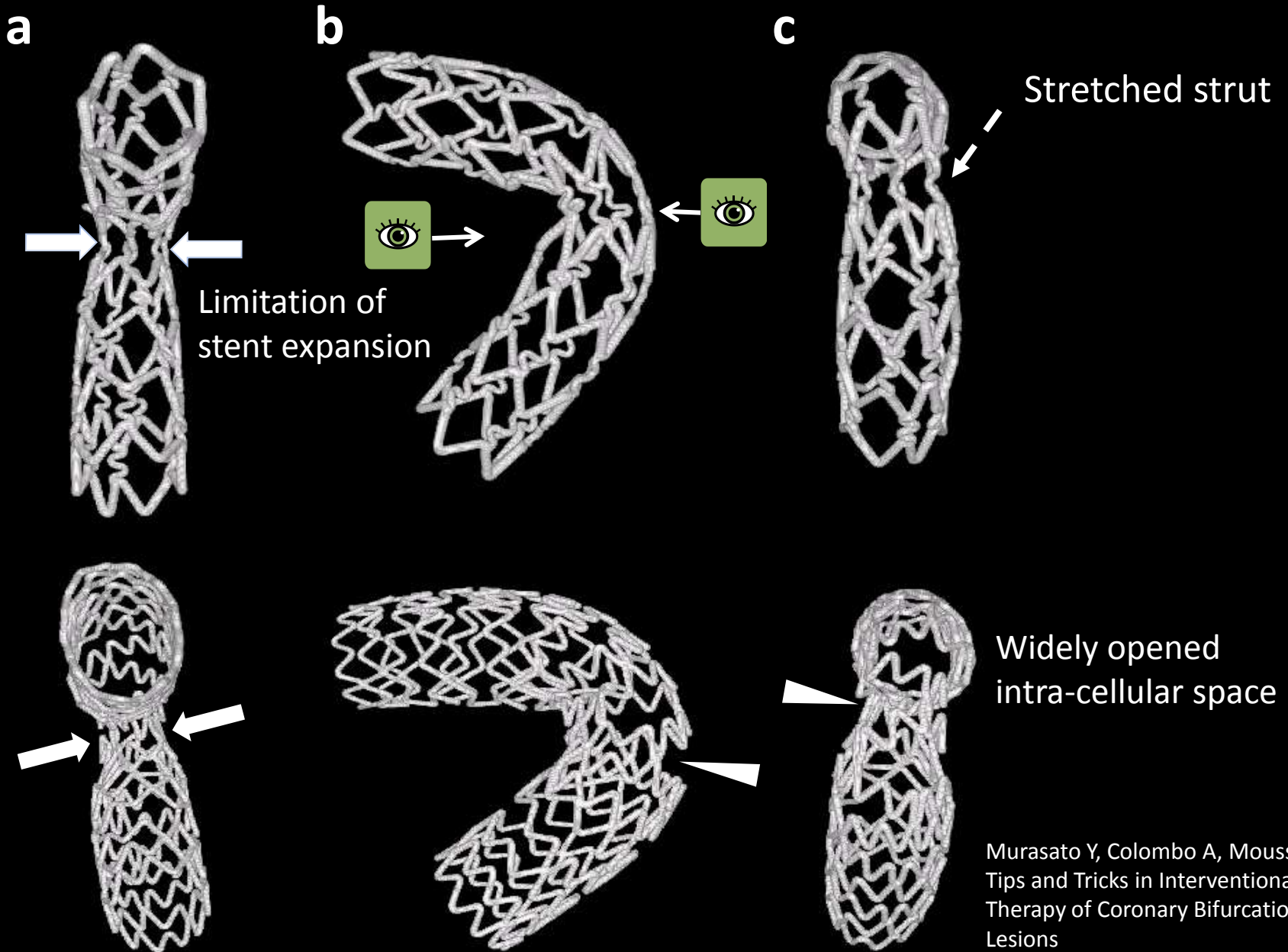
d



Extremely steep angle



Stent deformation in the SBOS in the steep-angled bifurcation



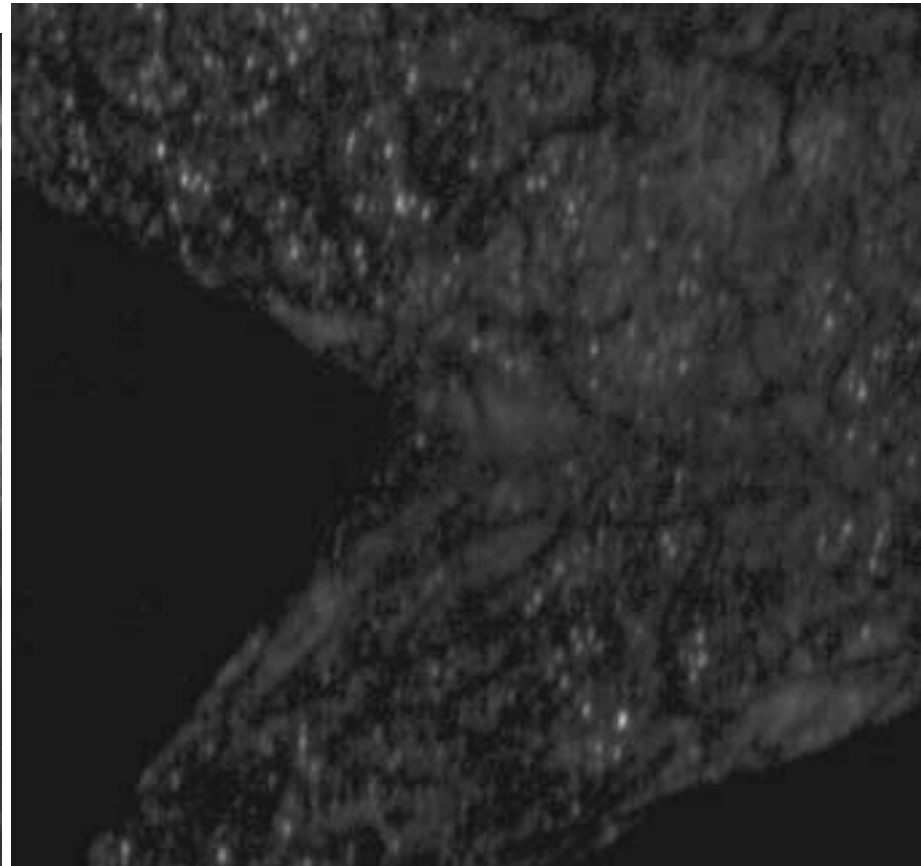
Murasato Y, Colombo A, Moussa I,
Tips and Tricks in Interventional
Therapy of Coronary Bifurcation
Lesions

Coronary flow after bifurcation stenting

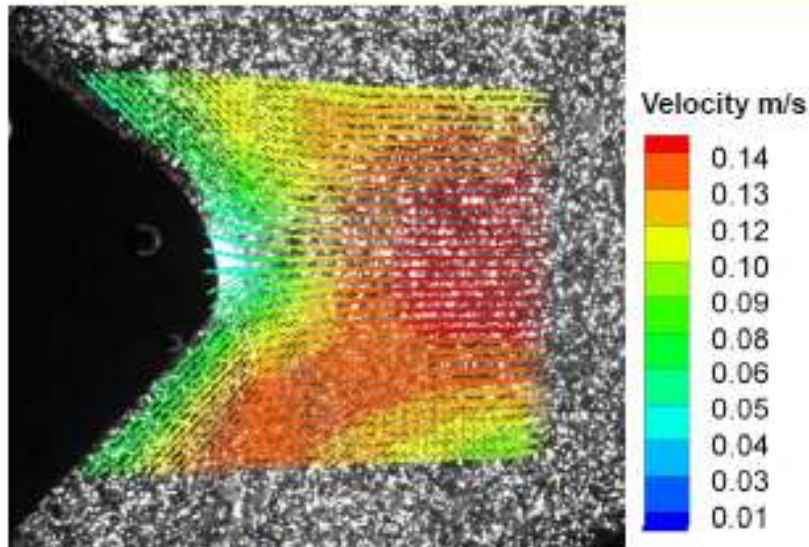
MV stenting followed by KBT



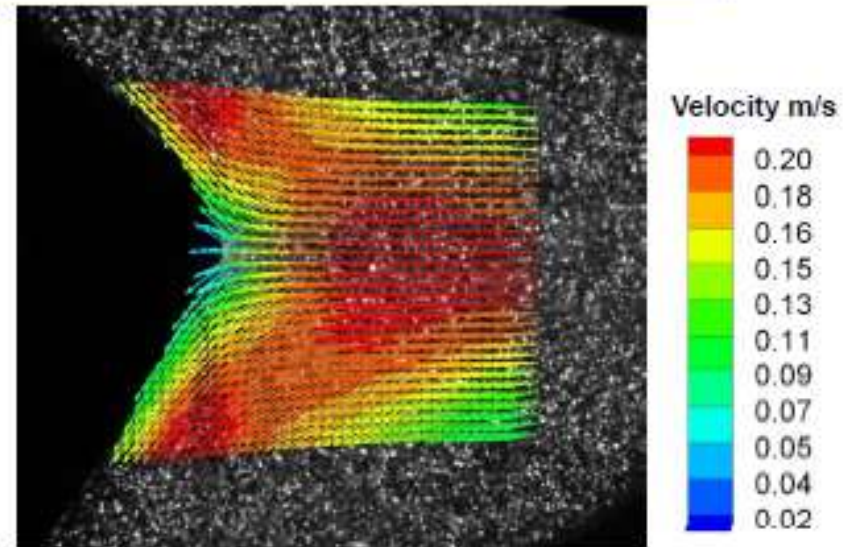
Mini-Crush stenting



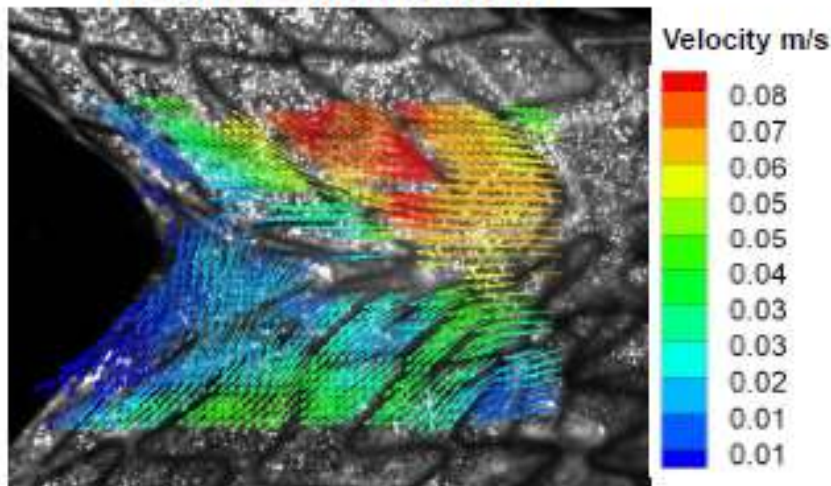
Comparison of Flow Velocity Distributions at Carina



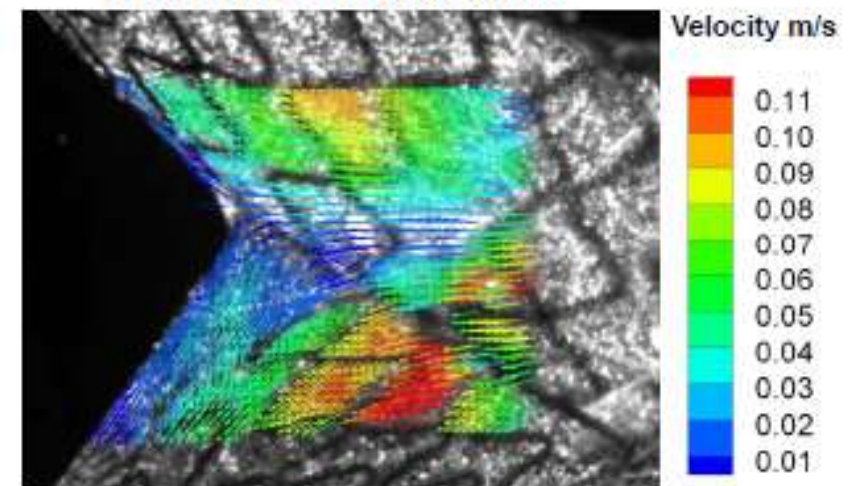
Normal Bifurcation



Stenotic Bifurcation

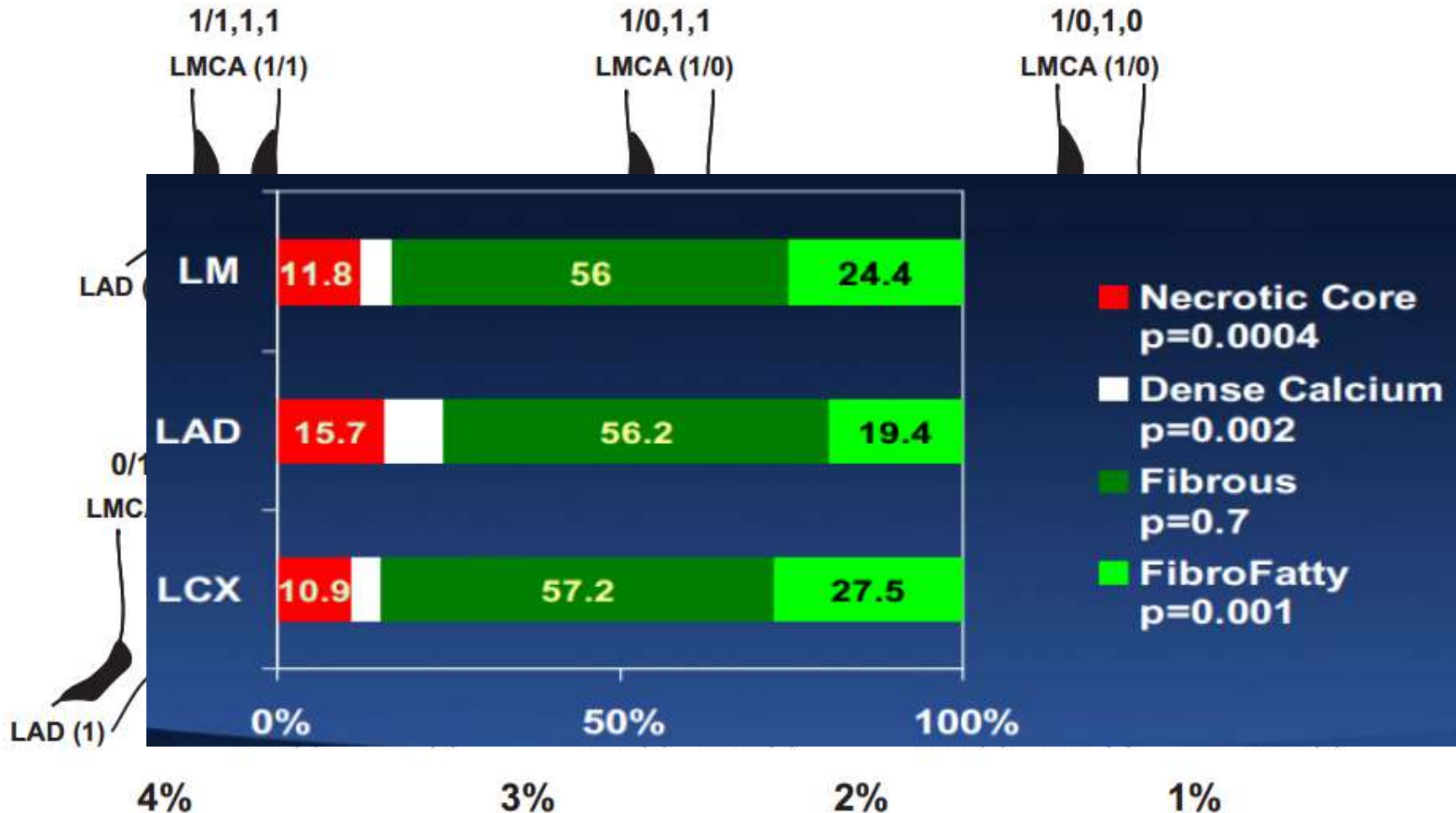


Mini-Crush Stenting



Modified-T Stenting

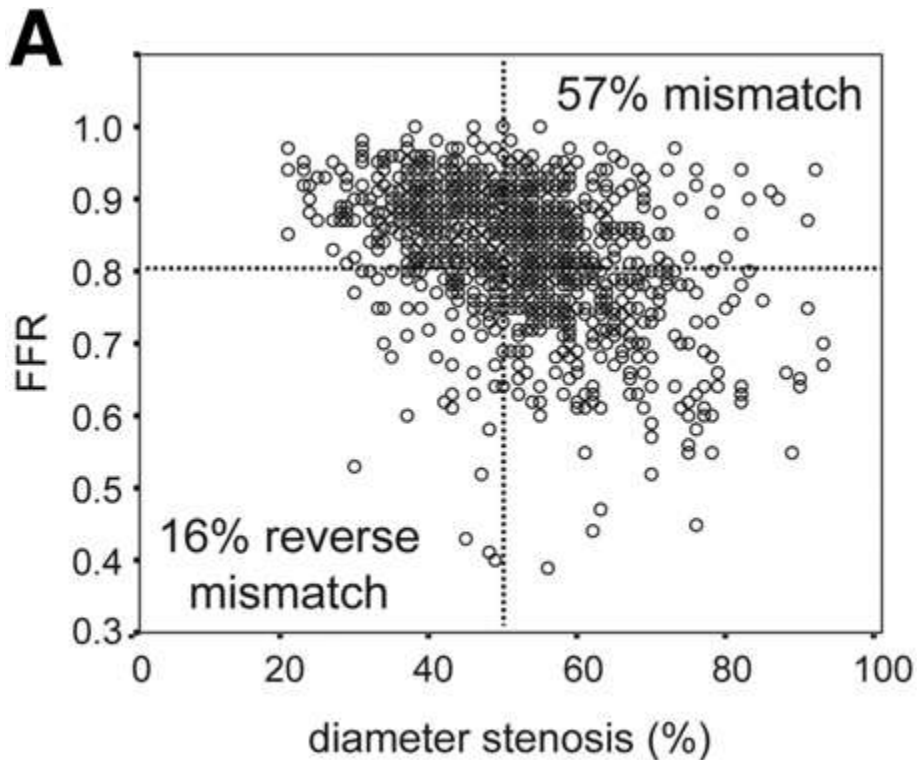
IVUS: Plaque distribution in LMCA bifurcation



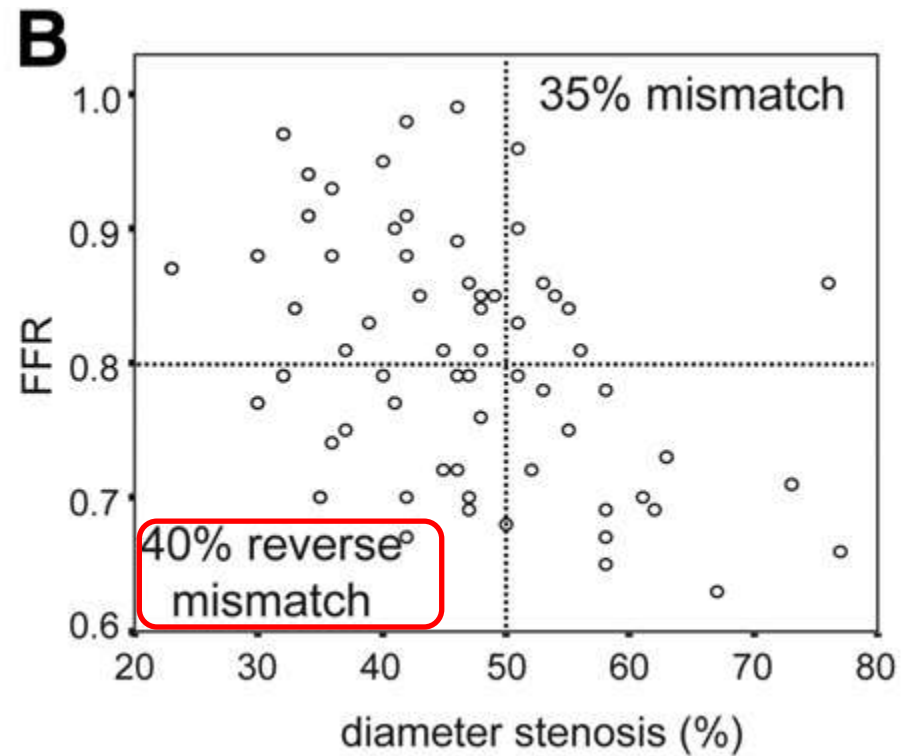
Atherosclerotic plaque was predominantly located in the LMCA lateral wall in the LAD side, which was likely to extend to the LAD ostium.

LMCA: more frequent reverse mismatch between FFR and QCA

Non-LMCA



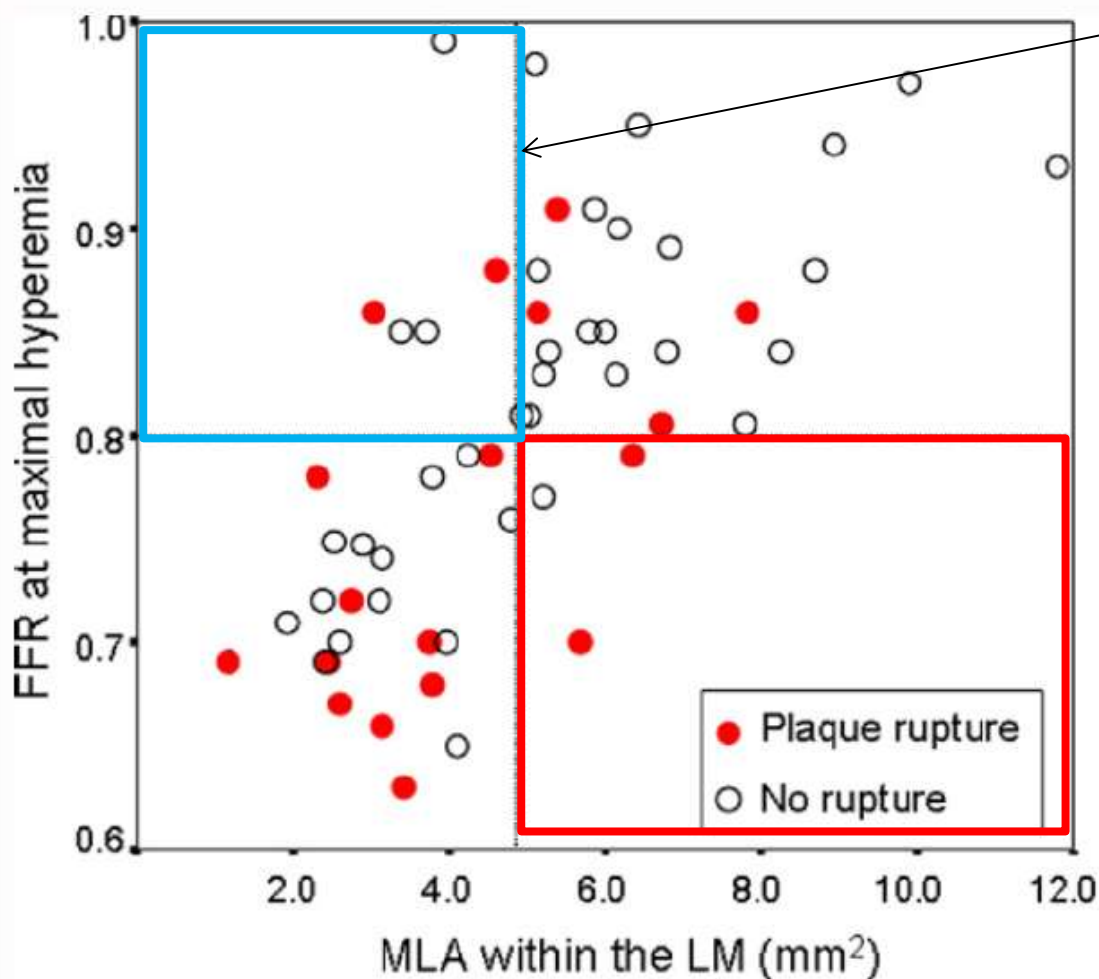
LMCA



Cut-off value of MLA for the LMCA intervention

	Kang et al. (55pts)	Jasti et al. (55pts)	LITRO study (354pts)	Fassa et al. (214pts)
MLA, mm²	4.9	7.6	7.2	9.4
PB, %	69	59	59	53
EEM area, mm²	17.8	18.7	18.8	20.5
Method	FFR IV adenosine	FFR IC adenosine 42 - 56 µg	Clinical validation	From "Normal" population- Clinical validation
Cut-off MLA	4.8	5.9	6	7.5

Correlation between FFR and MLA



Is PCI able to be safely deferred in the range of MLA $<4.8\text{mm}^2$ and FFR >0.80 ?

	MLA (mm^2)		total
	≥ 4.8	<4.8	
FFR <0.75	1	18	19
FFR $0.75-0.80$	2	5	7
FFR ≥ 0.80	24	5	29
total	27	28	55

Integrated use of FFR and IVUS

Intermediate LMCA stenosis (DS^* 30-70%)

Park S et al. J Am Heart Assoc 2012;1:e004556

Ostial or Shaft Stenosis

- Whether to Treat or Not: FFR guidance

FFR measurement is crucial

Indication

- FFR-guide
- IVUS assistance

Treatment

- IVUS-guidance

- Pre-intervention IVUS optimization

MSA[‡] >8.2mm² is important

Bifurcation Stenosis

- Whether to Treat or Not: FFR guidance

- FFR measurement is important
Consider a bifurcation stenosis as a single unit of disease (see Figure 2.)
- IVUS can assist the functional evaluation of bifurcation stenosis

MLA[†] >4.8mm² (sensitivity 89%, specificity 83%) and plaque burden >72% (sensitivity 73%, specificity 79%) to predict FFR ≤ 0.80 (see Figure 3.)

- How to Treat: IVUS guidance

- Pre-intervention IVUS evaluation
Evaluate anatomic features favoring single stent cross over stenting (see Table 4.)
- Post-intervention IVUS optimization
Evaluate MSA in every segment of LMCA (see Figure 5.)

* Visual estimated diameter stenosis; † Minimal lumen area; ‡ Minimal stent area

Conclusion

- Atherosclerosis occurs predominantly in the lateral area of the bifurcation with low shear stress.
- Vascular reconstruction should be performed in accordance with vascular branching law.
- SB stenting and KBT have some limitations in complete apposition and rheological aspect.
- Pre-PCI assessment using imaging devices is useful for the optimal PCI.
- FFR measurement is also useful for detection of myocardial ischemia.
- Integrated use of FFR and IVUS is complementary for the ideal LMCA bifurcation PCI.