Year-In-Review
Intracoronary Imaging & Physiology

Akiko Maehara, MD

Columbia University Medical Center

Cardiovascular Research Foundation

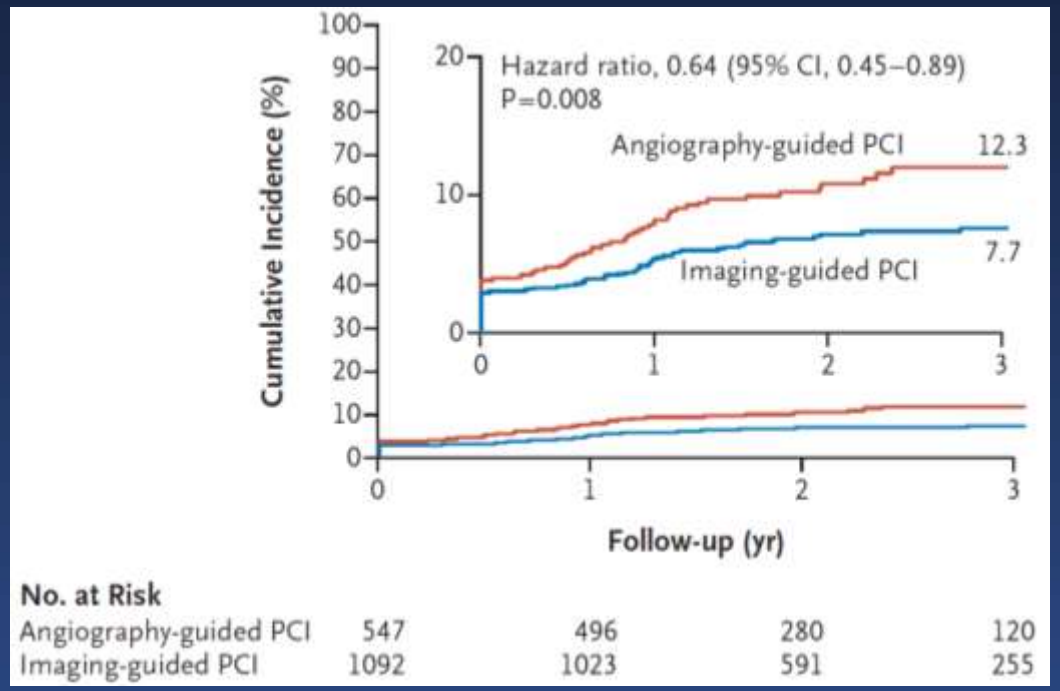
Disclosure Statement of Financial Interest

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

Affiliation/Financial Relationship	Company
• Consultant	• Boston Scientific, SpectraWave, Shockwave

RENOVATE-COMPLEX-PCI
IVUS/OCT vs Angio-guided Complex PCI

Primary Endpoint = Target Vessel Failure



	IVUS/OCT	Angio	HR (95%CI)
TVF	7.7%	12.3%	0.64 (0.45, 0.89)
Cardiac death	1.7%	3.8%	0.47 (0.24, 0.93)
TV-MI	3.7%	5.6%	0.74 (0.45, 1.22)
TVR	3.4%	5.5%	0.69 (0.40, 1.18)

- IVUS 73%, OCT 27%
- Unprotected LM 11.7%, CTO 19.5%, severe Ca 14.1%

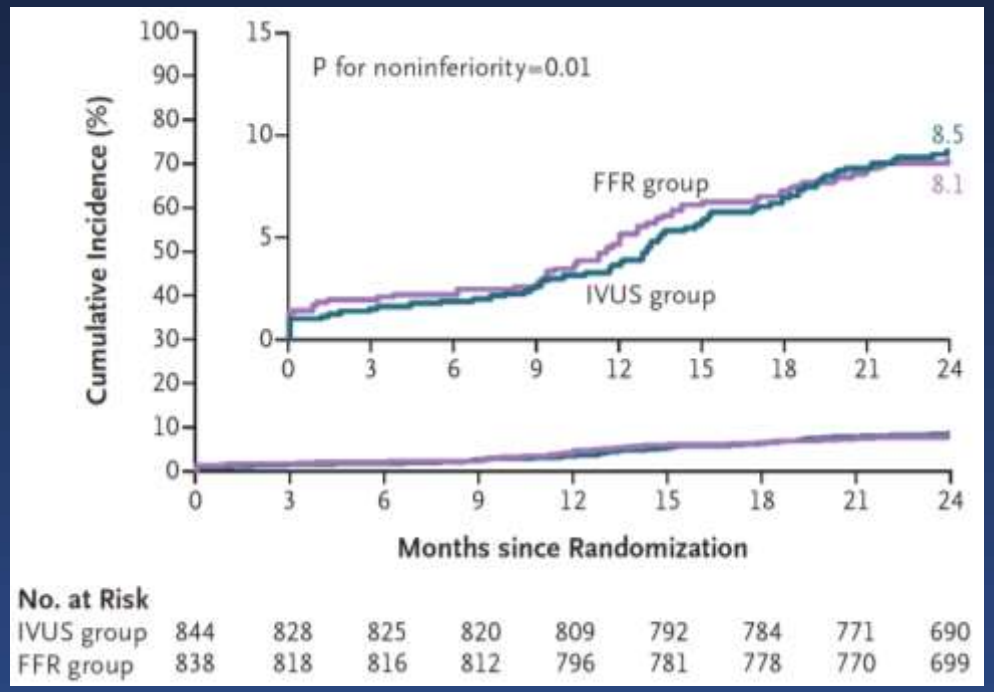
Long (>38mm) 55%, true bifurcation 22%, ostium 15%

Conclusion: Among the patients with complex lesions, IVUS or OCT-guided PCI let to lower risk of TVF compared with angio-guided PCI.

Lee JM et al. NEJM 2023, doi: 10.1056/NEJMoa2216607

FLAVOUR Trial
IVUS vs FFR-guided PCI for Intermediate Lesions

Primary Endpoint = Death, MI, or any Revas



	IVUS (n=844)	**FFR** (n=838)
Criteria for PCI	<3mm^2 or 3-4mm^2 with PB>70%	FFR≤0.80
Goal of PCI	MSA >5.5mm^2 or MSA≥ Dis ref LA and edge PB≤55%	FFR≥0.88 or intrastent ratio<0.05
Pts who underwent PCI	65.3%	44.4%
Total length of stent per vessel	30.4 ± 13.8 mm	32.7 ± 15.5 mm

Conclusion: In patients with intermediate stenosis who were being evaluated for PCI, FFR-guided PCI was non-inferior to IVUS-guidance.

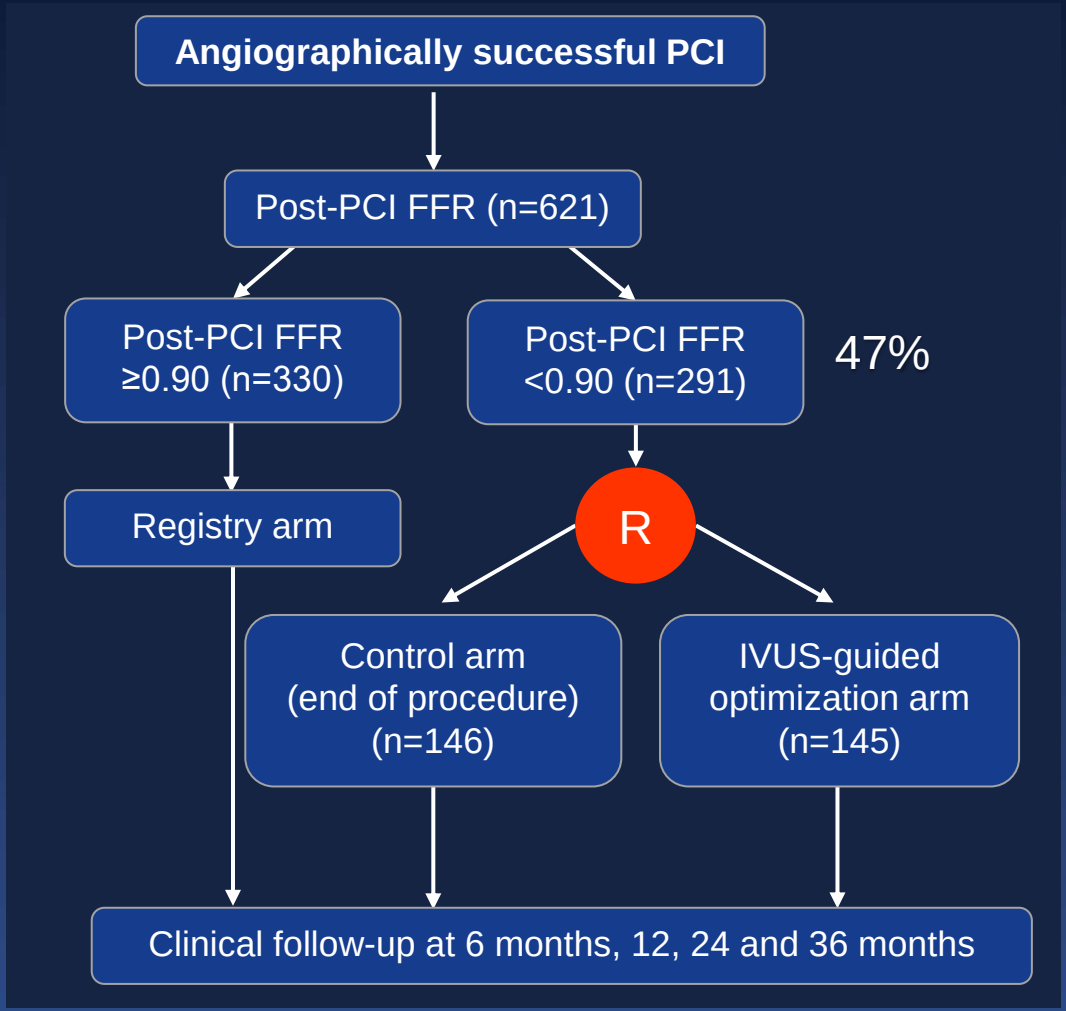
Koo BK et al. NEJM 2022; 387:779-89.

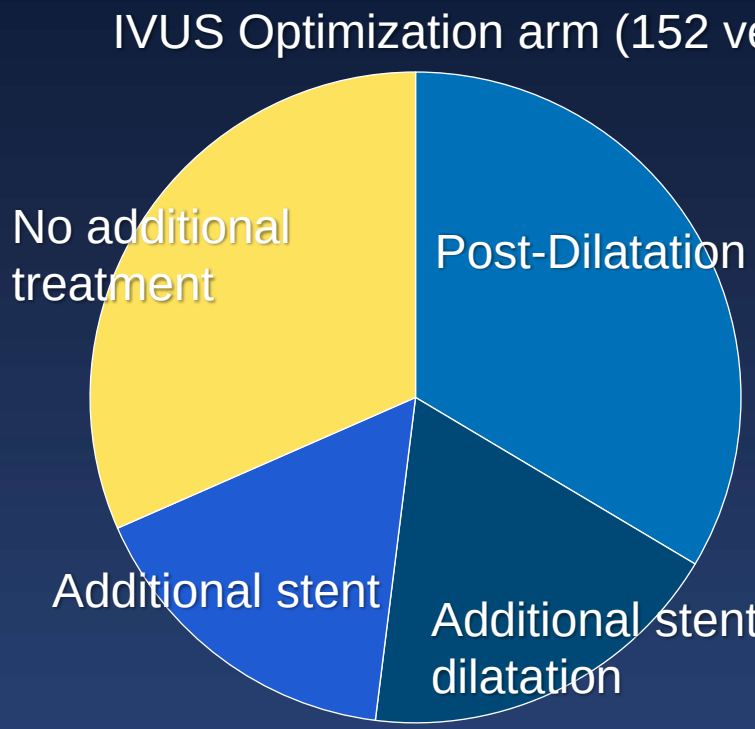
FFR- vs Imaging-guidance PCI

	Imaging criteria	PCI performed		MACE	
		FFR-Guidance	IVUS/OCT-Guidance	FFR-Guidance	IVUS/OCT-Guidance
FLAVOUR	<3mm^2 or 3-4mm^2 with PB>70%	44%	65%	8.5% at 2y	8.1% at 2y
FORZA	AS≥75% or MLA<2.5mm^2 & AS of 50-75%	32%	53%	14.8% at 13m	8.0% at 13m
Nam et al.	MLA<4.0mm^2	34%	91%	3.6% at 1y	3.2% at 1y

Koo BK et al. NEJM 2022; 387:779-89; Burzotta F, JACC Interv 2020; 13: 49-58; Nam CW JACC Interv 2010; 3: 812-7

FFR-REACT Trial





Additional treatment=68%

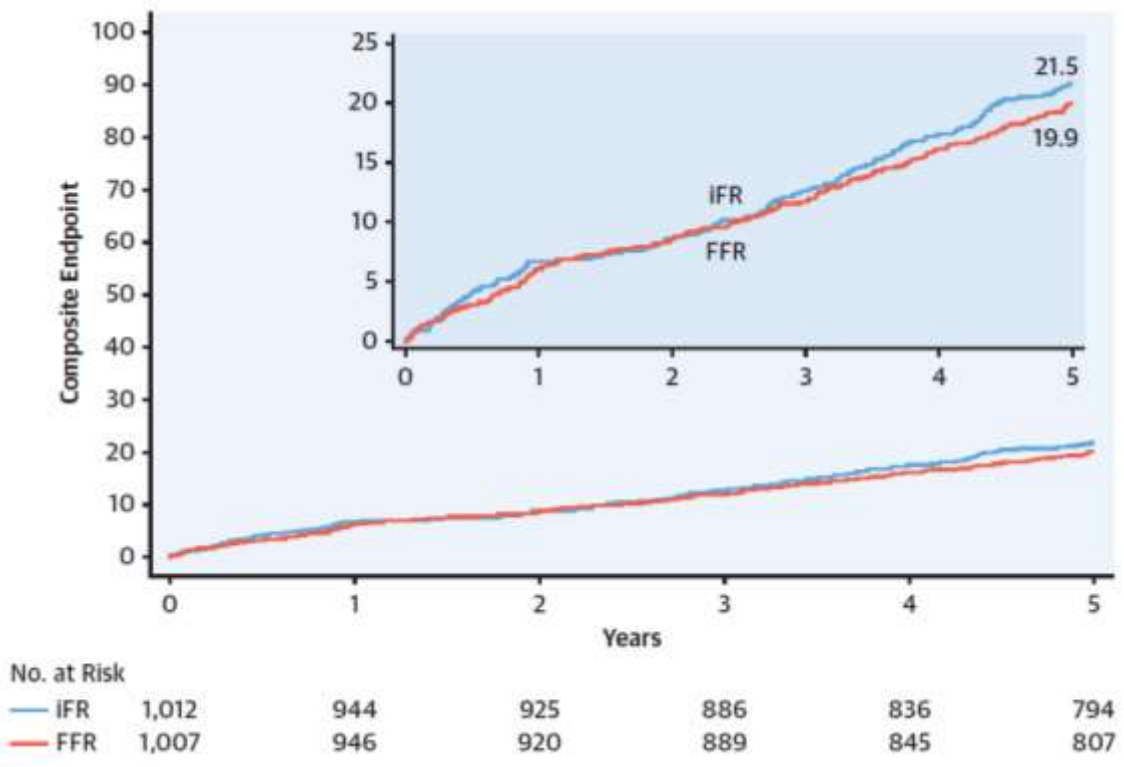
FFR 0.82±0.06 →0.85±0.05
FFR≥0.90 in 20% of vessels

At 1-year	**IVUS** (n=146)	**Control** (n=145)	p-value
TVF	4.2% (6)	4.8% (7)	0.79
CD-TVR	0.7% (1)	4.2% (6)	0.06

Conclusion: IVUS-guided PCI optimization improved post-PCI FFR.

Neleman T et al. JACC Interv 2022;15:1595-1607.

iFR SWEDEHEART
5-Year Result of iFR vs FFR-guided Treatment



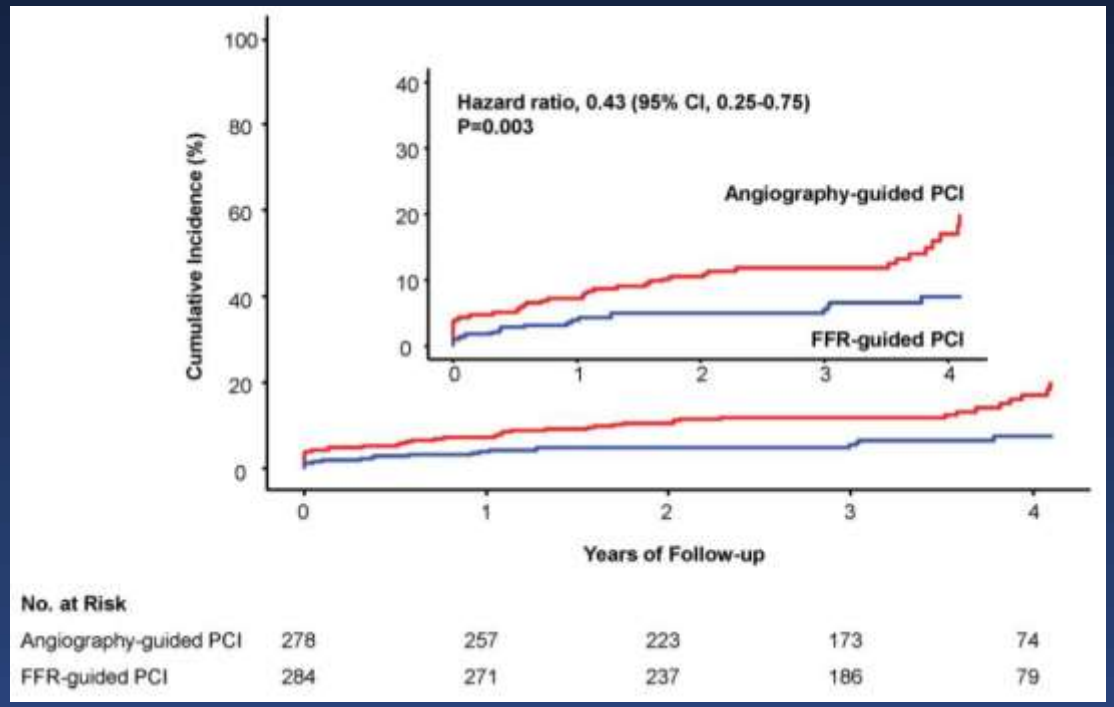
	iFR (n=1012)	**FFR** (n=1007)
# Lesions evaluated	1.55 ± 0.86	1.43 ± 0.70
Pts who underwent PCI	53.0%	56.5%
All-cause death	9.4%	7.9%
CV death	2.8%	3.3%
Non-fatal MI	5.7%	5.8%
Unplanned revasc	11.6%	11.3%

Conclusion: iFR-guided PCI was associated with no difference in the 5-year MACE compared with FFR-guided PCI.

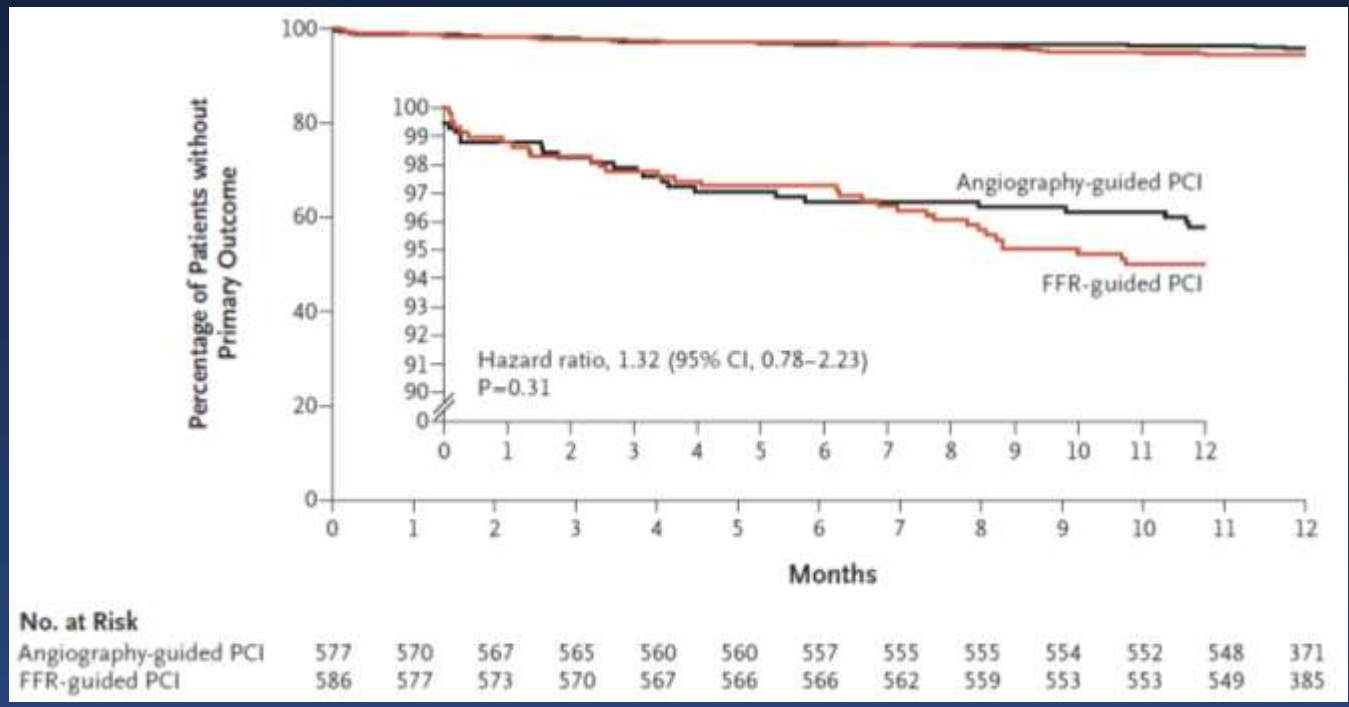
G Matthias et al. JACC 2022; 79: 965-974.

FRAME-AMI Trial

FRAME-AMI Trial (n=562)



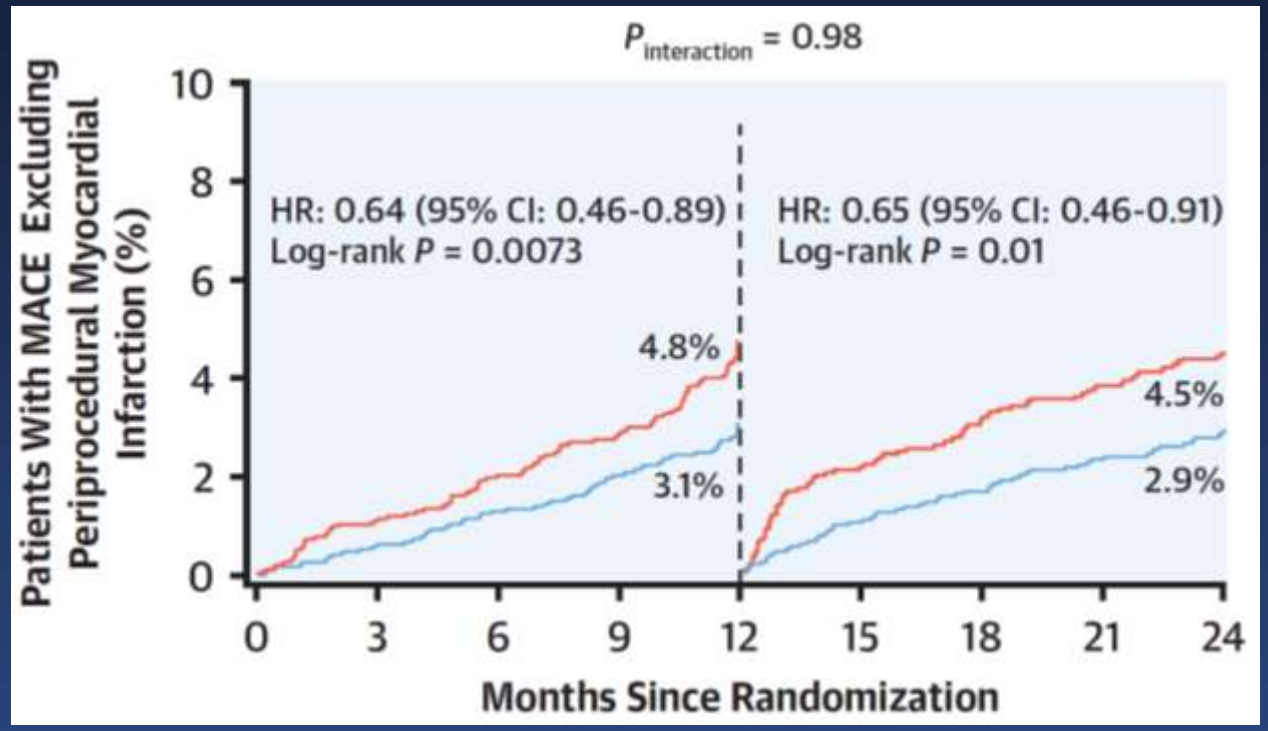
FLOWER-MI Trial (n=1163)



FRAME-AMI includes 53% of NSTEMI.

Conclusion: In patients with acute MI (STEMI or NSTEMI) and multivessel disease, FFR-guided PCI for non-infarcted related lesion was superior to angio-guidance.

FAVOR III: 2-year Result of QFR vs Angio-guided PCI



Off-line core lab QFR	QFR concordant vessel selection (n=3007)	QFR non-concordant vessel election (n=761)
MACE	8.5% (264)	17.2% (130)
	QFR-guidance	Angio-guidance
QFR non-concordant lesions	7.7% (146/1891)	32.8% (615/1877)

Conclusion: QFR-guided lesion selection improved 2-year outcome compared with angiography alone. The benefits were most pronounced among pts in whom QFR assessment altered planed revascularization strategy.

Song L et al. JACC 2022; 80: 2089-2101,

Basic Fluid Dynamics Equations

Poiseuille Equation

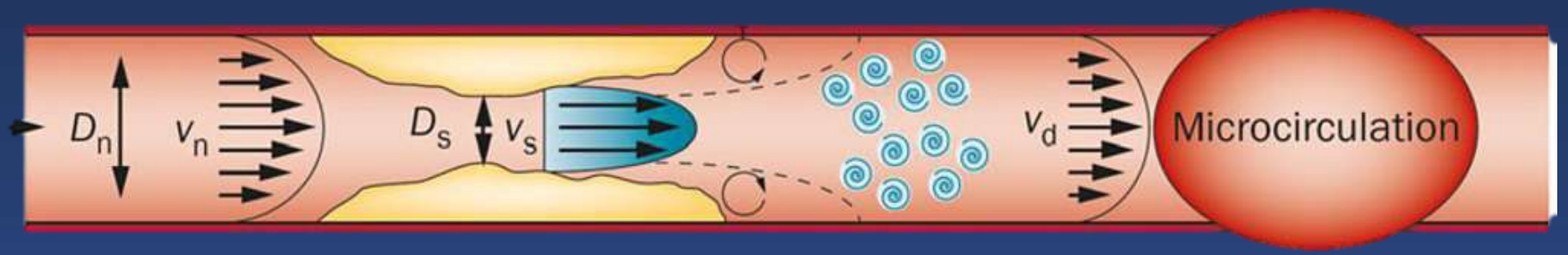
$$\Delta P = \frac{8\pi\mu L}{As}\ \frac{An}{As} \times V$$

Viscosity

Borda-Carnot Equation

$$\Delta P = \frac{\rho}{2}\left(\frac{An}{As} - 1\right)^2 \times V^2$$

Flow separation



Total Pressure Loss by Epicardial Stenosis

$$= \Delta \frac{8\pi\mu L}{As}\ \frac{An}{As} \times V + \frac{\rho}{2}\left(\frac{An}{As} - 1\right)^2 \times V^2$$

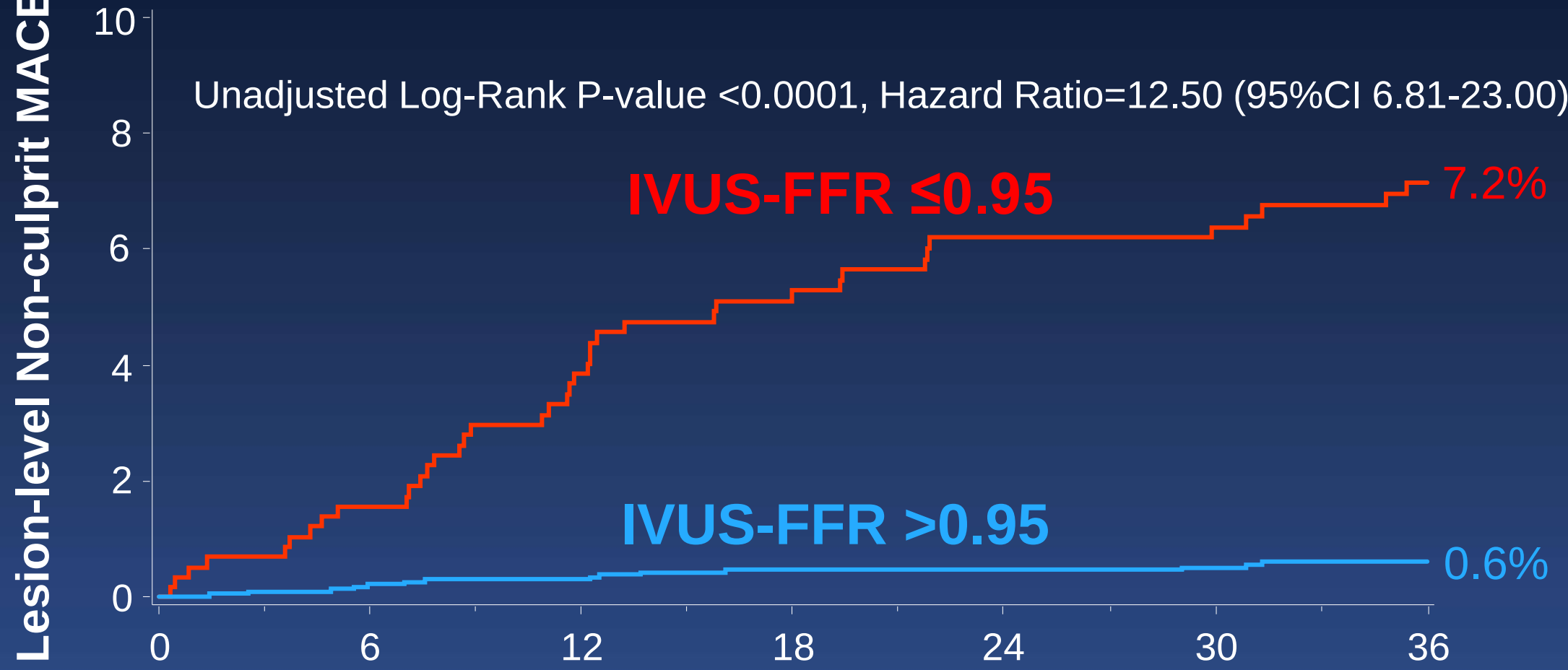
$$= F\,V + S\,V^2$$

L: Slice interval
μ: Blood viscosity
As: Lesion lumen area
An: Normal lumen area
ρ: Blood density
V: Flow velocity

Cardiovascular Research Foundation

Van de Hoef TP, et al. *Eur Heart J.* 2015:36:3312.

PROSPECT 1



Number at risk:

FFR ≤0.95	607	559	542	525	509	500	318
FFR >0.95	2,620	2,421	2,389	2,322	2,272	2,198	1,379

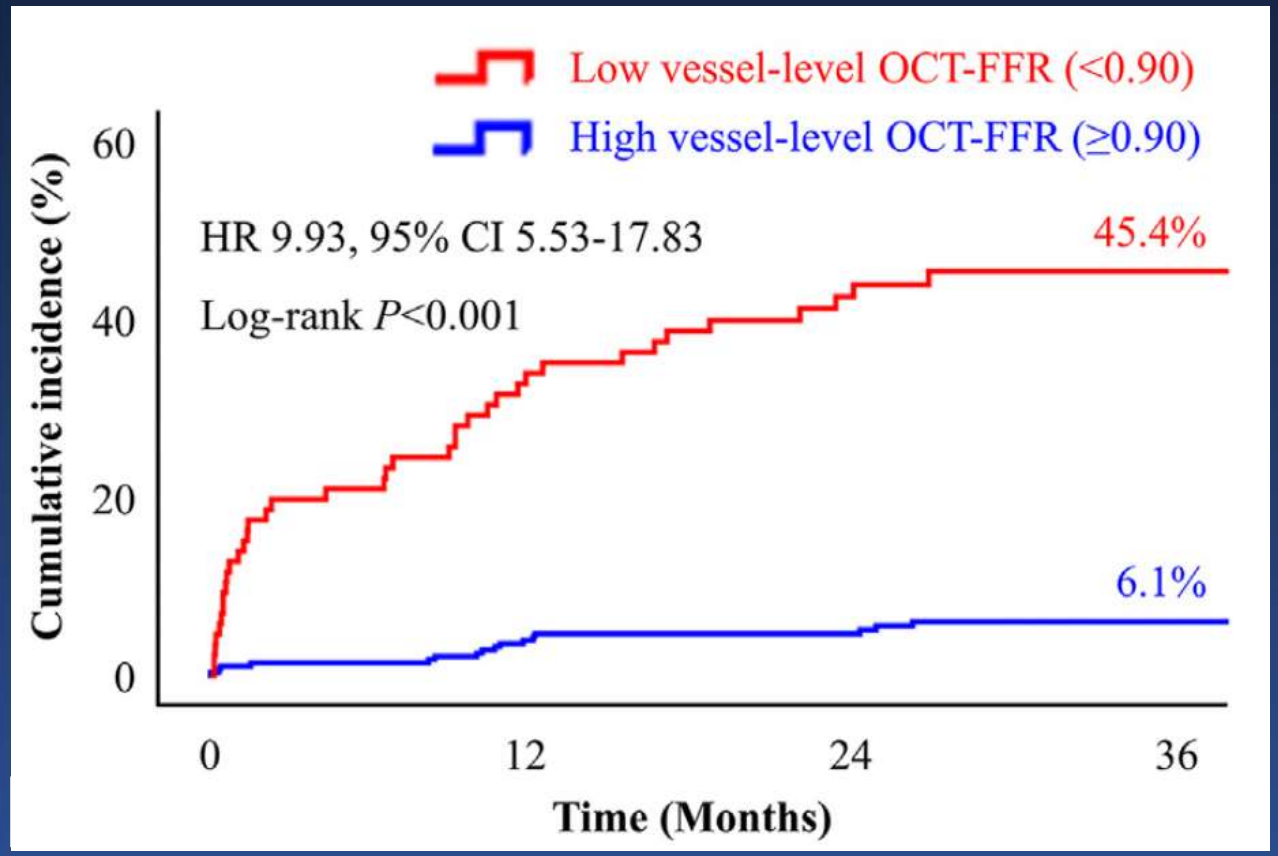
Cardiovascular Research Foundation

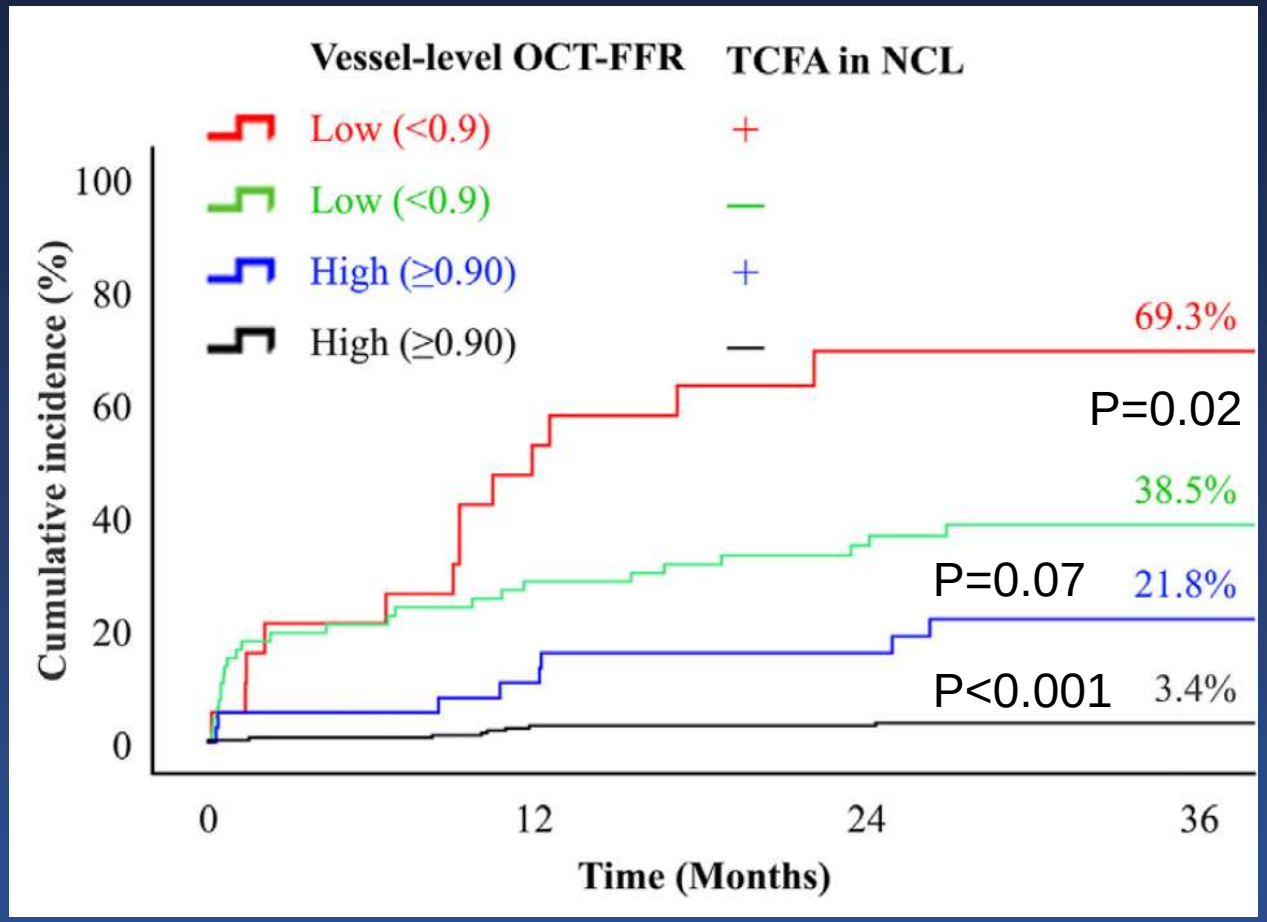
Seike F, et al. Circ Interv 2022; 15, 851-860.

Columbia University Medical Center
NewYork-Presbyterian

OCT-FFR can predict vessel event

Retrospective, 4 centers, 364 treated vessels in 364 patients, median follow-up of 3 years





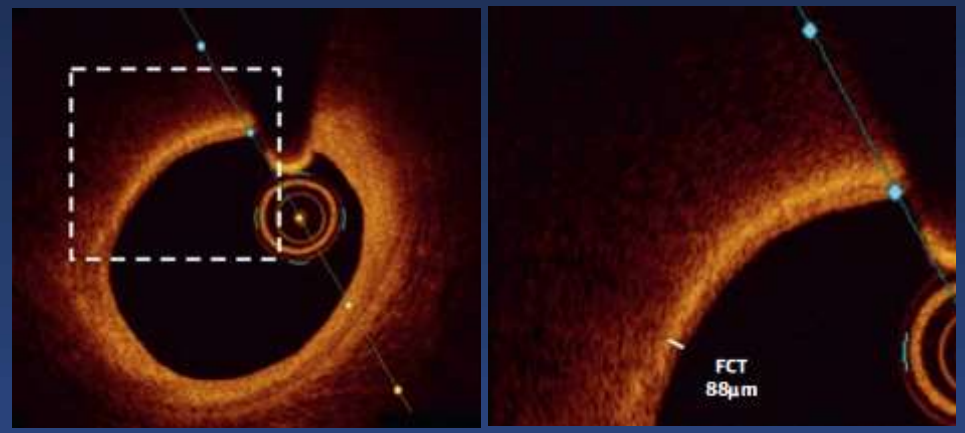
Kakisaki S, et al. JACC Interv 2022

HUYGENS

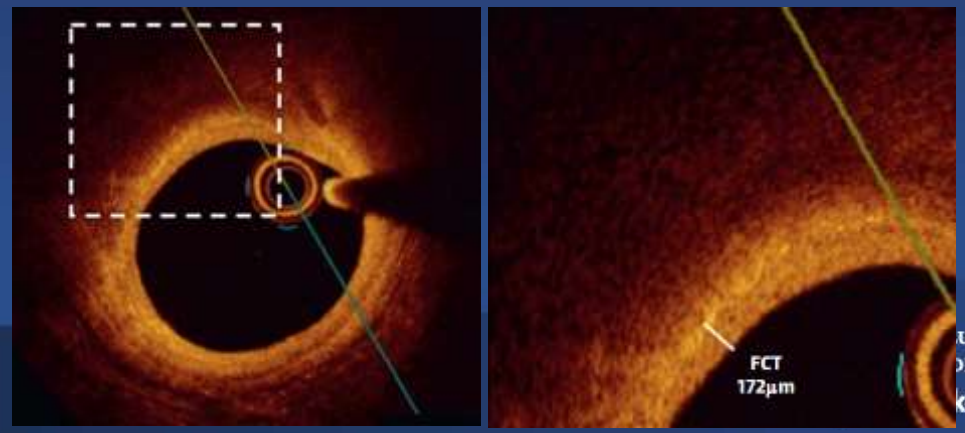
- **164 pts at Australia and European countries**
- **Non-culprit lesions in pts with NSTEMI**
- **Max lipid arc>90°and min cap thickness≤120μm**
- **Monthly Evolocumab 420mg × 52 weeks with statin**

Median change from baseline to 52 weeks	Evolovumab (n=70)	Control (n=65)	P-value
%Atheroma Volume	-2.29%	-0.61%	0.009
Max lipid arc	-51°	-25°	0.04
Min Cap thickness	39μm	22μm	0.02

Baseline



52 weeks



Nicholls S et al. JACC Img 2022;15:1308-21

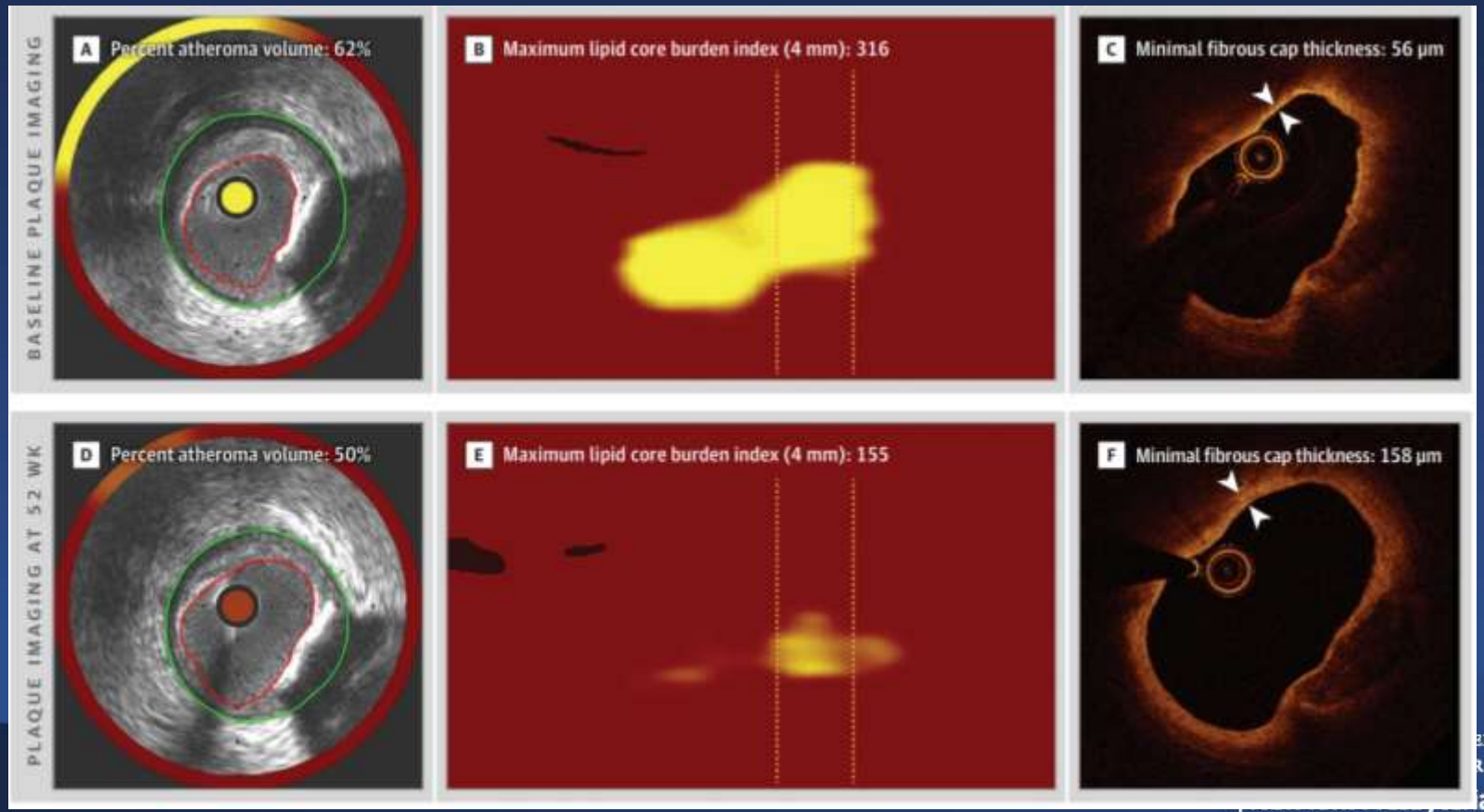
Cardiovascular Research Foundation

UMBIA UNIVERSITY
DICAL CENTER
K-Presbyterian

PACMAN-AMI Trial

- **300 pts at 4 European countries**
- **Non-culprit lesions in pts with STEMI (53%) or NSTEMI**
- **Biweekly Alirocumab 150mg × 52 weeks with rosuvastatin 20mg**

Median change from baseline to 52 weeks	Alirocumab (n=148)	Control (n=152)	P-value
%Atheroma Volume	-2.13%	-0.92%	<0.001
$MaxLCBI_{4mm}$	-79.42	-37.60	0.006
Min Cap thickness	62.67μm	33.19μm	0.001



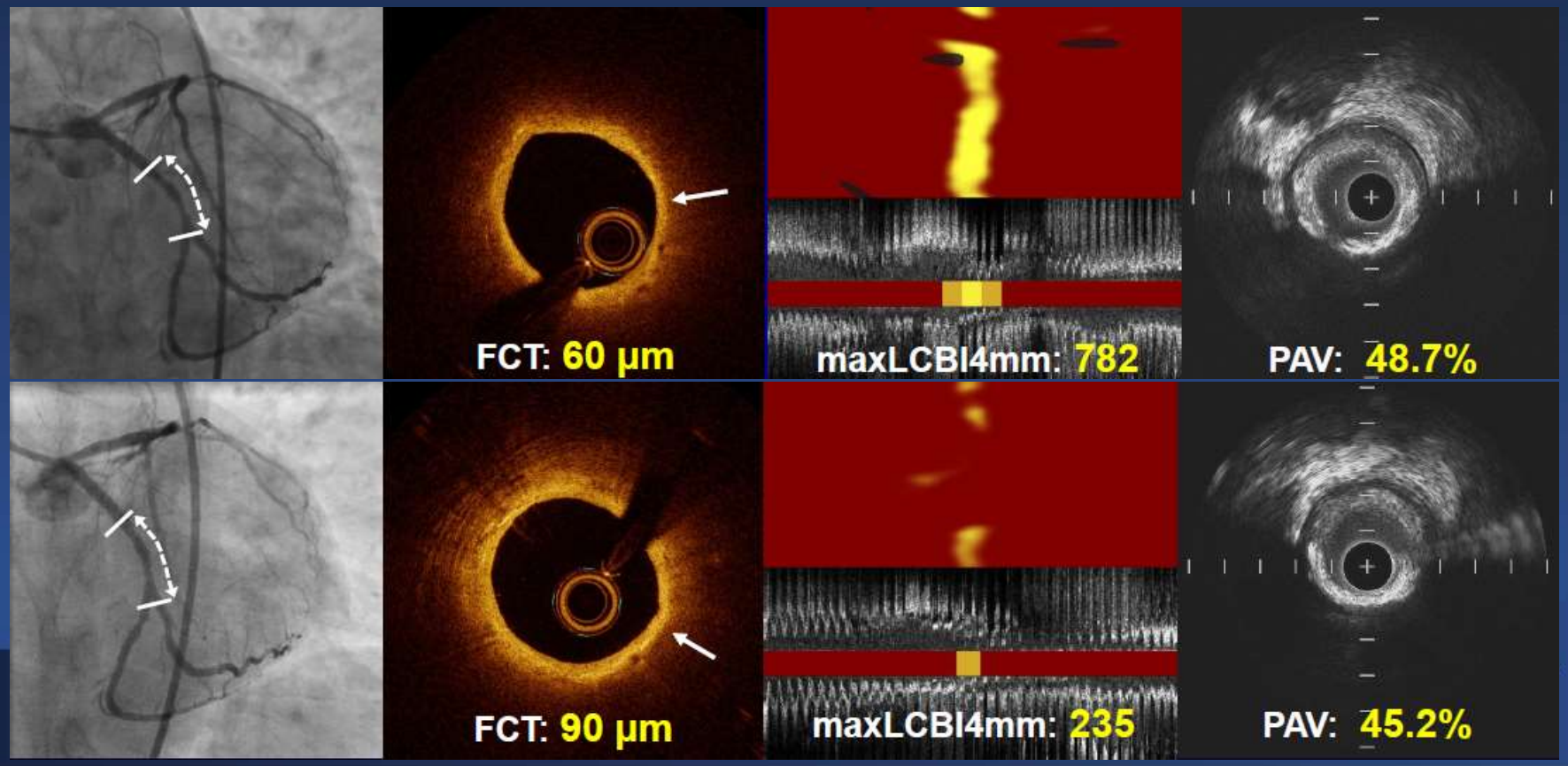
Räber L et al. JAMA 2022;327:1771-81

Cardiovascular Research Foundation

YELLOW III

- **137 pts at single US center**
- **Non-culprit lesions in pts with stable CAD**
- **Max lipid arc>90°and min cap thickness≦120μm**
- **Biweekly Evolocumab 140mg × 26 weeks with statin**

Median change from baseline to 26 weeks	Evolovumab (n=110)
%Atheroma Volume	-1.38%
$MaxLCBI_{4mm}$	-93.7
Min Cap thickness	26.8μm



Kini A et al. ACC2023

Cardiovascular Research Foundation

Summary of PCSK9-I Regression Studies

Study, pt#, drug, duration	Inclusion	ΔLDL, mg/dL	ΔhsCRP, mg/L	ΔMin cap thickness, μm	Δmax $LCBI_{4mm}$	ΔAtheroma volume, %
HUYGENS, NSTEMI, 70 vs 65, monthly Evolocumab ×52 weeks	Max lipid arc>90° and min FCT<120 μm	-114 vs -55, p<0.001	NA	39 vs 22, p=0.02	NA	-2.29 vs -0.61, p=0.009
PACMAN-AMI, STEMI (53%) /NSTEMI 126 vs 132, biweekly Alirocumab×52 weeks	NA	-132 vs -77, p<0.001	-3.2 vs -0.4, p=0.34	63 vs 33, p=0.001	-79 vs -38 0.006	-2.13 vs -0.92, p<0.001
YELLOW III, stable CAD 110 pts, biweekly Evolocumab 140mg ×26 weeks	Max lipid arc>90° and min FCT<120 μm	-58±29 p<0.001	0.34±4.1 p=0.87	27±22 p<0.001	-94±141 p<0.001	-1.38±1.48 p<0.001

p-value for comparison between treatment vs control for HUYGENS and PACKMAN, change from baseline to FU in YELLOW III

Nicholls S et al. JACC Img 2022;15:1308-21; Räber L et al. JAMA 2022;327:1771-81; Kini A et al. ACC2023