

# What is a Vulnerable Plaque?

## Insight from CT and OCT Studies

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# Disclosure

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- Chatter Foundation
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# Interview with WSJ

The aim of our research is to identify “vulnerable plaques” in the coronary tree and treat them with local or segmental therapy.

*Jang IK. 2003*

# What is a “Vulnerable Plaque”?

A plaque that is prone to disruption (rupture or erosion) leading to acute occlusive thrombosis resulting in MI or cardiac death.

*Minami Y, Jang IK. Braunwald Heart Disease Companion 2024*

# Definition of “Vulnerable Plaque” in Recent Clinical Studies

A plaque that is prone to rapid progression leading to progressive angina requiring revascularization, MI, or cardiac death.

# What is a “Vulnerable Plaque”?

Plaque Phenotype

VS.

Plaque Burden

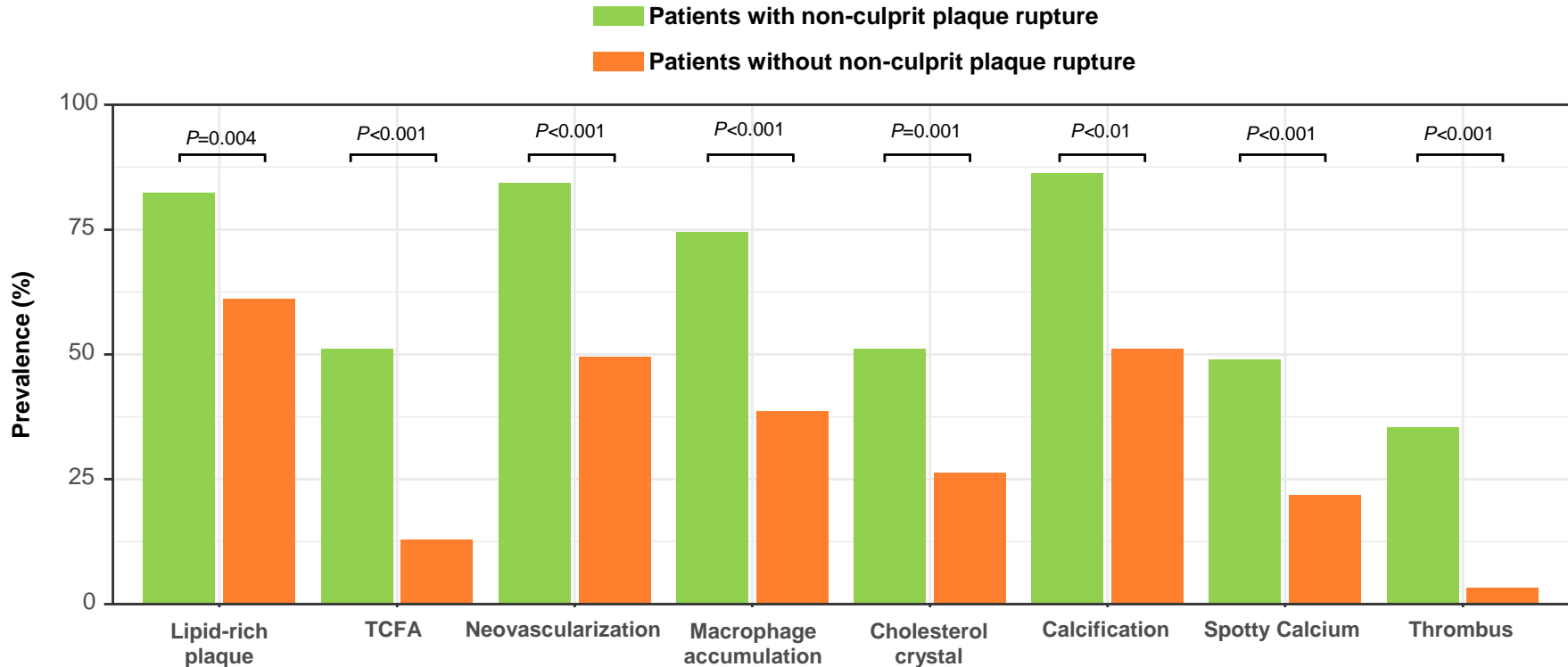
**“Vulnerable”**: “wound” by Latin

“easily hurt or harmed” by Britannica

# Plaque Phenotype

- Atherosclerosis is a pan-vascular process.
- Plaque phenotype changes over time.
- Subclinical plaque disruption and healing contributes to plaque progression.
- Plaque erosion is responsible for 25-40% of ACS.

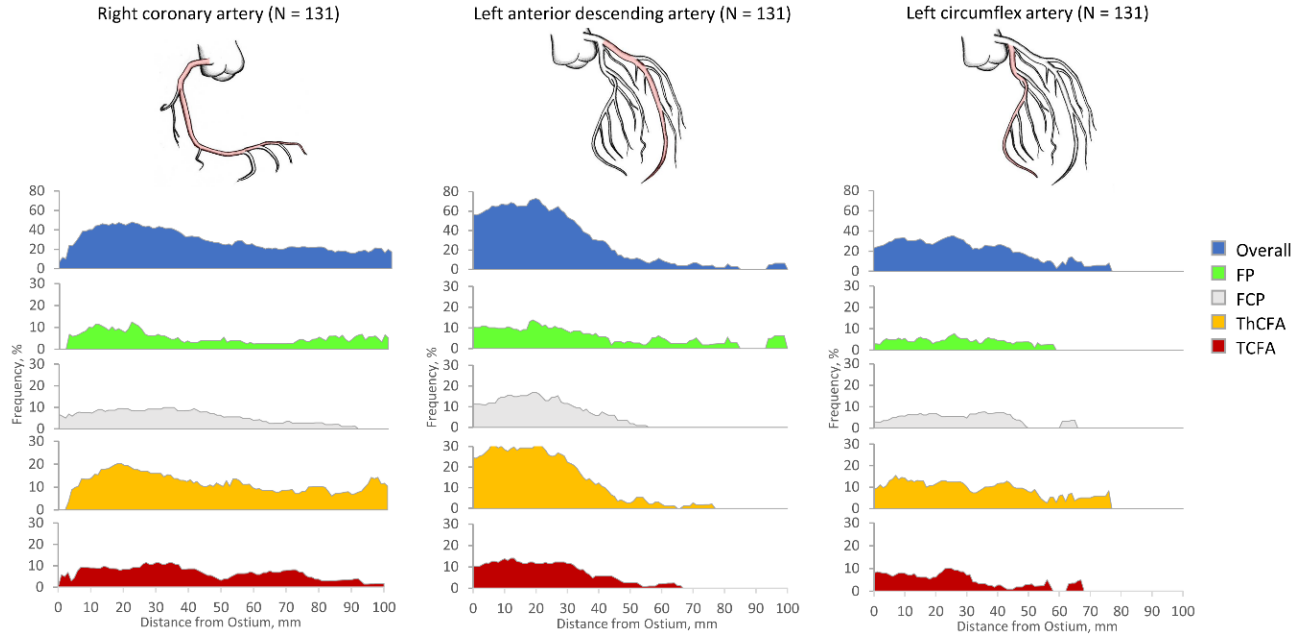
# Pan-coronary non-culprit plaque phenotype (patient-based analysis)



Vergallo R, Jang IK. ATVB 2016



# Spatial Distribution of Plaque Phenotypes



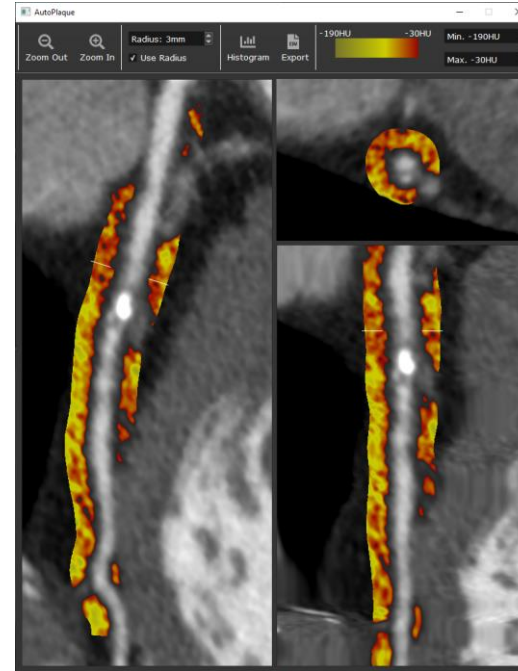
Araki M, Jang IK. JACC Img 2020

# PCAT (peri-coronary adipose tissue) attenuation: Vascular Inflammation

CCS



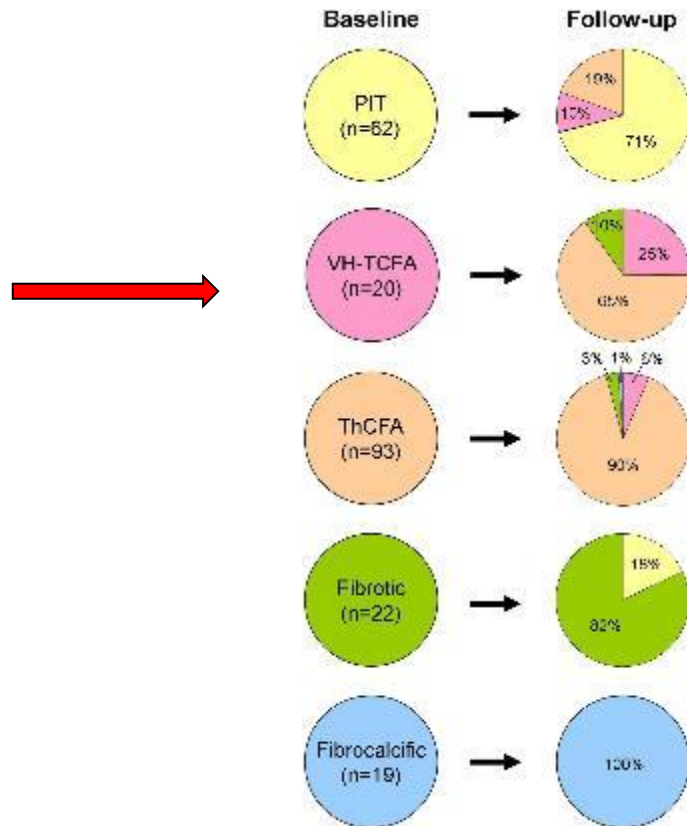
ACS



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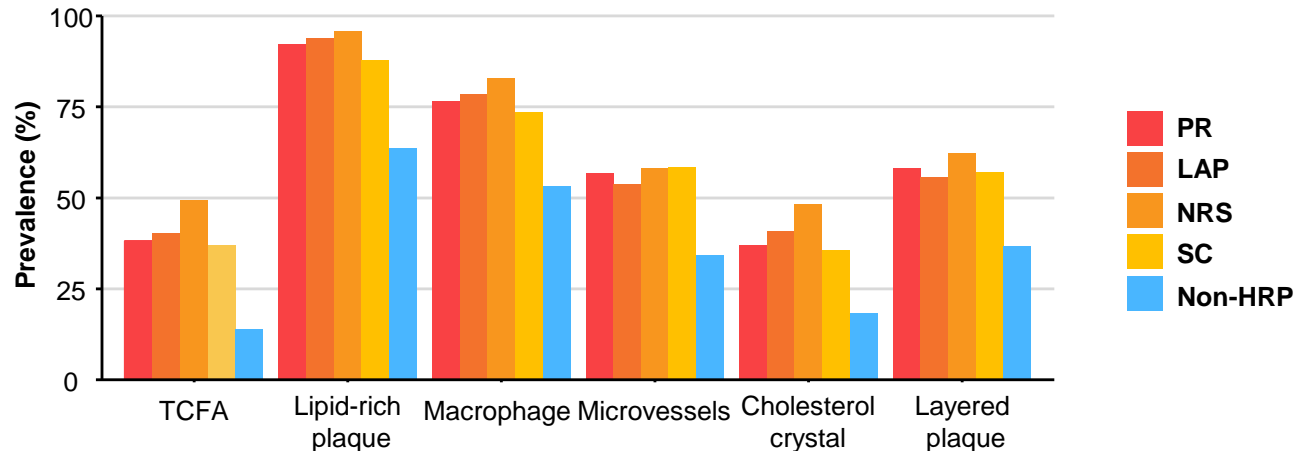
# Dynamic Nature of Coronary Plaque Phenotype



*Kubo T, Mintz G. JACC 2010*

# Comparison of plaque vulnerability between OCT and CTA

	PR	LAP	NRS	SC	Non-HRP
TCFA	38.1%*	40.3%*	49.4%*	37.0%*	14.0%
Lipid-rich plaque	92.2%*	93.8%*	95.9%*	87.7%*	63.6%
Macrophage	76.5%*	78.6%*	82.9%*	73.7%*	53.2%
Microvessels	56.6%*	53.8%*	58.2%*	58.5%*	34.1%
Cholesterol crystal	37.0%*	40.8%*	48.2%*	35.7%*	18.2%
Layered plaque	58.2%*	55.6%*	62.4%*	57.0%*	36.7%



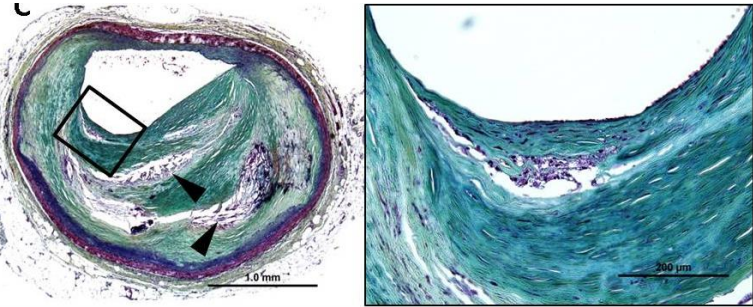
\* indicates  $P < .001$  vs. Non-HRP

Kinoshita D, Jang IK. JACC Img2024

# Plaque Phenotype

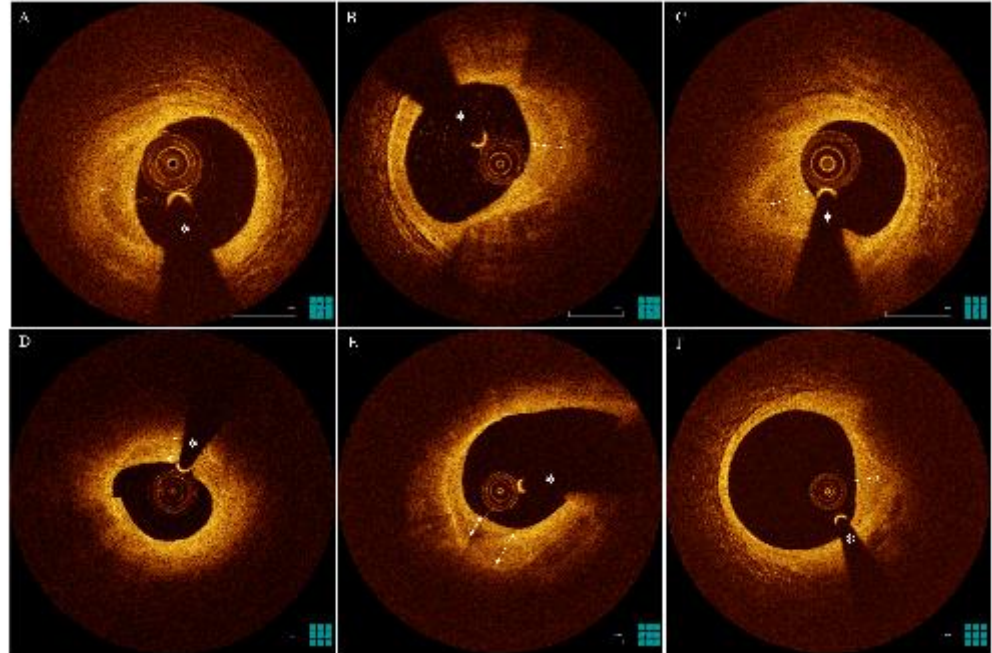
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# Healed (Layered) Plaque



Evidence of previous plaque disruption was present in up to 73% in autopsy cases

*Fracassi F, Jang IK. JACC 2019*  
*Vergallo R, Jang IK. JAMA Card 2019*  
*Russo M, Jang IK. ATVB 2020*



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# VP Clinical Studies

# The PROSPECT Study

Type of Events	Events due to Nonculprit Lesions
Death from cardiac causes	
Myocardial infarction	
Rehospitalization for angina	
Total MACE at 3.4 yrs	11.6% (75 patients)

# PROSPECT: Multivariable Correlates of Non-Culprit Lesion Related Events

Independent predictors of lesion level events by Cox Proportional Hazards regression

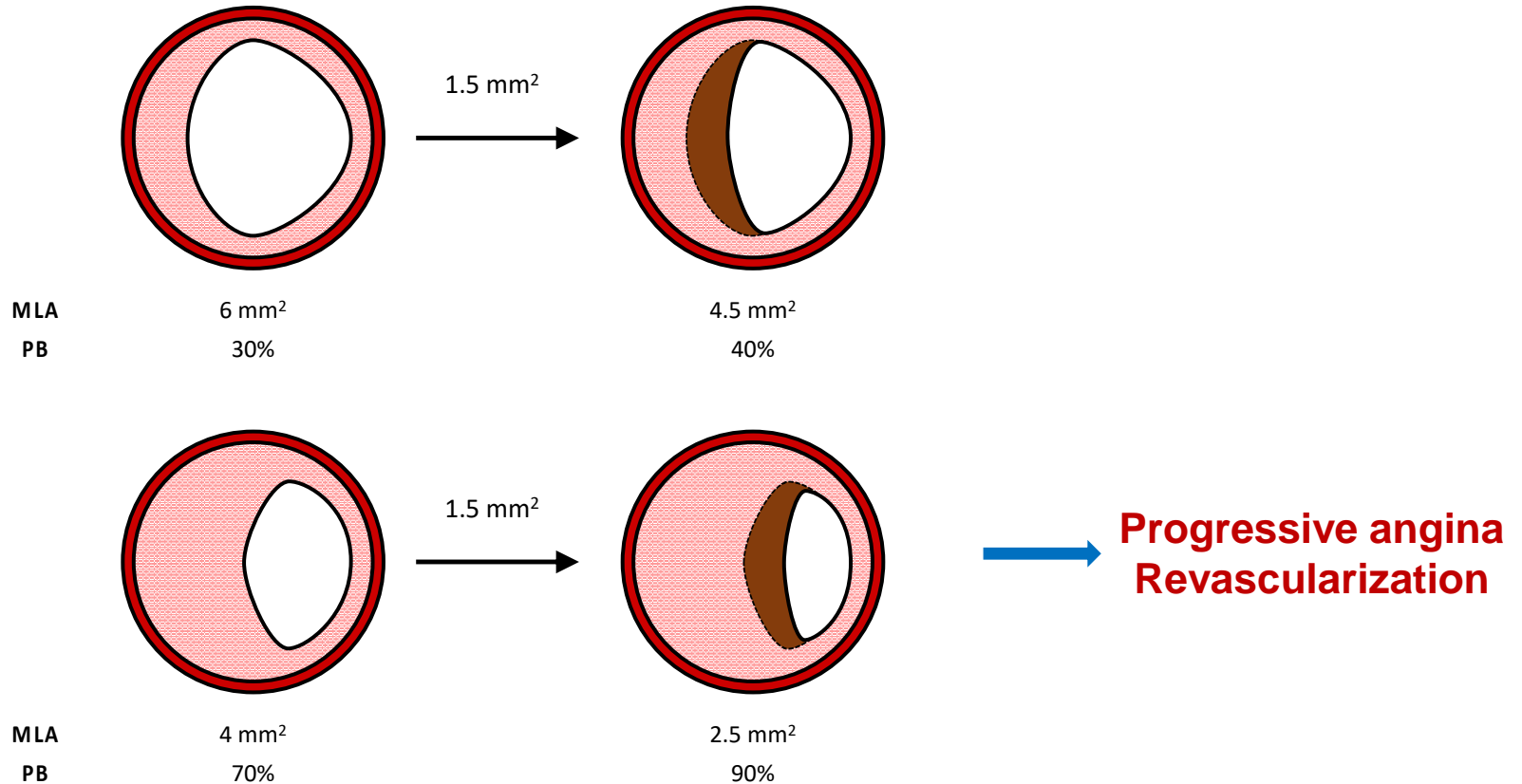
Variable	HR [95% CI]	P value
PB $\geq$ 70%	5.03 [2.51, 10.11]	<0.0001
MLA $\leq$ 4.0 mm <sup>2</sup>	3.21 [1.61, 6.42]	0.001
VH-TCFA	3.35 [1.77, 6.36]	0.0002

VH-TCFA: **Plaque burden (PB) > 40%** + absence of visible fibrous cap

# PROSPECT: Take home message

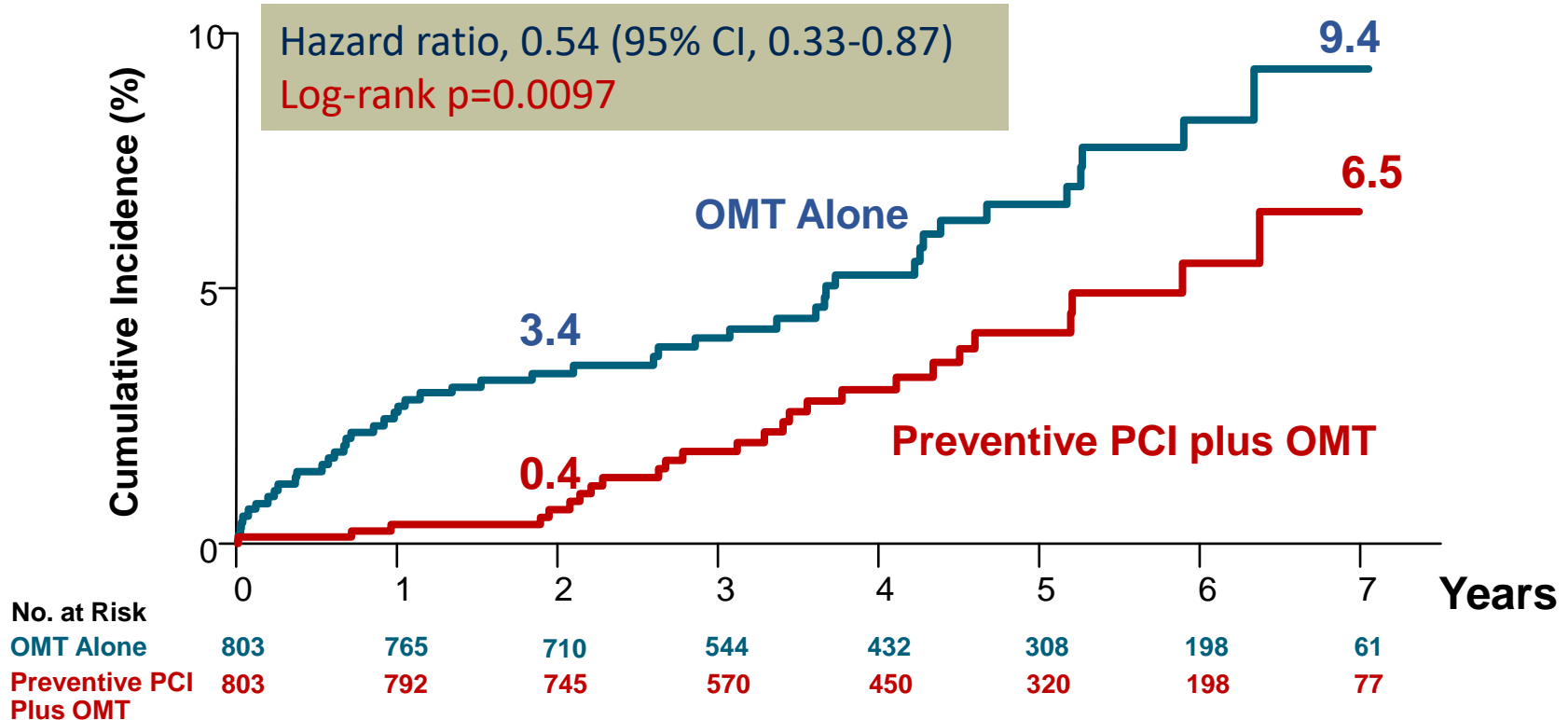
- Low positive predictive value
  - Risk of MI (STEMI + NSTEMI) from VH-TCFA is 1%.
  - One-half of pts with MACE had no HRP.
- Plaque burden (vs. plaque phenotype) is an important factor for development of recurrent ischemic events.

# Plaque burden



# PREVENT

## Primary Composite Outcome



Courtesy of Park SJ. Lancet 2024

## Primary Composite Outcome

Endpoints	Preventive PCI plus OMT (N=803)	OMT alone (N=803)	Difference in event rates (95% CI)	Hazard ratio (95% CI)
<b><i>Ischemia-driven target-vessel revascularization</i></b>				<b>0.44 (0.25 to 0.77)</b>
At 2 years	1 (0.1%)	19 (2.4%)	-2.3 (-3.4 to -1.2)	
At 4 years	10 (1.7%)	29 (4.4%)	-2.7 (-4.6 to -0.8)	
At 7 years	17 (4.9%)	38 (8.0%)	-3.2 (-7.4 to 1.1)	
<b><i>Hospitalization for unstable or progressive angina</i></b>				<b>0.19 (0.06 to 0.54)</b>
At 2 years	1 (0.1%)	12 (1.5%)	-1.4 (-2.3 to -0.5)	
At 4 years	4 (0.7%)	16 (2.4%)	-1.7 (-3.0 to -0.4)	
At 7 years	4 (0.7%)	21 (4.9%)	-4.2 (-7.17 to -1.4)	

# Conclusion

- Detection of VP helps to risk stratify patients.
  - *Minami Y, Jang IK. Braunwald Heart Dis.*
- Plaque burden is a strong predictor for future revascularization.
  - *Stone G. NEJM 2011*
  - *Park SJ. Lancet 2024*
- Preventive PCI reduces revascularization, MI, or cardiac death during 7-year FU.
  - *Park SJ. The Lancet 2024*
- “High risk plaque” rather than “vulnerable plaque” may be a more appropriate terminology.



# Thank you



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