IVUS Analysis

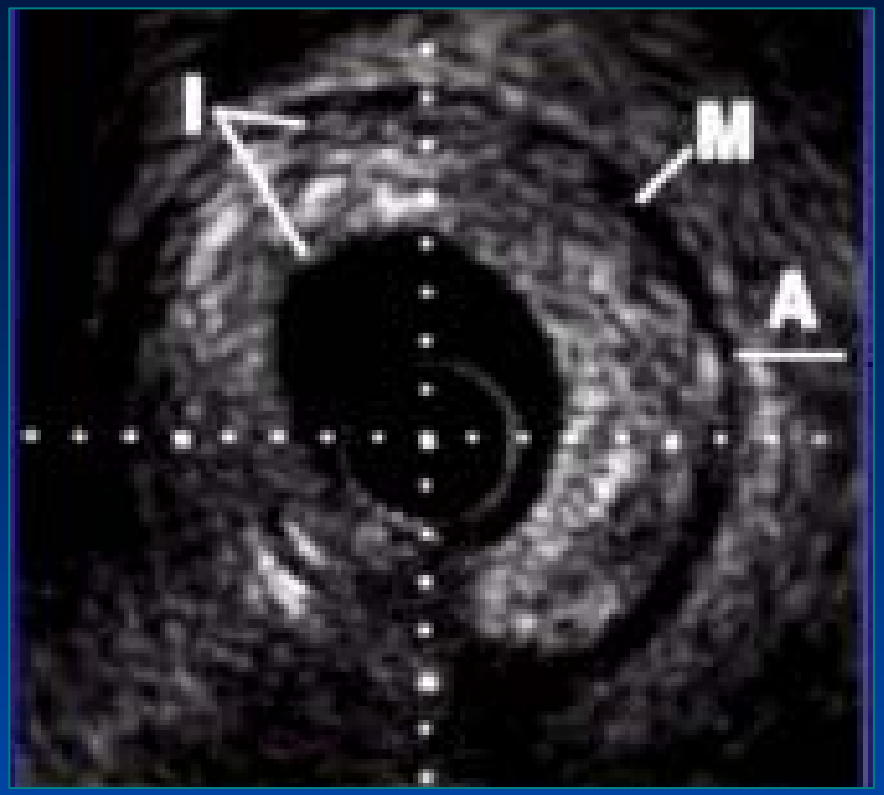
Myeong-Ki Hong, MD, PhD

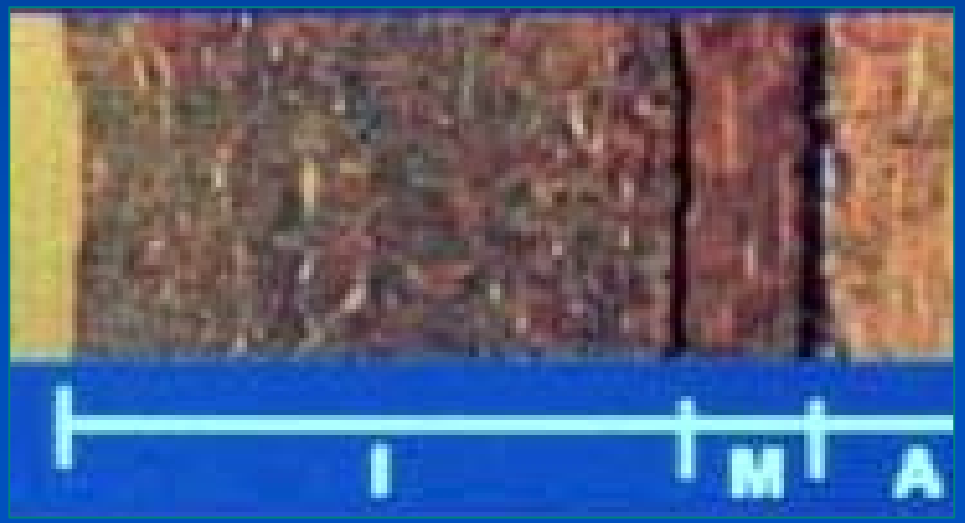
Cardiac Center, Asan Medical Center

University of Ulsan College of Medicine,

Seoul, Korea

- Intimal disease (plaque) is dense and will appear “white”
- Media is made of homogeneous smooth muscle cells and does not reflect ultrasound (appears dark)
- Adventitia has “sheets” of collagen that reflect a lot of ultrasound (appears white)





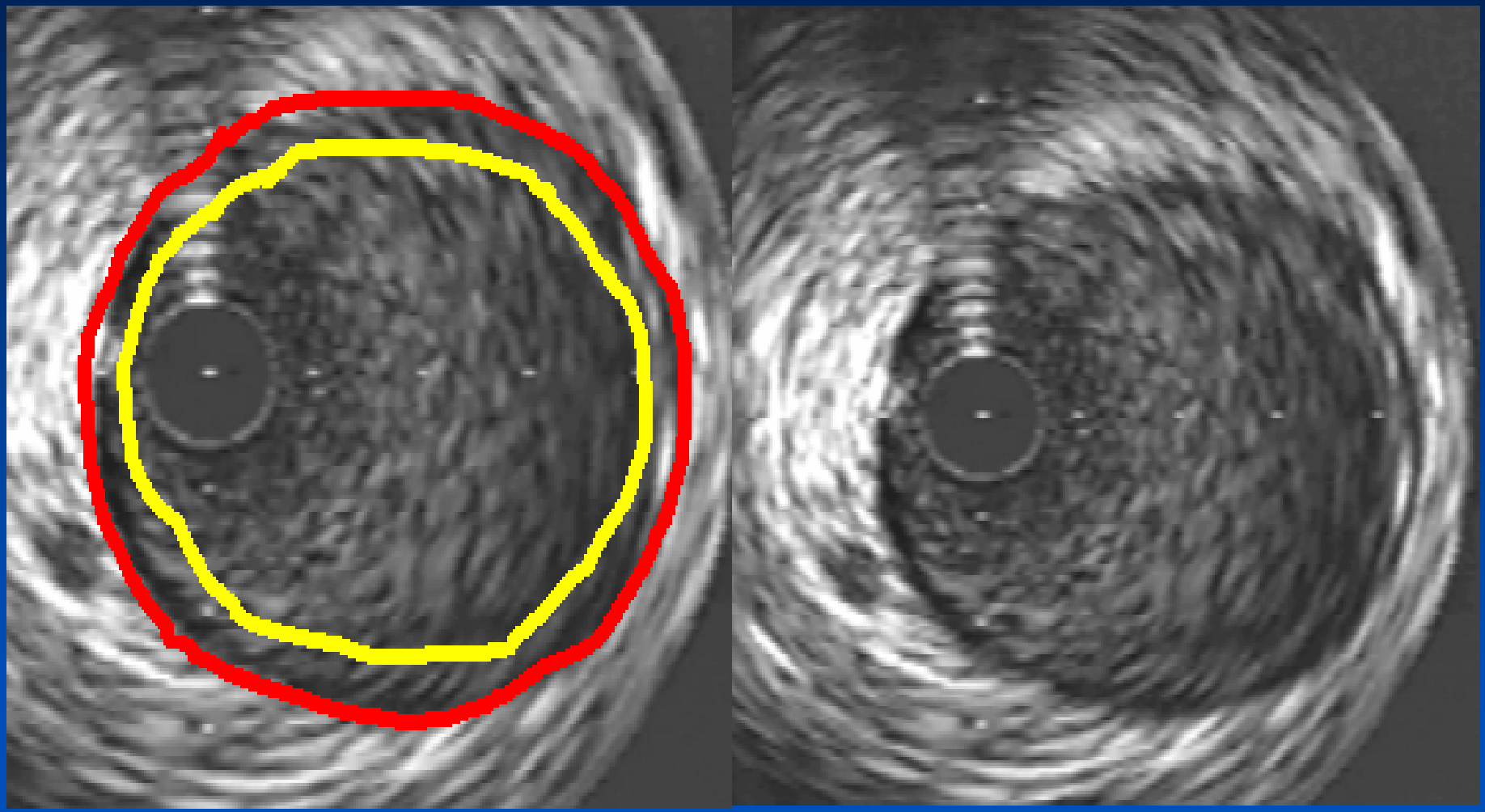
Normal

Diseased

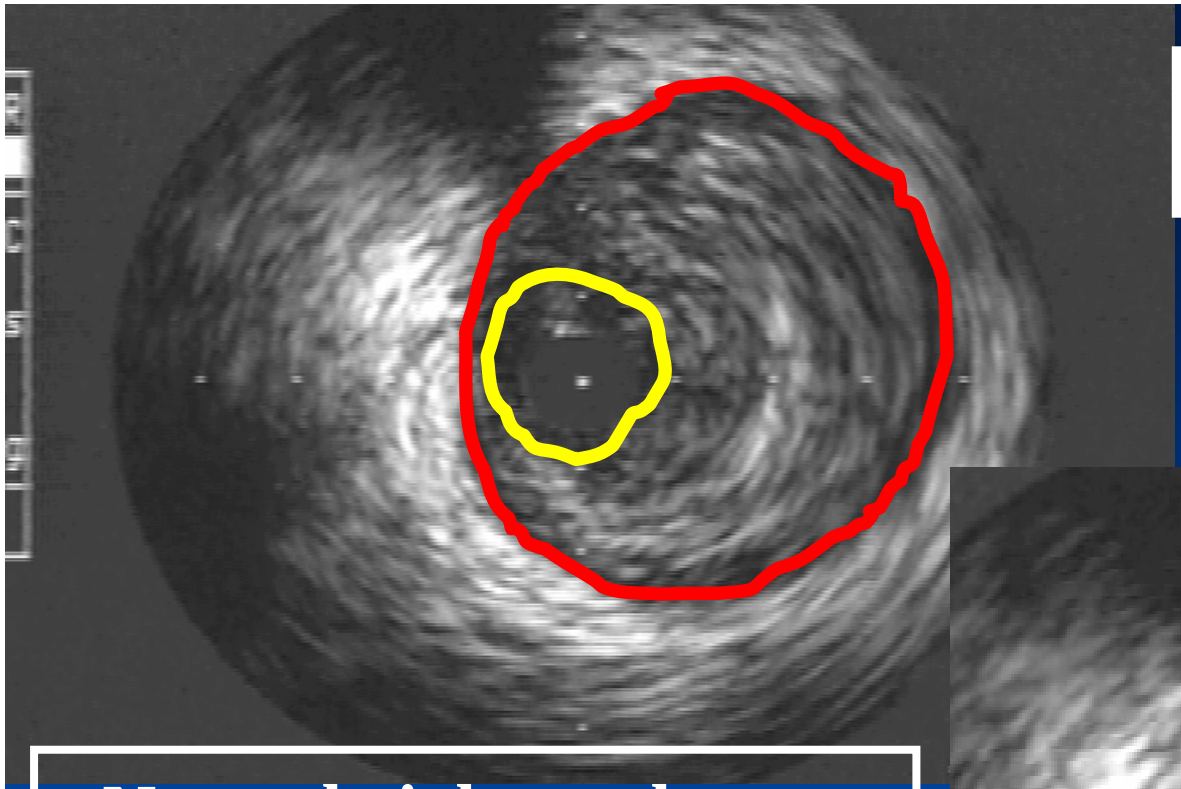
Classification of Plaque by IVUS

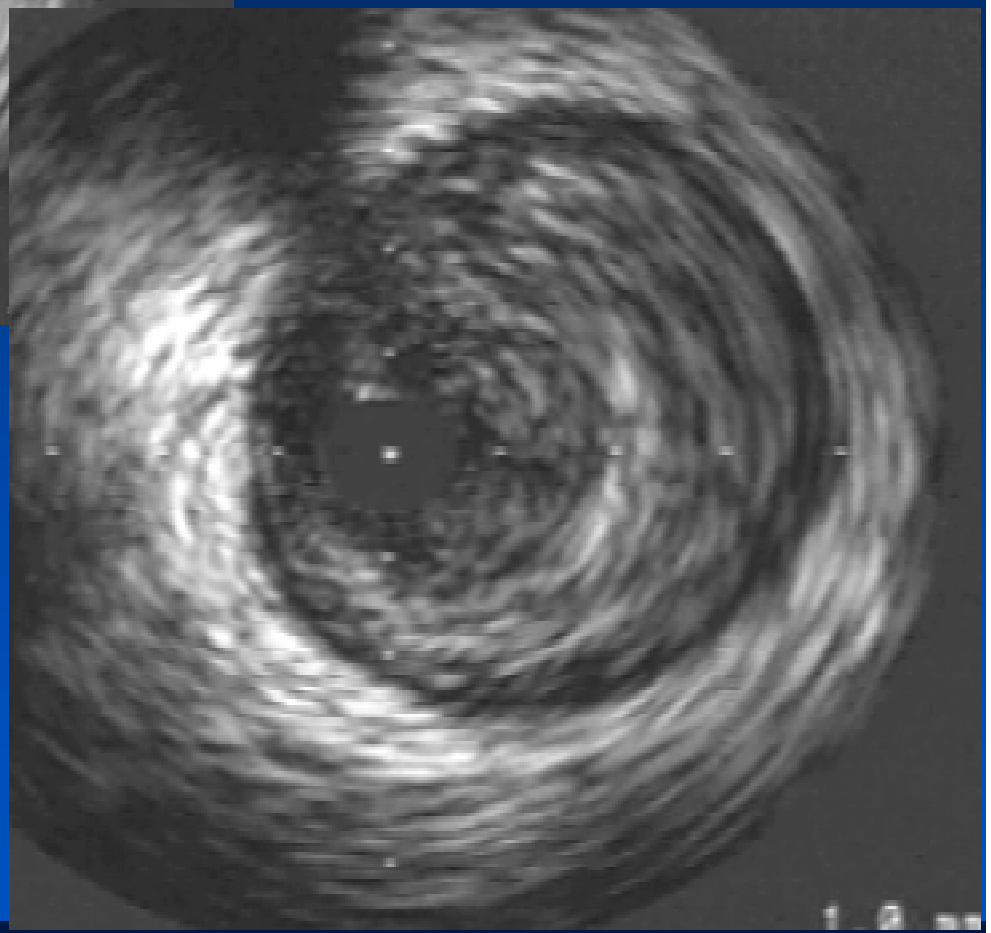
Soft Plaque
Fibrous Plaque
Fibro-calcific Plaque

Normal



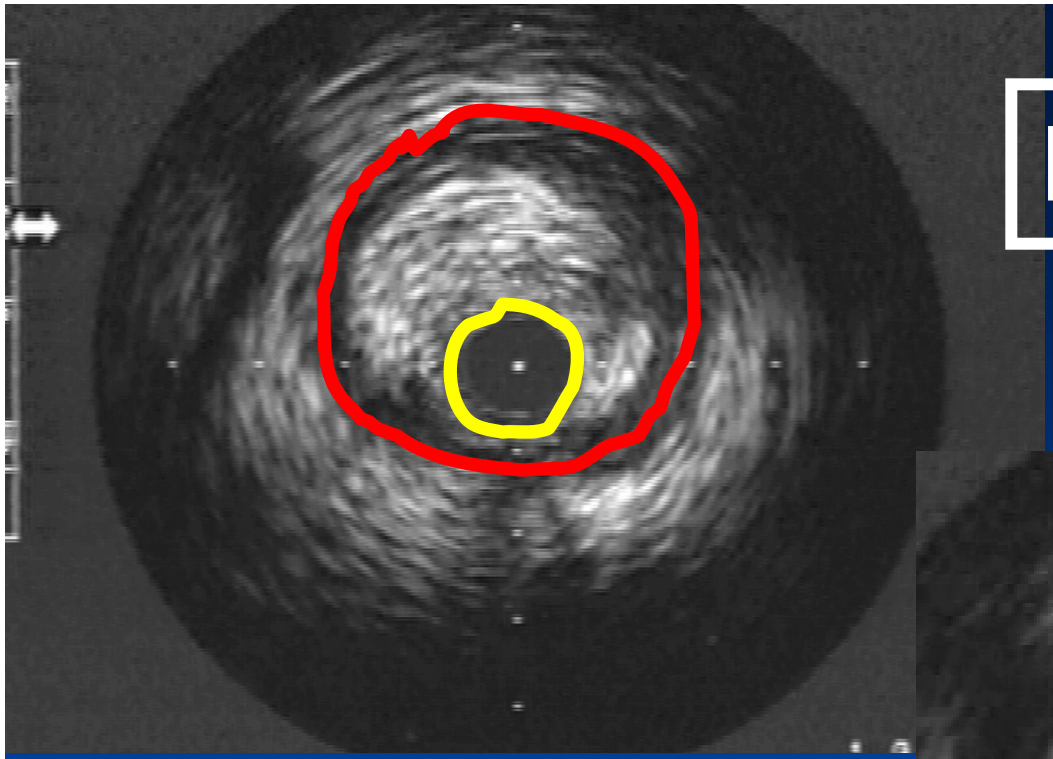
Soft plaque

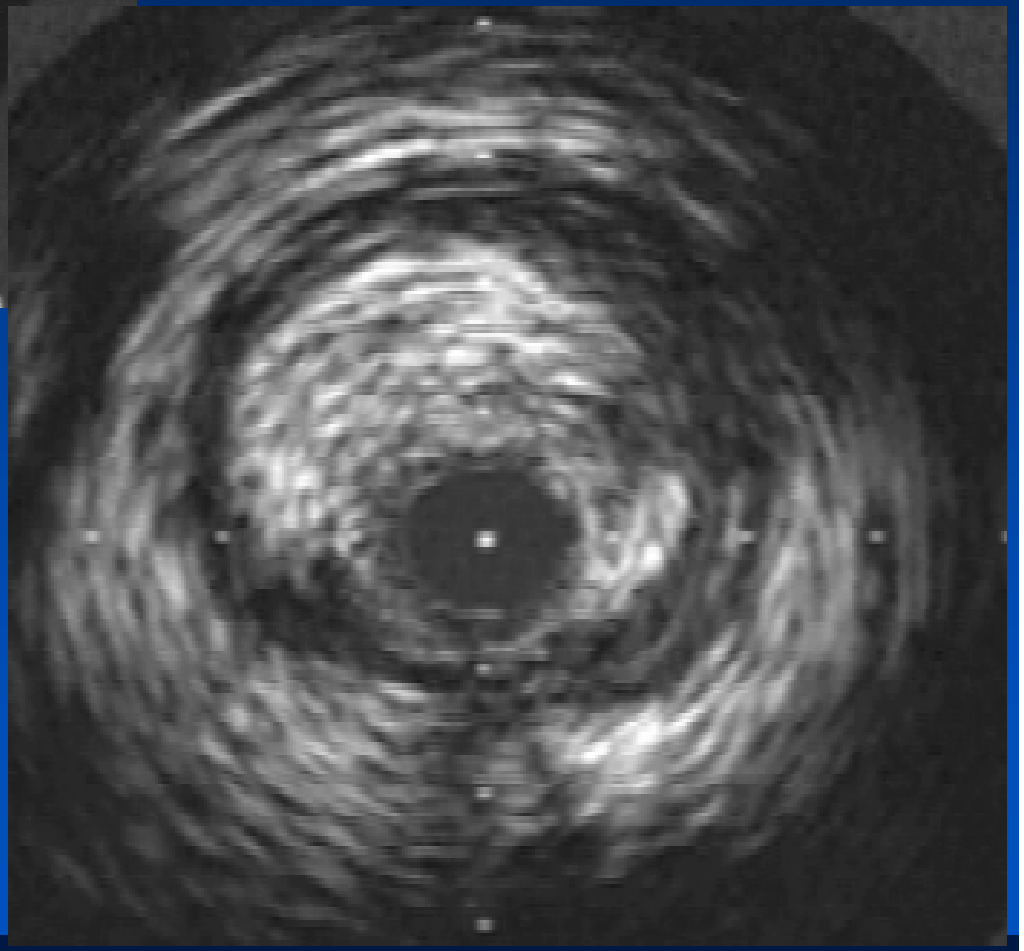




- Not as bright as the adventitia (hypoechoic)
- "Soft" refers to the low echogenicity, generally due to high lipid content in a mostly cellular lesion

Fibrous plaque

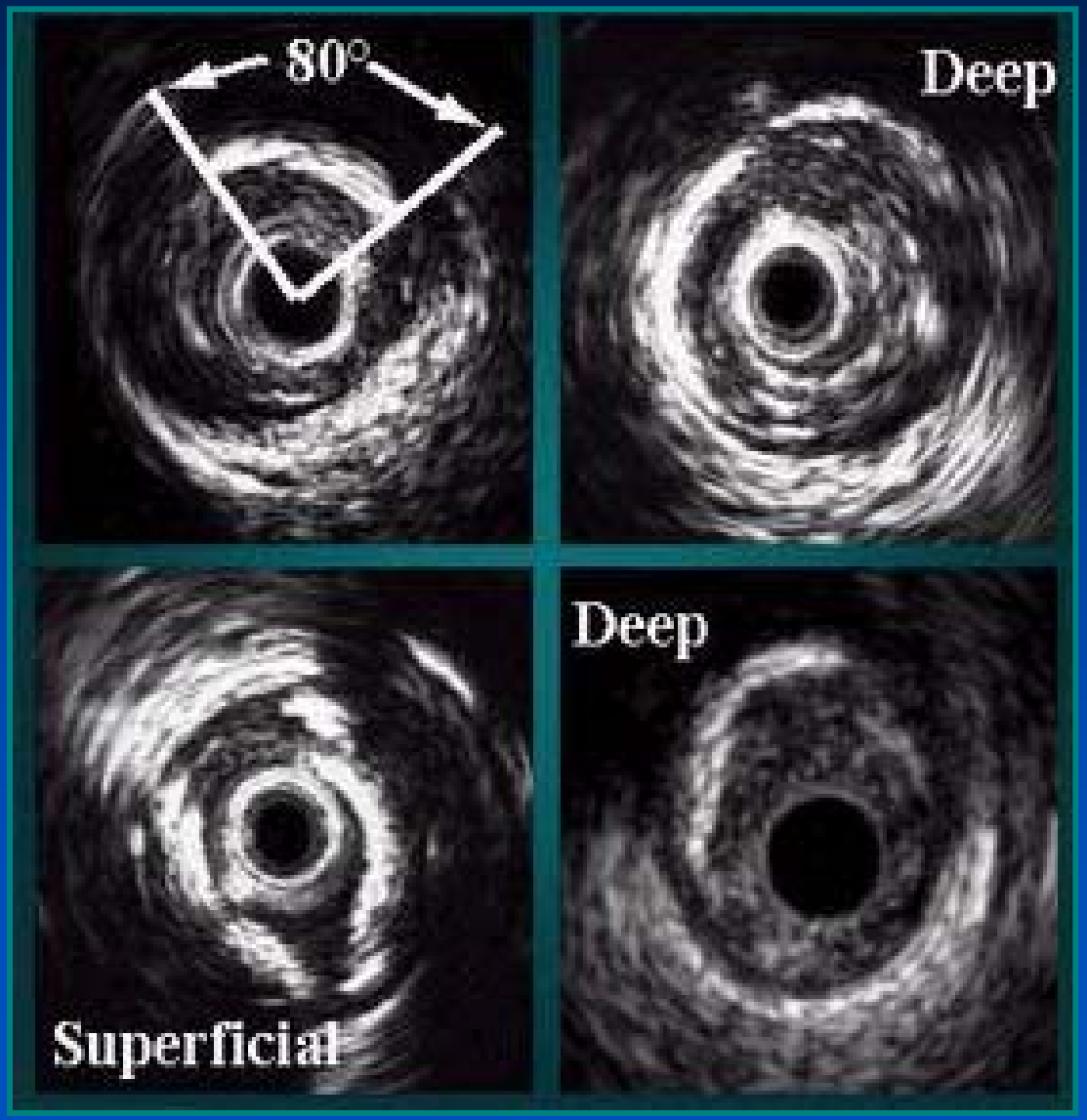


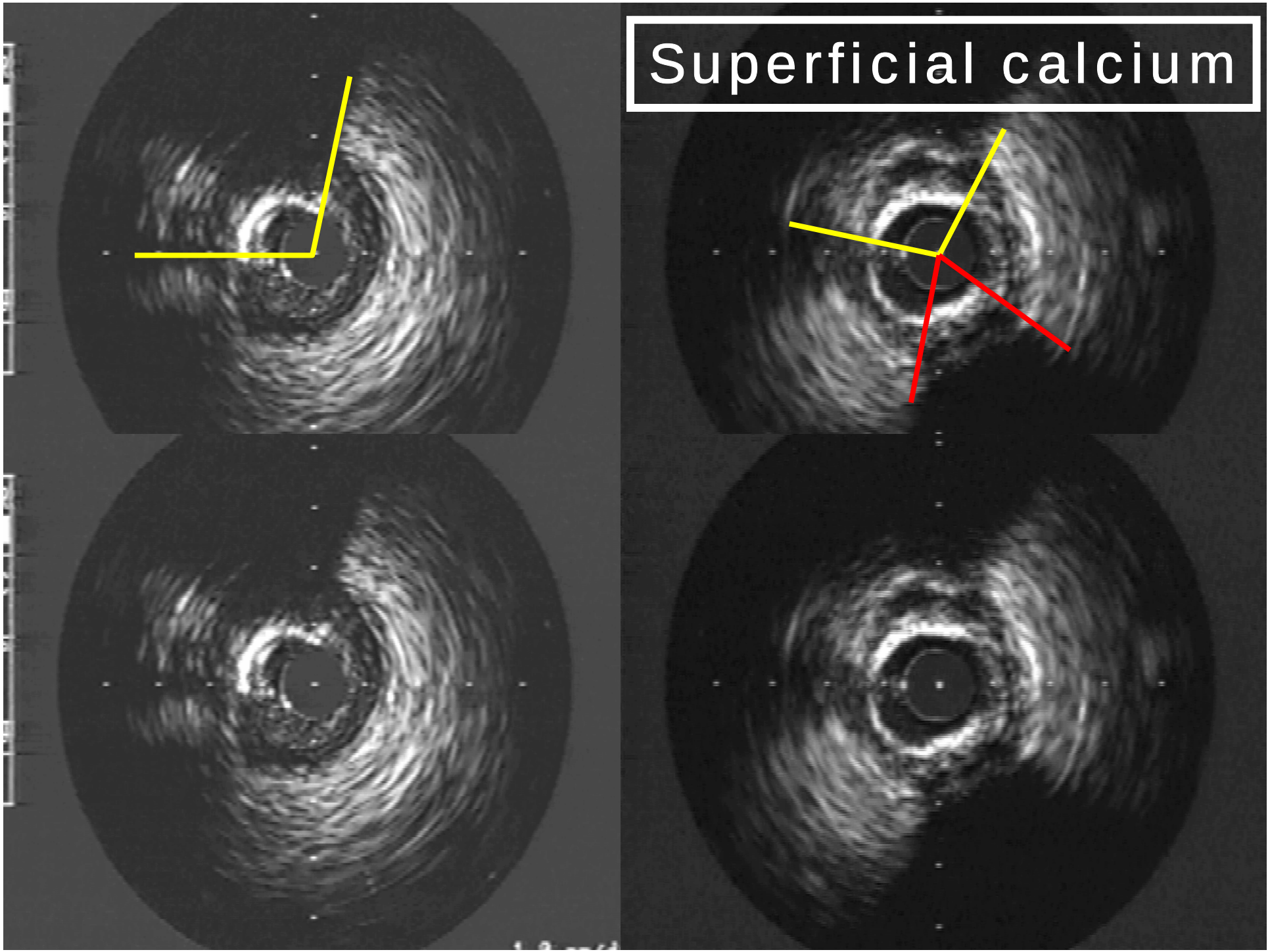


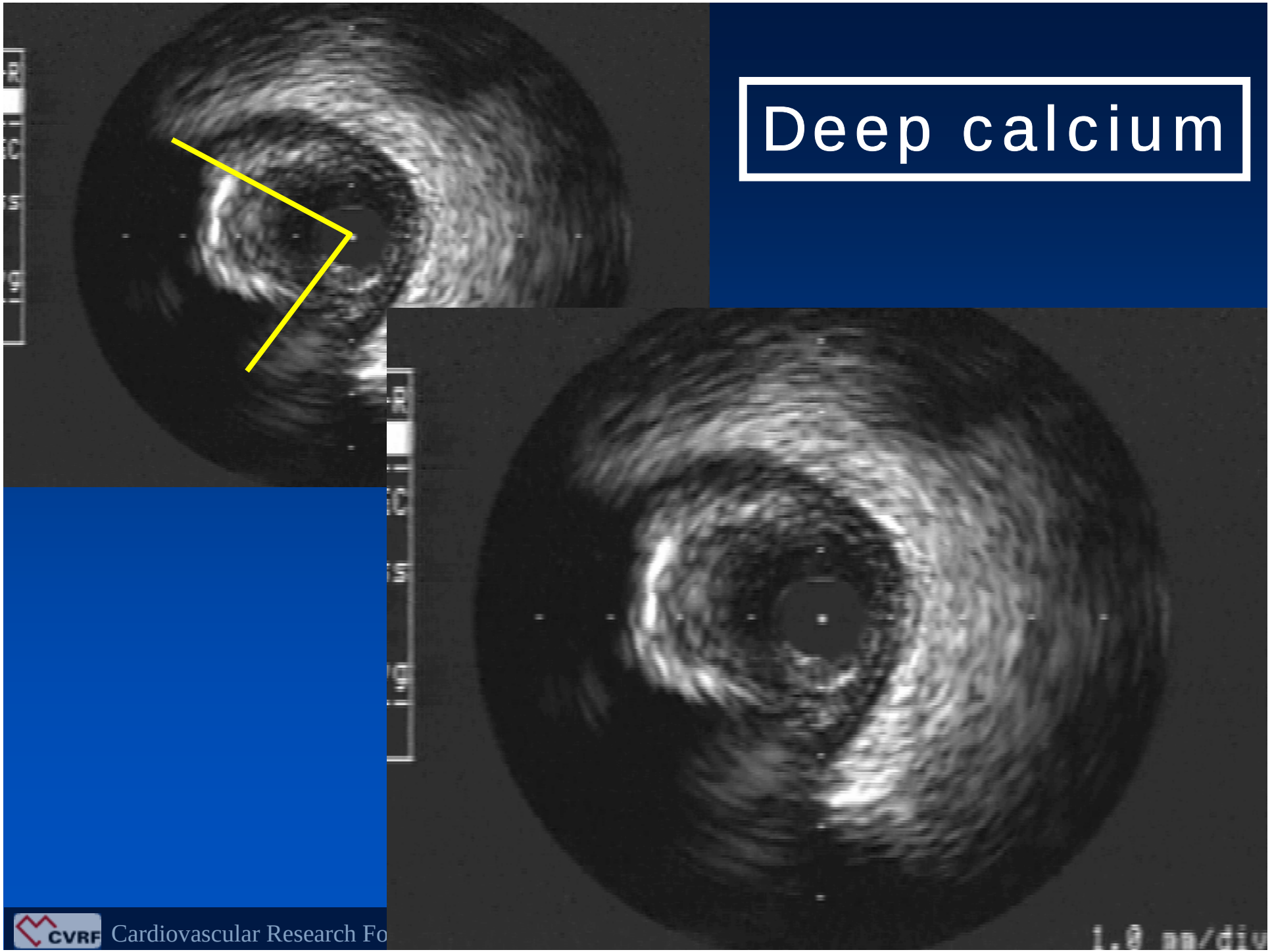
- **As bright or brighter than the adventitia (hyperechoic)**
- **Majority of lesions are fibrotic**

Calcium

- **Bright echos (brighter than the adventitia)**
- **Obstructs the penetration of ultrasound (acoustic shadowing)**
- **Only the leading edge is detected and thickness cannot be determined**

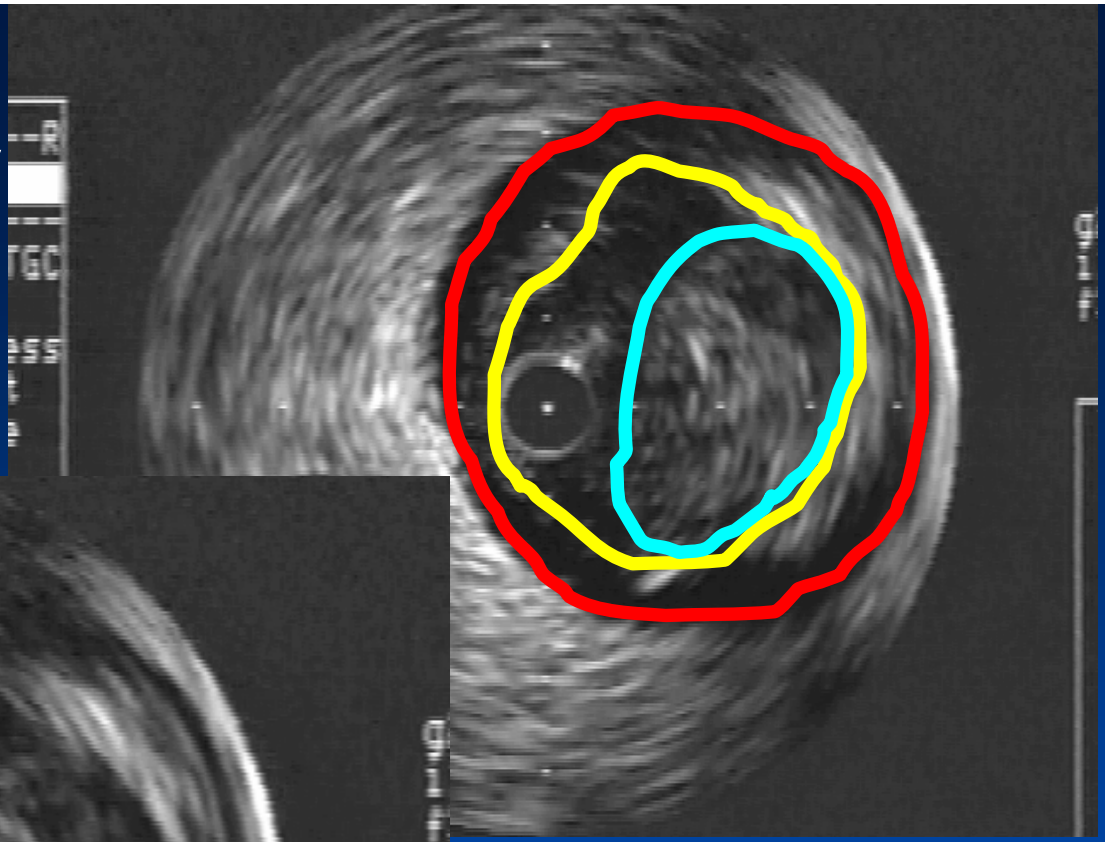


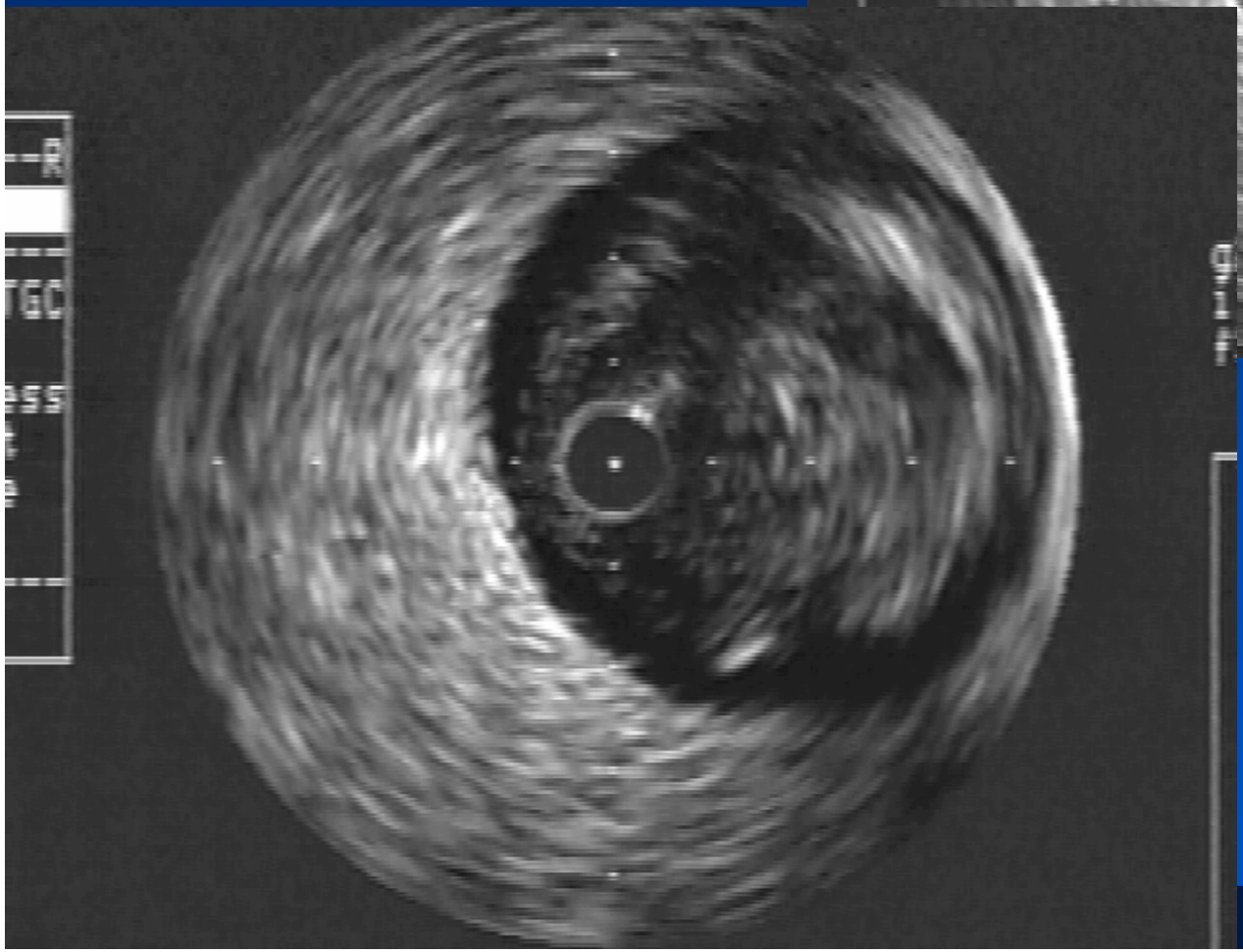

Superficial calcium


Deep calcium
CVRF
Cardiovascular Research Fo
1.0 mm/div

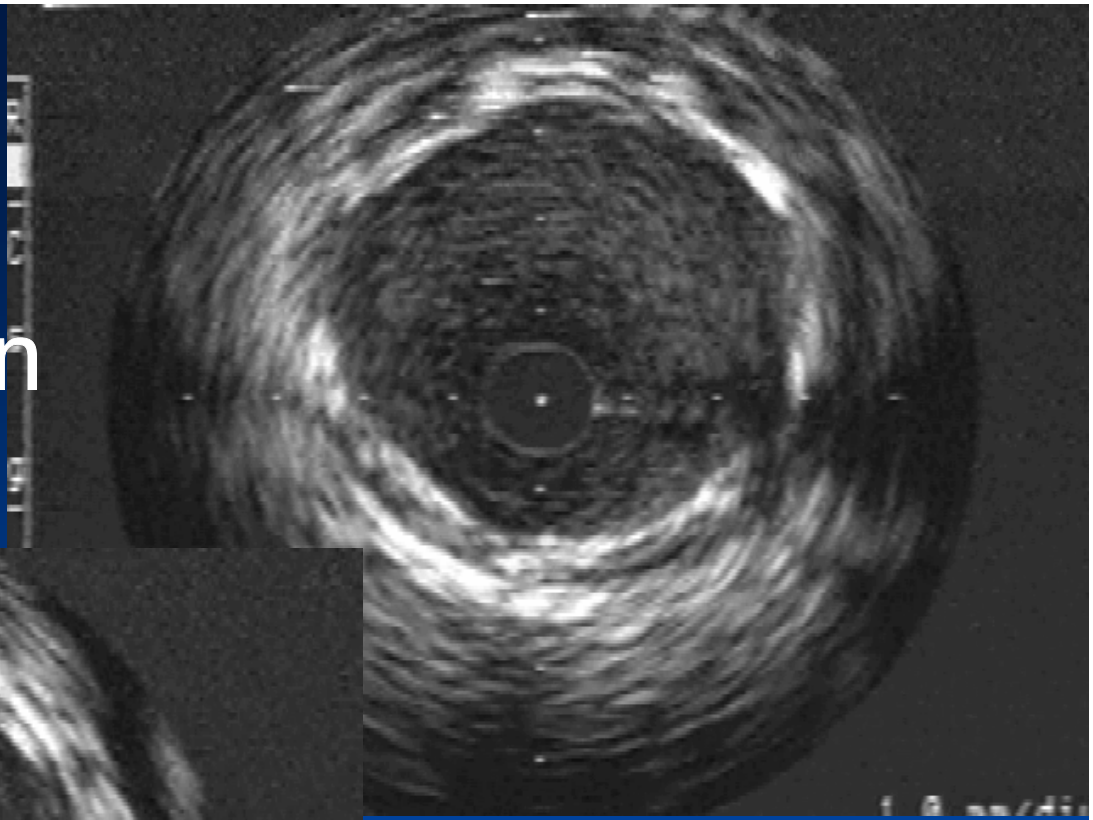
Other Interesting Images

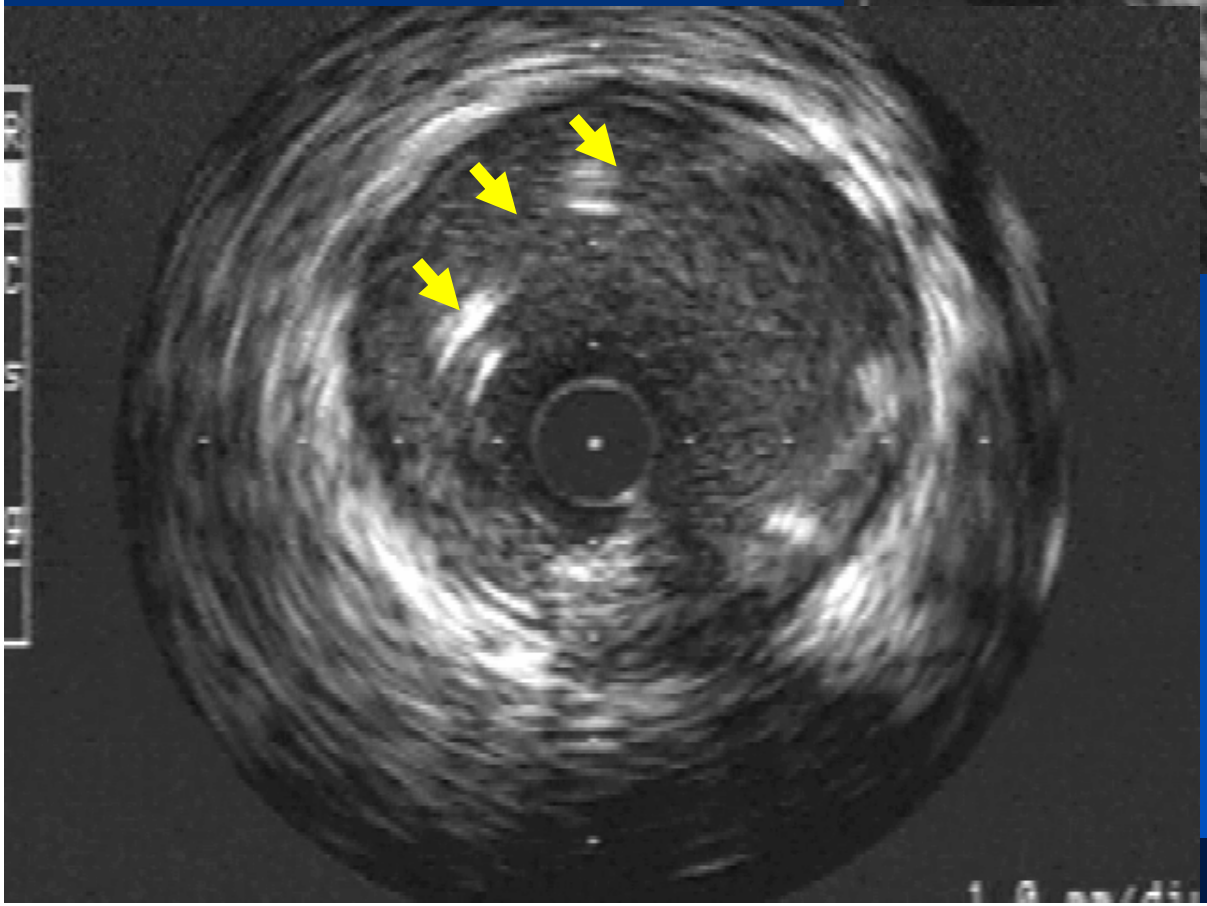
Intracoronary Thrombus



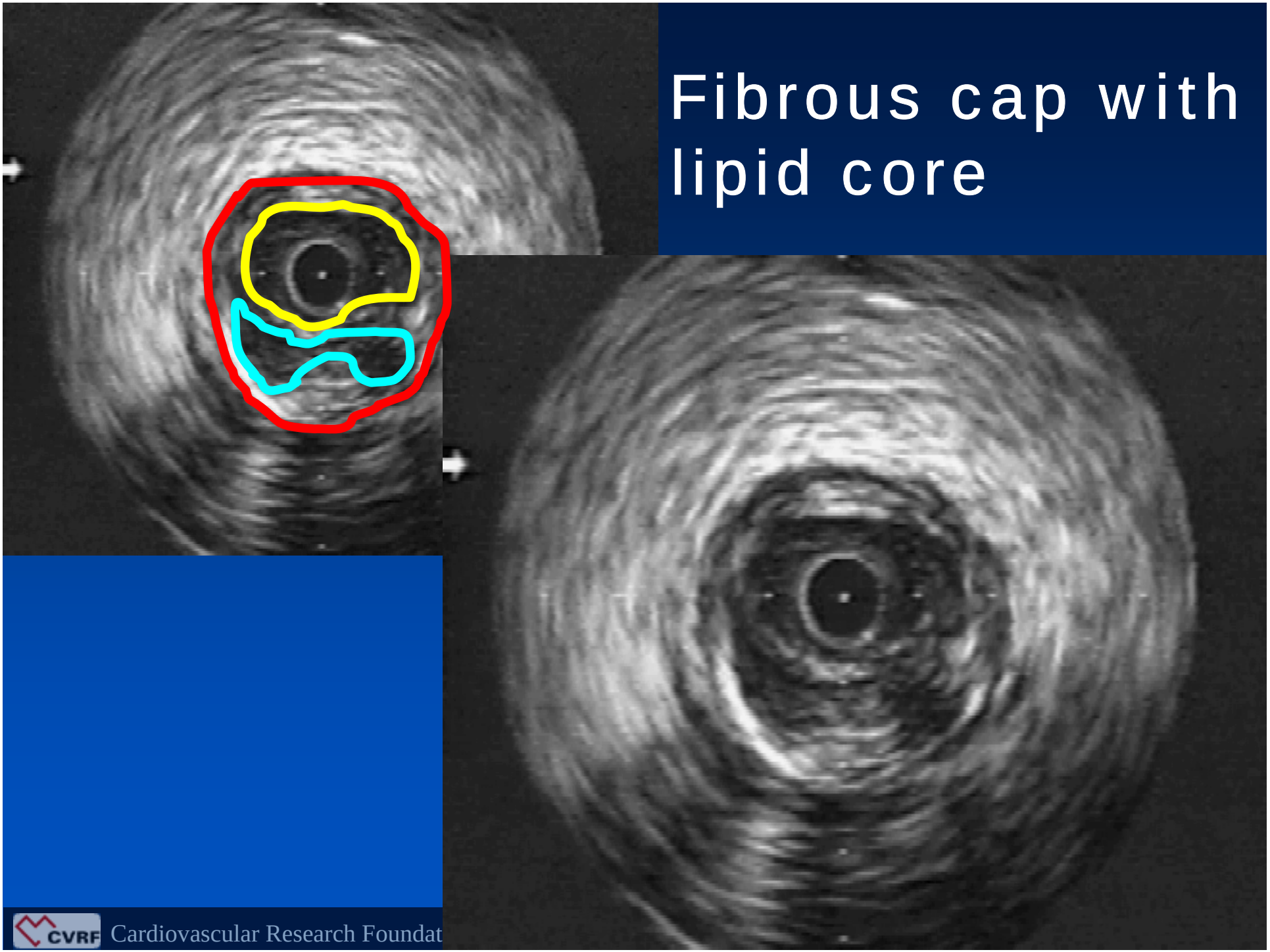


Incomplete stent apposition



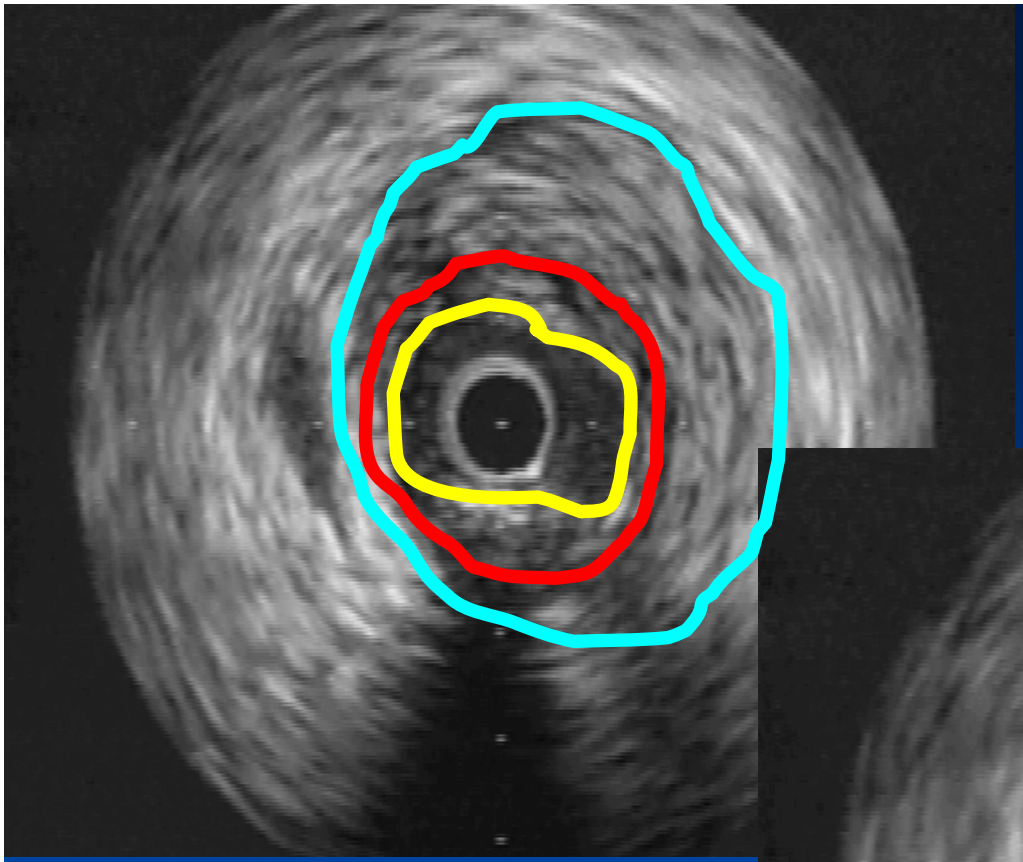


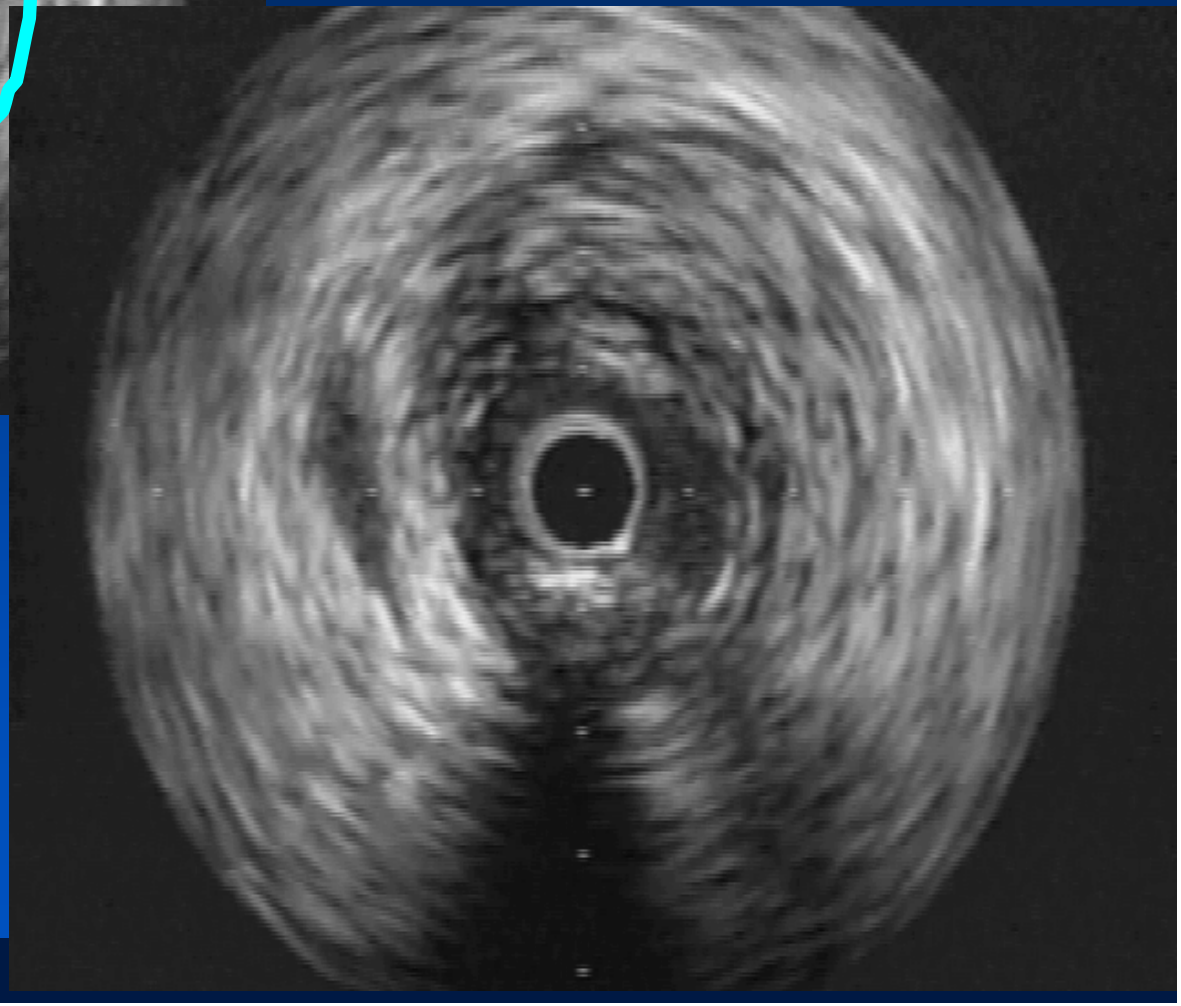
Fibrous cap with lipid core



CVRF Cardiovascular Research Foundat

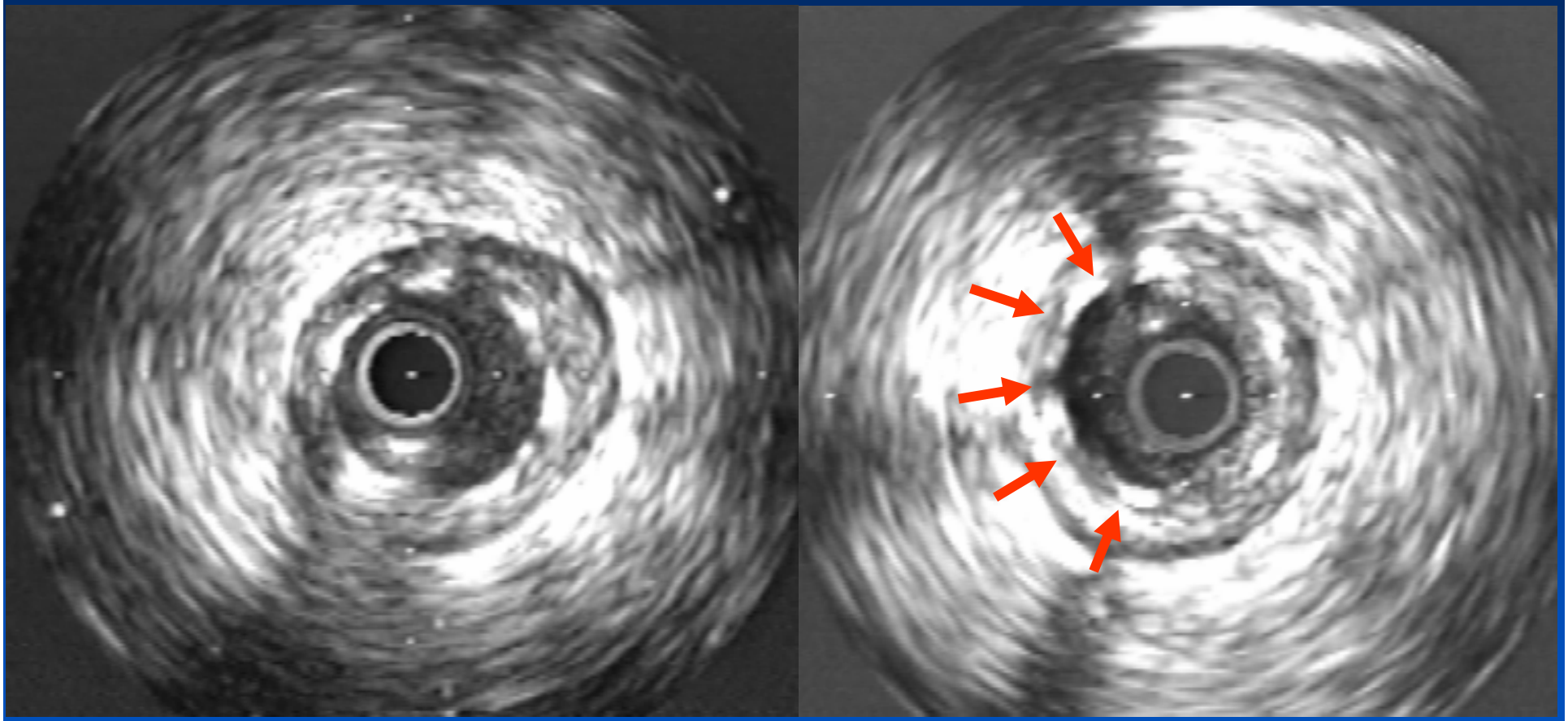
Hematoma





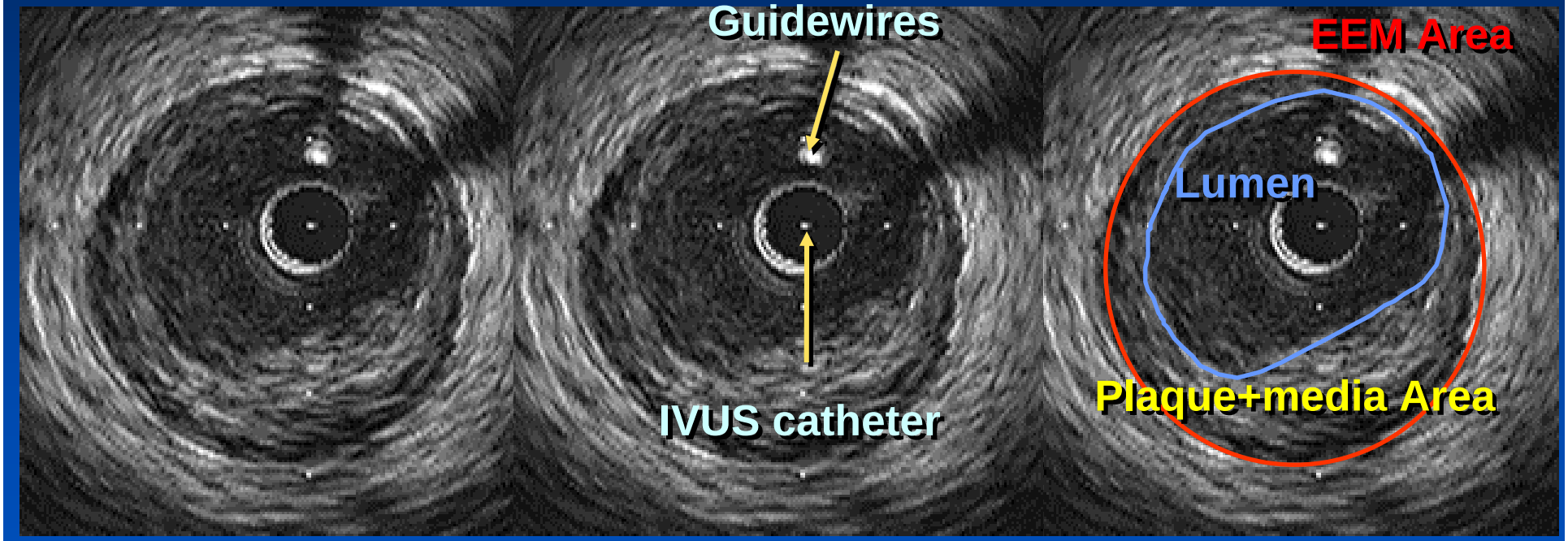
IVUS Comparison

Post-procedure **At 6 month follow-up**



Quantitative IVUS Analysis

Non-stented segment

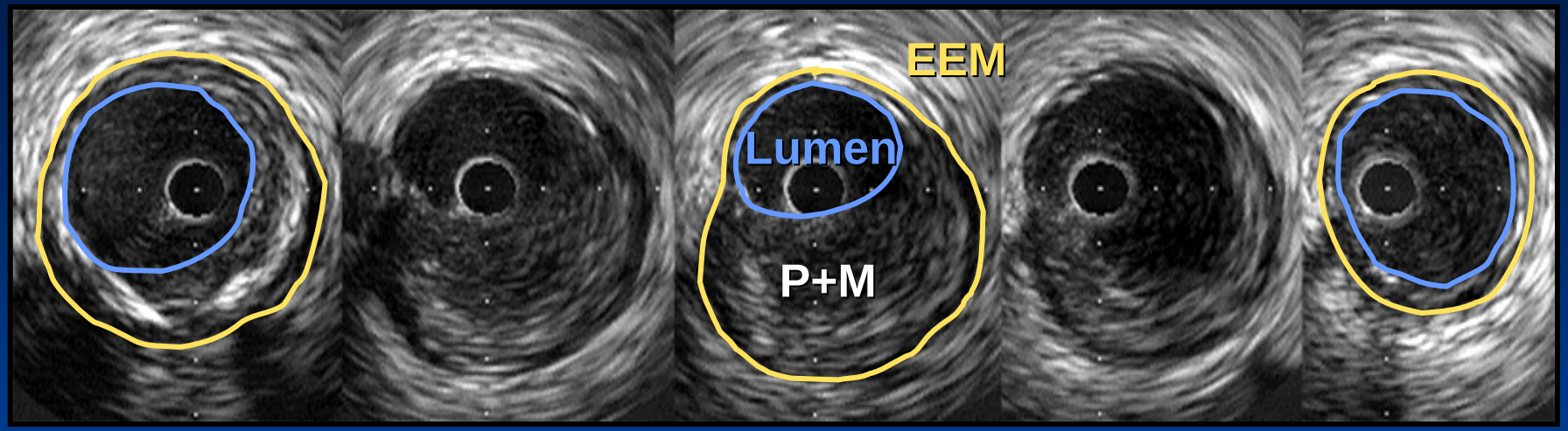


*PM Area = (EEM-Lumen) Area

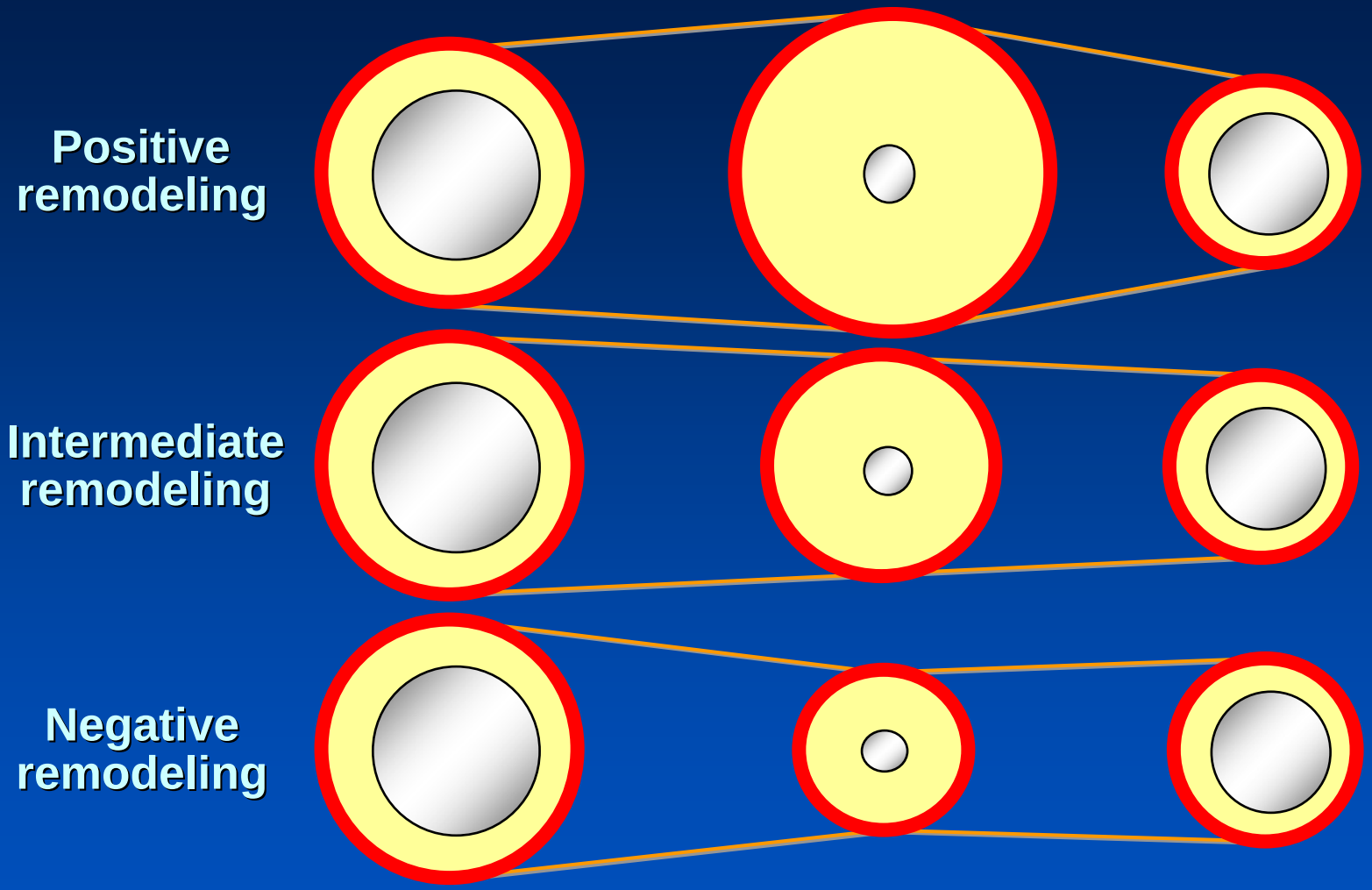
Proximal Reference

Lesion Site

Distal Reference



Classification of Remodeling

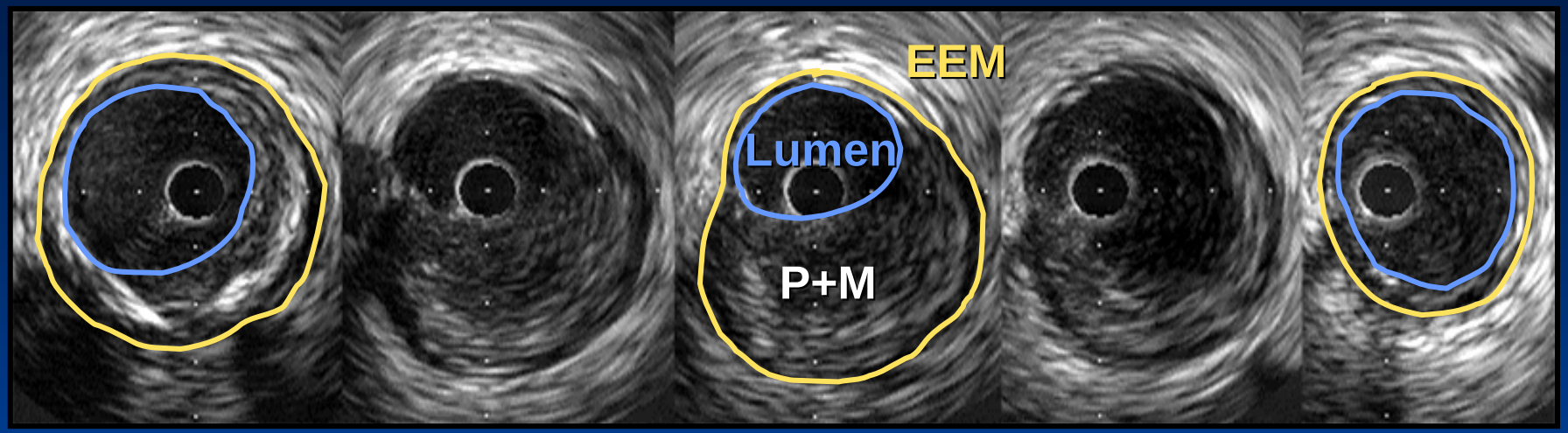


Nishioka. *JACC* 1996

Definitions of Remodeling

- Lesion/Average Reference EEM CSA
  - Positive remodeling: >1.05
  - No Remodeling: 0.95-1.05
  - Negative remodeling: <0.95

Proximal Reference	Lesion Site	Distal Reference

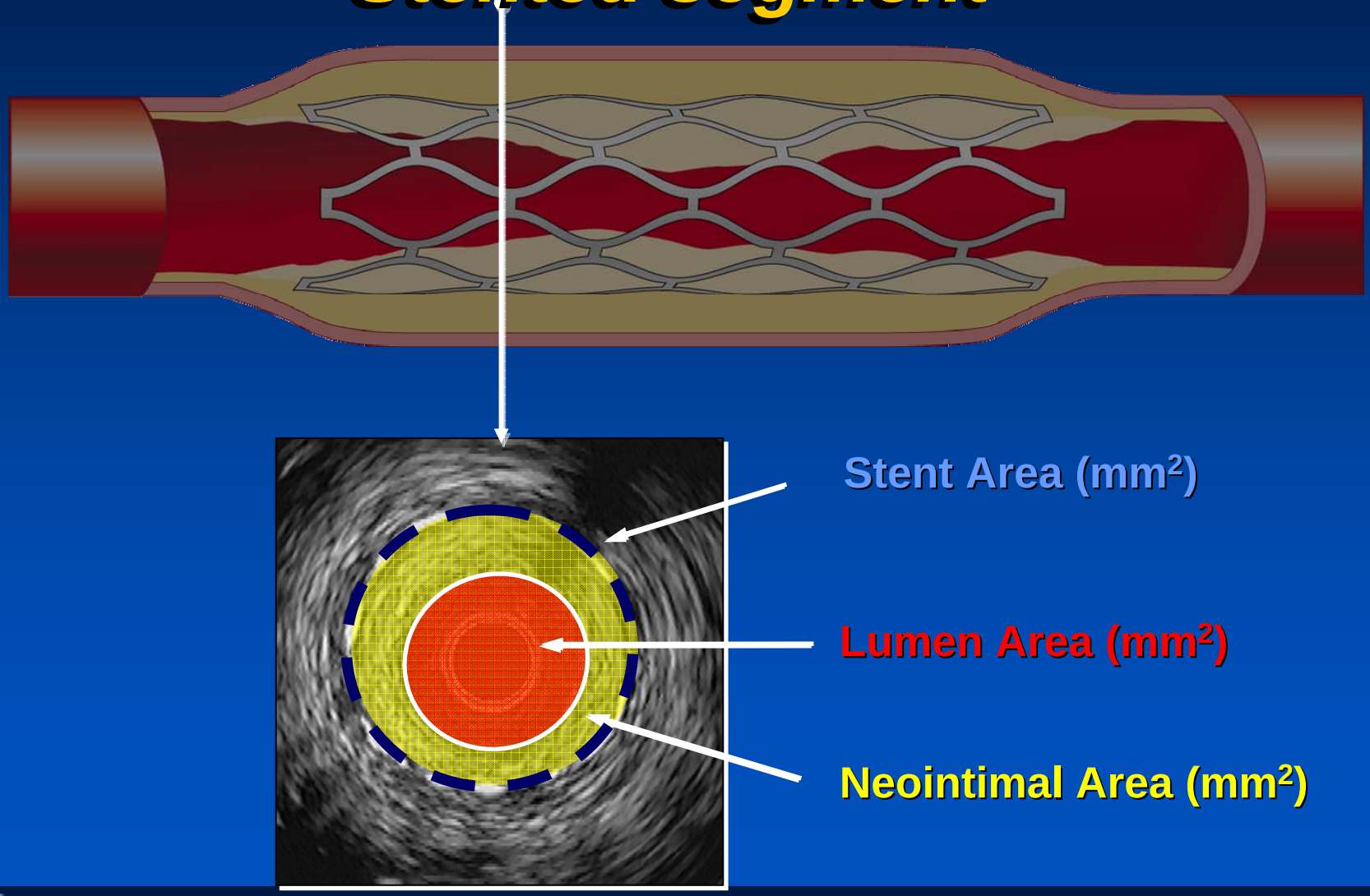


Proximal Reference	Lesion Site	Distal Reference
EEM CSA = 20.4	EEM CSA = 21.6	EEM CSA = 13.3
Lumen CSA = 9.7	Lumen CSA = 4.5	Lumen CSA = 8.9
P+M CSA = 10.7	P+M CSA = 17.1	P+M CSA = 4.4
Max lumen diam = 3.7	Max lumen diam = 32.8	Max lumen diam = 3.6
MLD = 3.1	MLD = 2.3	MLD = 3.0
Eccentricity = 1.0/0.3	Eccentricity = 3.0/0.1	Eccentricity = 0.6/0.2
Plaque burden = 0.52	Plaque burden = 0.79	Plaque burden = 0.33
Arc of Ca = 60		

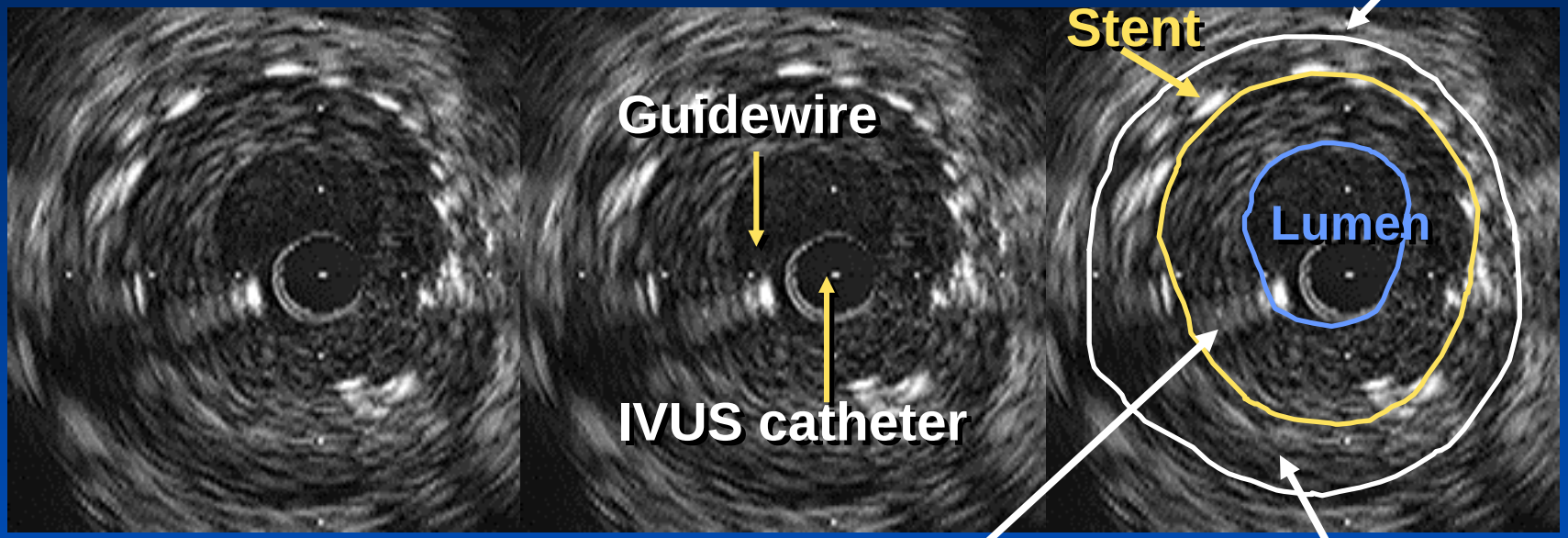
Average Reference EEM CSA = 16.9
Remodeling Index = 1.3
=> Positive Remodeling

Quantitative IVUS Analysis

Stented segment



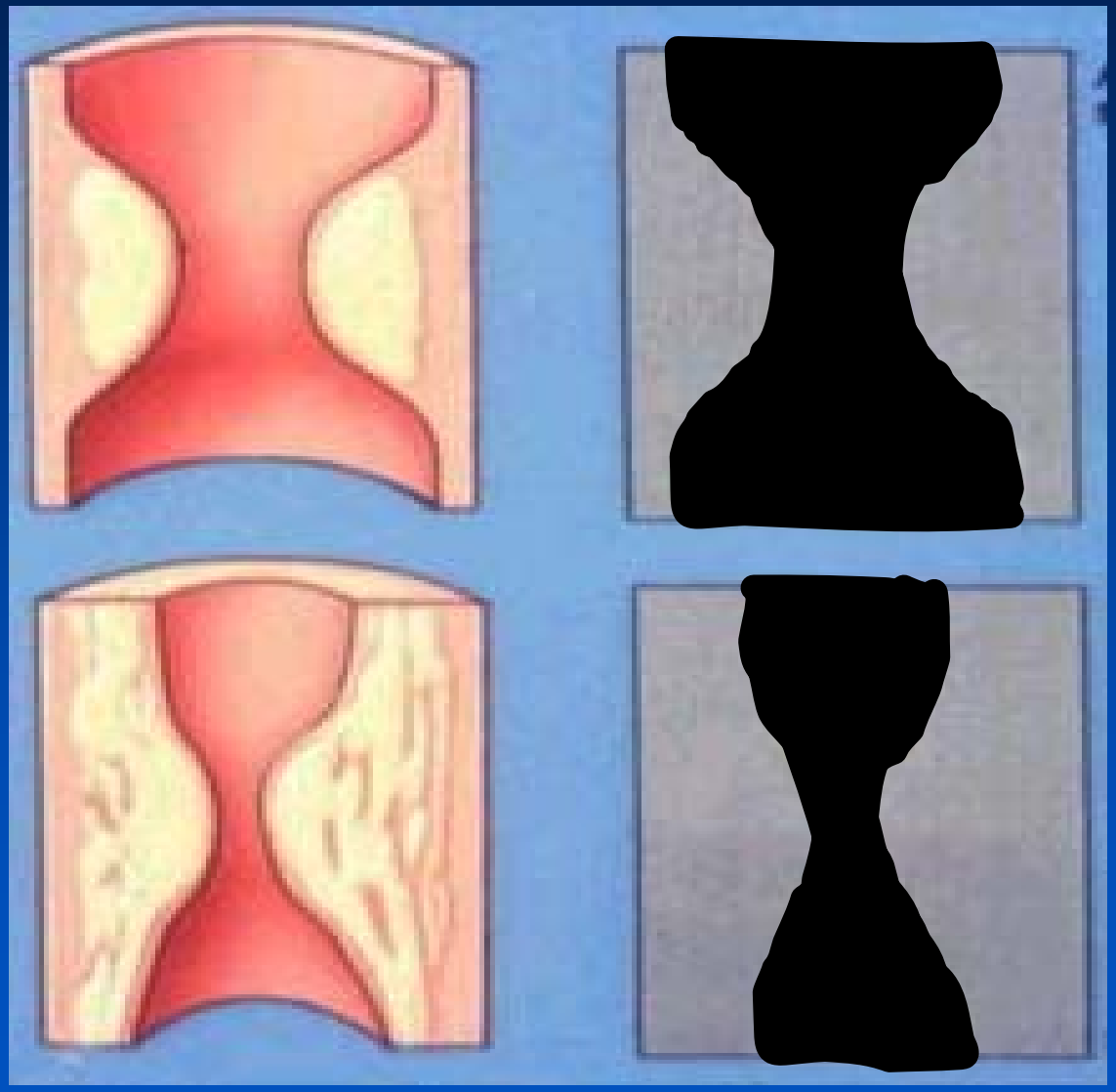
Stented Artery



IVUS vs. Angiography

LIMITATIONS OF CORONARY ANGIOGRAPHY

Focal disease



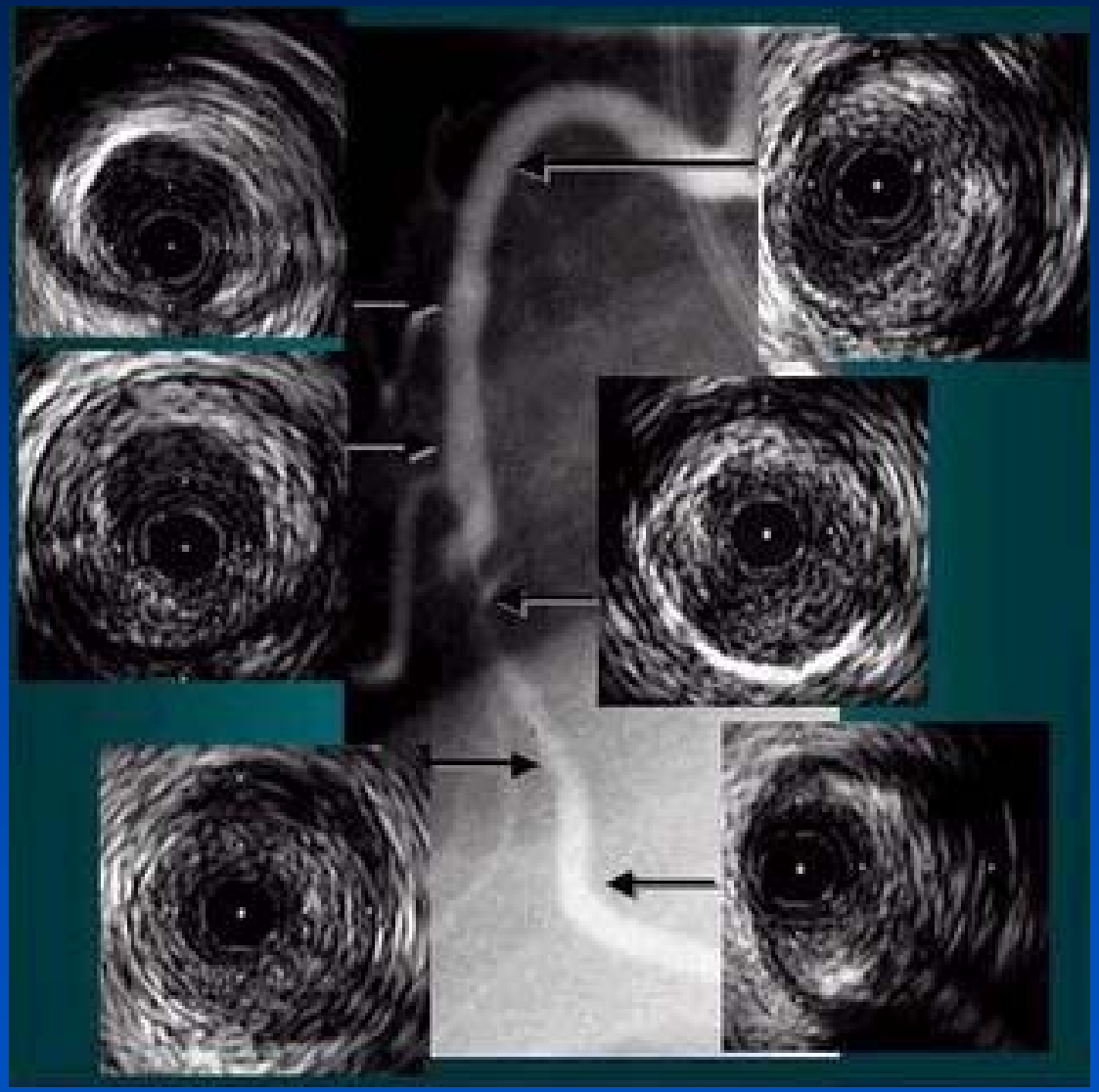
50% lesion

Diffuse disease

50% lesion

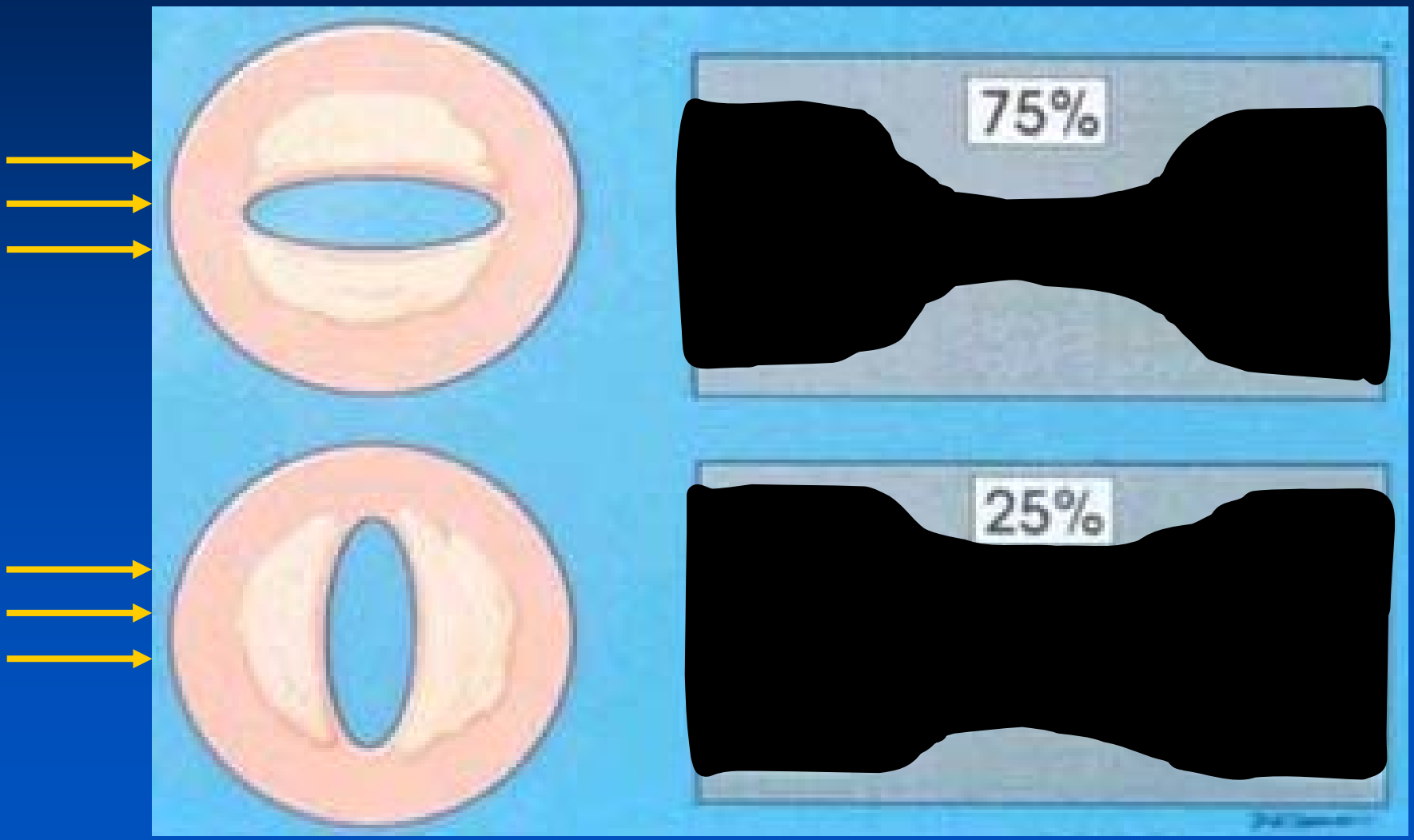
Angiograpically Silent Disease

In 884 native coronary arteries, the plaque burden in the angiographically "normal" reference segment was 51 ± 13%

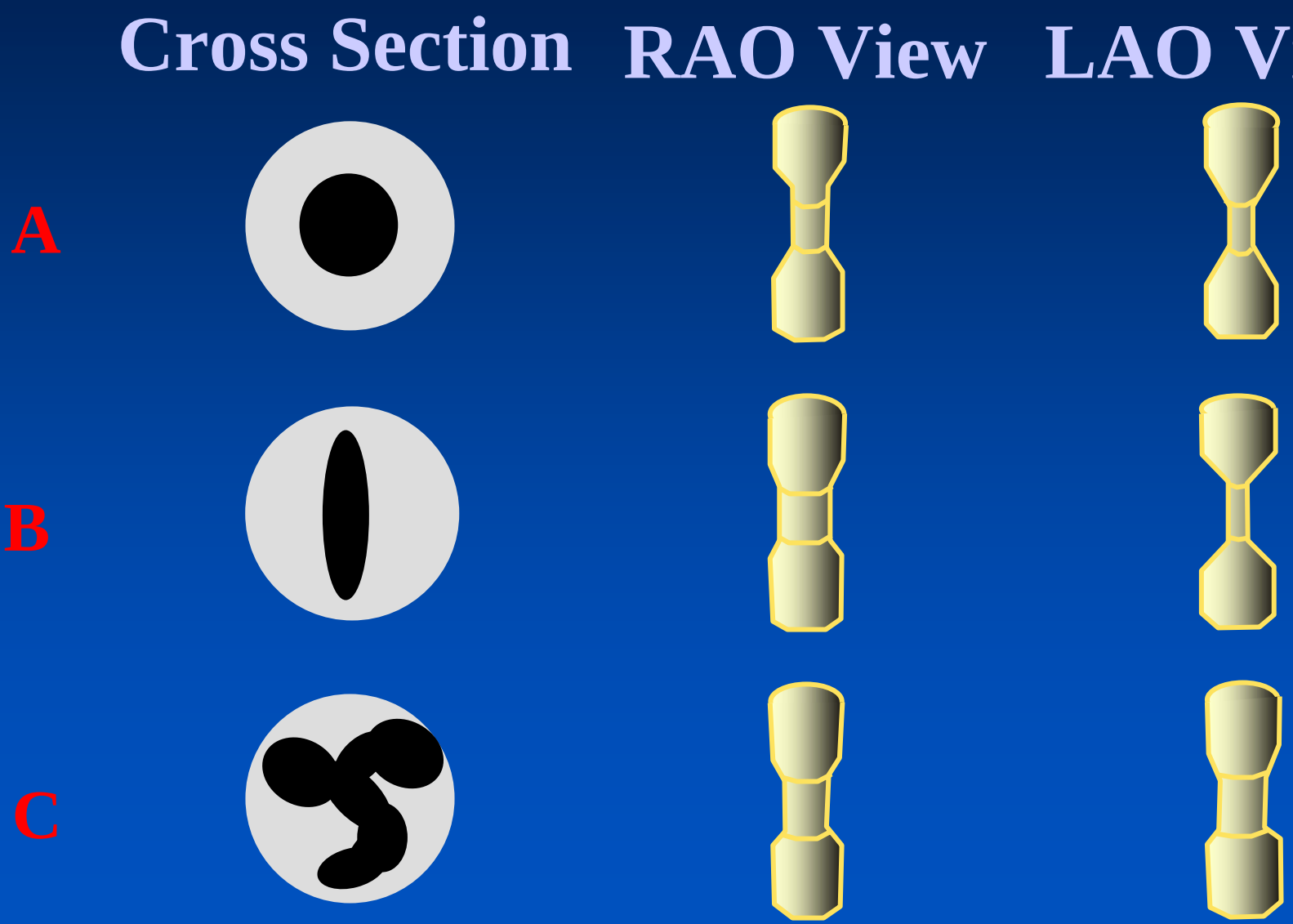


Mintz GS, et al. Atherosclerosis in angiographically normal coronary artery reference segments. J Am Coll Cardiol 1995;25:1479-1485

LIMITATIONS OF CORONARY ANGIOGRAPHY

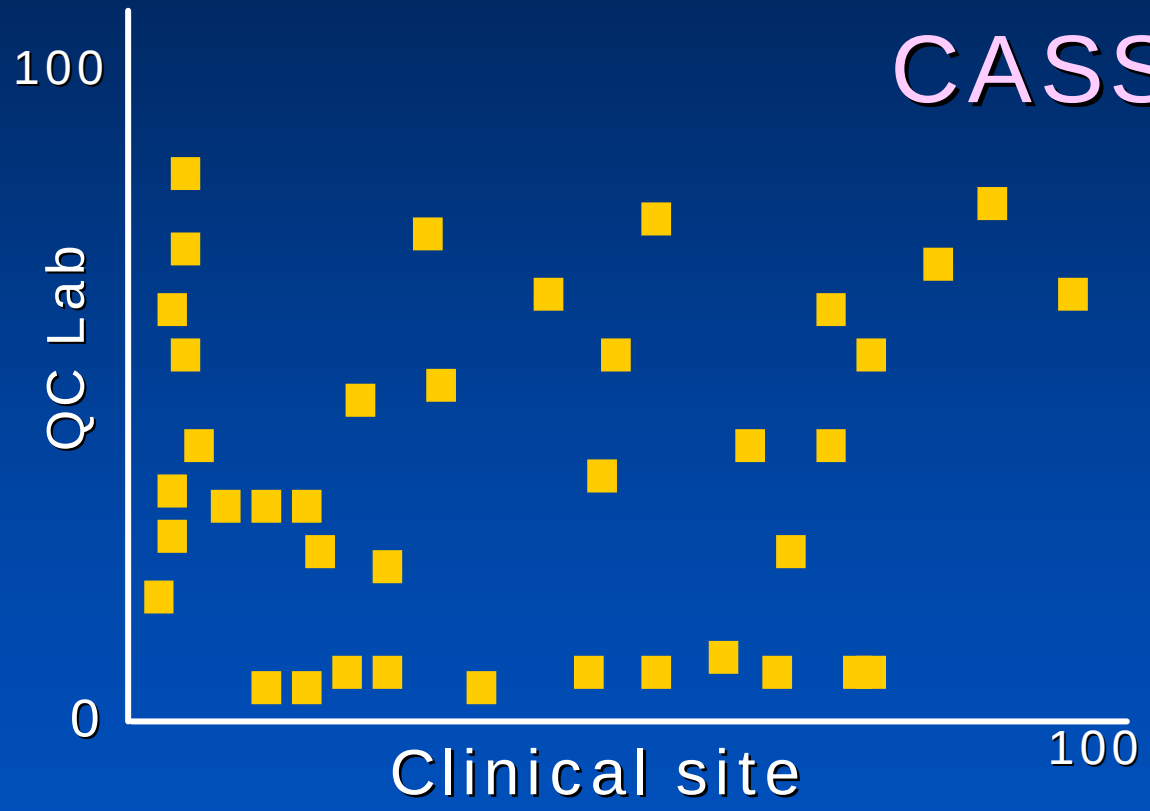


Irregular Plaque / Irregular Lumen



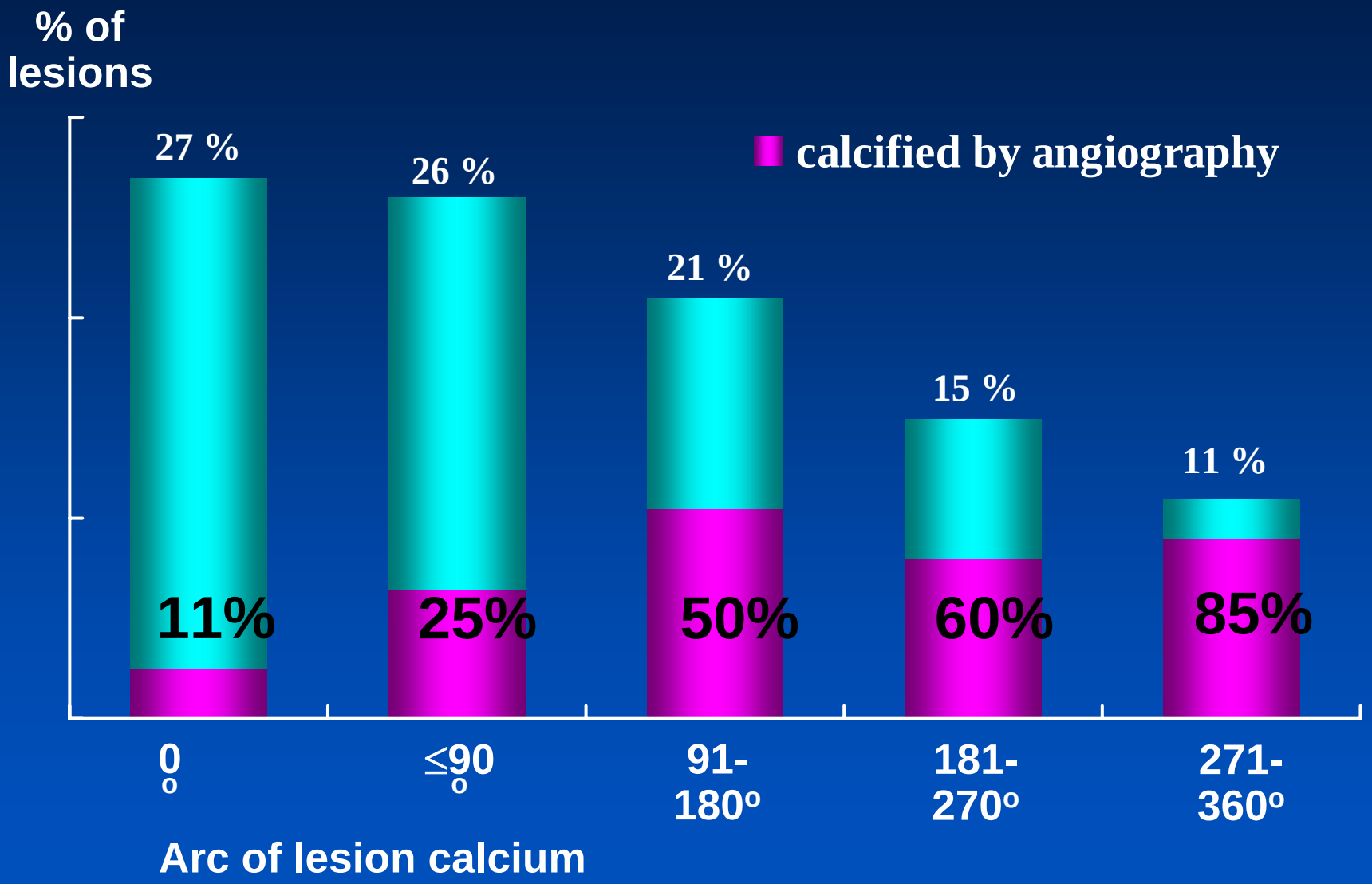
Limitation of coronary Angiography

"Poor inter-observer Correlation"



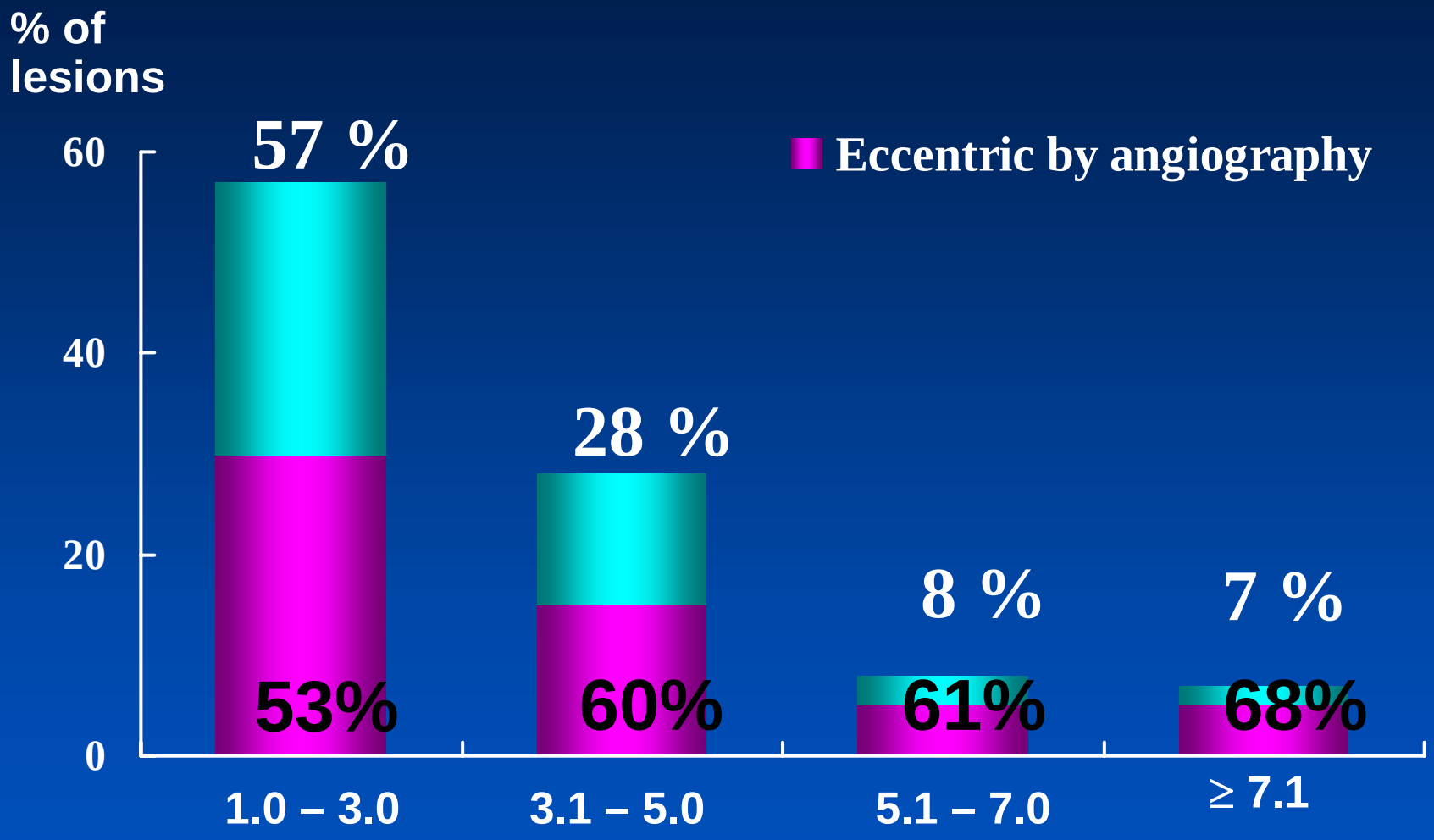
Fisher et al, CCD 1982

IVUS arc of target lesion calcification



Mintz et al. Circulation 1995;91:1959-1965.

IVUS eccentricity index



Eccentricity index = max/min P + M thickness

Mintz et al. Circulation 1996;93:924-931