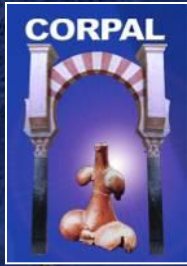


El Teide desde el sur de Gran Canaria

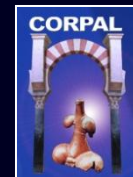
*Técnicas diagnósticas en
la enfermedad coronaria:
más allá de la angiografía*



CÓRDOBA

LAS PALMAS





Más allá de la angiografía

... CORPAL 1988-2011



the trigger ...

While conducting an imaging procedure in which dye was to be injected into the aortic valve of a patient with valvular disease, Dr. Mason Sones a pediatric cardiologist at The Cleveland Clinic discovered that the catheter had accidentally entered the patient's right coronary artery and, before it could be removed, 30cc's of contrast dye had been released. He expected the heart to fibrillate, but it did not and Sones discovered that the coronary arteries could tolerate contrast dye. Sones recalled, ***"I knew that night that we finally had a tool that would define the anatomic nature of coronary artery disease."***

Axial Cineangiography in Congenital Heart Disease

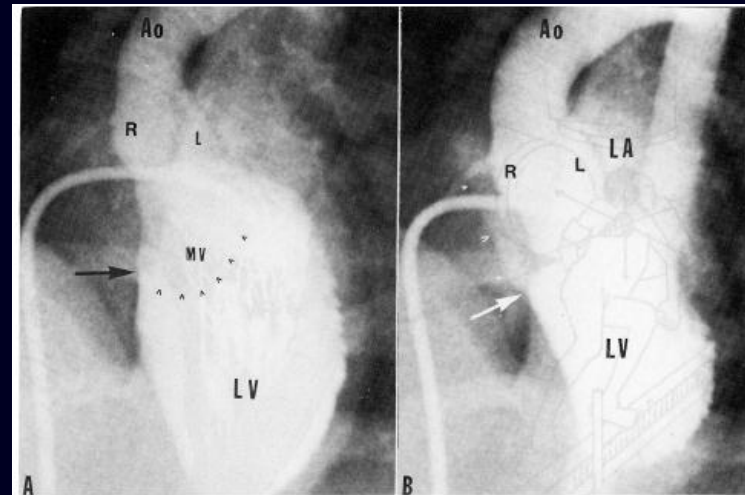
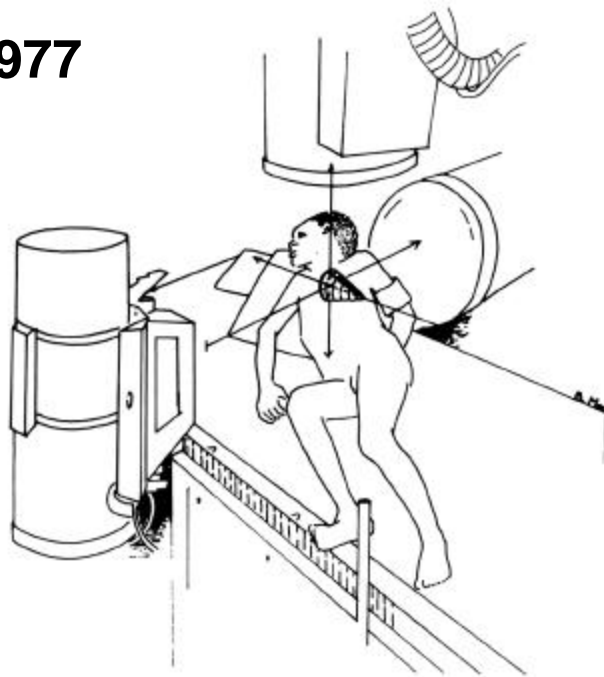
Section I. Concept, Technical and Anatomic Considerations

L. M. BARGERON, JR., M.D., LARRY P. ELLIOTT, M.D., BENIGNO SOTO, M.D.,
PETER R. BREAM, M.D., AND GEORGE C. CURRY, M.D.

SUMMARY Cineangiographic axial techniques were designed to overcome the limitations of conventional angiography in the diagnosis of congenital heart disease. Two basic patient (or equipment) maneuvers are involved; 1) long axis of the heart is aligned perpendicular to the X-ray beam, and 2) rotation of patient results in the heart being radiographically sectioned at 30° angles. To accomplish this with fixed vertical and horizontal X-ray tubes, three positions were developed: 1) "hepato-clavicular," 2) "long axial oblique," 3) "anterior-posterior axial." A fourth, the "sitting-up"

projection is discussed. The hepato-clavicular position profiles the posterior ventricular septum and atrial septum, separates the A-V valves, places the four cardiac chambers en face, and clarifies mitral valve-semilunar valve and outflow tract relationships. The long axial oblique profiles the anterior ventricular septum, left ventricular outflow tract, aortic valve-anterior mitral valve leaflet. The sitting-up view visualizes the bifurcation of the pulmonary trunk and separates true pulmonary arteries from systemic collaterals.

1977



CLINICAL STUDIES

Coronary Angiographic Morphology in Myocardial Infarction: A Link Between the Pathogenesis of Unstable Angina and Myocardial Infarction

JOHN A. AMBROSE, MD, FACC,* STEPHEN L. WINTERS, MD,* ROHIT R. ARORA, MD,*
JACOB I. HAFT, MD, FACC,† JONATHAN GOLDSTEIN, MD, FACC,†
K. PETER RENTROP, MD, FACC,* RICHARD GORLIN, MD, FACC,*
VALENTIN FUSTER, MD, FACC*

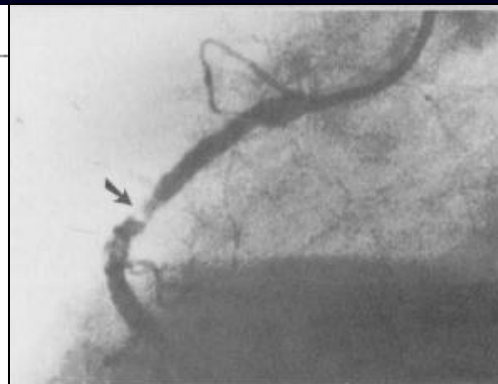
New York, New York and Newark, New Jersey

It has previously been shown that analysis of coronary morphology can separate unstable from stable angina. An eccentric stenosis with a narrow neck or irregular borders, or both, is very common in patients who present with acute unstable angina, whereas it is rare in patients with stable angina. To extend these observations to myocardial infarction, the coronary morphology of 41 patients with acute or recent infarction and nontotally occluded infarct vessels was studied. For all patients, 27 (66%) of 41 infarct vessels contained this eccentric narrowing, whereas only 2 (11%) of 18 noninfarct vessels with narrowing of 50 to less than 100% had this lesion ($p < 0.001$). In addition, a separate group of patients with acute myocardial infarction who underwent intracoronary streptokinase infusion were also analyzed in similar fashion. Fourteen (61%) of 23 infarct vessels contained this lesion after streptokinase infusion com-

pared with 1 (9%) of 11 noninfarct vessels with narrowing of 50 to less than 100% ($p < 0.01$).

Therefore, an eccentric coronary stenosis with a narrow neck or irregular borders, or both, is the most common morphologic feature on angiography in both acute and recent infarction as well as unstable angina. This lesion probably represents either a disrupted atherosclerotic plaque or a partially occlusive or lysed thrombus, or both. The predominance of this morphology in both unstable angina and acute infarction suggests a possible link between these two conditions. Unstable angina and myocardial infarction may form a continuous spectrum with the clinical outcome dependent on the subsequent change in coronary supply relative to myocardial demand.

(J Am Coll Cardiol 1985;6:1233-8)

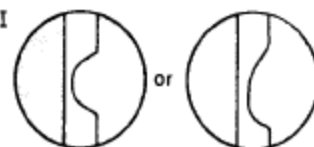


CONCENTRIC LESIONS

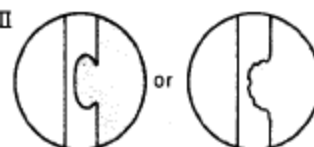


ECCENTRIC LESIONS

Type I



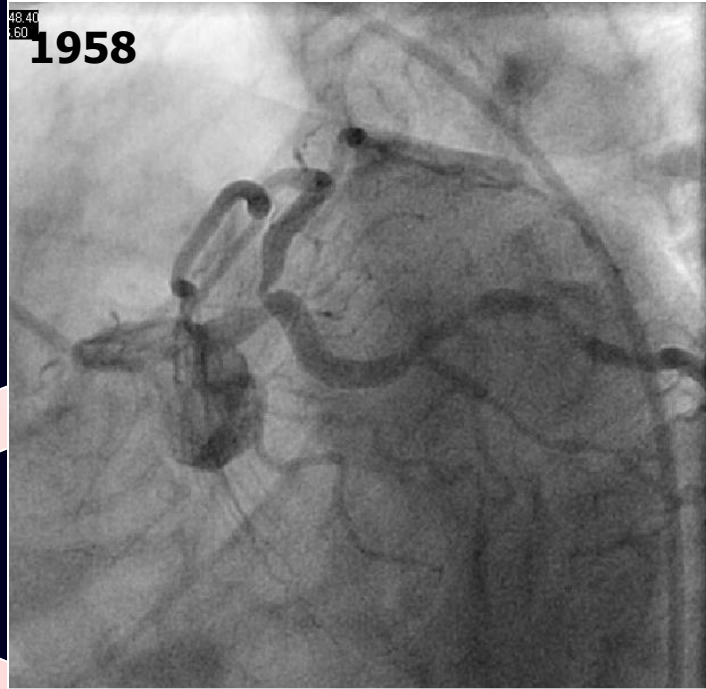
Type II



MULTIPLE IRREGULARITIES



Un círculo...

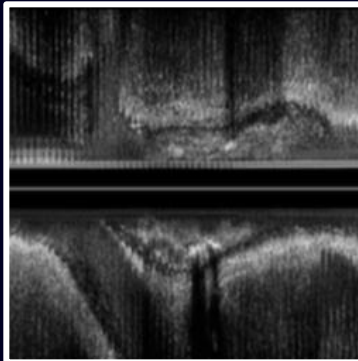


1990

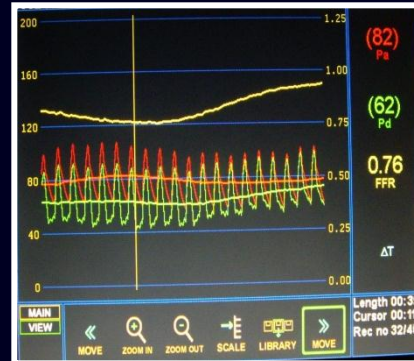
1995

2001 (in-vivo)

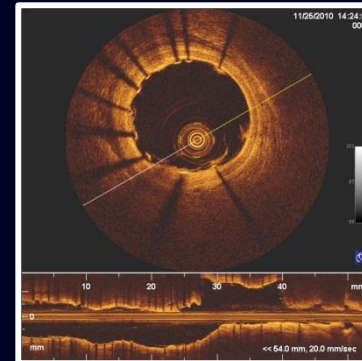
2002 (ex-vivo)



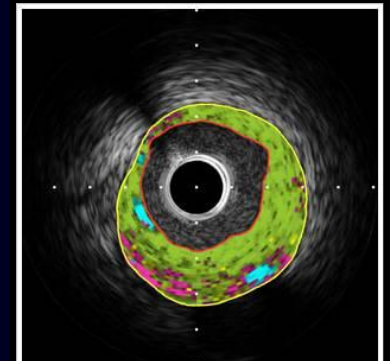
IVUS



Guía de presión

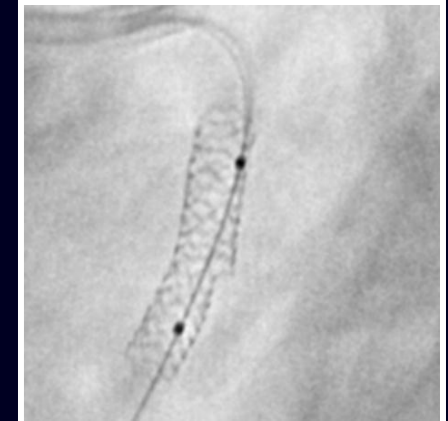
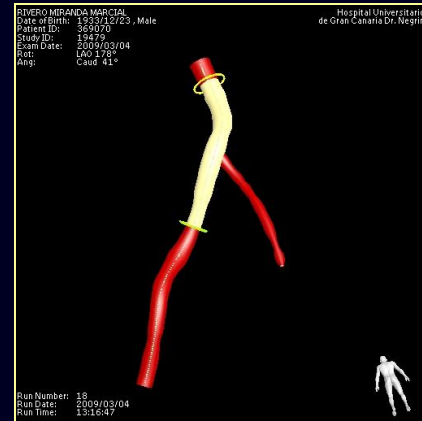
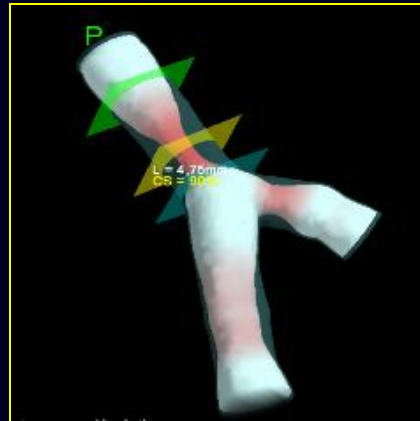
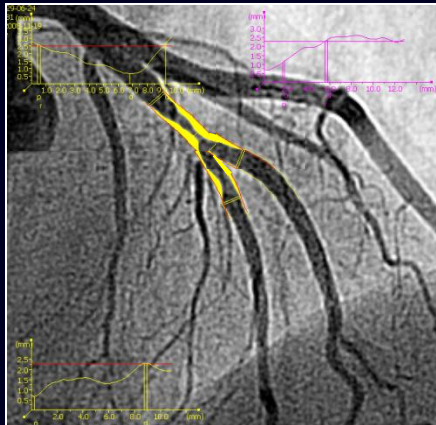
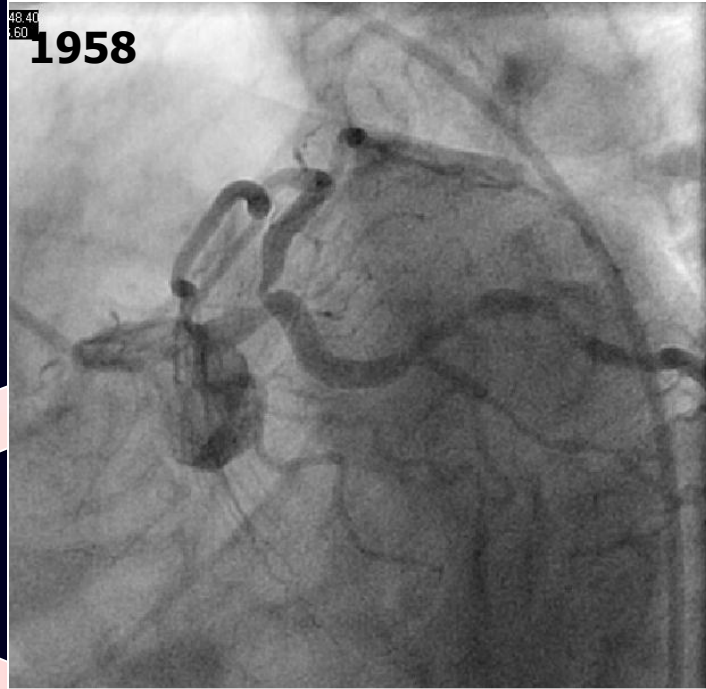


OCT

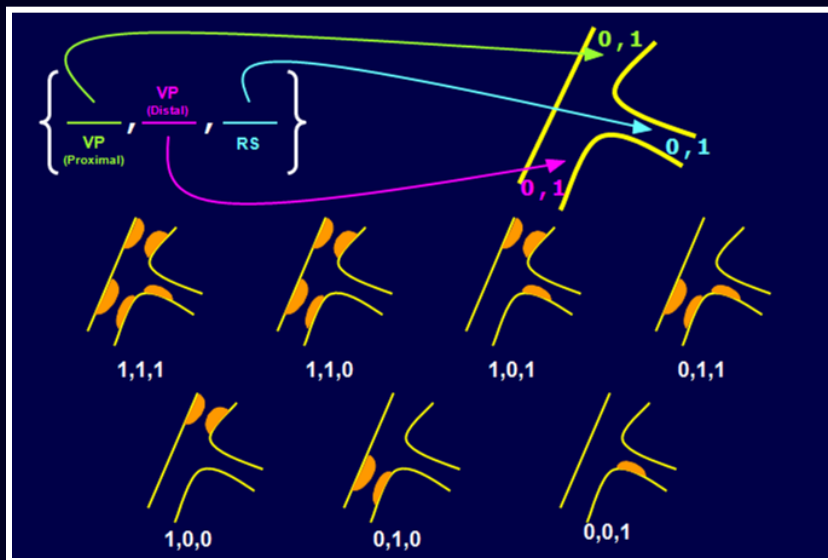
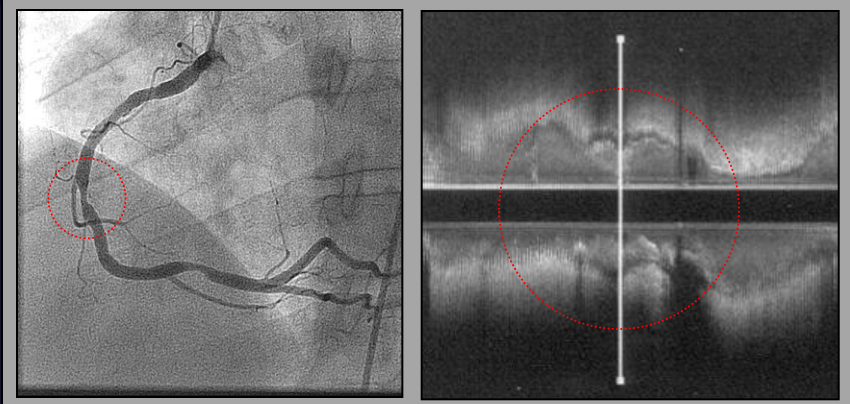


Histología virtual

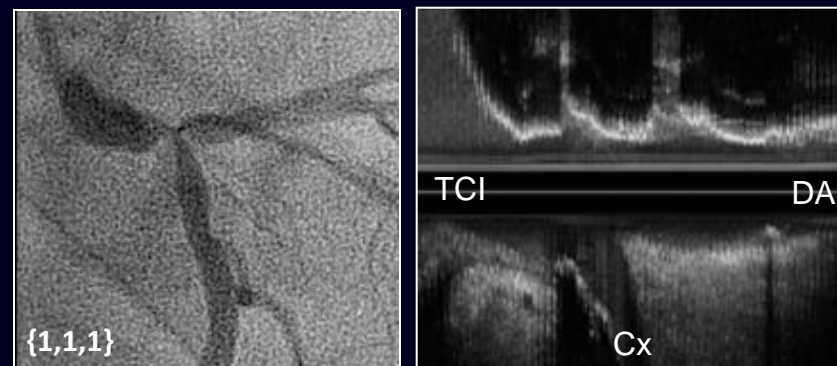
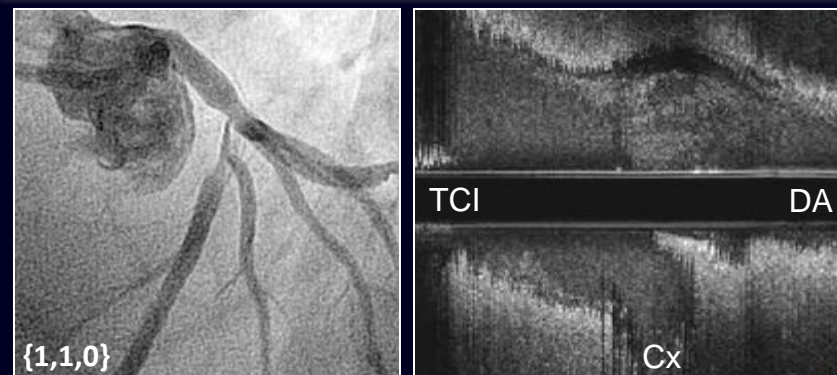
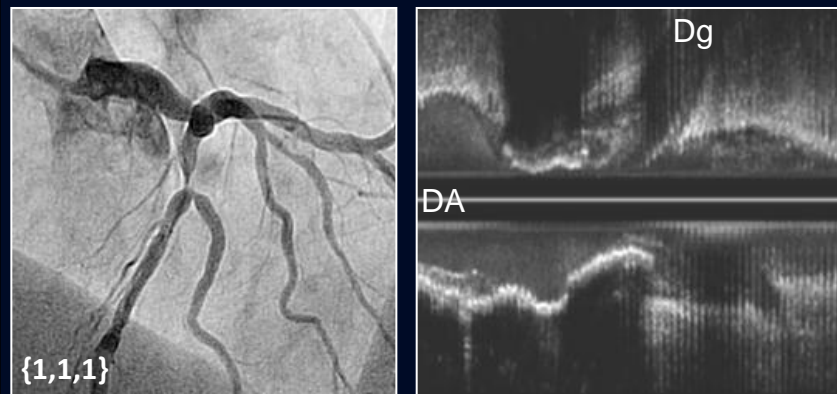
Un círculo...



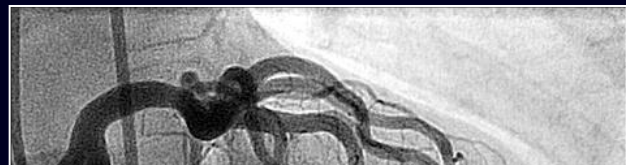
Lesiones en segmentos no bifurcados



Lesiones en bifurcación coronaria



... UNA RECONSTRUCCIÓN AXIAL ENDOLUMINAL



Placa fibrótica excéntrica

IVUS

1990

TCI

Carina puntiaguda

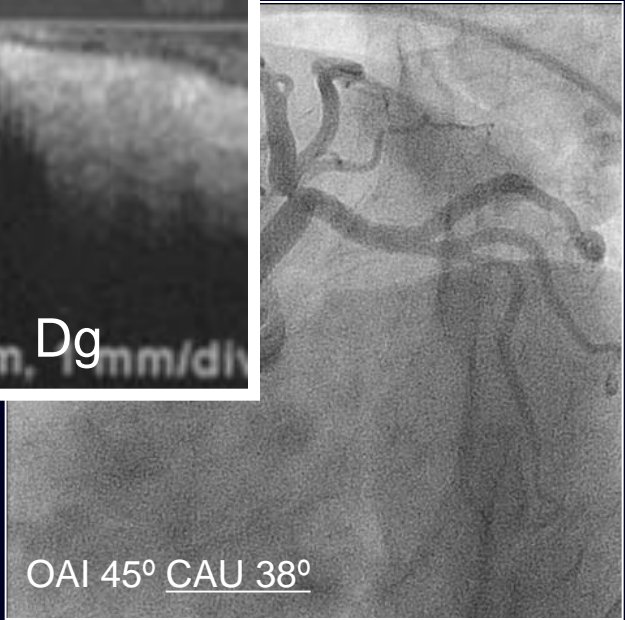
DA

$\{0,1,0\}$

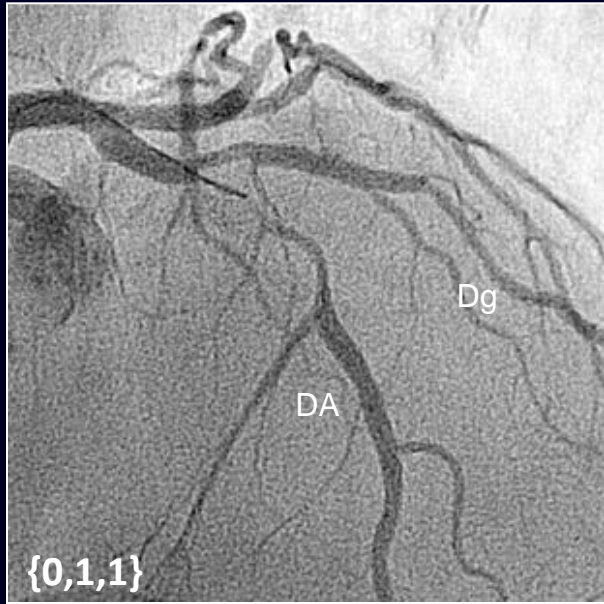
Cx 11.4 mm, Dg mm/dl



“Fore-shortening”
Solapamiento de otros vasos
Número limitado de proyecciones



Reconstrucción longitudinal del IVUS



Long axis reconstruction

Type $\{0,1,1\}$

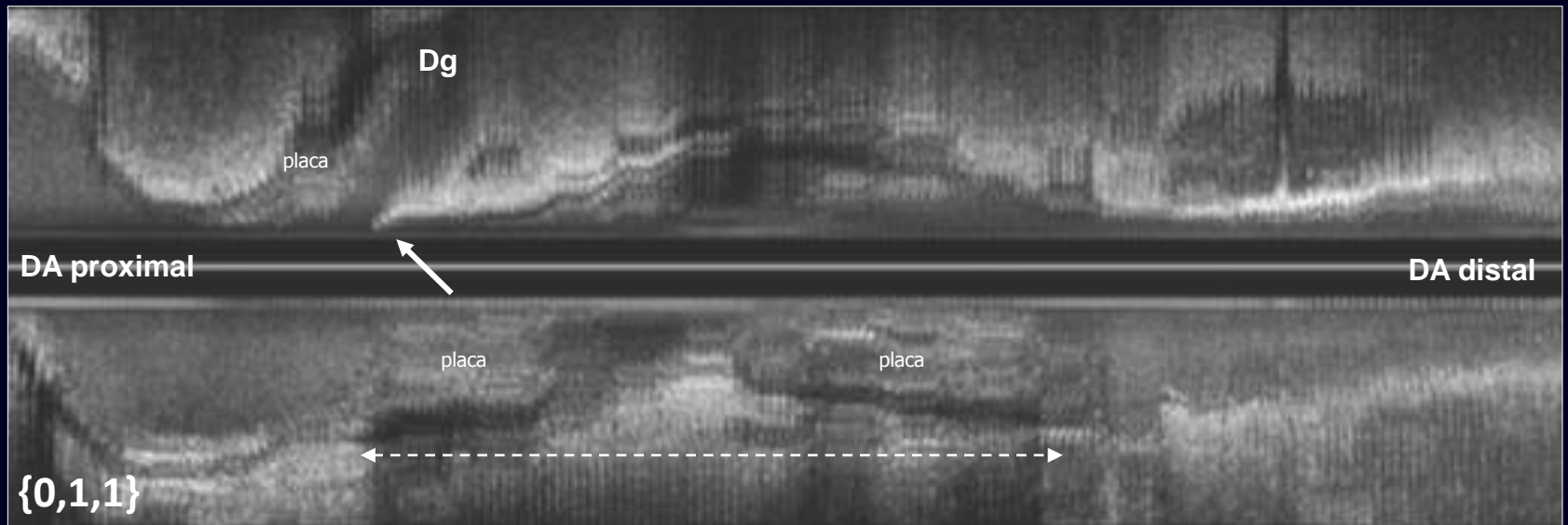
Spiky carina

Carina free of plaque (both sides)

Soft plaque (countercarina SB)

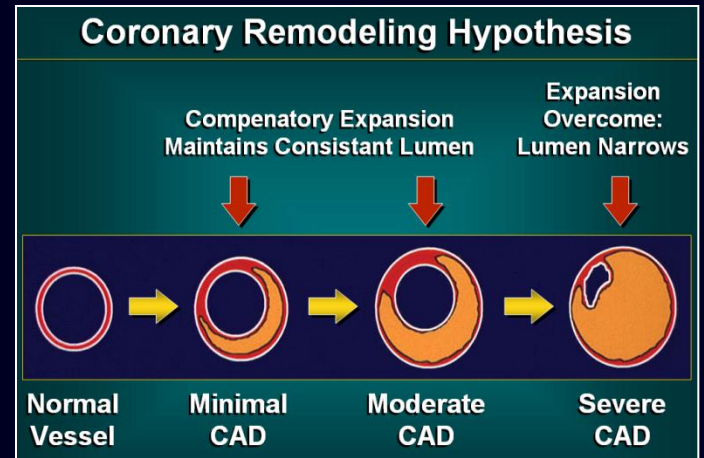
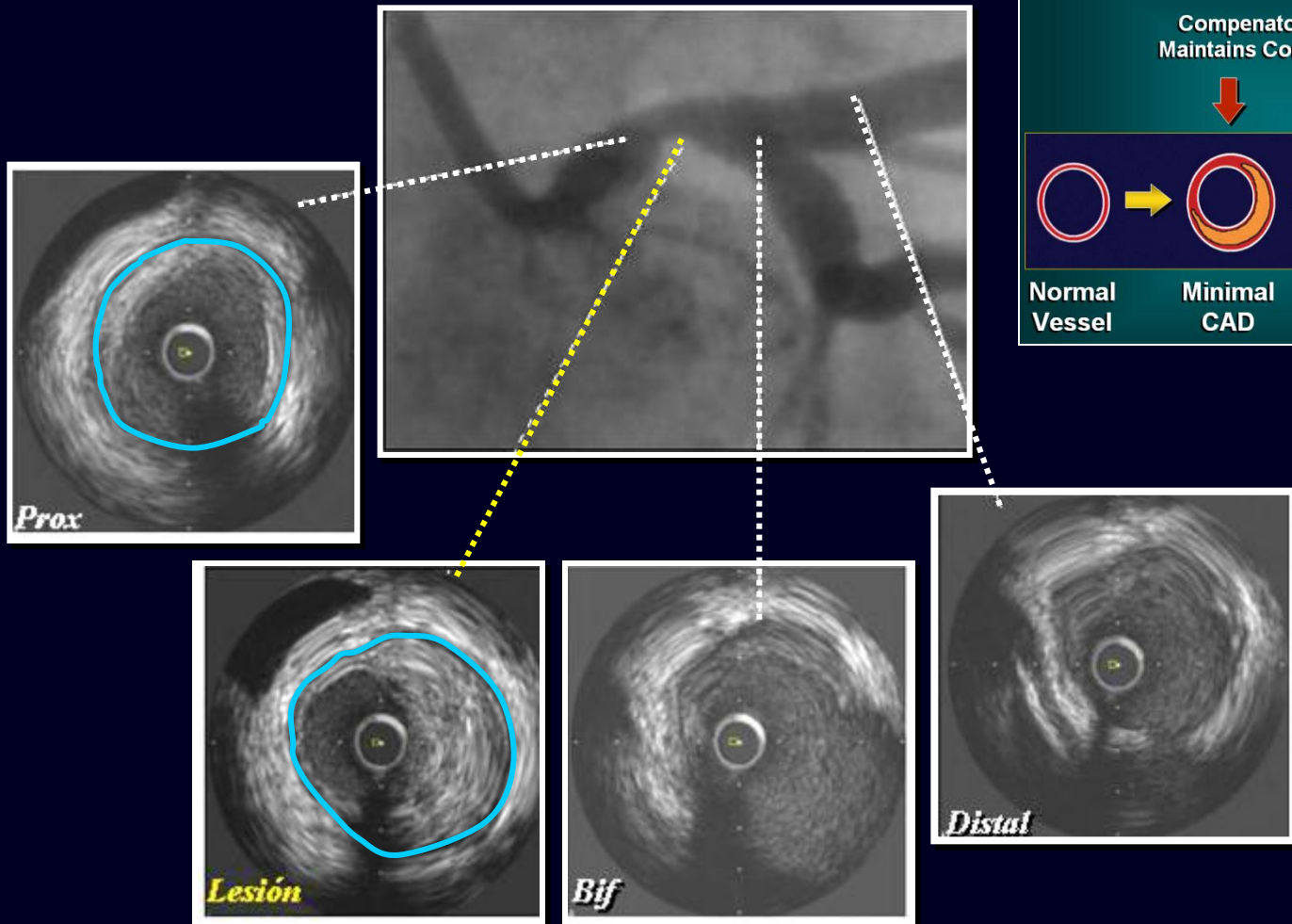
Acute angle

Non calcified plaque

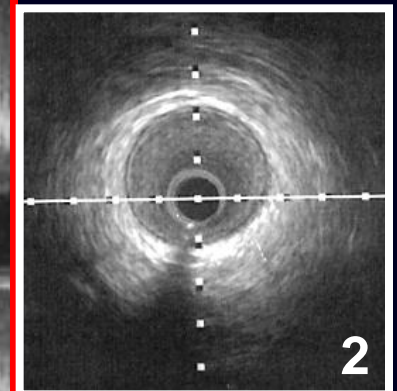
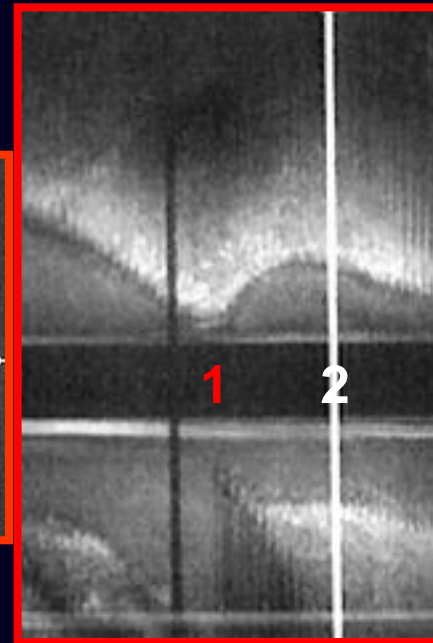
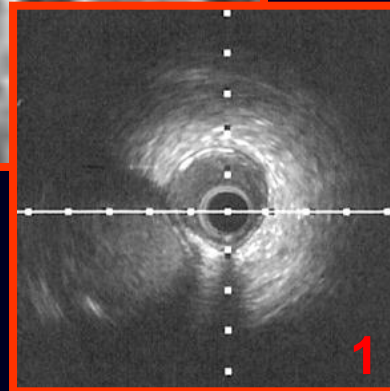


REMDELADO POSITIVO

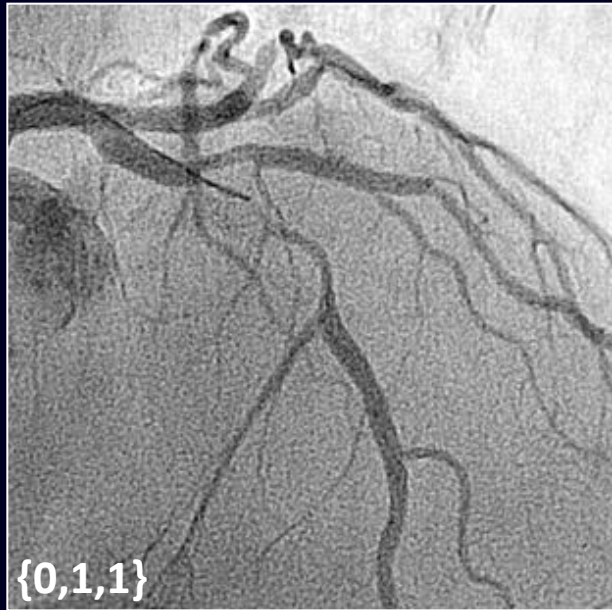
Indice de remodelado = Área LEE lesión / Área referencia



REMODELADO NEGATIVO



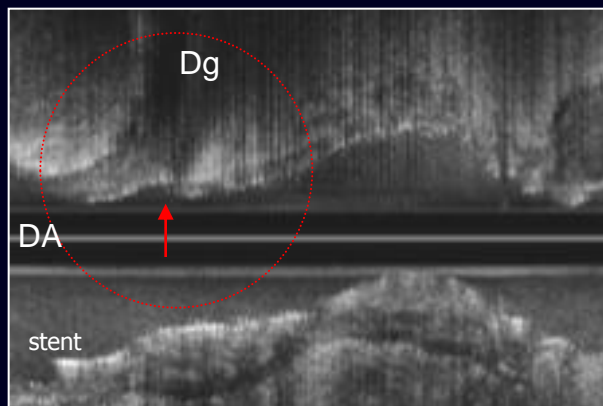
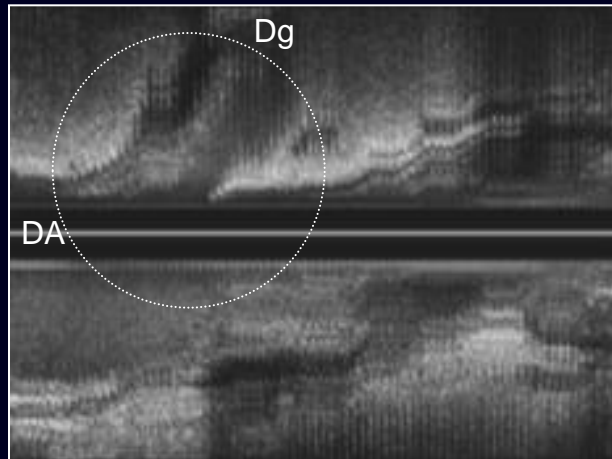
Basal



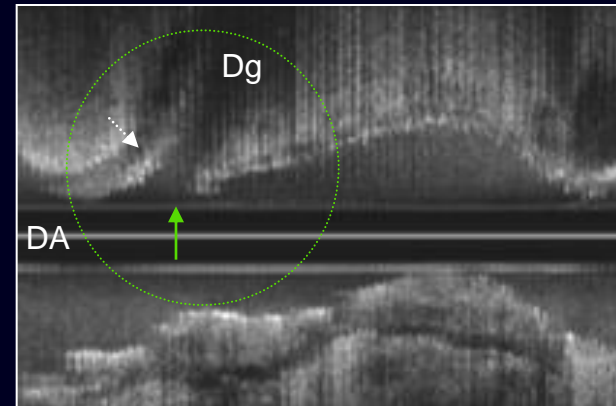
Tras stent en VP



Tras SMS



Desplazamiento de la carina – daño ostial



Reposicionamiento de la carina

MORFOLOGIA DE LA CARINA EN LESIONES EN BIFURCACIÓN CORONARIA

Signo de la ceja

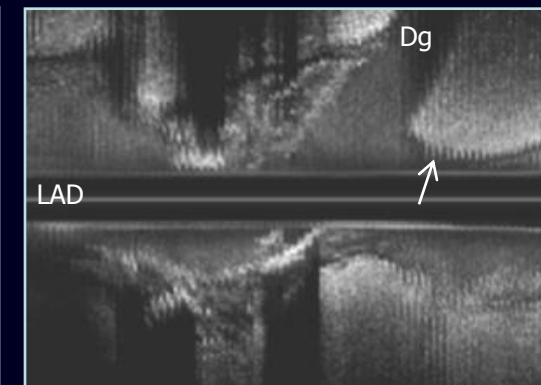
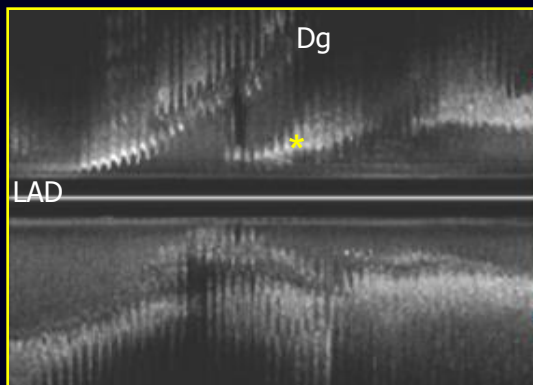
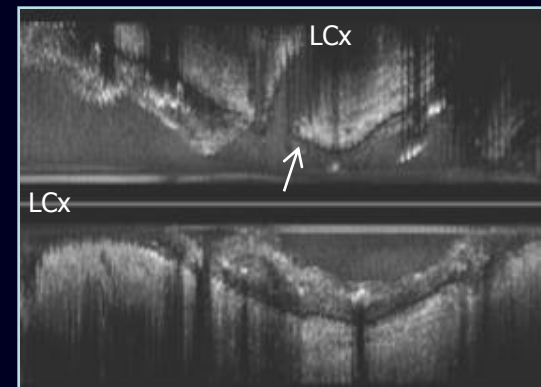
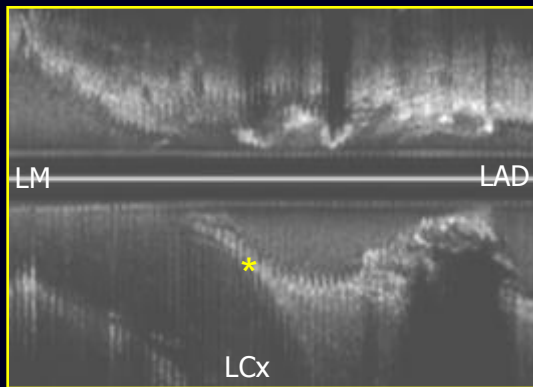
(n=195)



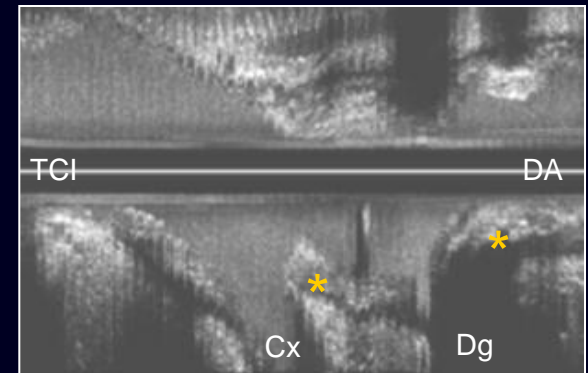
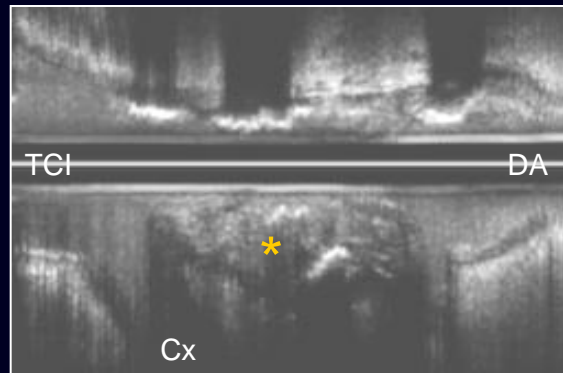
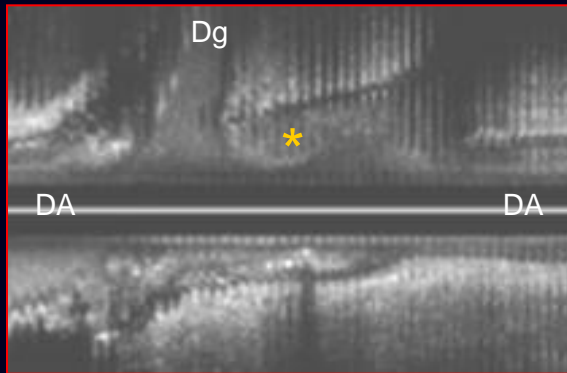
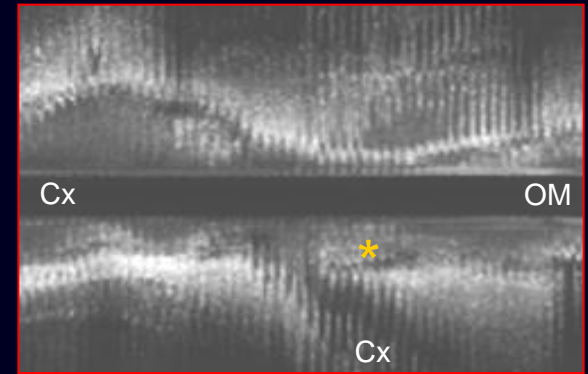
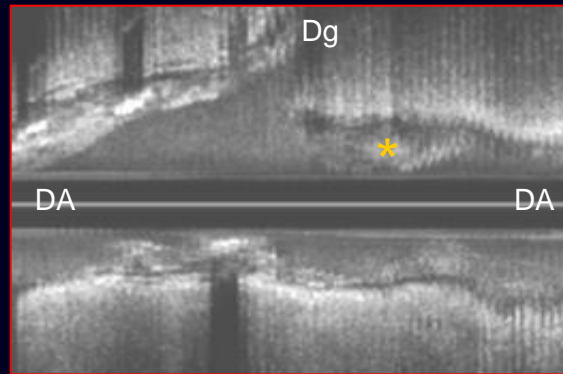
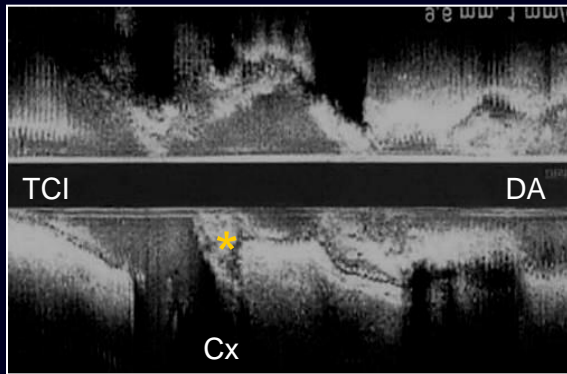
SI: 87 (45%)

"spiky carina"

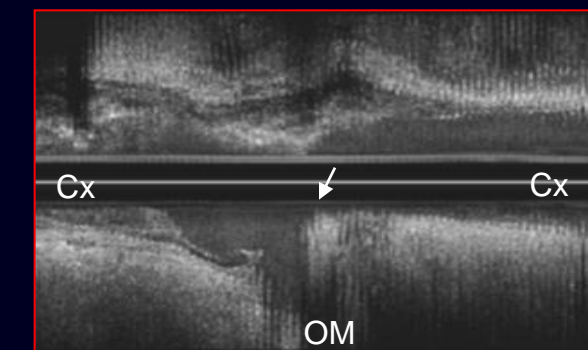
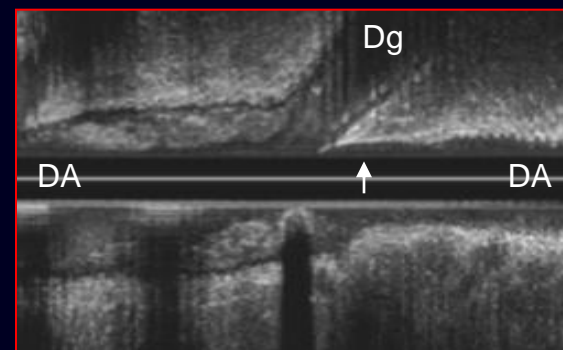
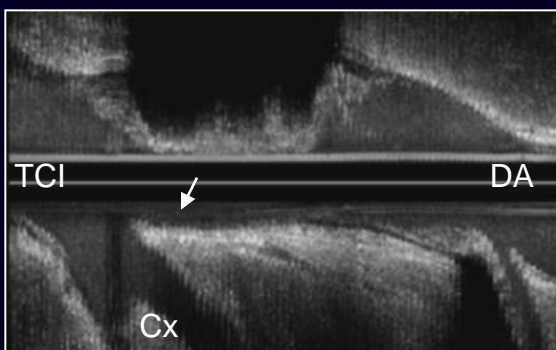
NO: 108 (55%)



Placa en la carina 63/195 (32%)



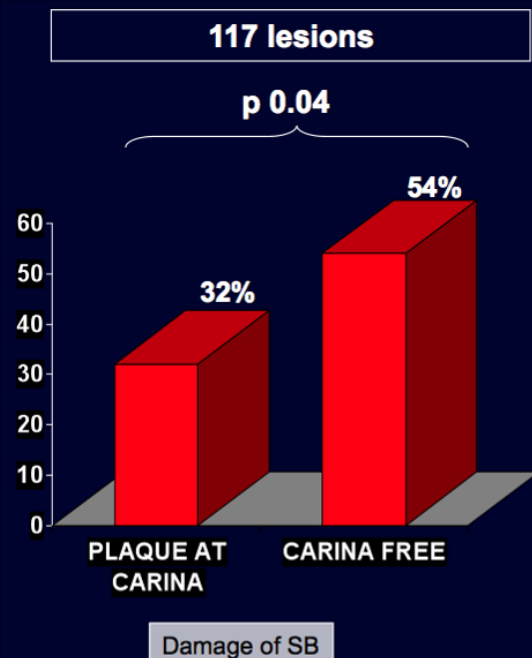
Carina libre de placa 132/195 (68%)



The carina is not always free of disease! Is it important or not?

Original article

Ultrasound Study of the Prevalence of Plaque at the Carina in Lesions That Affect the Coronary Bifurcation: Implications for Treatment With Provisional Stent



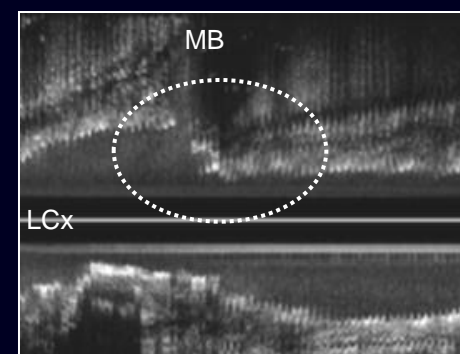
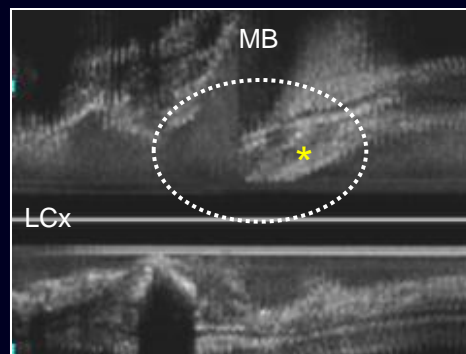
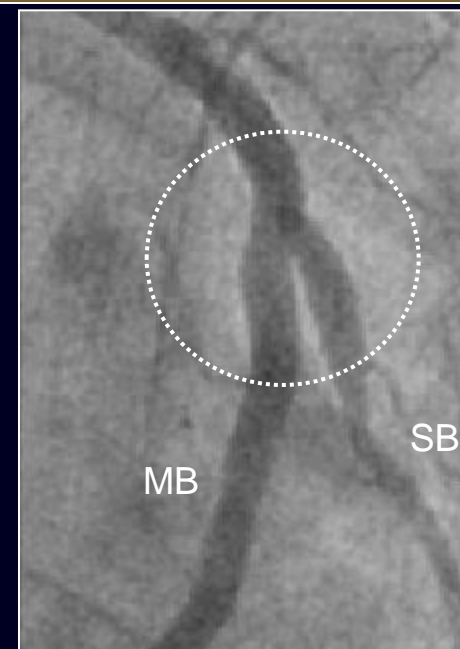
Introduction and objectives: The plaque distribution patterns in coronary bifurcation lesions are not well understood. It has been speculated that carina is free of plaque partly because of high wall shear stress providing an atheroprotective effect. The objective was to study plaque distribution with intravascular ultrasound (IVUS) in the coronary bifurcation and the prevalence of carina involvement.

Methods: IVUS study was performed on 195 coronary bifurcation lesions in the main vessel (MV) and on 91 in the side branch (SB). Plaque at the carina was considered when its thickness was >0.3 mm. Plaque burden was measured at different levels: proximal reference, distal, carina and at the point of minimal lumen area (MLA).

Results: The prevalence of plaque at the carina was 32%. Its thickness was 0.8 (0.36) mm, less than that observed at the counter-carina [1.22 (0.54) mm; $P < .01$]. The prevalence was higher (52%) when the MLA point was distal to the carina. The plaque at the carina was associated with a lower incidence of damage at the SB ostium after stenting the MV (32% versus 54%; $P < .04$).

Conclusions: The carina is not immune to atherosclerosis, showing plaque at this level in one-third of the bifurcations. The incidence of plaque is higher in those bifurcations with the MLA point distal to the carina and seems to be associated with a lower incidence of damage to the SB ostium.

Plaque at the carina might prevent carina shifting!!



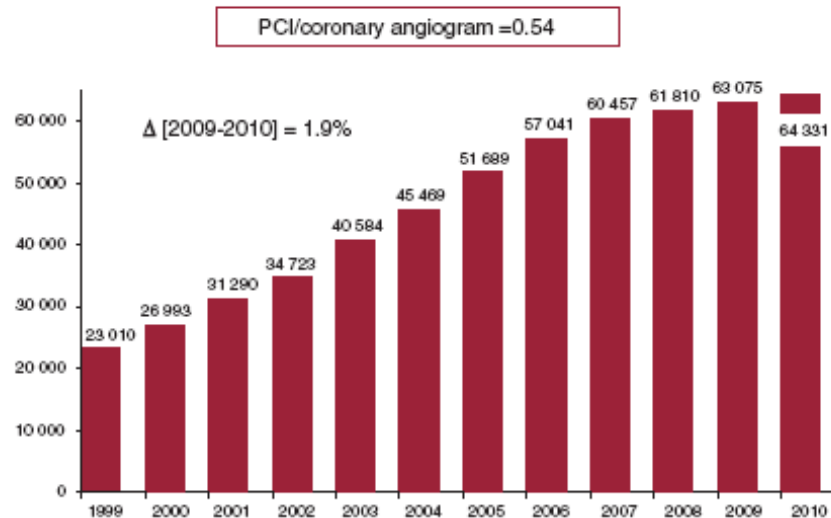


Figure 6. Evolution of the number of percutaneous coronary interventions performed between 1999 and 2010. PCI, percutaneous coronary intervention.

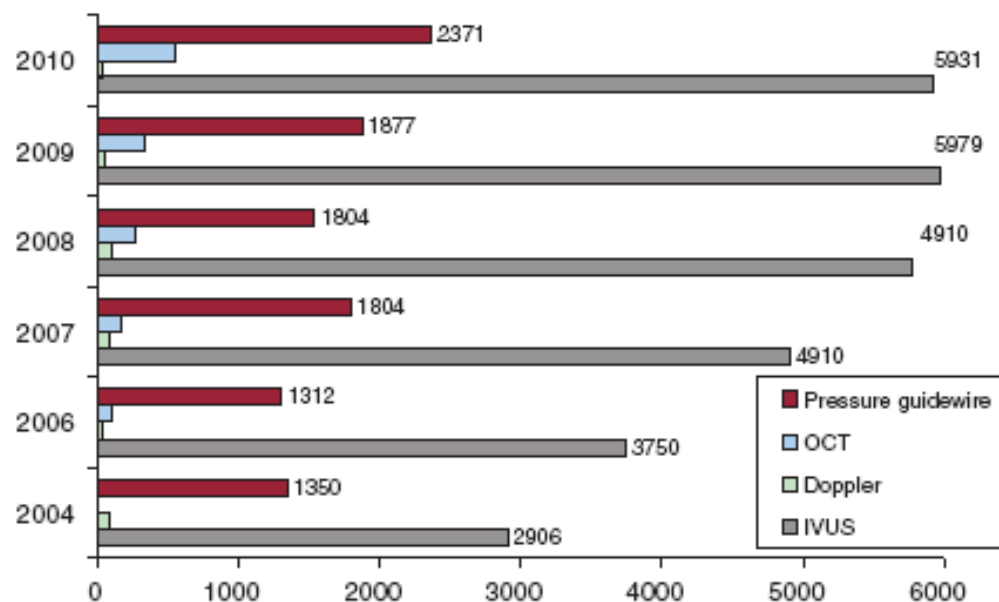


Figure 5. Evolution of intracoronary diagnostic techniques. IVUS, intravascular ultrasound; OCT, optical coherence tomography.

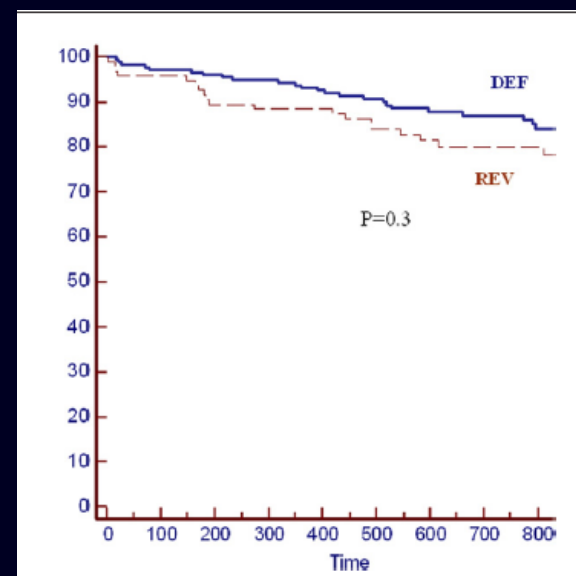
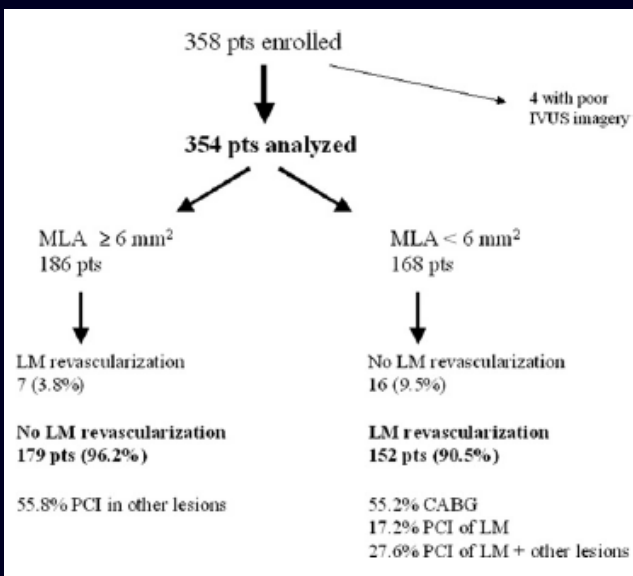
CLINICAL RESEARCH

Invasive Cardiology

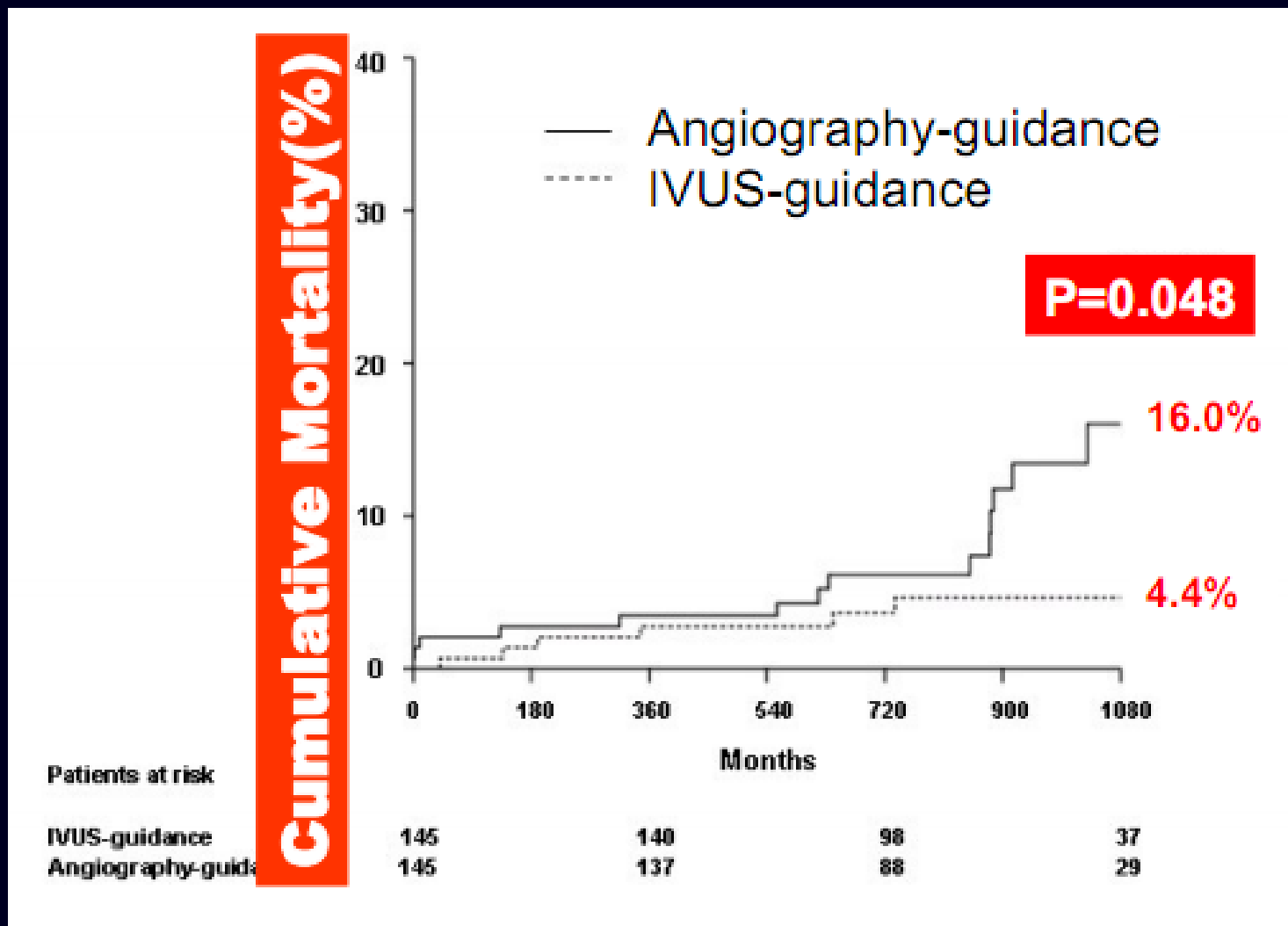
Prospective Application of Pre-Defined Intravascular Ultrasound Criteria for Assessment of Intermediate Left Main Coronary Artery Lesions

Results From the Multicenter LITRO Study

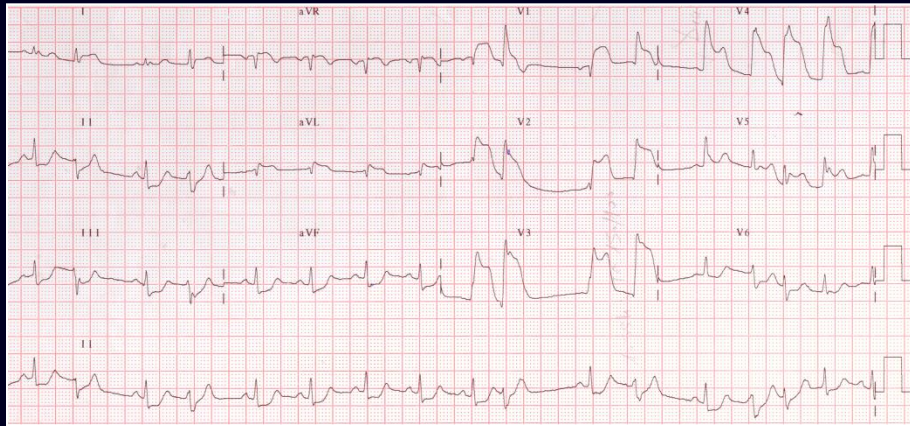
Jose M. de la Torre Hernandez, MD, PhD,* Felipe Hernández Hernandez, MD,†
 Fernando Alfonso, MD, PhD,‡ Jose R. Rumoroso, MD, PhD,§ Ramon Lopez-Palop, MD, PhD,||
 Mario Sadaba, MD,‡ Pilar Carrillo, MD, PhD,§ Juan Rondan, MD, PhD,¶ Iñigo Lozano, MD, PhD,¶
 Juan M. Ruiz Nodar, MD, PhD,# Jose A. Baz, MD,** Eduard Fernandez Nofrerias, MD,††
 Fernando Pajin, MD,‡‡ Tamara Garcia Camarero, MD,* Hipolito Gutierrez, MD,§§
 on behalf of the LITRO Study Group (Spanish Working Group on Interventional Cardiology)
 Santander, Madrid, Bilbao, Alicante, Oviedo, Vigo, Badalona, Toledo, and Valladolid, Spain



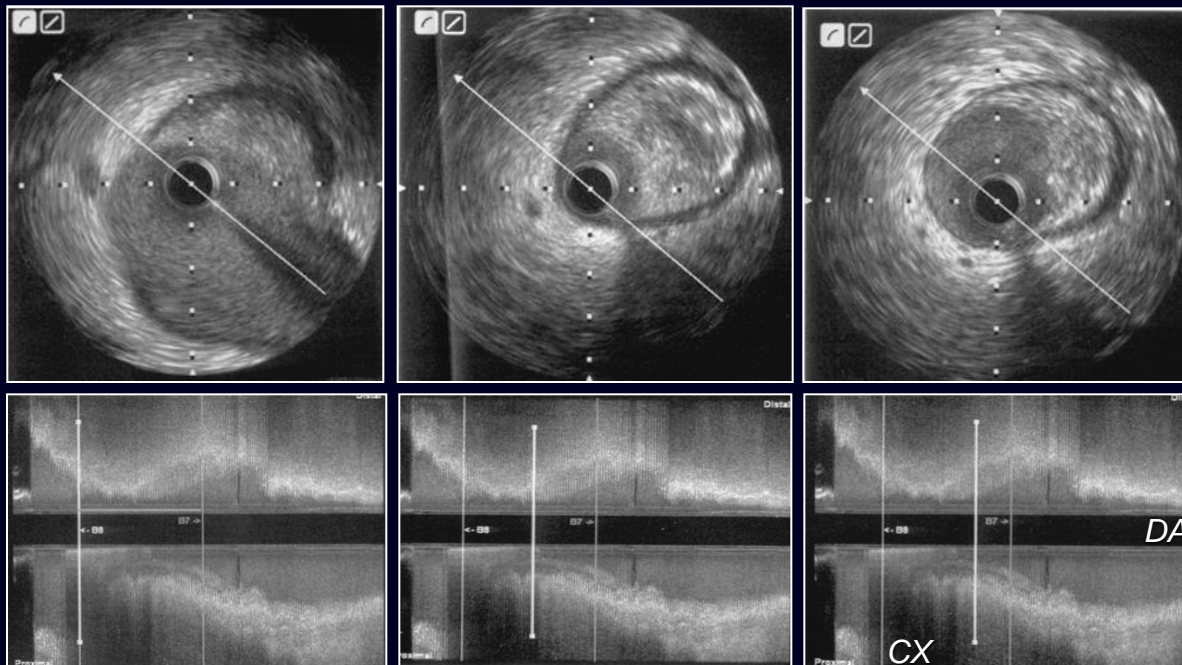
Monitorización con IVUS del tratamiento del TCI



A su llegada al Hospital... 04:00 horas



... necesito más información,



... se implantó un stent.

A su llegada al Hospital... 04:00 horas



Am J Cardiol. 2011 Jul 1;108(1):8-14. Epub 2011 Apr 27.

Role of intravascular ultrasound in patients with acute myocardial infarction undergoing percutaneous coronary intervention.

Ahmed K, Jeong MH, Chakraborty R, Ahn Y, Sim DS, Park K, Hong YJ, Kim JH, Cho KH, Kim MC, Hachinohe D, Hwang SH, Lee MG, Cho MC, Kim CJ, Kim YJ, Park JC, Kang JC; Other Korea Acute Myocardial Infarction Registry Investigators.

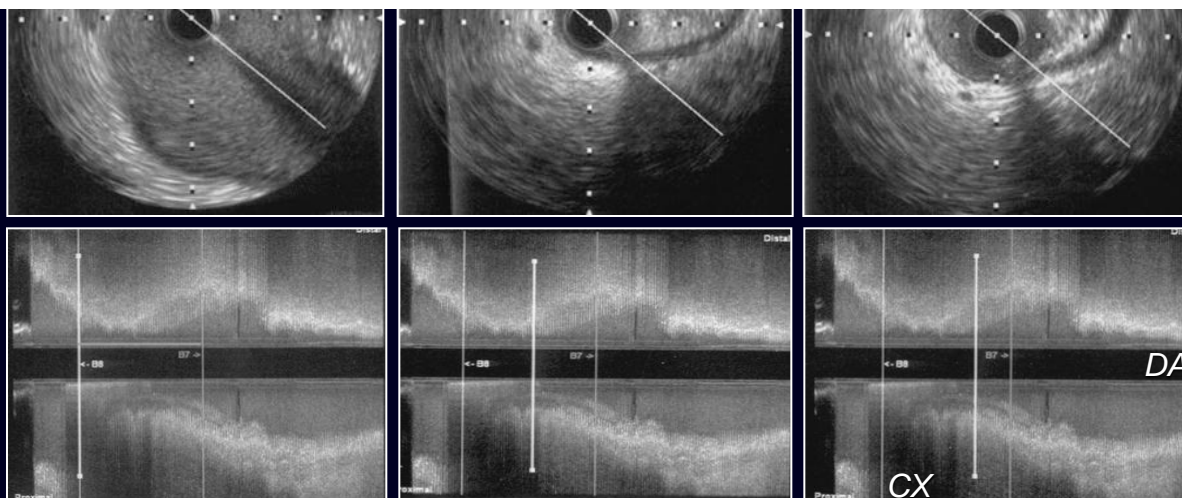
+ Collaborators (56)

The Heart Center of Chonnam National University Hospital, Chonnam National University Research Institute of Medical Sciences, Gwangju, Korea.

Abstract

Stent thrombosis and restenosis remain drawbacks of drug-eluting stents in patients with acute myocardial infarction (AMI). Intravascular ultrasound (IVUS) guidance for stent deployment helps optimize its results in stable patients. The aim of this study was to examine the utility of routine IVUS guidance in patients with AMI undergoing percutaneous coronary intervention (PCI). Employing data from Korea Acute Myocardial Infarction Registry (KAMIR), we analyzed 14,329 patients with AMI from April 2006 through September 2010. Patients with cardiogenic shock and rescue PCI after thrombolysis were excluded. Clinical outcomes of 2,127 patients who underwent IVUS-guided PCI were compared to those of 8,235 patients who did not. Mean age was 63.6 ± 13.5 years and 72.3% were men. Patients undergoing IVUS-guided PCI were younger, more often men, more hyperlipemic, and had increased body mass index and left ventricular ejection fraction. Number of treated vessels and stents used, stent length, and stent diameter were increased in the IVUS-guided group. Multivessel involvement was less frequent and American College of Cardiology/American Heart Association type C lesion was more frequent in the IVUS-guided group. Drug-eluting stents were more frequently used compared to bare-metal stents in the IVUS group. There was no significant relation of stent thrombosis between the 2 groups. Twelve-month all-cause death was lower in the IVUS group. After multivariate analysis and propensity score adjustment, IVUS guidance was not an independent predictor for 12-month all-cause death (hazard ratio 0.212, 0.026 to 1.73, $p = 0.148$). In conclusion, this study does not support routine use of IVUS guidance for stent deployment in patients who present with AMI and undergo PCI.

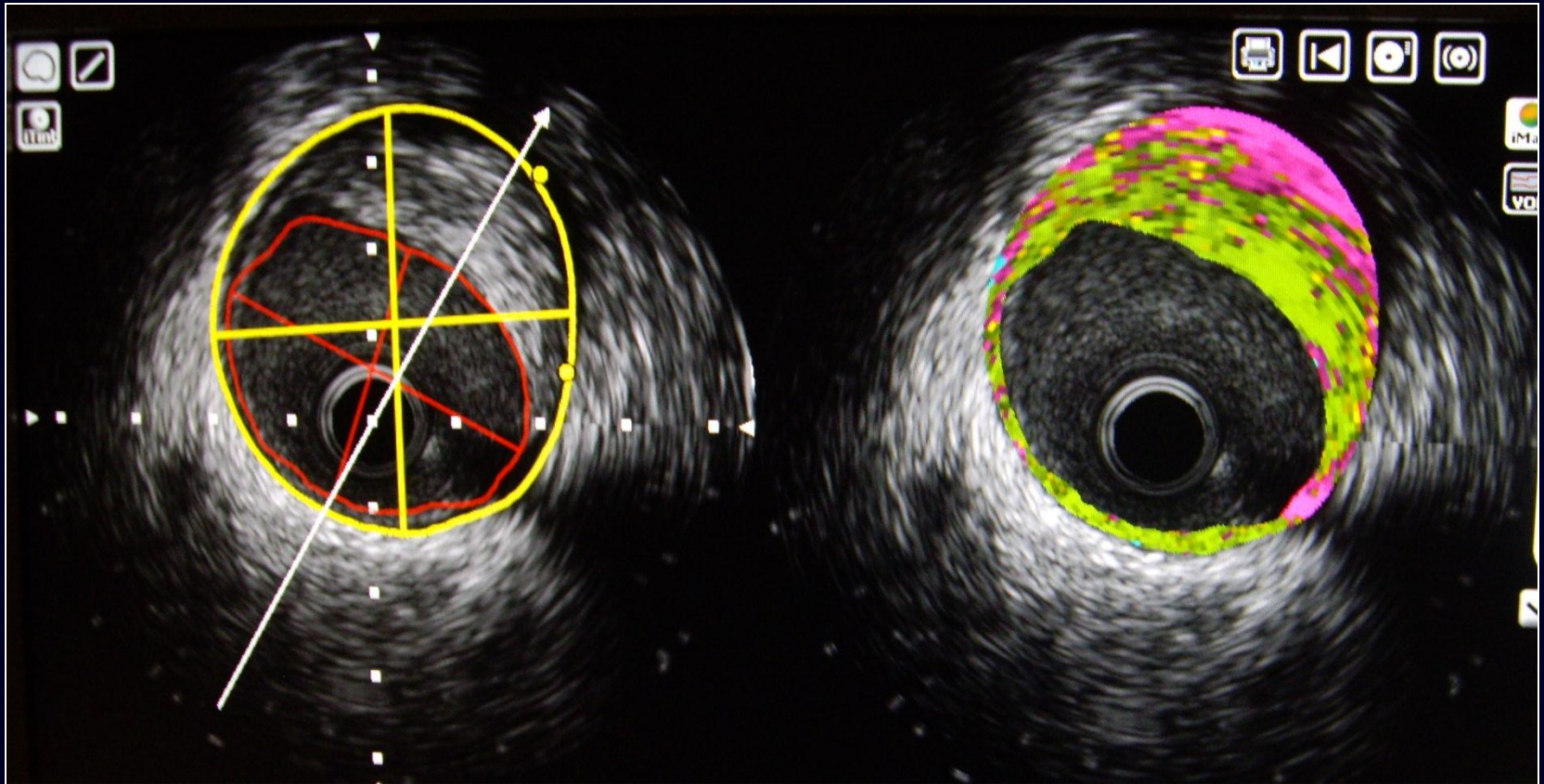
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... se implantó un stent.

Histología virtual (2002)

Fibroso. Fibrolipídico. Core lipídico. Calcio.



Measurements		
A1	TA	9.35 mm ²
		2.98 mm / 3.98 mm
A2	TA	20.78 mm ²
		4.79 mm / 5.46 mm

Area 55%

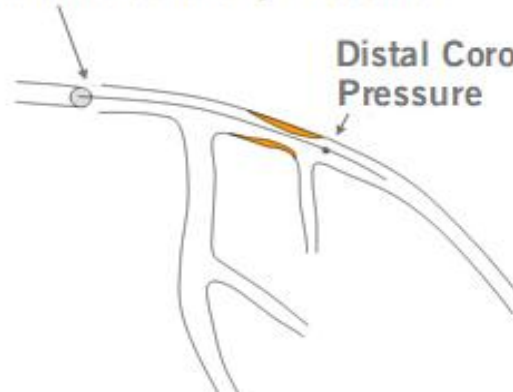
Frame	Segment	
Fibrotic:	72%	CL:79%
Lipidic:	8%	CL:57%
Necrotic:	19%	CL:68%
Calcified:	1%	CL:67%

Evaluación funcional de lesiones coronarias

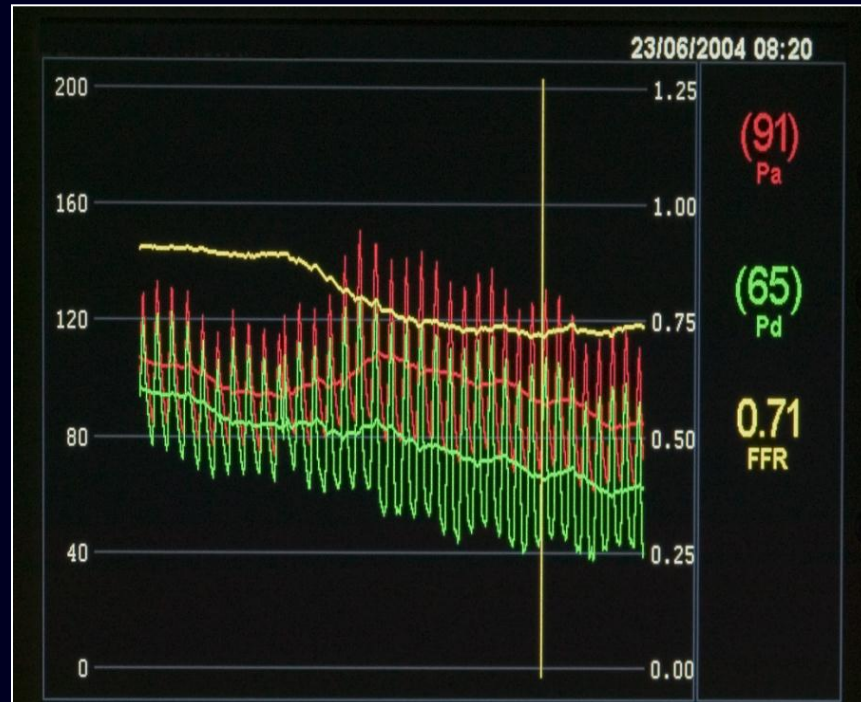
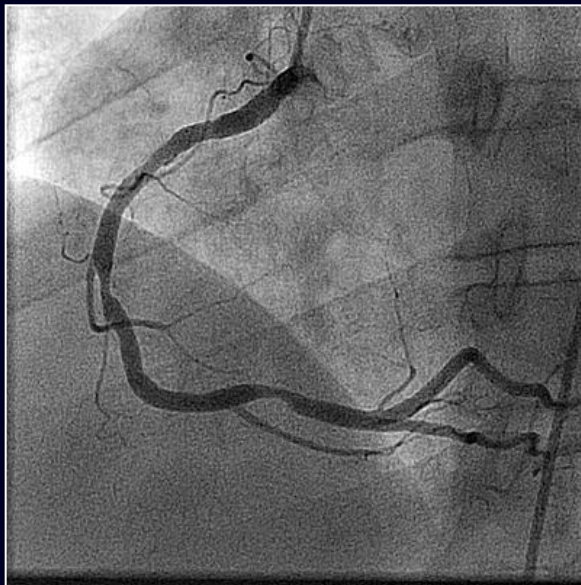
$$\text{FFR} = \frac{\text{Distal Coronary Pressure}}{\text{Proximal Coronary Pressure}}$$

(During Maximum Hyperemia)
FFR

Proximal Coronary Pressure



Distal Coronary Pressure



MEASUREMENT OF FRACTIONAL FLOW RESERVE TO ASSESS THE FUNCTIONAL SEVERITY OF CORONARY-ARTERY STENOSES

NICO H.J. PIJLS, M.D., PH.D., BERNARD DE BRUYNE, M.D., KATHINKA PEELS, M.D.,
PEPIJN H. VAN DER VOORT, M.D., HANS J.R.M. BONNIER, M.D., PH.D., JOZEF BARTUNEK, M.D.,
AND JACQUES J. KOOLEN, M.D., PH.D.

Abstract *Background.* The clinical significance of coronary-artery stenoses of moderate severity can be difficult to determine. Myocardial fractional flow reserve (FFR) is a new index of the functional severity of coronary stenoses that is calculated from pressure measurements made during coronary arteriography. We compared this index with the results of noninvasive tests commonly used to detect myocardial ischemia, to determine the usefulness of the index.

Methods. In 45 consecutive patients with moderate coronary stenosis and chest pain of uncertain origin, we performed bicycle exercise testing, thallium scintigraphy, stress echocardiography with dobutamine, and quantitative coronary arteriography and compared the results with measurements of FFR.

Results. In all 21 patients with an FFR of less than 0.75, reversible myocardial ischemia was demonstrated

unequivocally on at least one noninvasive test. After coronary angioplasty or bypass surgery was performed, all the positive test results reverted to normal. In contrast, 21 of the 24 patients with an FFR of 0.75 or higher tested negative for reversible myocardial ischemia on all the noninvasive tests. No revascularization procedures were performed in these patients, and none were required during 14 months of follow-up. The sensitivity of FFR in the identification of reversible ischemia was 88 percent, the specificity 100 percent, the positive predictive value 100 percent, the negative predictive value 88 percent, and the accuracy 93 percent.

Conclusions. In patients with coronary stenosis of moderate severity, FFR appears to be a useful index of the functional severity of the stenoses and the need for coronary revascularization. (N Engl J Med 1996;334:1703-8.)

©1996, Massachusetts Medical Society.

FAME

Fractional Flow Reserve versus Angiography for Guiding Percutaneous Coronary Intervention

Pim A.L. Tonino, M.D., Bernard De Bruyne, M.D., Ph.D., Nico H.J. Pijls, M.D., Ph.D., Uwe Siebert, M.D., M.P.H., Sc.D., Fumiaki Ikeno, M.D., Marcel van 't Veer, M.Sc., Volker Klauw, M.D., Ph.D., Ganesh Manoharan, M.D., Thomas Engström, M.D., Ph.D., Keith G. Oldroyd, M.D., Peter N. Ver Lee, M.D., Philip A. MacCarthy, M.D., Ph.D., and William F. Fearon, M.D., for the FAME Study Investigators*

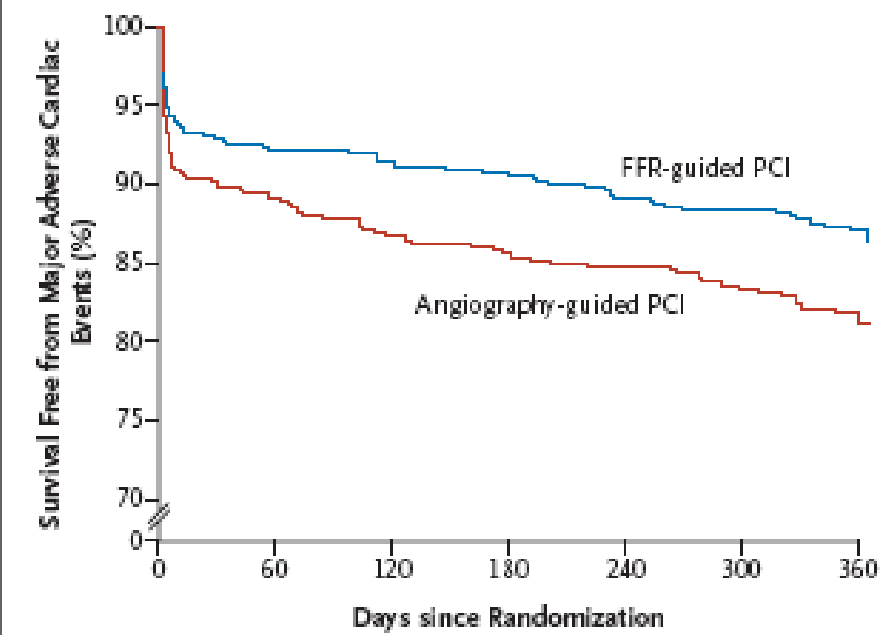
ABSTRACT

BACKGROUND

Table 2. Results of PCL*

Variable	Angiography Group (N=496)	FFR Group (N=509)	P Value†
Procedure time — min‡	70±44	71±43	0.51
Volume of contrast agent used — ml	302±127	272±133	<0.001
Drug-eluting stents			
No. of stents per patient			
Mean	2.7±1.2	1.9±1.3	<0.001
Median (interquartile range)	3 (2–3)	2 (1–3)	
Total length per patient — mm	51.9±24.6	37.9±27.8	<0.001
Average diameter per patient — mm	2.96±0.33	2.92±0.36	0.13
Total no. of stents			
Zotarolimus-eluting — no. (%)	603 (44.4)	403 (41.1)	
Sirolimus-eluting — no. (%)	273 (20.1)	202 (20.6)	
Paclitaxel-eluting — no. (%)	414 (30.5)	316 (32.2)	
Other — no. (%)	69 (5.1)	59 (6.0)	
Lesions in which stents successfully placed — no./total no. (%)§	1237/1350 (91.6)	819/874 (93.7)	
FFR-guided strategy			
Lesions successfully measured for FFR — no./total no. (%)¶	NA	1329/1414 (94.0)	
FFR	NA	0.71±0.18	
Ischemic lesions	NA	0.60±0.14	
Nonischemic lesions	NA	0.88±0.05	
Lesions with FFR ≤0.80 — no./total no. (%)	NA	874/1387 (63.0)	
Lesions with FFR >0.80 — no./total no. (%)	NA	513/1387 (37.0)	
Cost of materials — \$	6,007±2,819	5,332±3,261	<0.001
Hospital stay at baseline admission — days	3.7±3.5	3.4±3.3	0.05

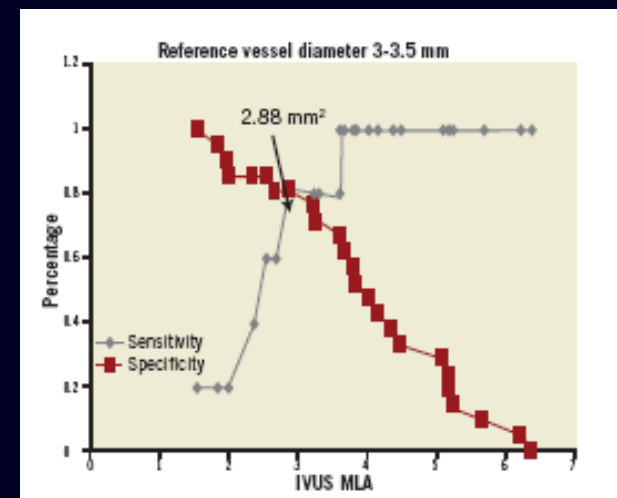
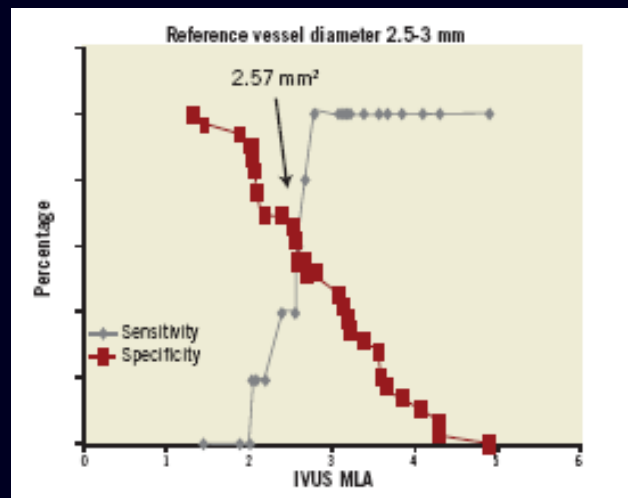
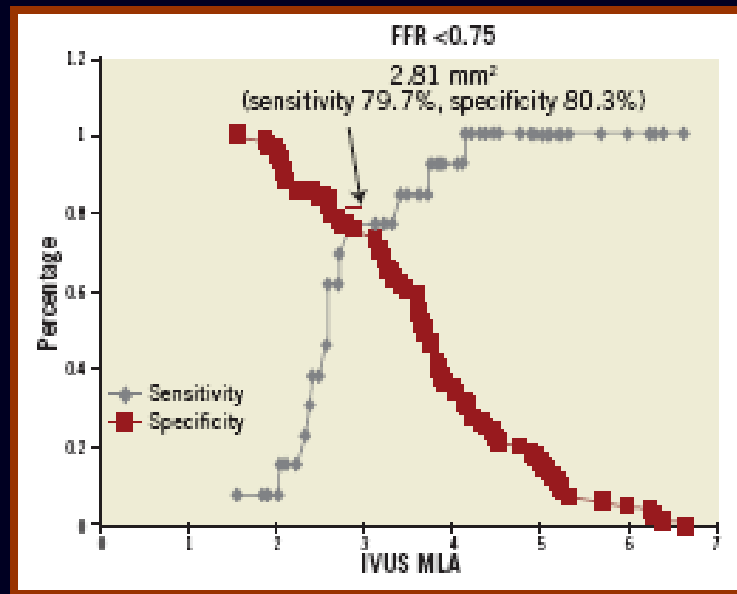
A



are undergoing PCI with drug-eluting stents significantly reduces the rate of the composite end point of death, nonfatal myocardial infarction, and repeat revascularization at 1 year. (ClinicalTrials.gov number, NCT00267774.)

Correlation between fractional flow reserve and intravascular ultrasound lumen area in intermediate coronary artery stenosis

Itsik Ben-Dor, MD; Rebecca Torguson, MPH; Michael A. Gaglia, Jr., MD, MSc; Manuel A. Gonzalez, MD, MPH; Gabriel Maluenda, MD; Anh B. Bui, MD; Zhenyi Xue, MS; Lowell F. Satler, MD; William O. Suddath, MD; Joseph Lindsay, MD; Augusto D. Pichard, MD; Ron Waksman*, MD



Physiologic Assessment of Jailed Side Branch Lesions Using Fractional Flow Reserve

Bon-Kwon Koo, MD, PHD,* Hyun-Jai Kang, MD, PHD,* Tae-Jin Youn, MD, PHD,† In-Ho Chae, MD, PHD,† Dong-Joo Choi, MD, PHD,† Hyo-Soo Kim, MD, PHD,* Dae-Won Sohn, MD, PHD,* Byung-Hee Oh, MD, PHD, FACC,* Myoung-Mook Lee, MD, PHD, FACC,* Young-Bae Park, MD, PHD,* Yun-Shik Choi, MD, PHD,* Seung-Jae Tahk, MD, PHD‡
Seoul, Seongnam, Gyeonggi-do, and Surwon, Republic of K

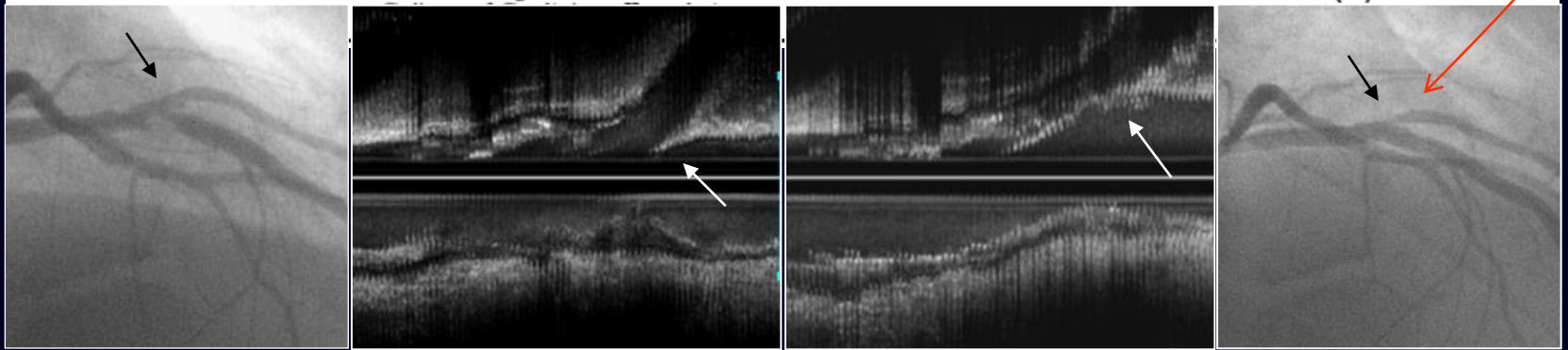
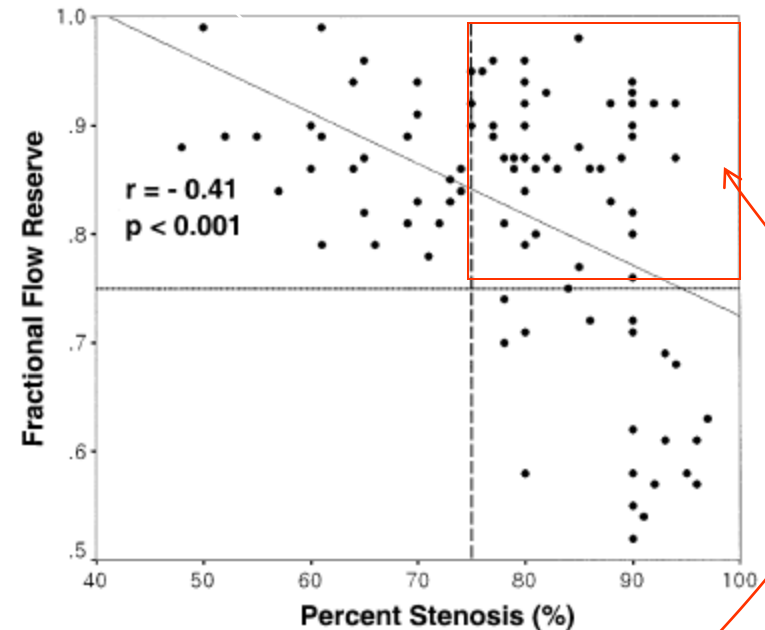
OBJECTIVES This study was performed to evaluate side branches using fractional flow reserve stenosis severity assessed by quantitative

BACKGROUND It is not well-known which side branch branches and how to assess the functional

METHODS Ninety-seven jailed side branch lesions (estimation) after stent implantation at was measured using a pressure wire at jailed side branch.

RESULTS The FFR measurement was successful in 0.11 at the main branches and jailed side between the percent stenosis and FFR (r stenosis had $FFR < 0.75$. Among 73 lesions significant.

CONCLUSIONS The FFR measurement in jailed side coronary angiography is unreliable in the branch lesions, and measurement of functional significance. (J Am Coll



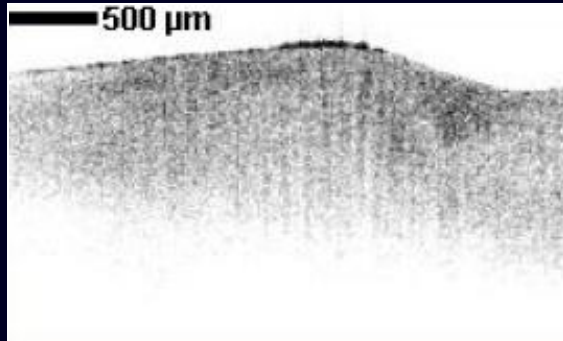
¿COMPITEN O SE COMPLEMENTAN?



	IVUS	OCT
Resolución (axial) (lateral)	100-150 um 150-300 um	10-20 um 25-40 um
Diámetro de scaneo	10-15 mm	7 mm
Maxima profundidad de penetración	4-8 mm	1.5 – 3 mm
Velocidad de frame	30 frames/s	Hasta 160 frames/s
Rango dinámico	40-60 dB	90-100 dB
Tamaño del núcleo de imagen	0.8 mm	0.4 mm

CARACTERÍSTICAS DE LA PLACA

Fibrótica

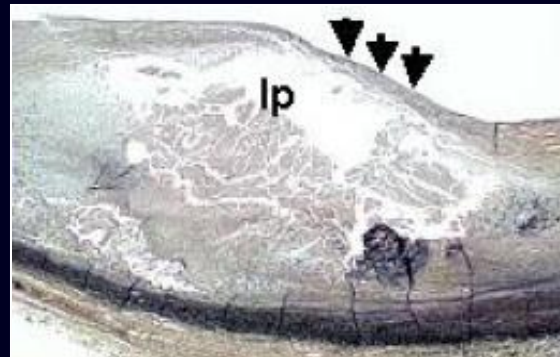
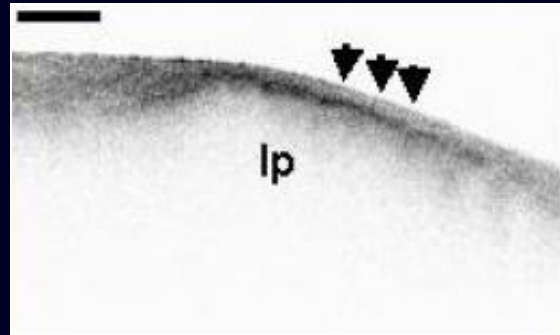


Alta reflectividad

Homogénea

Textura fina

Lipídica

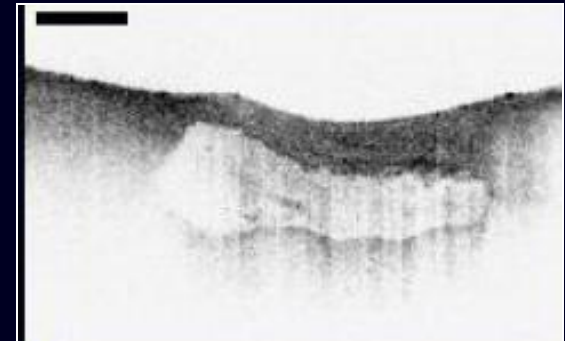


Baja reflectividad

Homogénea

Márgenes difusos

Calcificada



Baja reflectividad

No homogénea

Márgenes definidos

Caracterización de las lesiones coronarias

Utilización durante el intervencionismo coronario

Evaluación a medio-largo plazo de los stents

LESIONES ESTABLES

Fibrótica

Lipídica

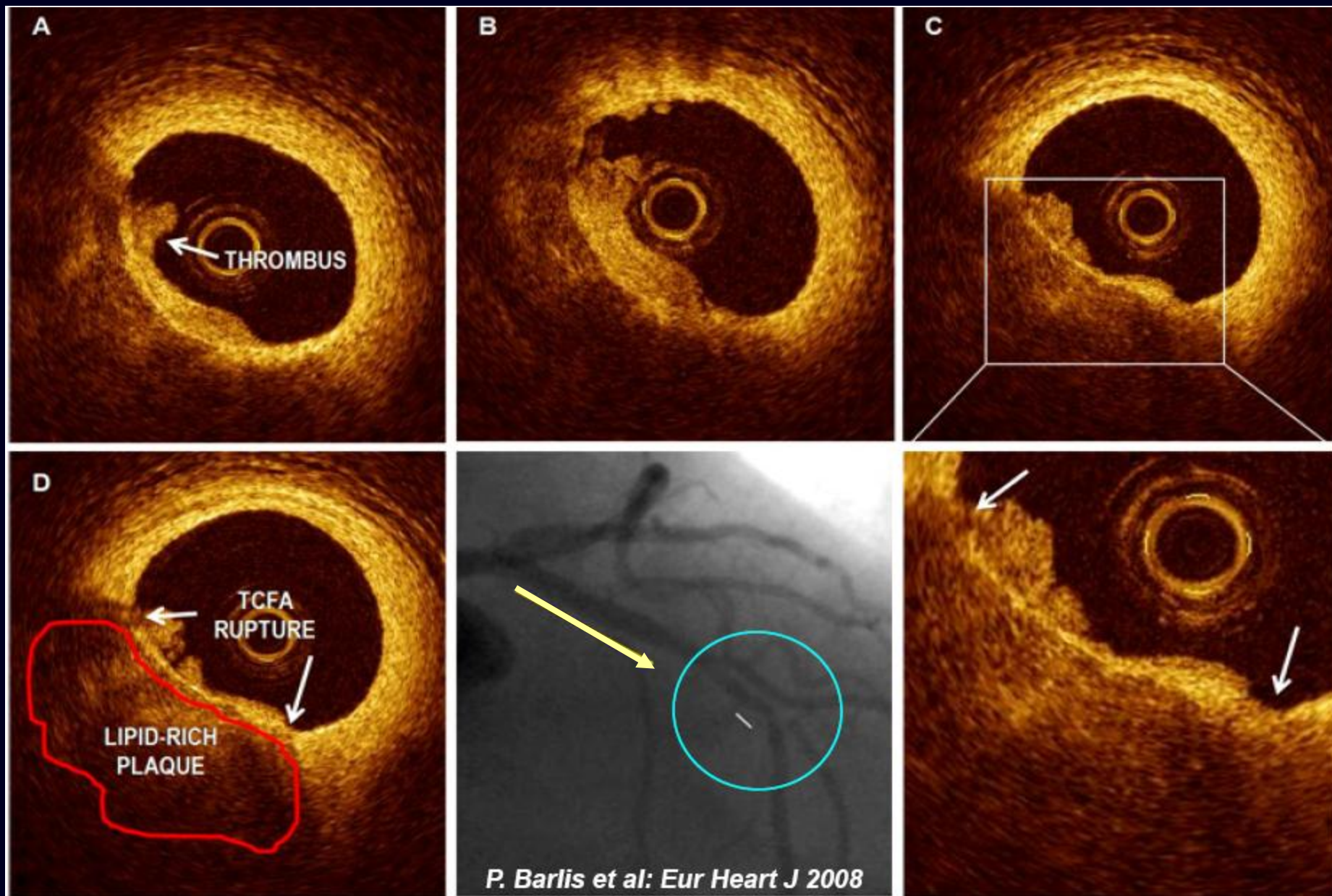
Calcificada

Vulnerable



Fig. 6. Diferentes tipos de placas¹⁰⁻¹⁵. A: placa de características fibrosas; las placas de aspecto homogéneo con alta intensidad de señal corresponden con placas fibrosas (F). B: placa con alto contenido lipídico; las áreas de baja intensidad con señal de contorno mal delimitado se corresponden con núcleo lipídico (L). C: placa con alto contenido en calcio; las áreas de baja intensidad con señal de contorno bien definido se corresponden con calcio (Ca). D: la flecha señala la capa fibrosa de una placa de fibroateroma con capa fibrosa fina, y bajo ésta se encuentra una región de hipodensidad mal definida que se corresponde con un núcleo lipídico.

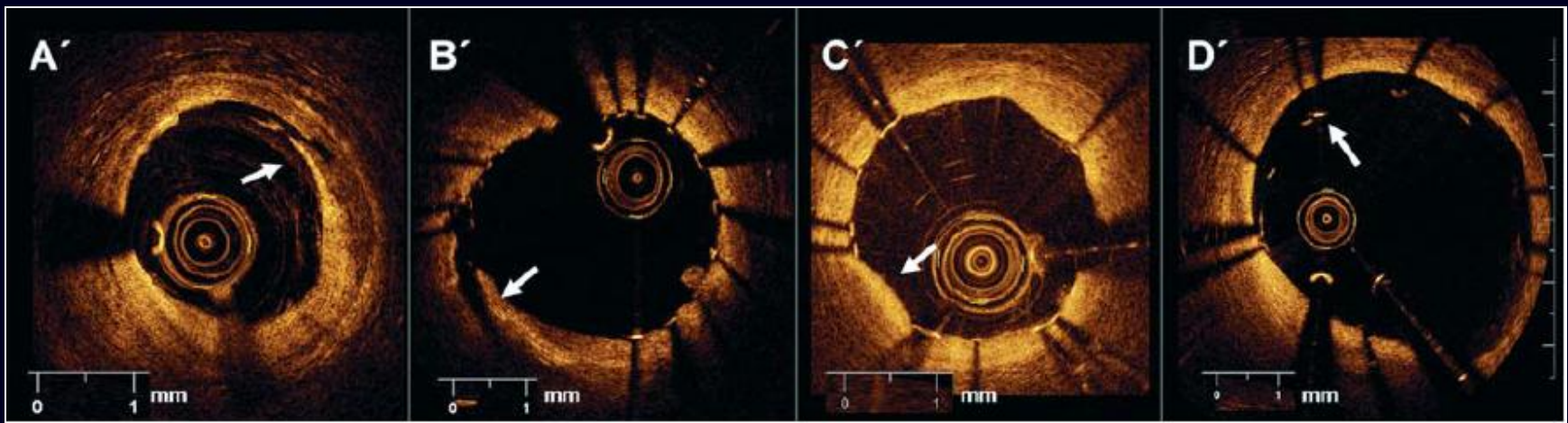
RUPTURA DE UNA PLACA VULNERABLE

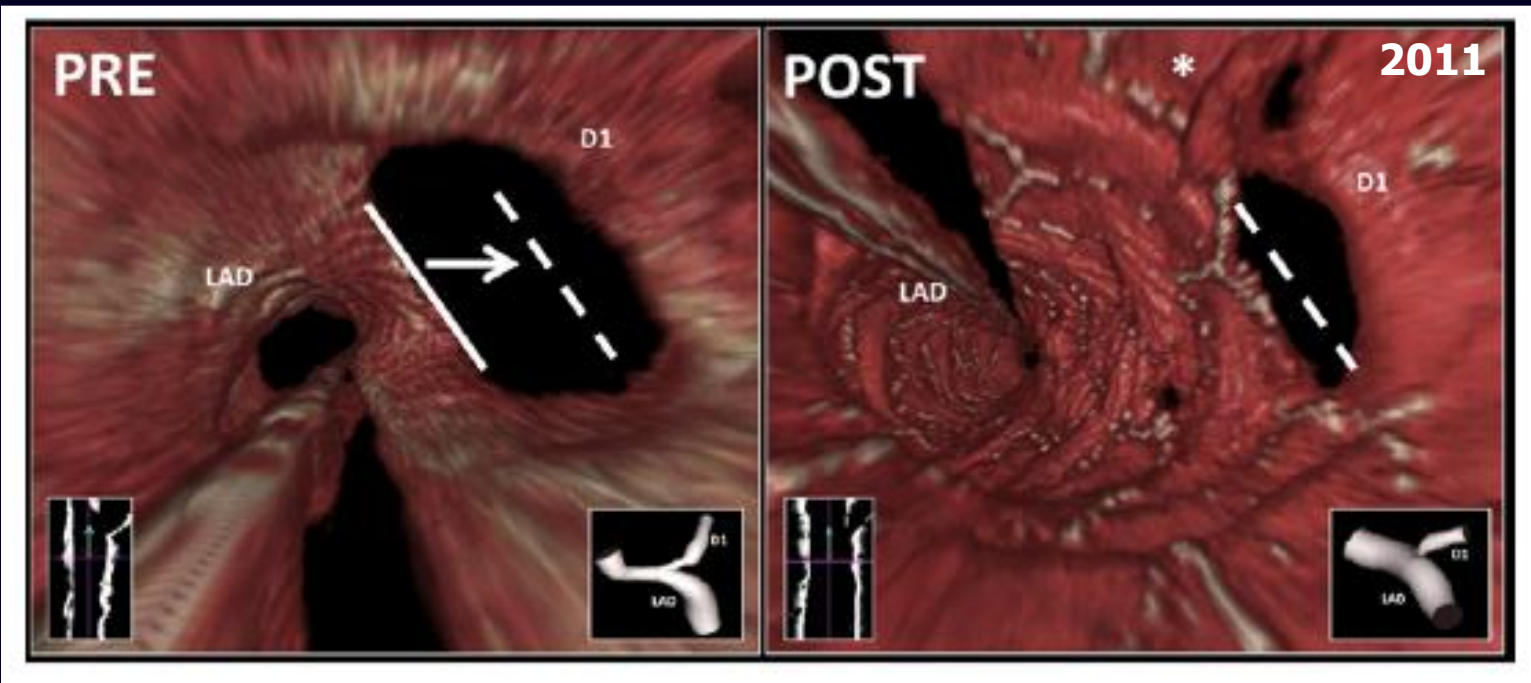
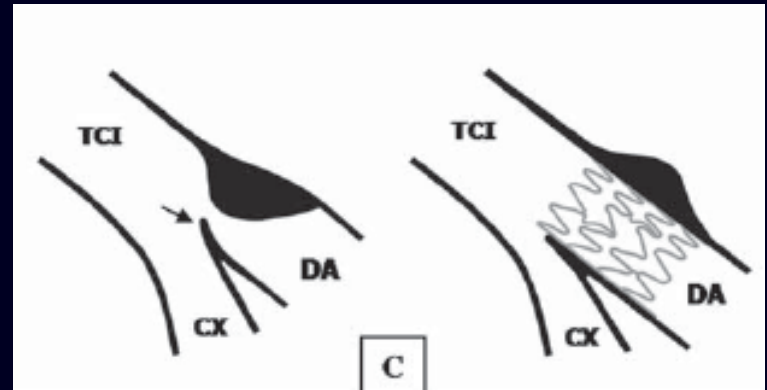
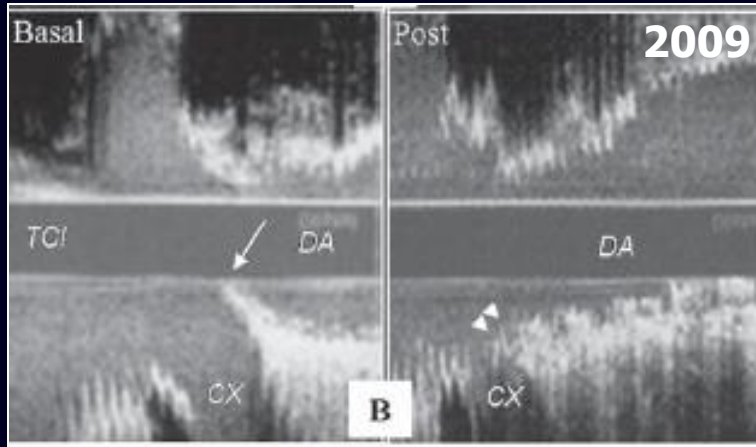


Caracterización de las lesiones coronarias

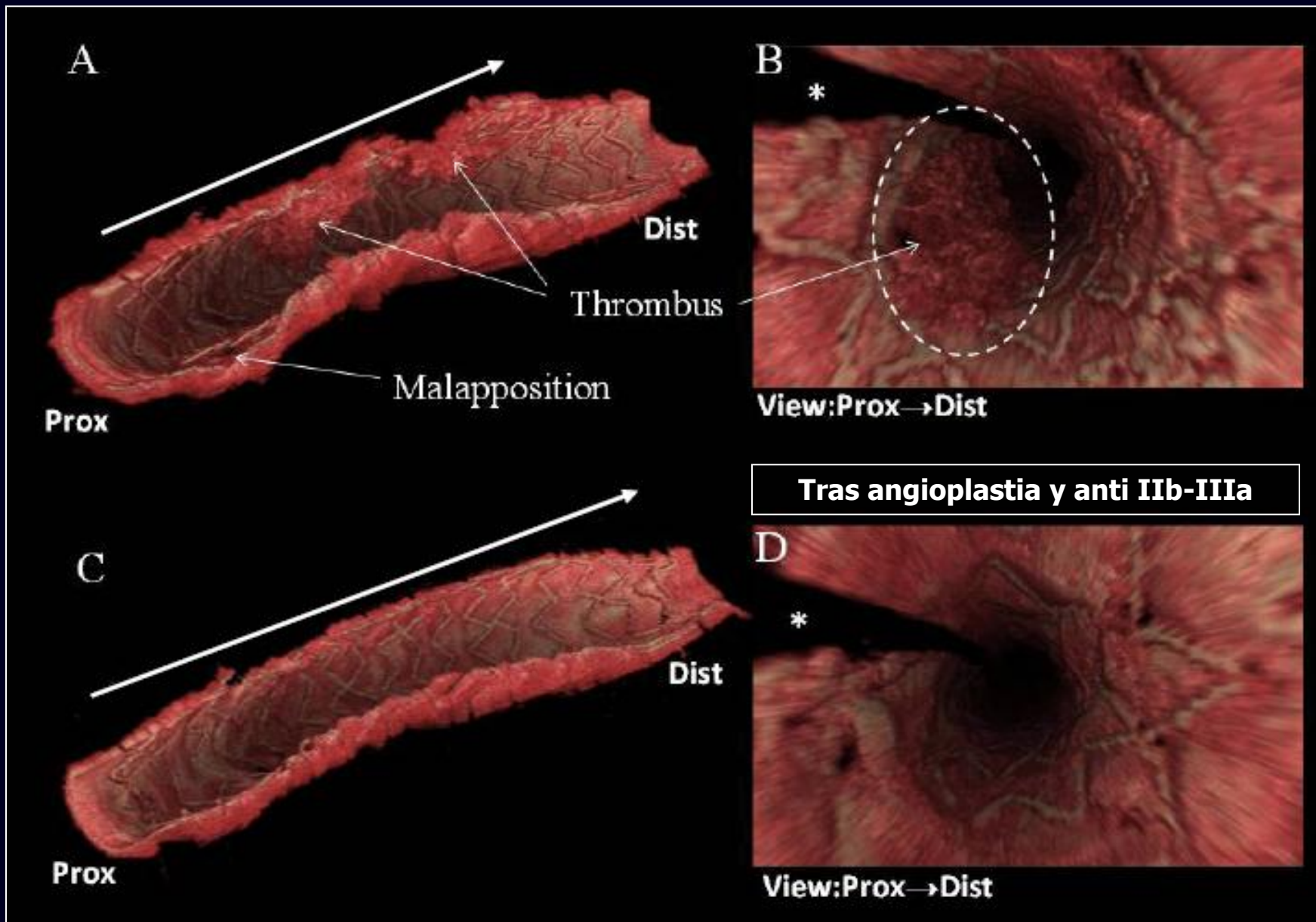
Utilización durante el intervencionismo coronario

Evaluación a medio-largo plazo de los stents





TROMBOSIS SUBAGUDA DEL STENT

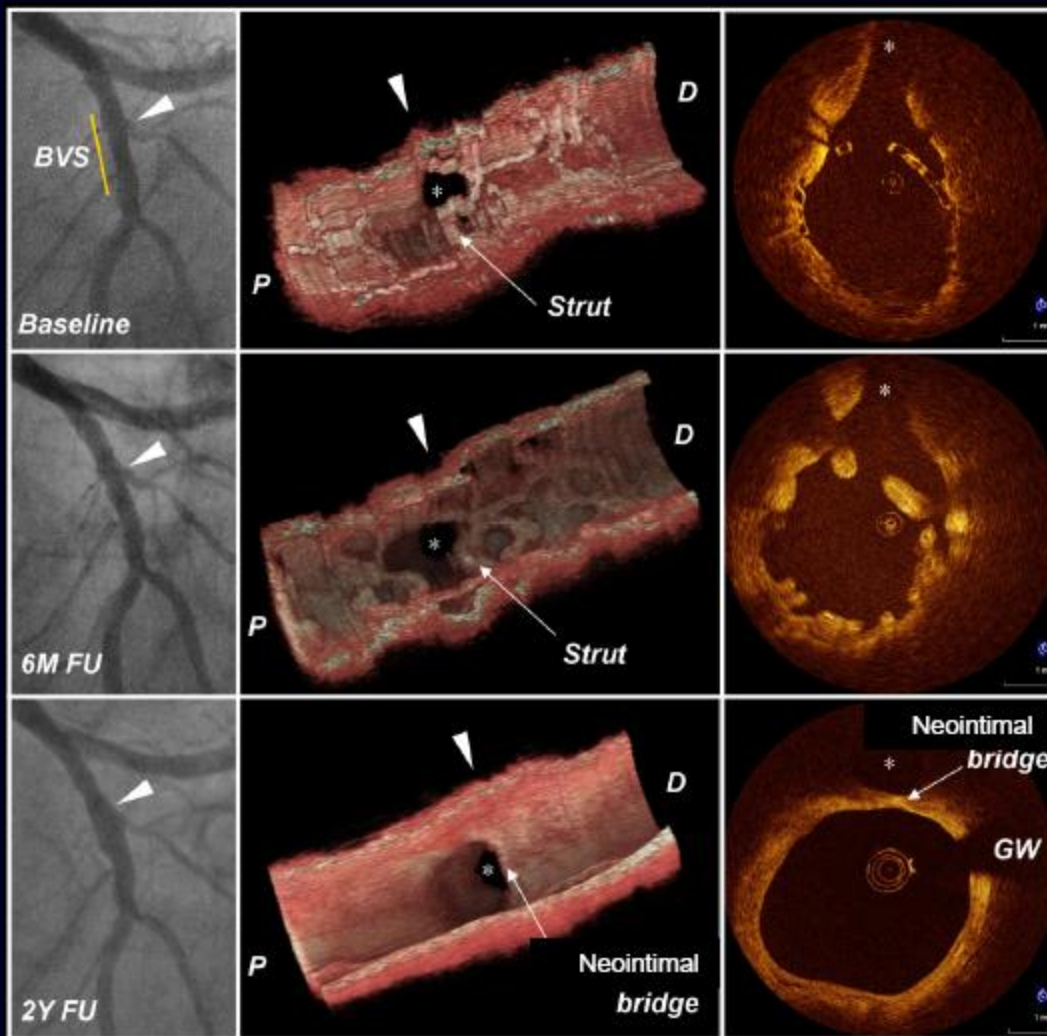


Caracterización de las lesiones coronarias

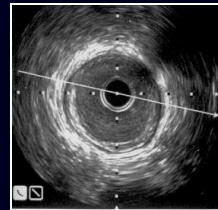
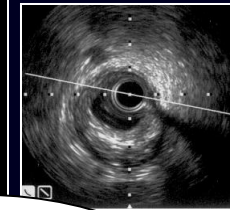
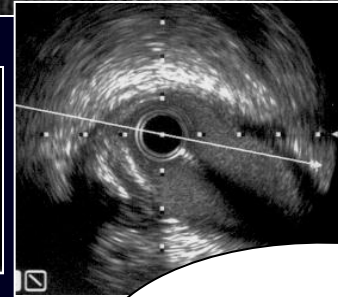
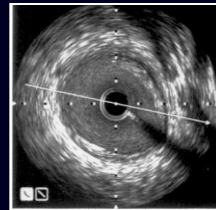
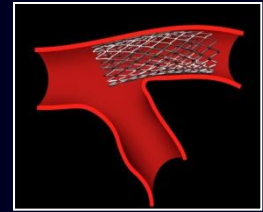
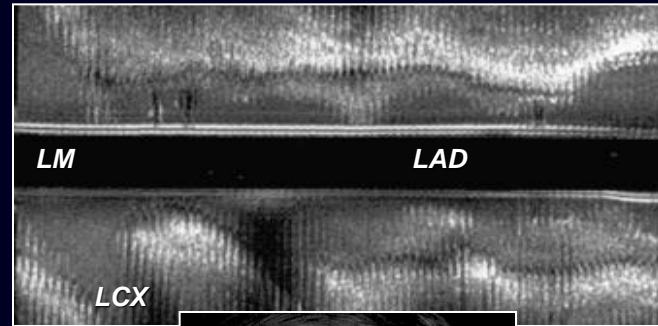
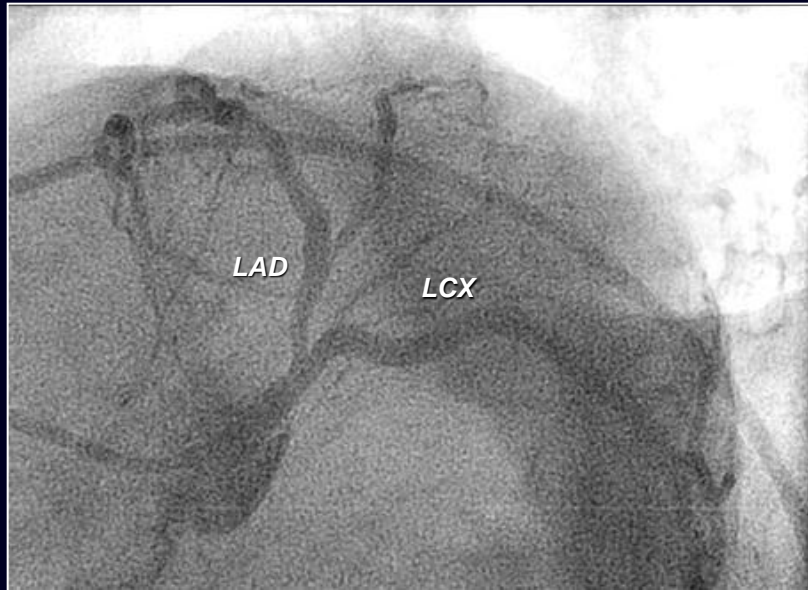
Utilización durante el intervencionismo coronario

Evaluación a medio-largo plazo de los stents

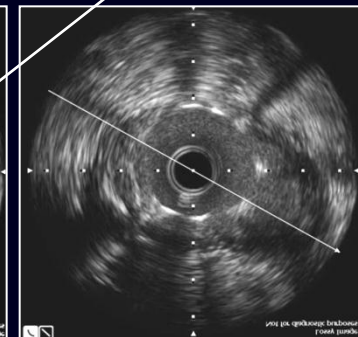
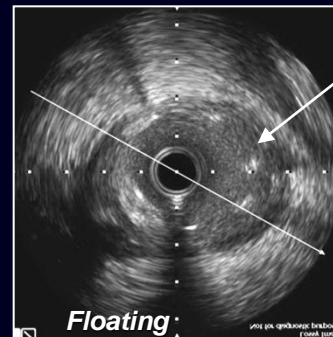
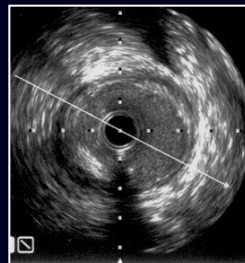
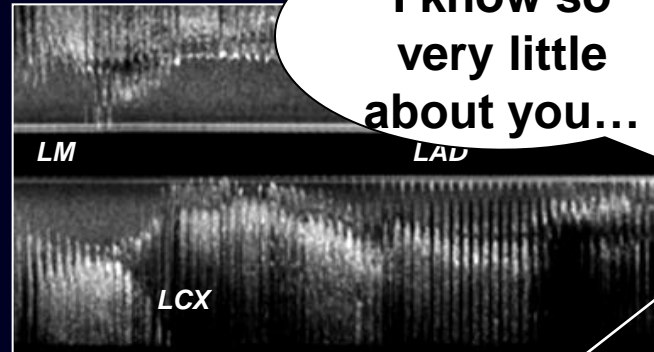
STENT BIOABSORBIBLE (ABSORB)



El problema de los struts flotantes...

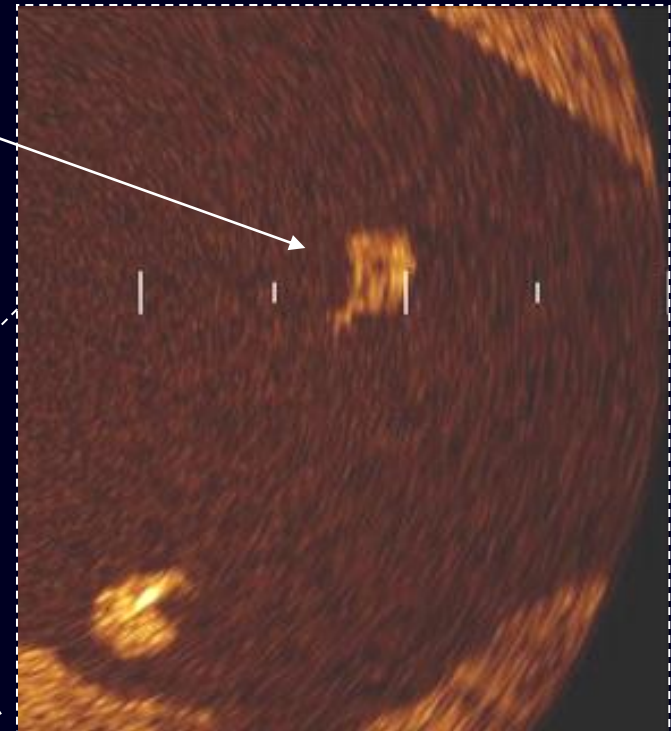
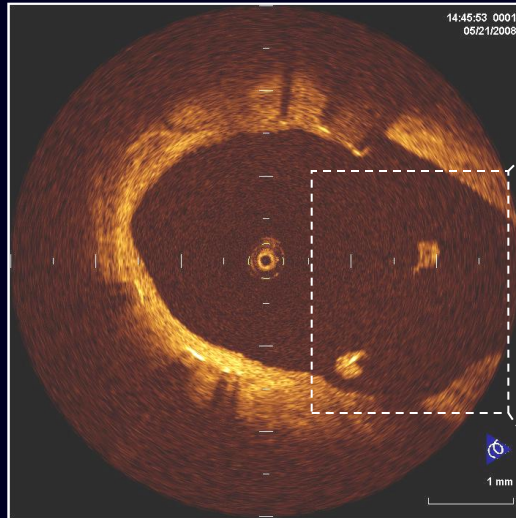
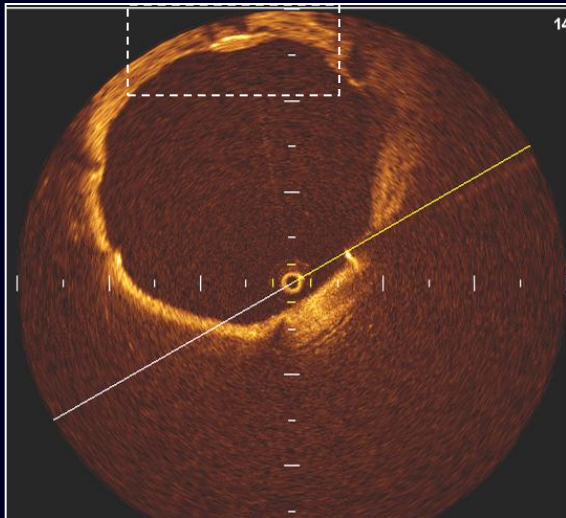
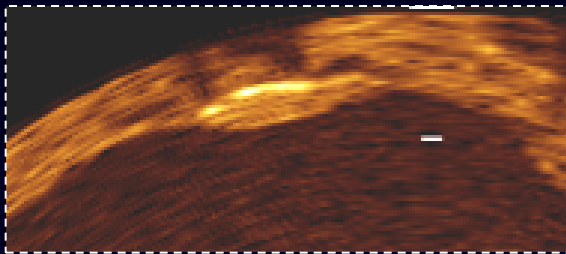
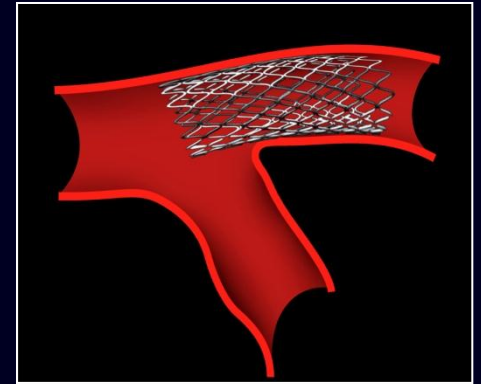


I know so very little about you...

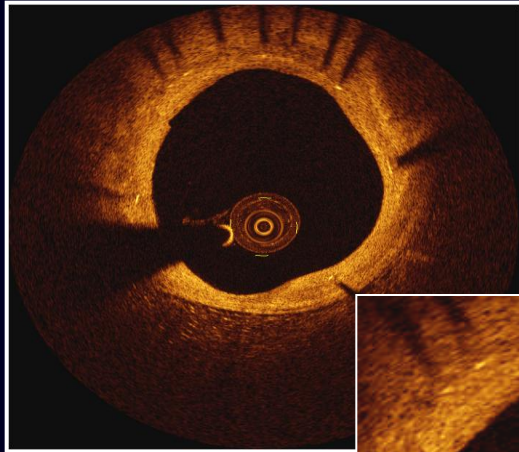


Seguimiento a medio plazo

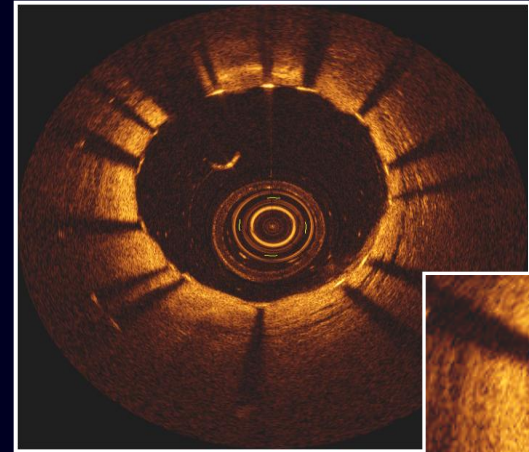
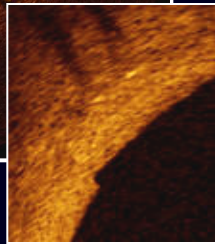
It is all right



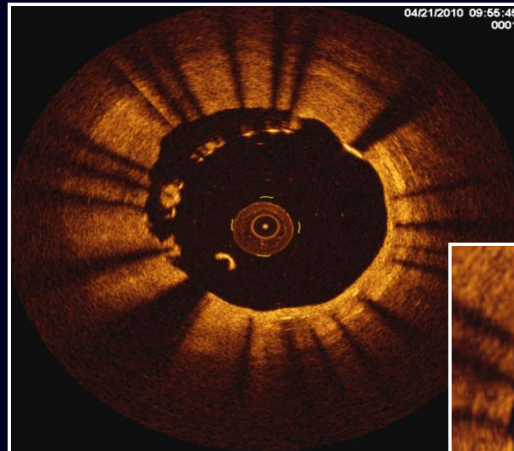
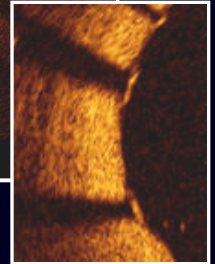
**ONE-YEAR DEGREE OF NEOINTIMAL COVERAGE OF DIFFERENT
DRUG ELUTING STENTS.
A COMPARATIVE STUDY WITH OPTICAL COHERENCE TOMOGRAPHY**



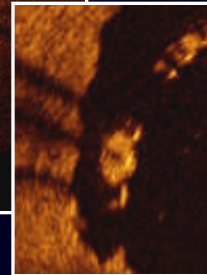
Covered



Uncovered

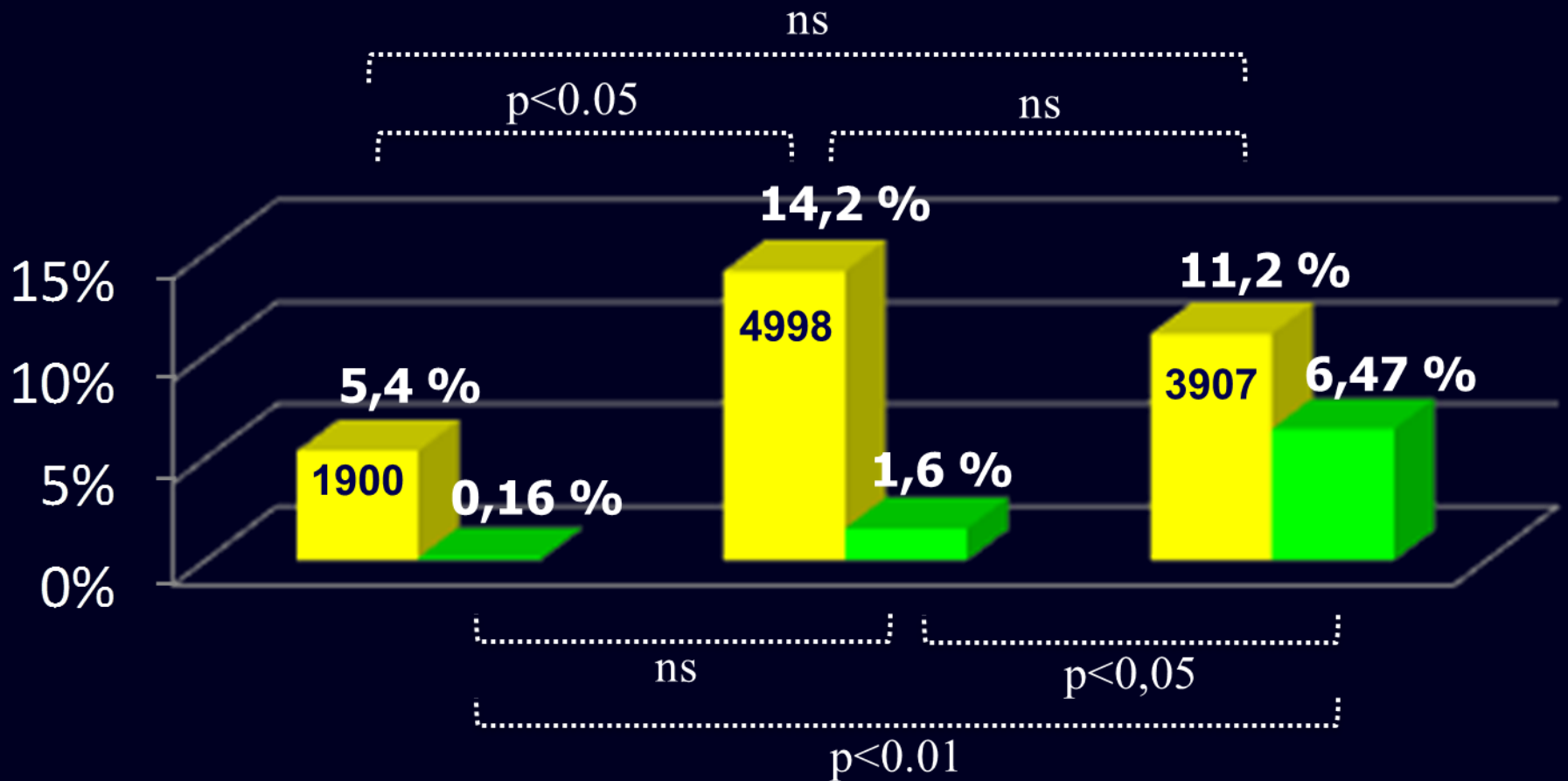


Non-apposed



RESULTS

Distribution of **uncovered** and **non-apposed** struts

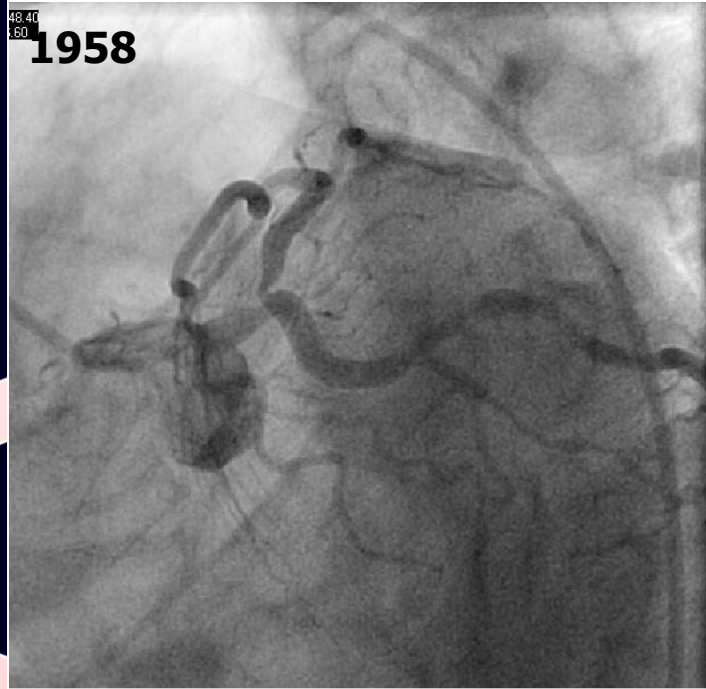


Everolimus

Sirolimus

Paclitaxel

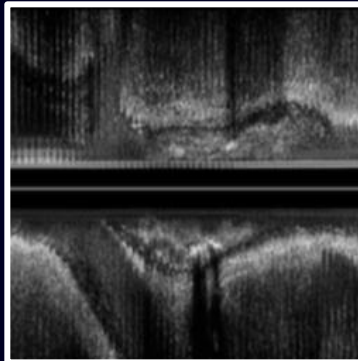
Un círculo...



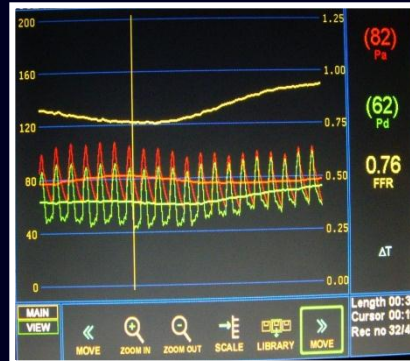
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1995

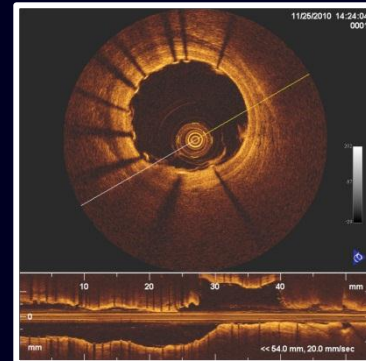
2001



IVUS



Guía de presión



OCT