# Relation Between Baseline Plaque Characteristics and Post-PCI Outcome

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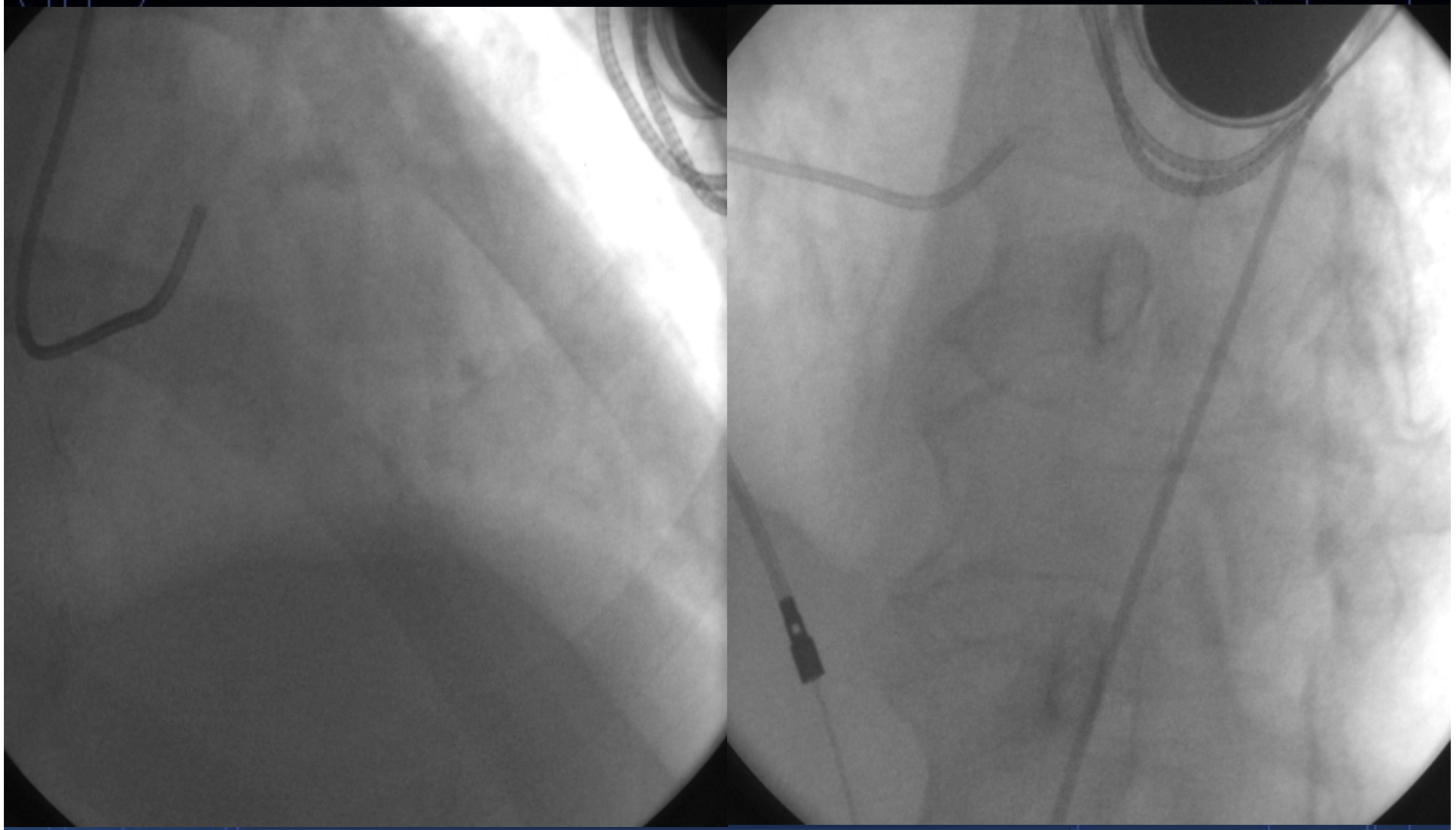
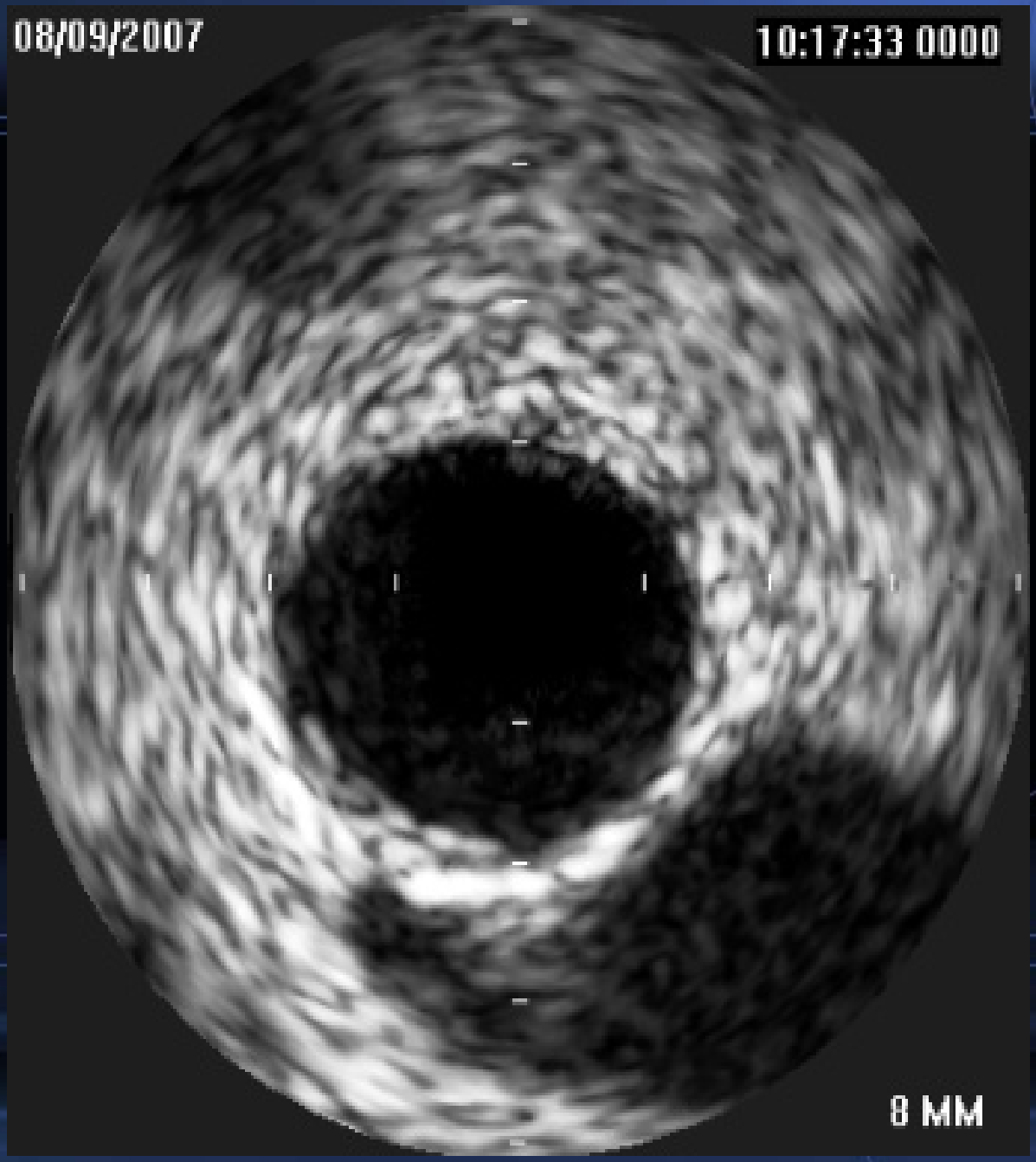
**Gwangju, Korea**

# 74/M NSTEMI, HT, DM, ESRD, s/p PPM (VDD)

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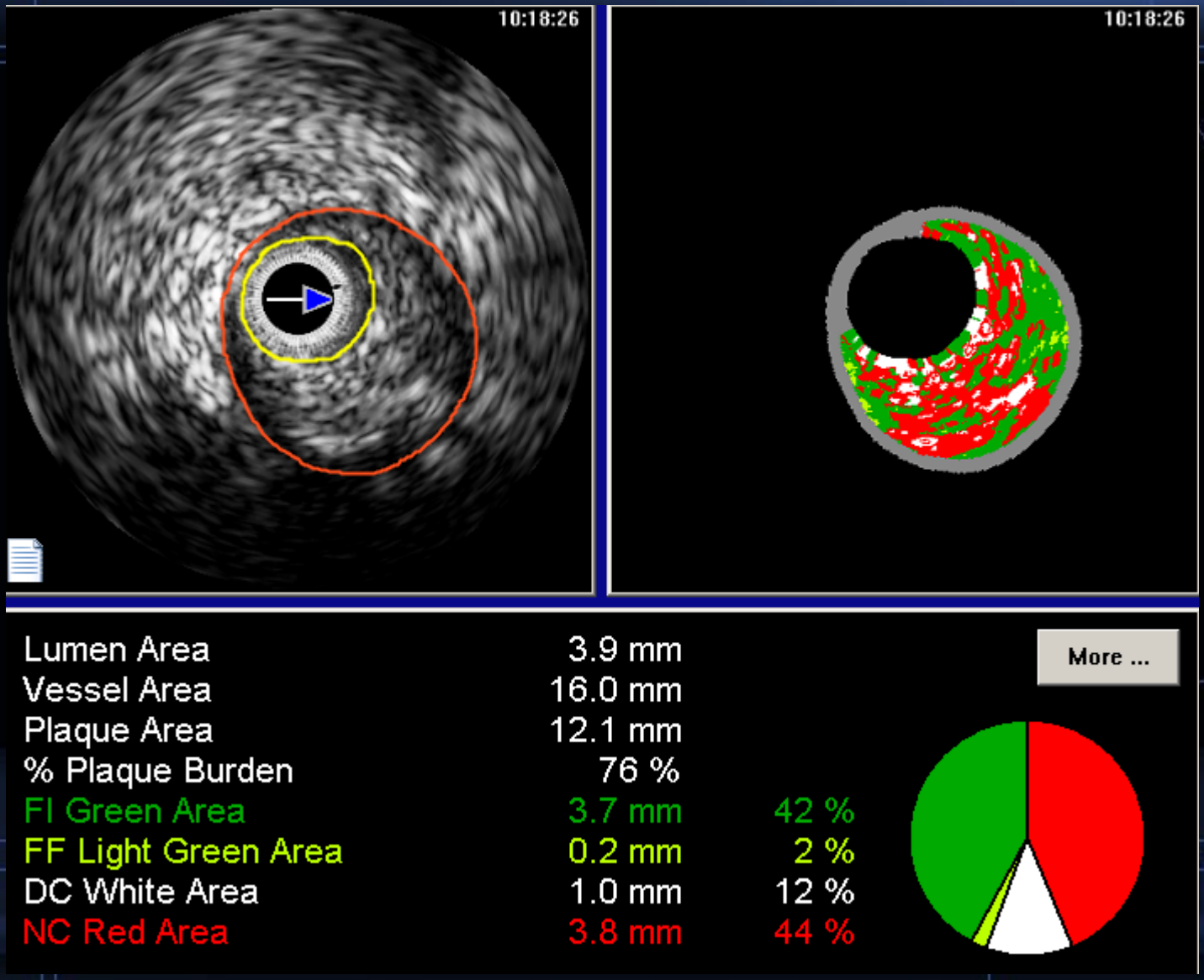
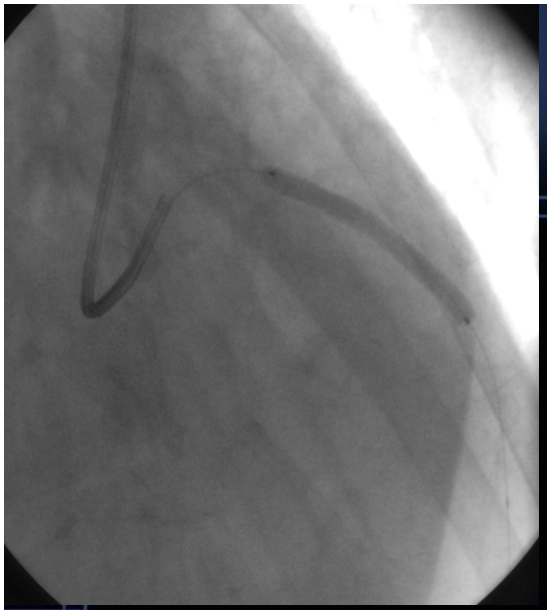
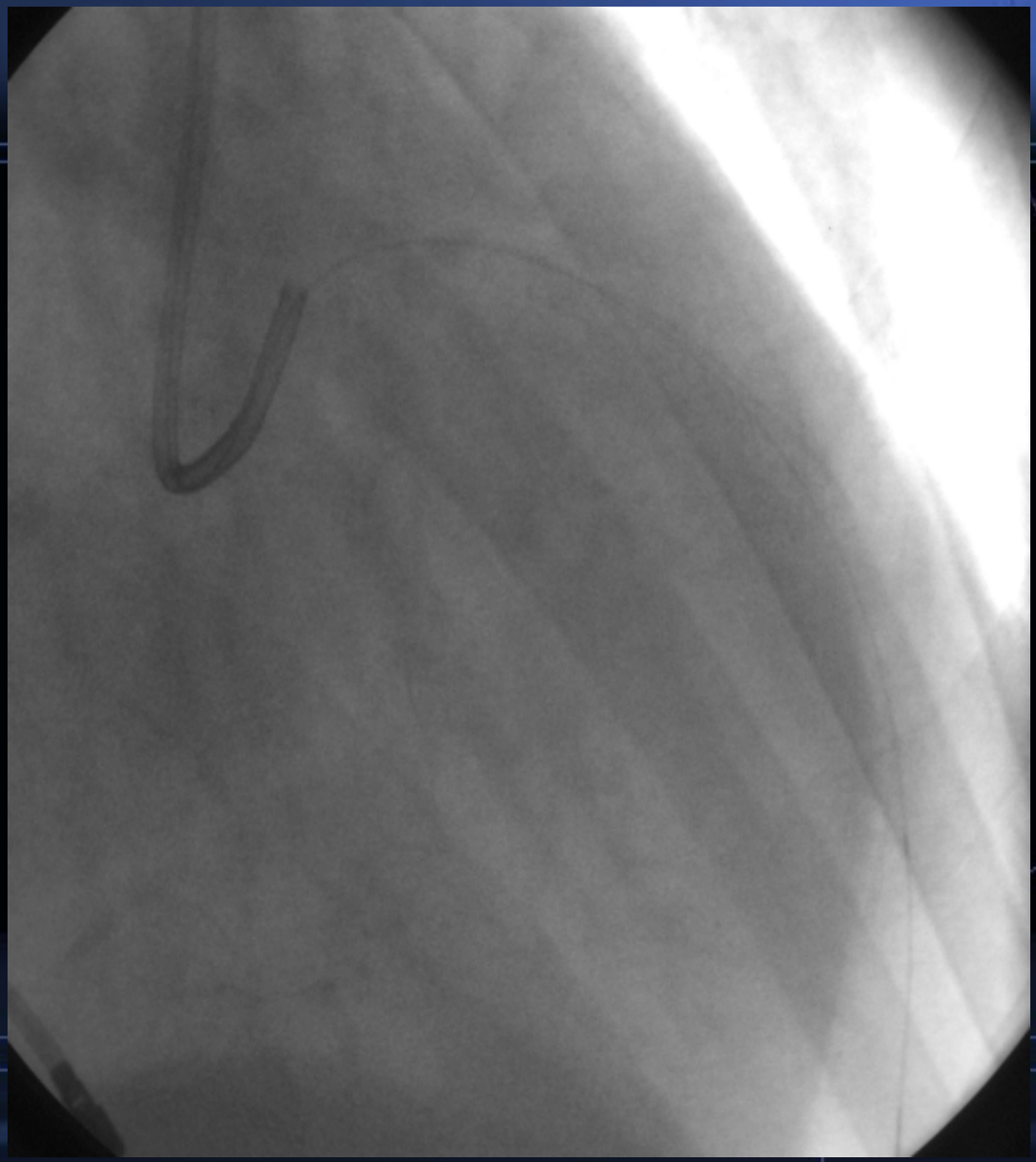
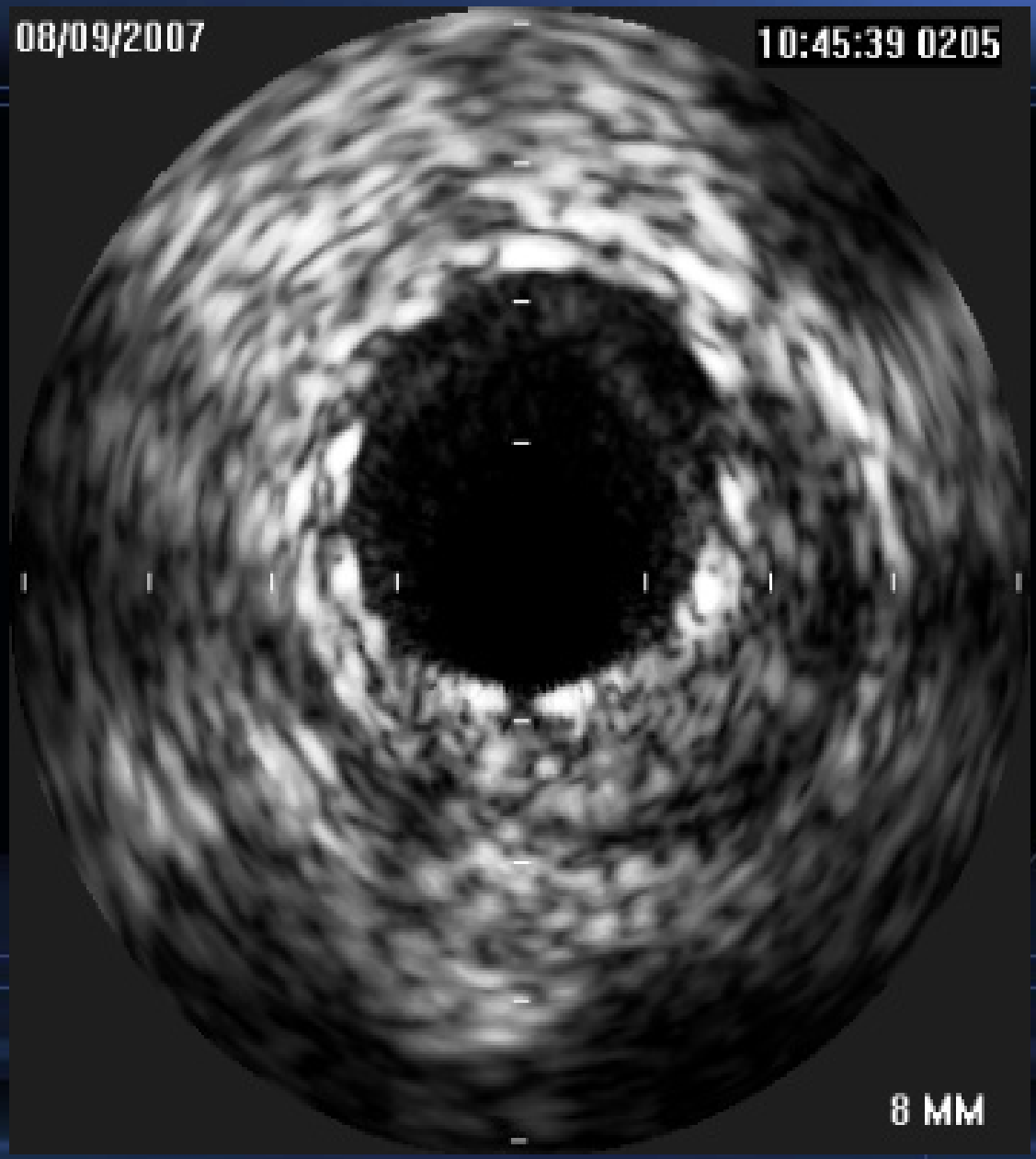

10:18:26
10:18:26
Lumen Area 3.9 mm
Vessel Area 16.0 mm
Plaque Area 12.1 mm
% Plaque Burden 76 %
FI Green Area 3.7 mm 42 %
FF Light Green Area 0.2 mm 2 %
DC White Area 1.0 mm 12 %
NC Red Area 3.8 mm 44 %
More ...





3.5*38mm stent for mLAD at 8atm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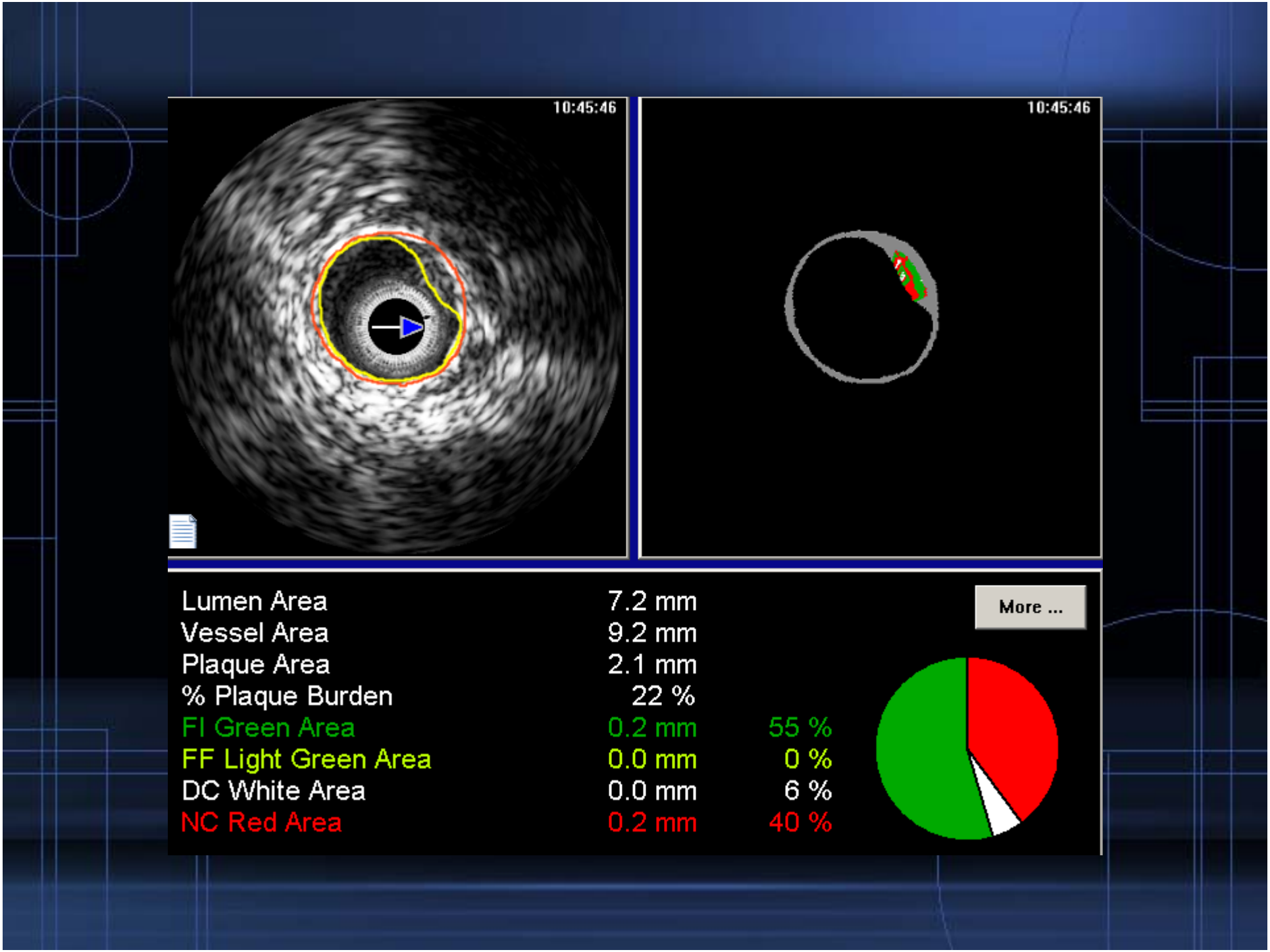
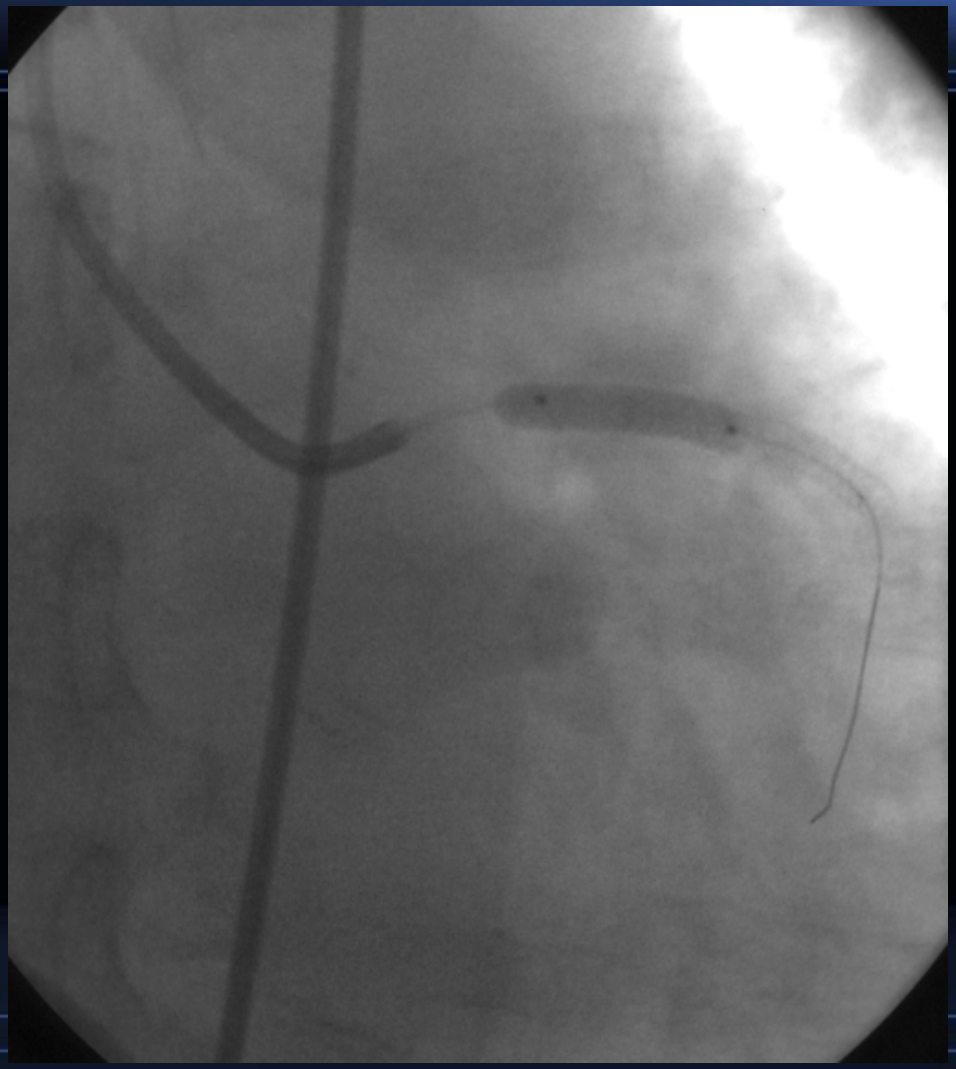
8 MM

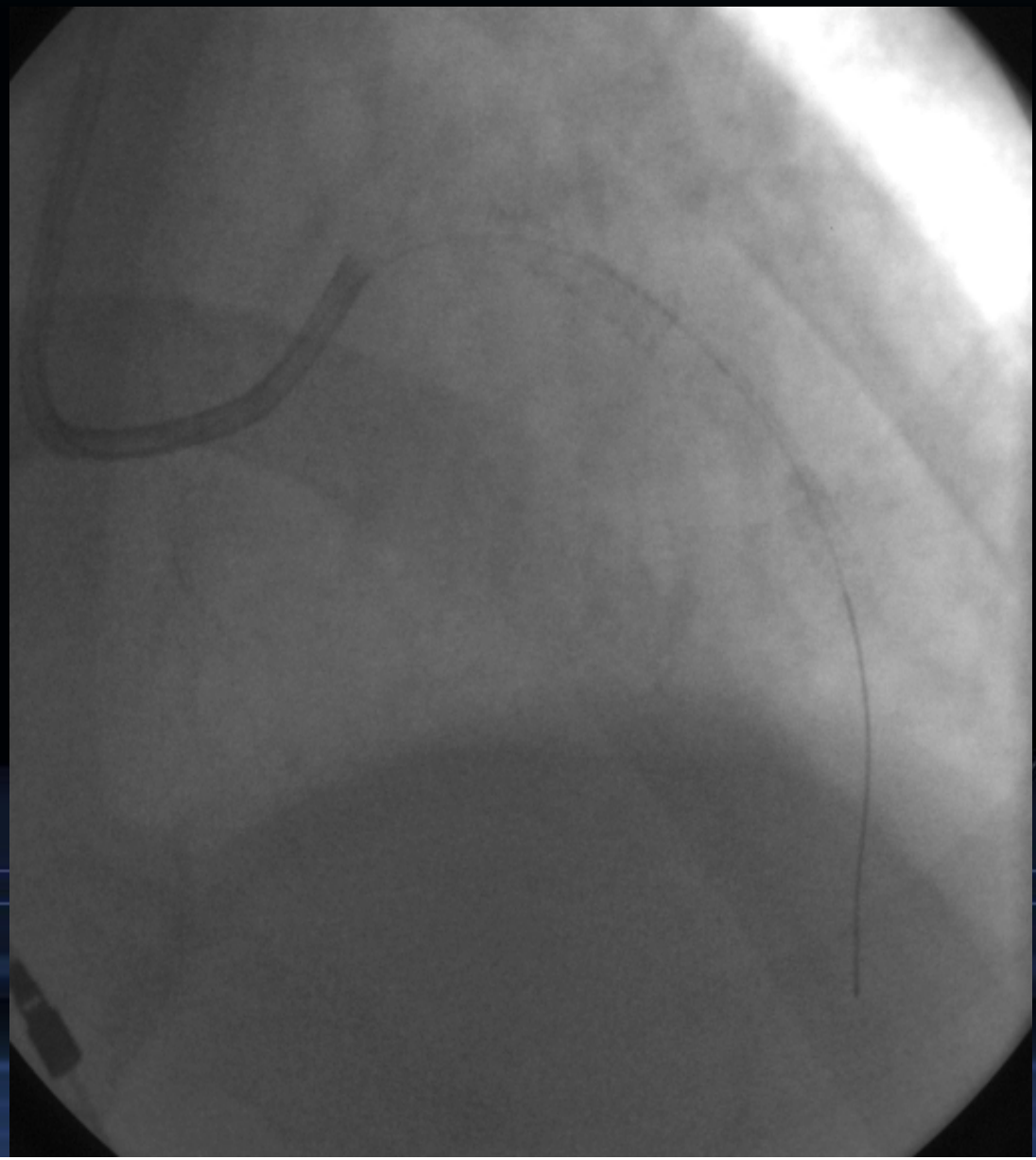

10:45:46
10:45:46
Lumen Area 7.2 mm
Vessel Area 9.2 mm
Plaque Area 2.1 mm
% Plaque Burden 22 %
FI Green Area 0.2 mm 55 %
FF Light Green Area 0.0 mm 0 %
DC White Area 0.0 mm 6 %
NC Red Area 0.2 mm 40 %
More ...



3.5*18mm stent for pLAD at 14atm

# 3.5*18, 3.5*38mm Stent Implantation

No-reflow



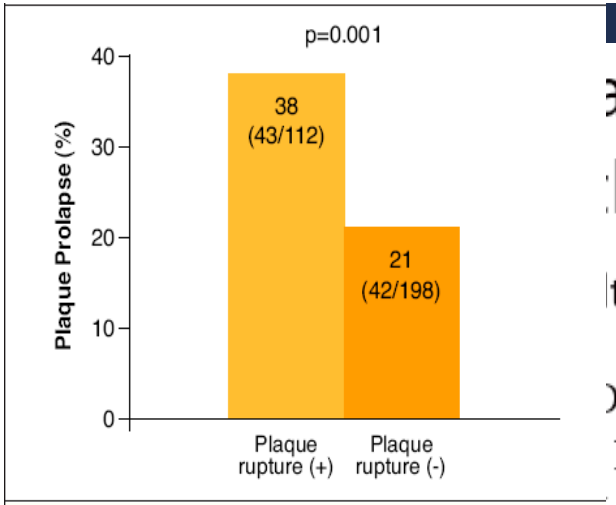



**Figure 2. Incidence of PP in Relation to the Presence or Absence of the Plaque Rupture**

A ruptured plaque contained a cavity that communicated with the lumen with an overlying residual fibrous cap fragment. A fragmented and loosely adherent plaque without a distinct cavity and without a fibrous cap fragment was not considered a plaque rupture. The PP was observed more frequently in lesions with plaque rupture compared with lesions without plaque rupture.

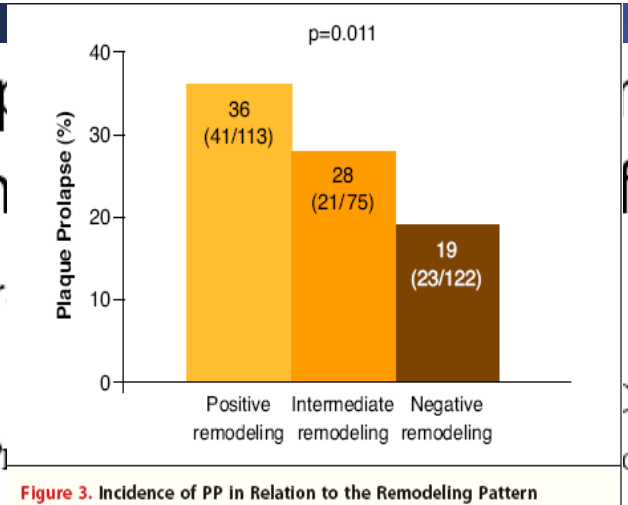



**Figure 3. Incidence of PP in Relation to the Remodeling Pattern**

Remodeling index was defined as the lesion site external elastic membrane (EEM) cross-sectional area (CSA) divided by the average of the proximal and distal reference EEM CSA. Positive remodeling (n = 113) was defined as a remodeling index >1.05, intermediate remodeling (n = 75) as a remodeling index between 0.95 and 1.05, and negative remodeling (n = 122) as a remodeling index <0.95. The PP was most frequently observed in the group showing positive remodeling compared with the groups showing intermediate or negative remodeling.

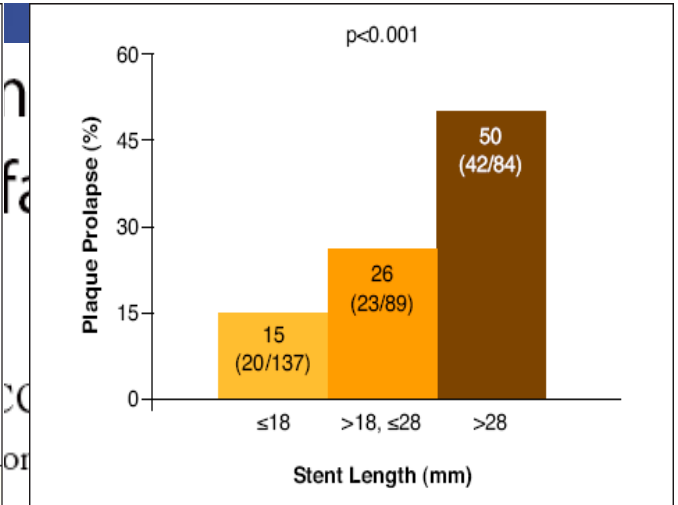


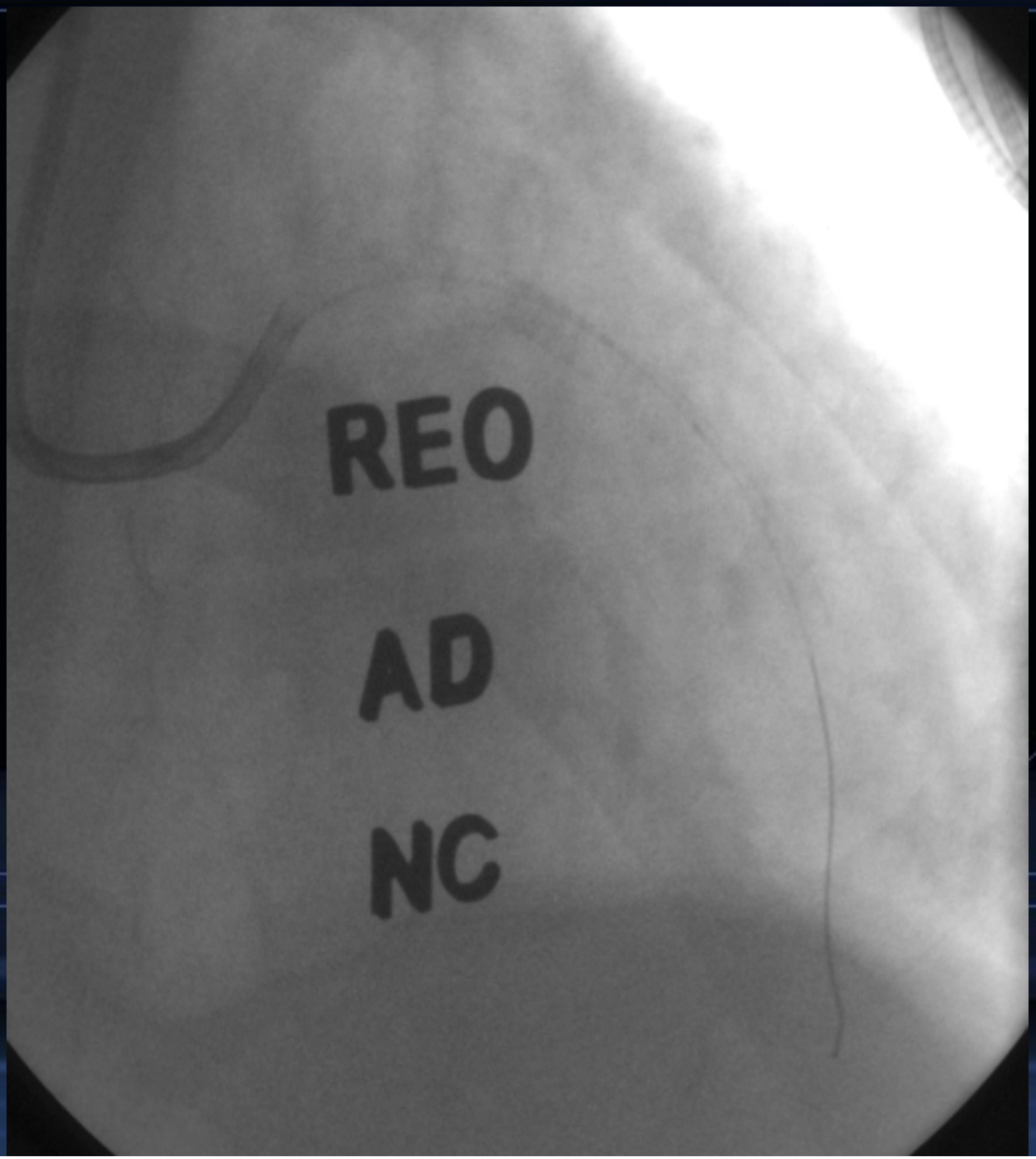

**Figure 1. Incidence of PP in Relation to the Stent Length**

Stent length was divided into 3 groups such as short stent length group (less than 18 mm, n = 137), intermediate stent length group (between 18 and 28 mm, n = 89), and long stent length group (more than 28 mm, n = 84). Plaque prolapse (PP) was most frequently observed in the group with the long stents (>28 mm) compared with the groups with short- (≤18 mm) or intermediate-length (>18 and ≤28 mm) stents.

**METHODS** Intravascular ultrasound (IVUS) imaging was performed in 310 patients immediately following stenting for their first acute myocardial infarction. Multiple clinical, angiographic and IVUS derived variables were compared among patients with and without intrastent PP.

**CONCLUSIONS** PP occurs in one-fourth of infarct-related arteries after stent implantation. Lesion characteristics such as plaque rupture and positive remodeling, together with longer stent predict PP. Although long-term follow-up is pending, PP is associated with more myonecrosis after stenting in patients with acute myocardial infarction. (J Am Coll Cardiol Img 2008;1:489–97) © 2008 by the American College of Cardiology Foundation

# ReoPro, Adenosin, Nicorandil



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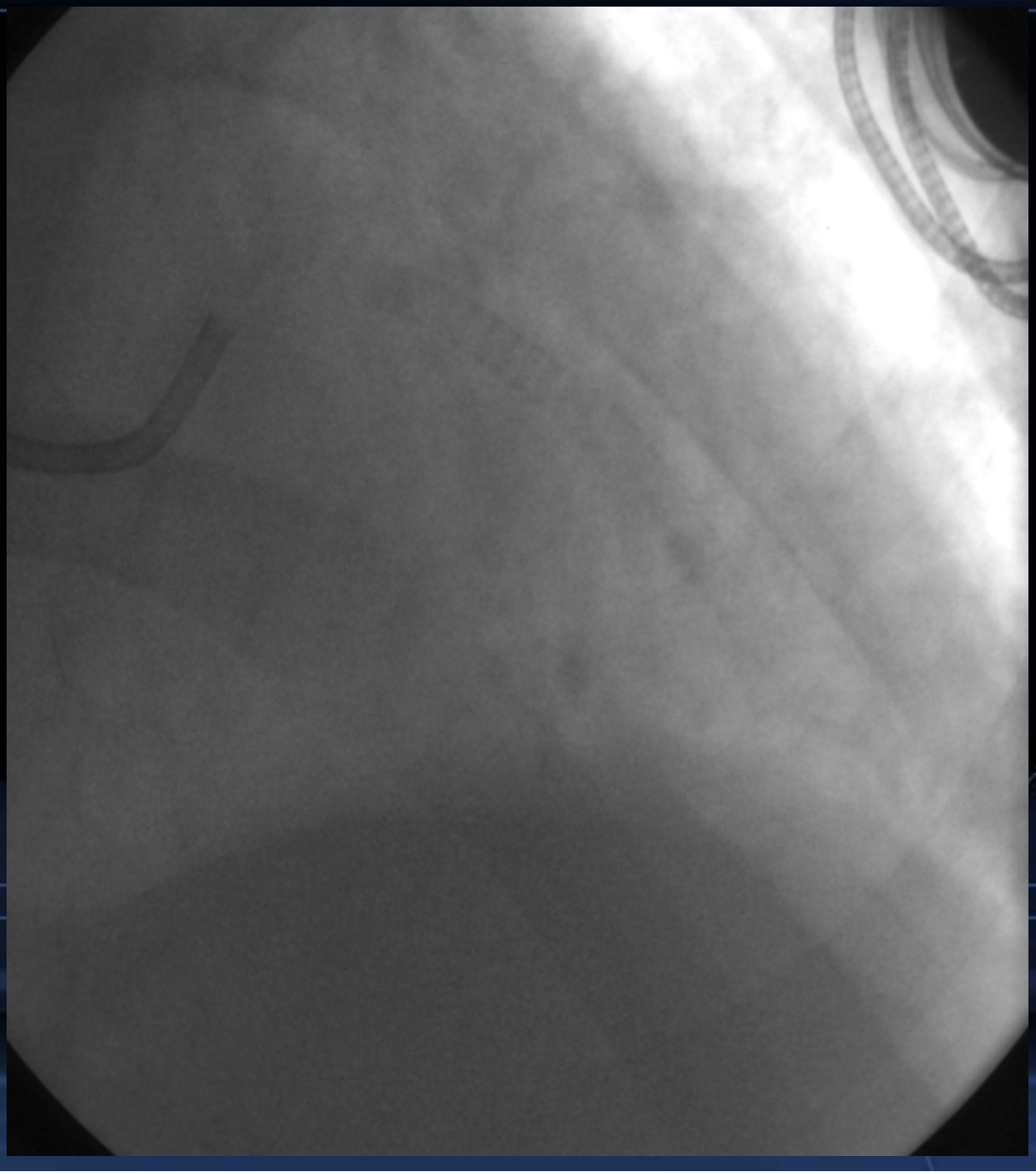

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doi:10.1093/eurheartj/ehp034

CLINICAL RESEARCH

# Impact of plaque components on no-reflow phenomenon after stent deployment in patients with acute coronary syndrome: a virtual histology-intravascular ultrasound analysis

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*Received 18 October 2008; revised 23 December 2008; accepted 12 January 2009*

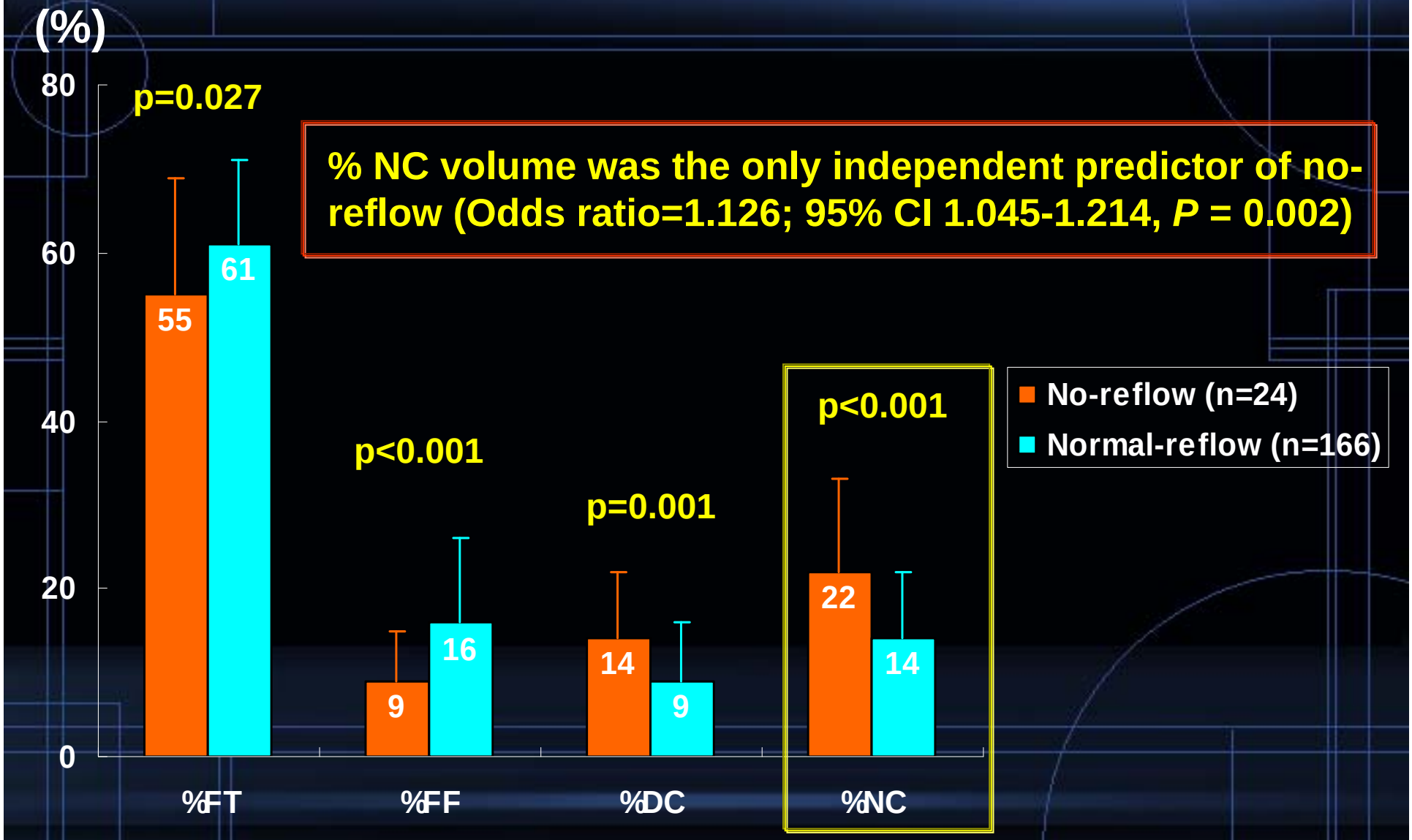
**Aims** We used virtual histology-intravascular ultrasound (VH-IVUS) to evaluate the relation between coronary plaque characteristics and no-reflow in acute coronary syndrome (ACS) patients.

**Methods and results** A total of 190 consecutive ACS patients were imaged using VH-IVUS and analysed retrospectively. Angiographic no-reflow was defined as TIMI flow grade 0, 1, and 2 after stenting. Virtual histology-intravascular ultrasound classified the colour-coded tissue into four major components: fibrotic, fibro-fatty, dense calcium, and necrotic core (NC). Thin-cap fibroatheroma (TCFA) was defined as focal, NC-rich ($\geq$10% of the cross-sectional area) plaques being in contact with the lumen in a plaque burden $\geq$40%. Of the 190 patients studied at pre-stenting, no-reflow was observed in 24 patients (12.6%) at post-stenting. The absolute and %NC areas at the minimum lumen sites ($1.6 \pm 1.2$ vs. $0.9 \pm 0.8$ mm$^2$, $P < 0.001$, and $24.5 \pm 14.3$ vs. $16.1 \pm 10.6$%, $P = 0.001$, respectively) and the absolute and %NC volumes ($30 \pm 24$ vs. $16 \pm 17$ mm$^3$, $P = 0.001$, and $22 \pm 11$ vs. $14 \pm 8$%, $P < 0.001$, respectively) were significantly greater, and the presence of at least one TCFA and multiple TCFAs within culprit lesions (71 vs. 36%, $P = 0.001$, and 38 vs. 15%, $P = 0.005$, respectively) was significantly more common in the no-reflow group compared with the normal-reflow group. In the multivariable analysis, %NC volume was the only independent predictor of no-reflow (odds ratio = 1.126; 95% CI 1.045–1.214, $P = 0.002$).

**Conclusion** In ACS patients, post-stenting no-reflow is associated with plaque components defined by VH-IVUS analysis with larger NC and more TCFAs.

**Keywords** Coronary disease • Stents • Plaque • Ultrasonics

# Plaque Component and No-Reflow




**% NC volume was the only independent predictor of no-reflow (Odds ratio=1.126; 95% CI 1.045-1.214, *P* = 0.002)**

Hong YJ et al., Eur Heart J 2009 Feb 19. [Epub ahead of print]

JACC Cardiovasc Imaging. 2009 Apr;2(4):458-68.

# Impact of plaque composition on cardiac troponin elevation after percutaneous coronary intervention: an ultrasound analysis.

Hong YJ, Mintz GS, Kim SW, Lee SY, Okabe T, Pichard AD, Satler LF, Waksman R, Kent KM, Suddath WO, Weissman NJ.

Cardiovascular Research Institute/Medstar Research Institute, Washington Hospital Center, Washington, DC 20010, USA.

Comment in:

JACC Cardiovasc Imaging. 2009 Apr;2(4):469-72.

## Abstract

**OBJECTIVES:** We used virtual histology-intravascular ultrasound (VH-IVUS) to study the relationship between pre-percutaneous coronary intervention (PCI) coronary plaque characteristics and post-PCI cardiac troponin I (cTnI) elevation.

**BACKGROUND:** Percutaneous coronary intervention is often complicated by post-procedural myocardial necrosis as manifested by elevated cardiac markers.

**METHODS:** Eighty consecutive patients (29 stable and 51 unstable angina) with normal pre-PCI cTnI levels were imaged before PCI using VH-IVUS. Patients were divided into 2 groups according to the presence (Group I, n = 38) or absence (Group II, n = 42) of post-PCI cTnI elevation > or =3x the upper limit of normal (0.08 ng/ml).

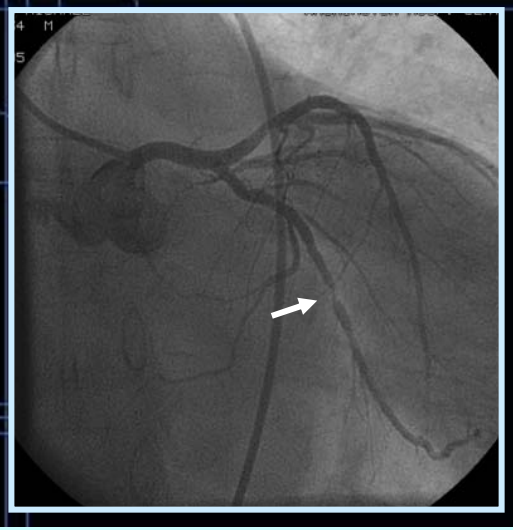
**RESULTS:** The absolute and percent necrotic core volumes were significantly greater in Group I than in Group II (13.6 +/- 6.4 mm(3) vs. 7.9 +/- 4.4 mm(3), p < 0.001, and 19.8 +/- 10.4% vs. 12.8 +/- 8.4%, p = 0.015, respectively). The absolute and percent necrotic core areas were significantly greater in Group I than in Group II at the minimum lumen site (1.70 +/- 0.91 mm(2) vs. 0.61 +/- 0.39 mm(2), p < 0.001, and 22.9 +/- 11.7% vs. 10.4 +/- 6.6%, p < 0.001, respectively) and at the largest necrotic core site (2.00 +/- 0.86 mm(2) vs. 0.81 +/- 0.78 mm(2), p < 0.001, and 24.0 +/- 11.7% vs. 12.9 +/- 6.6%, p < 0.001, respectively). The DeltacTnI correlated with: 1) absolute and percent necrotic core area at the minimum lumen site and at the largest necrotic core site; 2) absolute necrotic core volume; 3) percent fibrofatty area at the minimum lumen site; and 4) lesion site plaque burden. In the multivariate analysis, absolute necrotic core area at the minimum lumen site was the only independent predictor of post-PCI cTnI elevation > or =3x the upper limit of normal (odds ratio: 1.318; 95% confidence interval: 1.090 to 1.594, p = 0.004).

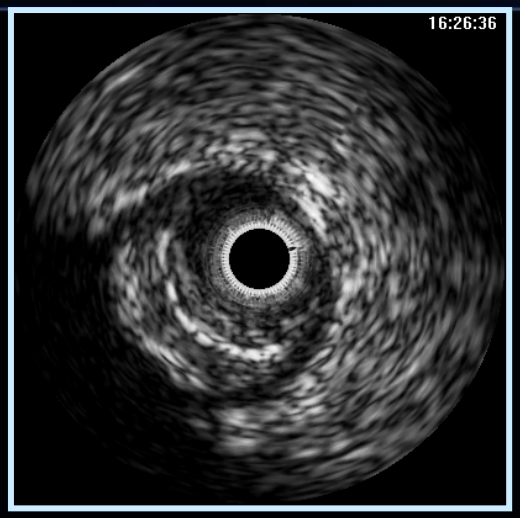
**CONCLUSIONS:** The VH-IVUS analysis shows that post-PCI cTnI elevation occurs in lesions with a large necrotic core area. The VH-IVUS may play an important role in detecting which lesions are high risks for myocardial necrosis after PCI.

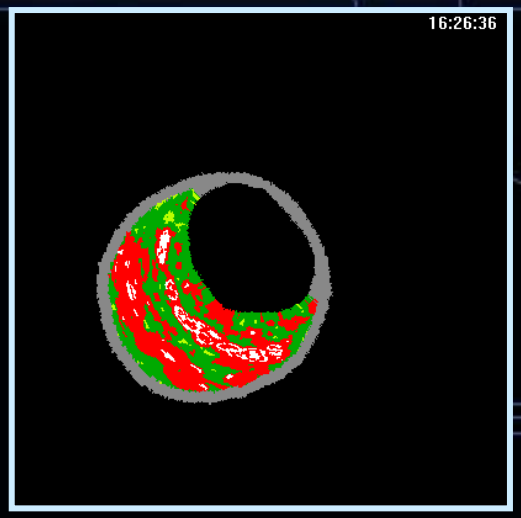
PMID: 19580729 [PubMed - indexed for MEDLINE]

# Plaque Component and TnI Elevation

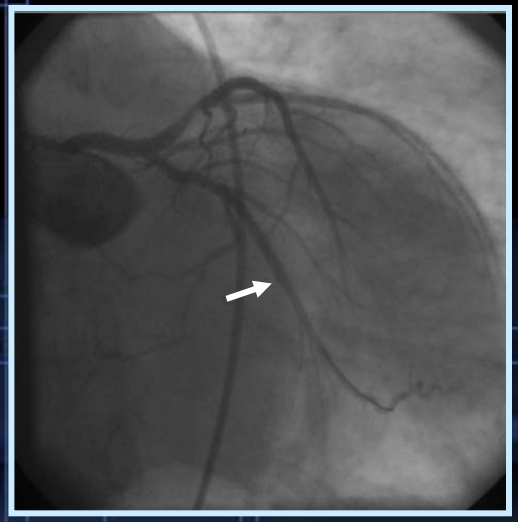
Pre-PCI (cTnI=0ng/ml)



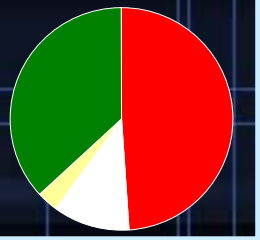



Cypher (cTnI=3.24ng/ml)

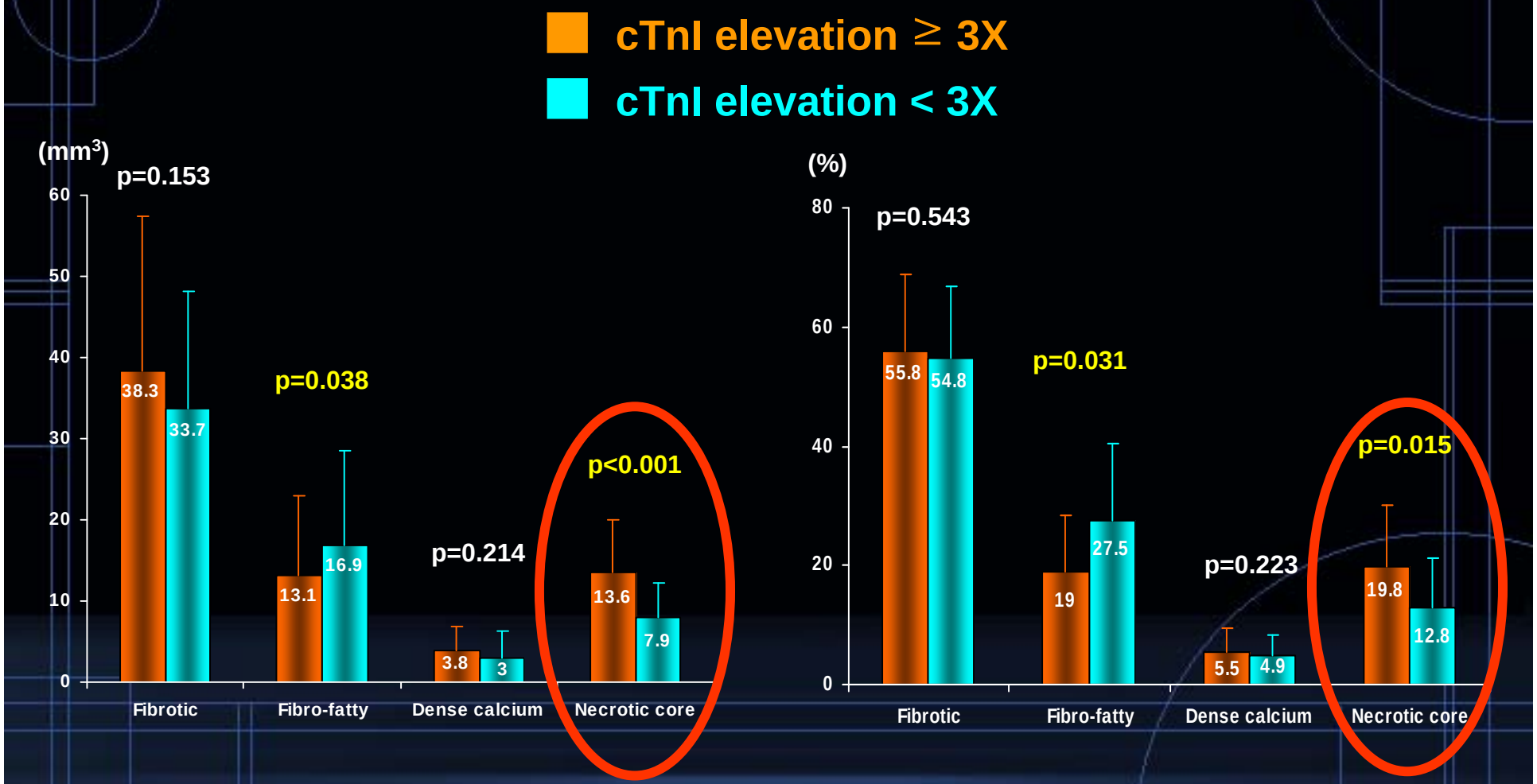


| | | |
|---|---|---|
| Lumen Area | 3.8 $mm^2$ | |
| EEL Area | 16.0 $mm^2$ | |
| Plaque Area | 12.2 $mm^2$ | |
| % Plaque Burden | 76% | |
| Fibrous Area | 3.7 $mm^2$ | 37% |
| Fibro-Fatty Area | 0.3 $mm^2$ | 3% |
| Dense Calcium Area | 1.1 $mm^2$ | 11% |
| Necrotic Core Area | 5.0 $mm^2$ | 49% |



Hong YJ, et al. JACC Cardiovasc Imaging 2009;2:458-68

# Plaque Component and TnI Elevation




Hong YJ, et al. JACC Cardiovasc Imaging 2009;2:458-68

Circulation Journal
Official Journal of the Japanese Circulation Society
http://www.j-circ.or.jp

ORIGINAL ARTICLE
Imaging

# Relation Between Plaque Components and Plaque Prolapse After Drug-Eluting Stent Implantation

## – Virtual Histology–Intravascular Ultrasound –

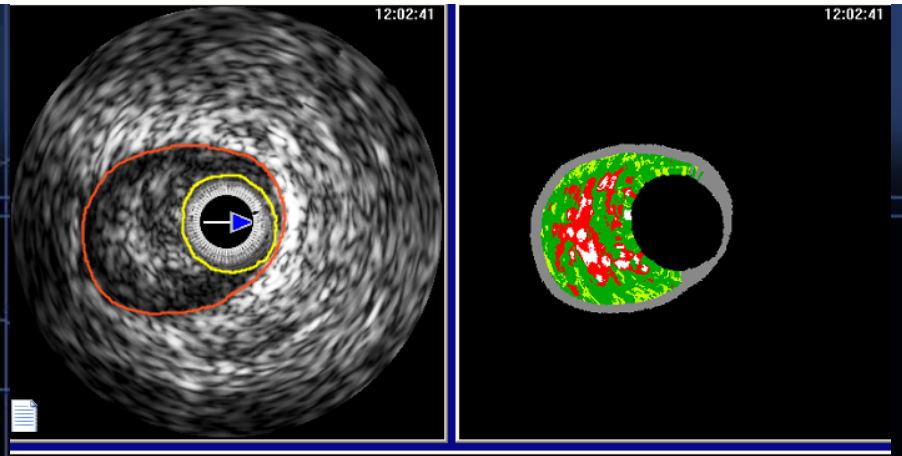
Young Joon Hong, MD; Myung Ho Jeong, MD; Sang Wook Kim, MD*; Yun Ha Choi; Eun Hae Ma; Jum Suk Ko, MD; Min Goo Lee, MD; Keun Ho Park, MD; Doo Sun Sim, MD; Nam Sik Yoon, MD; Hyun Ju Yoon, MD; Kye Hun Kim, MD; Hyung Wook Park, MD; Ju Han Kim, MD; Youngkeun Ahn, MD; Jeong Gwan Cho, MD; Jong Chun Park, MD; Jung Chaee Kang, MD

***Background:*** It is not well known which plaque components are associated with the development of plaque prolapse (PP) and what are the major components in prolapsed plaque. The relationship between pre-stenting plaque components and post-stenting PP was assessed and the plaque components of prolapsed plaque were evaluated in patients who underwent drug-eluting stent (DES) implantation using virtual histology–intravascular ultrasound (VH-IVUS).

***Methods and Results:*** The study group consisted of 132 patients who underwent DES implantation and pre- and post-stenting VH-IVUS. Of these patients, 68 patients had 76 PP lesions and 64 patients had 76 non-PP lesions. Intra-stent PP volume was 3.6±1.5 $mm^3$. Plaque volume was significantly greater and absolute fibrotic (FT) and necrotic core (NC) volumes were significantly greater in PP lesions compared with non-PP lesions. On multivariate analysis, absolute NC (odds ratios [OR]=1.14, P<0.001) and FT volume (OR=1.09, P<0.001) were independently associated with the development of PP. In intra-stent prolapsed plaque the FT component was greatest, but the NC component was also large, and %NC volume correlated positively with Δcreatine kinase-MB (r=0.489, P<0.001) and Δtroponin-I (r=0.679, P<0.001), and %FT volume correlated negatively with ΔCK-MB (r=–0.539, P<0.001) and Δtroponin-I.

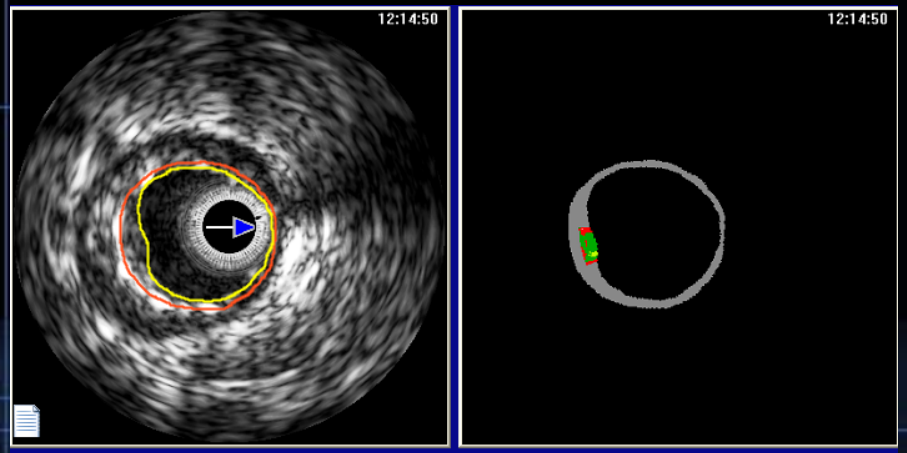
***Conclusions:*** NC and FT components were associated with development of PP; and NC and FT components in prolapsed plaque were associated with cardiac enzyme elevation after DES implantation. (*Circ J* 2010; **74:** 1142–1151)

**Key Words:** Atherosclerosis; Coronary disease; Intravascular ultrasound; Stent



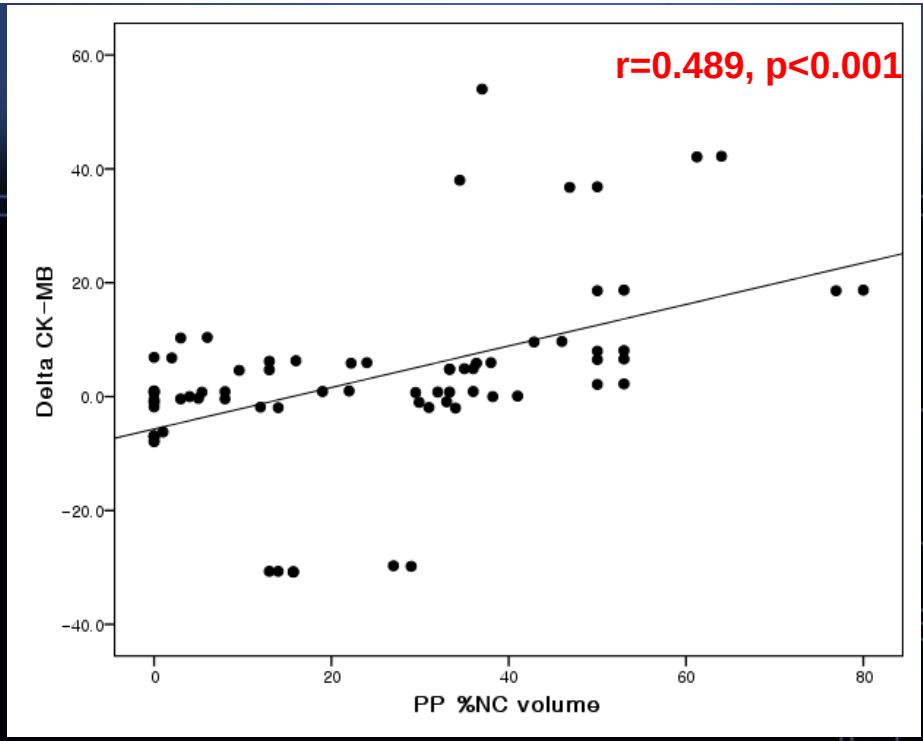

| | | |
|---|---|---|
| Lumen Area | 3.9 mm² | |
| Vessel Area | 15.0 mm² | |
| Plaque Area | 11.1 mm² | |
| % Plaque Burden | 74 % | |
| FI Green Area | 4.6 mm² | 58 % |
| FF Light Green Area | 0.9 mm² | 11 % |
| DC White Area | 0.5 mm² | 7 % |
| NC Red Area | 1.9 mm² | 24 % |

More ...




| | | |
|---|---|---|
| Lumen Area | 7.7 mm² | |
| Vessel Area | 10.2 mm² | |
| Plaque Area | 2.6 mm² | |
| % Plaque Burden | 25 % | |
| FI Green Area | 0.2 mm² | 66 % |
| FF Light Green Area | 0.0 mm² | 7 % |
| DC White Area | 0.0 mm² | 0 % |
| NC Red Area | 0.1 mm² | 27 % |

More ...

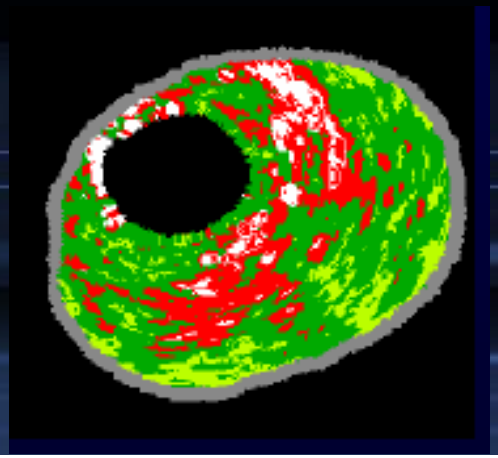



# Plaque Component, Plaque Prolapse, Post-PCI CK-MB Elevation

Hong YJ et al., Circ J 2010;74:1142- 51

# Could Necrotic Core be the Determinant Factor We Should Target Our Attention?

- What is necrotic core?
  - It is plaque composition filled with intracellular lipid, often inflammatory cells, and has no matrix
  - It is the predominant composition with or without Ca found in plaques which cause a SCD and a thrombotic event



# Conclusions

Plaque rupture

Multiple Plaque rupture

Thrombus

Positive remodeling

Necrotic core

Thin-cap fibroatheroma

Plaque prolapse

No-reflow

Cardiac enzyme




# Thank You For Your Attention!