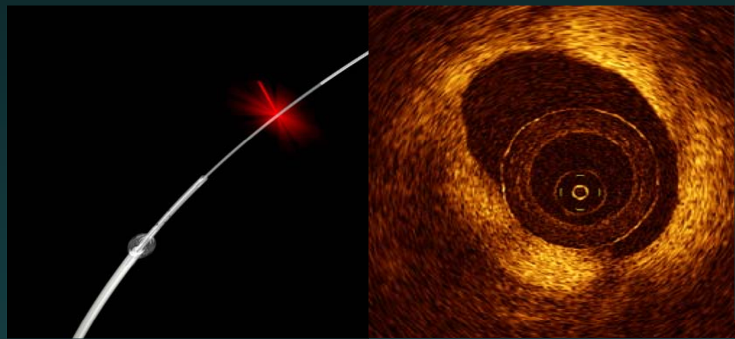
"Experience with Optical Coherence Tomography in Korea"



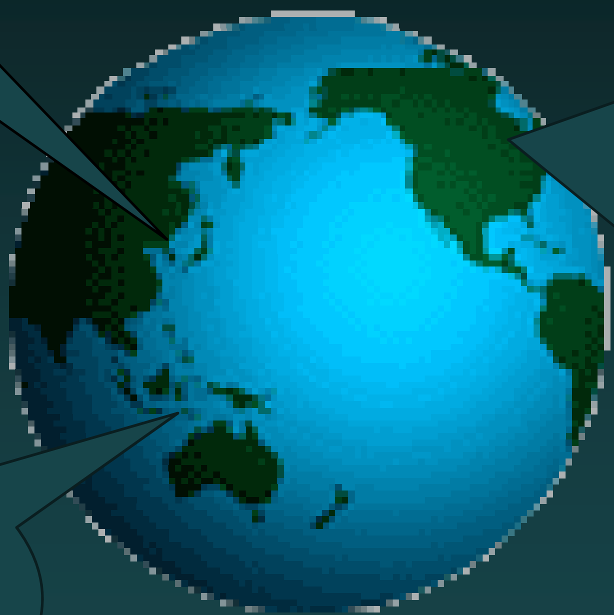
So-Yeon Choi, MD., PhD.
Department of Cardiology
Ajou University School of Medicine, Suwon, Korea

Brief History of Development of OCT

1990-91	Invention of OCT by Fujimoto (USA), Tanno (Japan)
1996	Exploratory in vitro studies by Brezinski et al in MIT and MGH
1996-99	Validated the superior resolution compared to IVUS by Weissman In vivo imaging in animal (rabbit) by Fujimoto
2000	First published clinical studies by IK Jang, Bouma, Tearney, SJ Park, SW Park, KB Seung, KB Choi et al. in US and Korea
2002	Clinical trials began by Grube, Serruys, William, Suzuki
2003	CE-approved on Oct
Nov. 2006	KFDA approved The LightLab OCT system

Current Statement of OCT

Korea 6
Japan 20
China 16

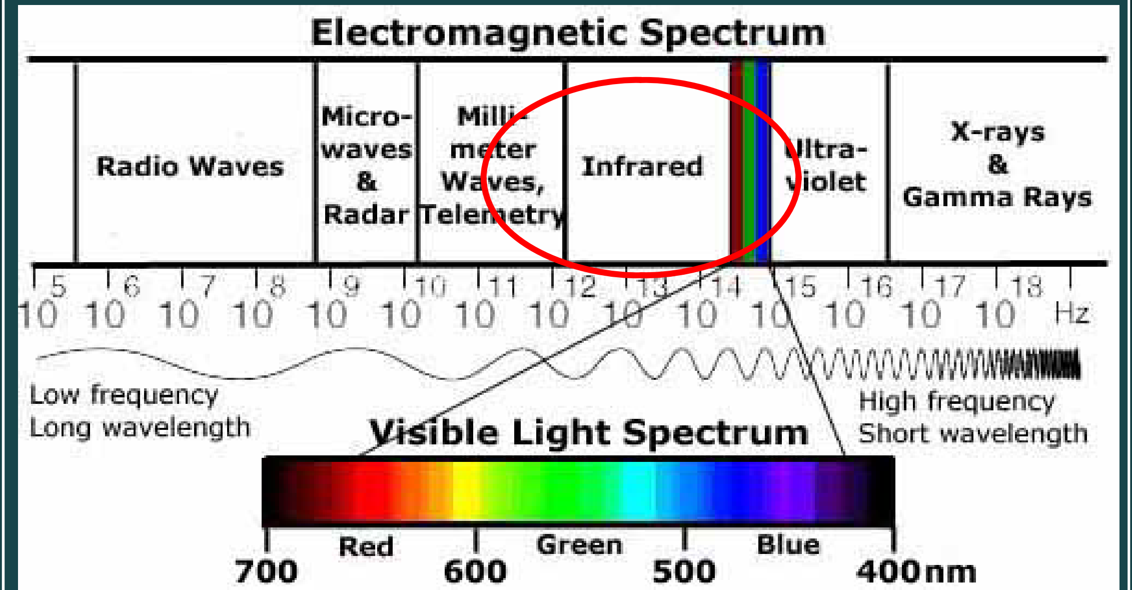


Italy 21
Sweden 4
Germany 6
The Netherland 5
UK 5
Austria 3
Greece/Cyprus 10
Spain 15
Switzerland 3
France 2
Poland 3
Latvia 1
Belarus 2
Denmark 1
Norway 1
Lithuania 1

Brazil 8
Israel 1
South Africa 2
New Zealand 1

What is OCT?

- **Optical Coherence Tomography (OCT) is a high-resolution imaging technology that employs near-infrared light (1.3 μM) to probe micrometer-scale structures inside biological tissues.**



Near-infrared light

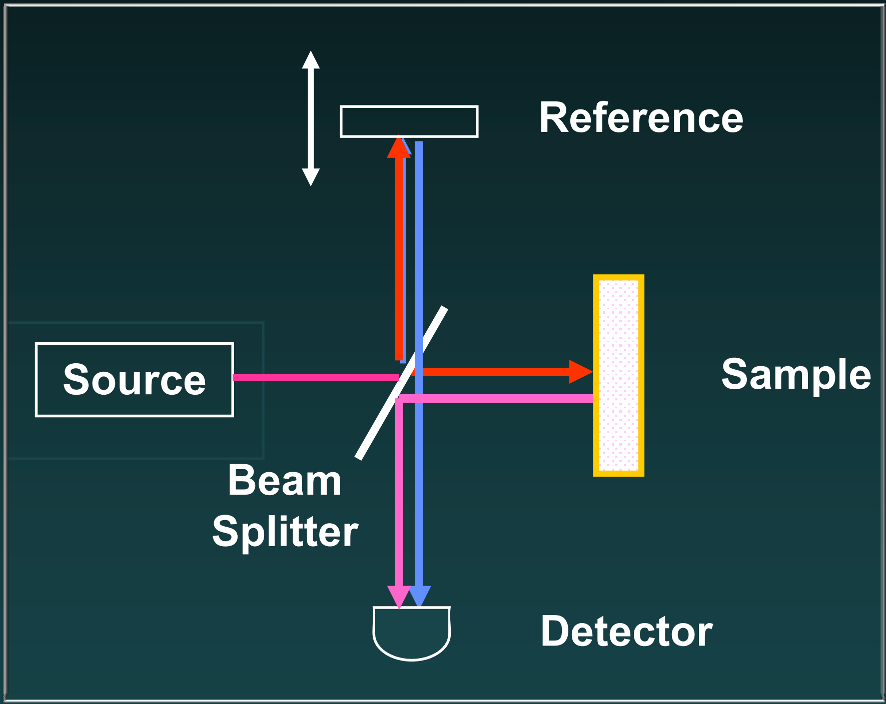
0.77-3μm, biologically safe

Property of particle and wave

- Goes straightly
- Reflection, refraction, interference, diffraction
- Doppler effect

The Key Basic Mechanism of OCT

Interferometer Schematic



- Analogous to sonar and radar, OCT measures back-reflected optical intensity in terms of "optical echoes".

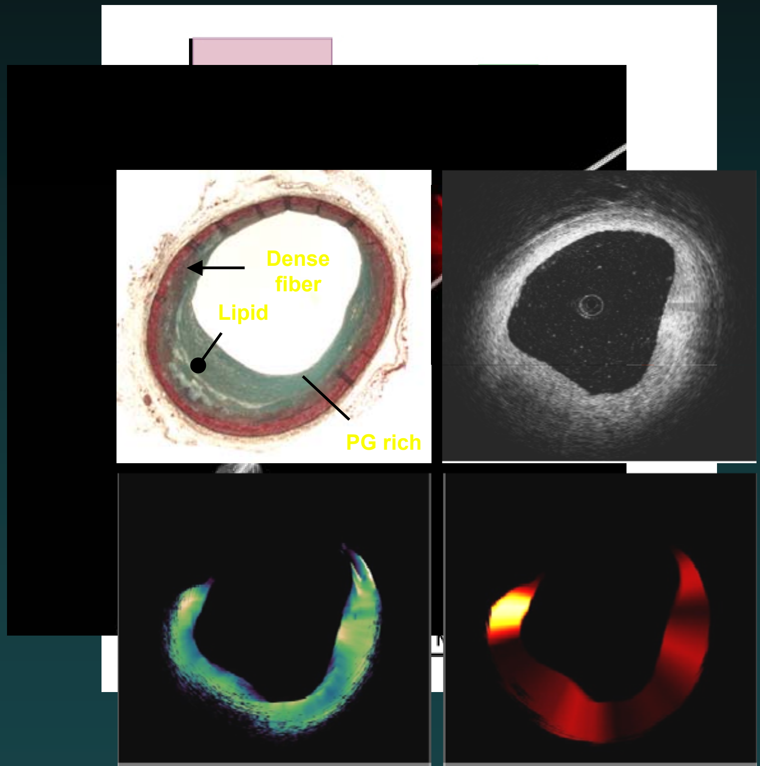
Getting OCT Imaging

OCT from LightLab Imaging system

- LightLab ImageWire
- Helios Occlusion Balloon Catheter

Why Use OCT ?

1. High Resolution
2. Real time image for intravascular structure
3. Tissue characterization

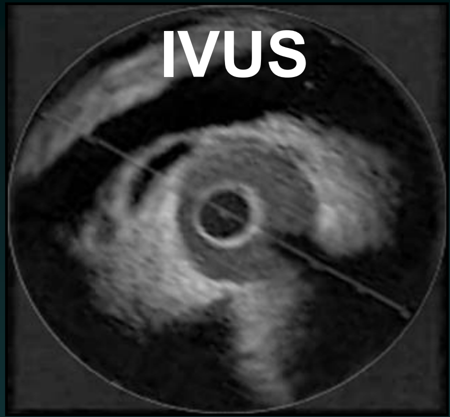


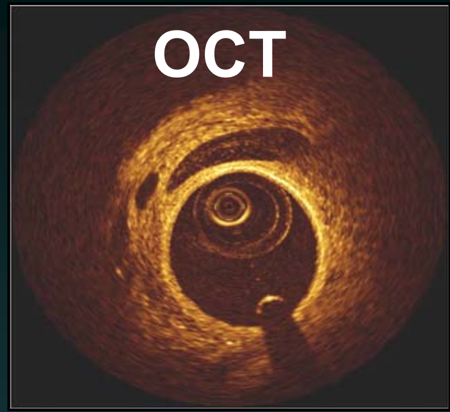
Renu Virmani, MD, Erik Mont, MD AFIP

OCT provides not only high resolution image.
But also, it has benefit to obtain real time image for intravascular structures because of small size probe and inherently able to provide information on tissue composition.

Comparison of IVUS and OCT

As comparing currently widely used Intravascular ultrasound (IVUS) in clinical practice….





		IVUS	OCT
Resolution	*(axial)*	100 - 150 μm	10 - 20 μm
	(lateral)	150 - 300 μm	25 - 40 μm
Scan area		10 - 15 mm	7.0 mm
Max. depth of penetration		4 - 8 mm	1 – 1.5 mm
		Blood clearing not required	Requires blood clearing

The OCT has a higher resolution, almost 10 times more than IVUS.
The scan area and penetration depth are narrow and shallow.
Also OCT requires blood clearing to avoid the attenuation by blood.

Potential Applications of OCT

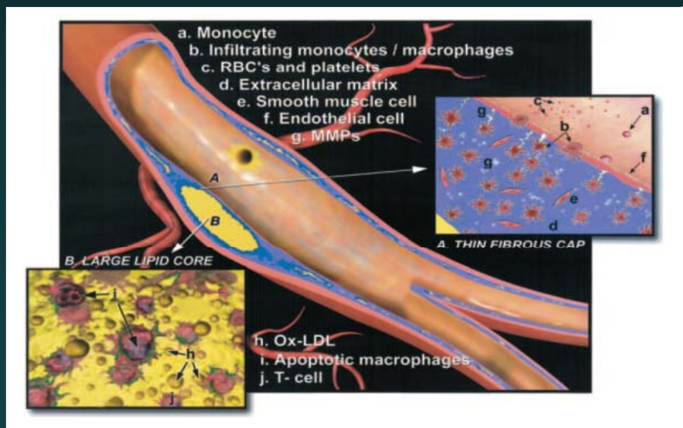
Vulnerable Plaque

OCT may provide better understand the natural progression of coronary artery disease and the answers longstanding questions about the relationship between vulnerable plaque and the risk of heart attack.

Therapeutic Guidance
Evaluation of Therapeutic Results

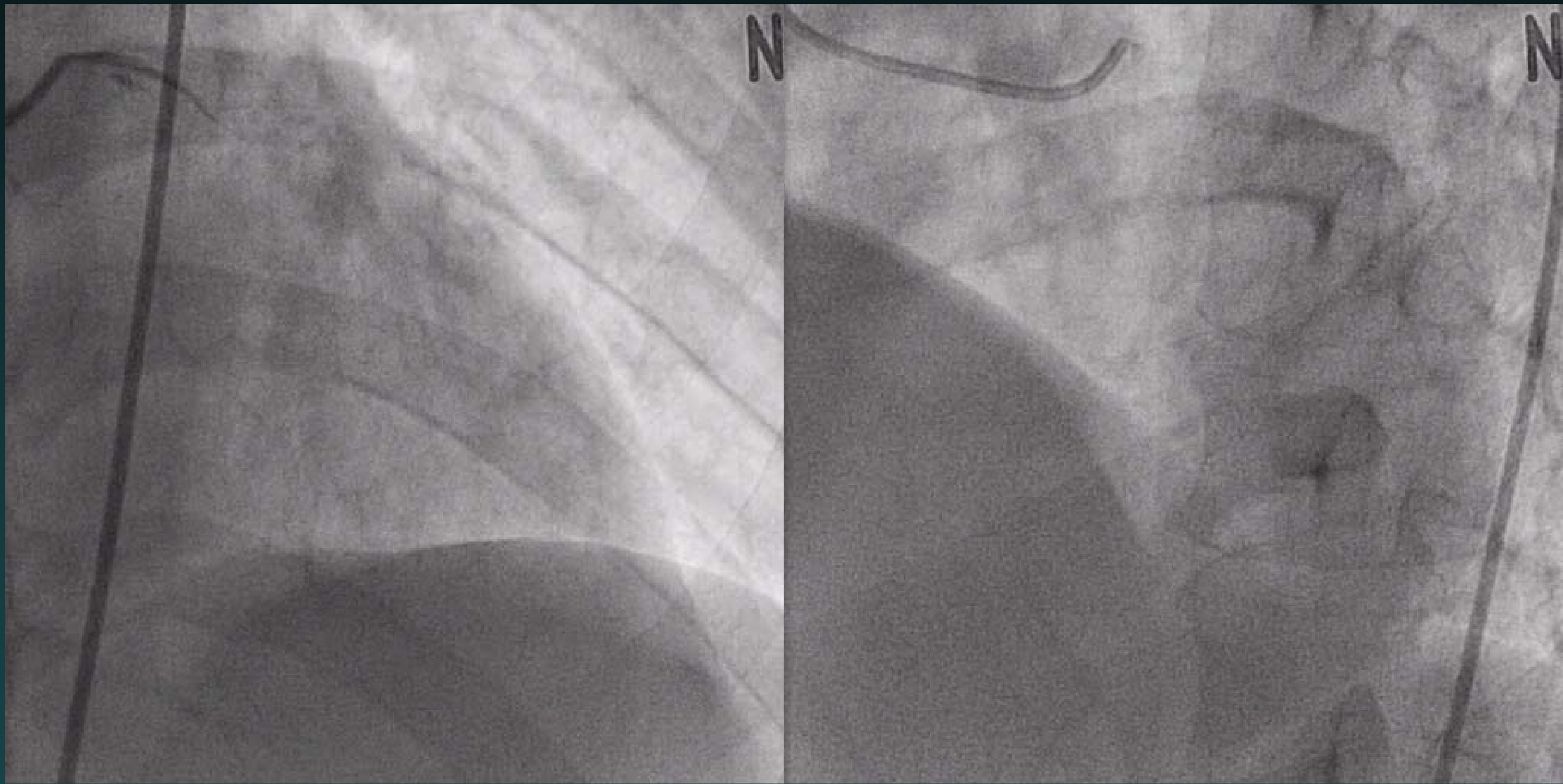
The technique is poised to play an important role in the guidance of therapeutic interventions and assessment of the results of medical and interventional treatment.

Detection of VP in OCT



Case

SJS M/46 STEMI

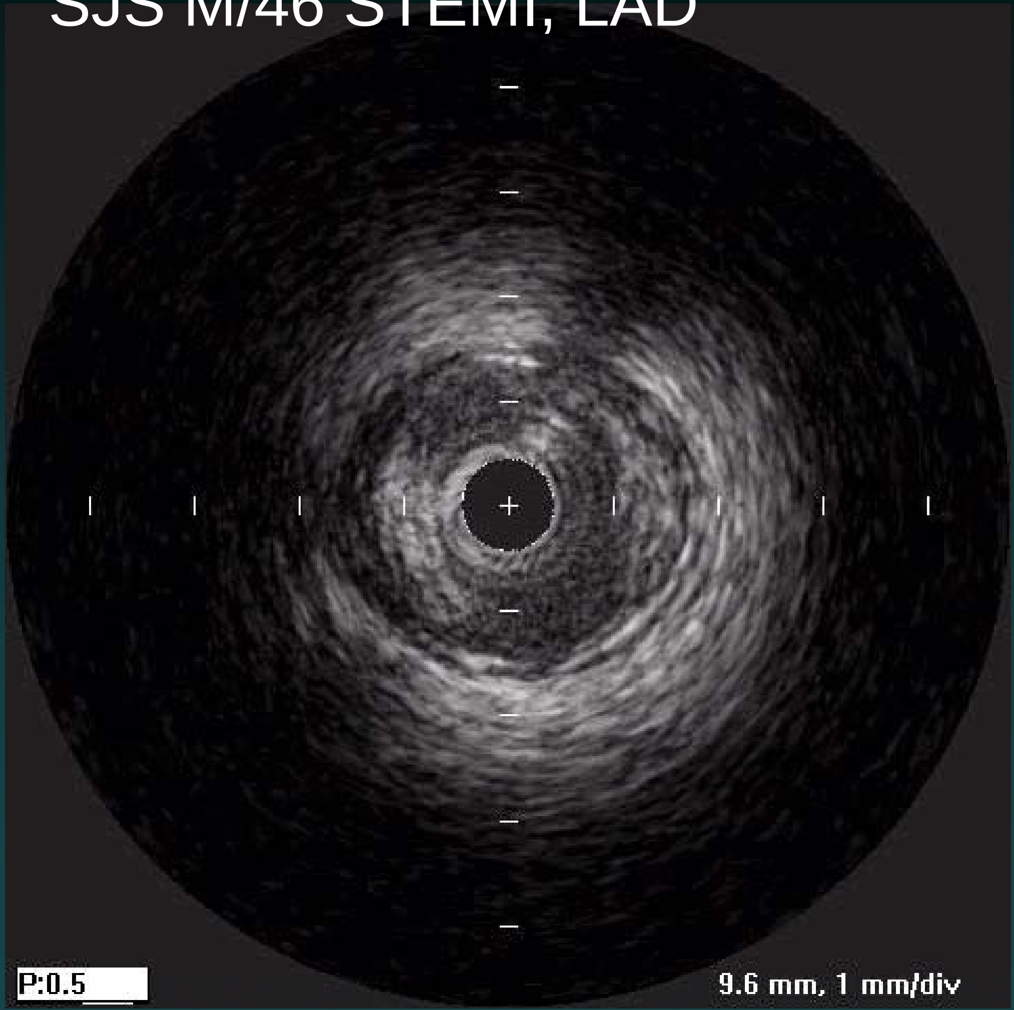


AP **LAO**

90% of tubular stenosis at mid LAD

Case

SJS M/46 STEMI, LAD

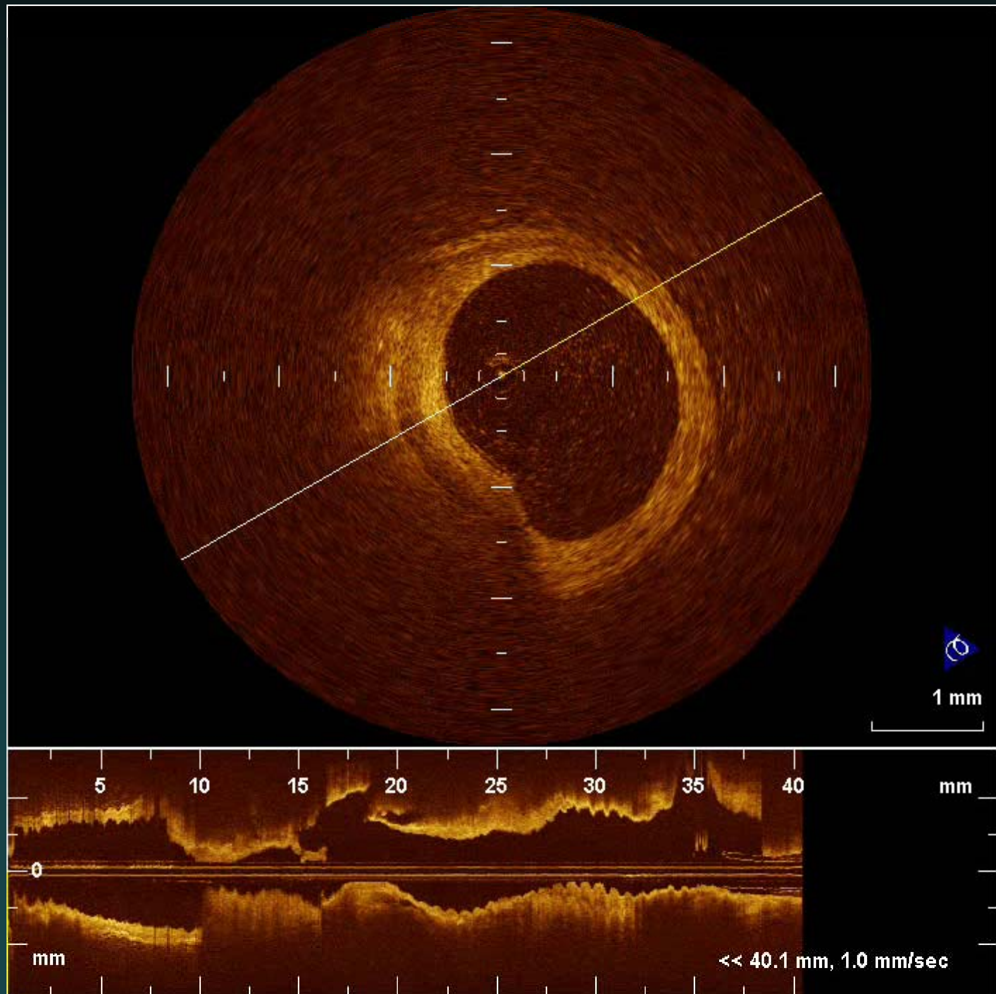


A significant stenosis with large plaque burden characterizing mixed plaque

Irregular and disrupted contour on surface of plaque

Case

SJS M/46 STEMI, LAD



Various superfical lesion:

fissuring or erosion

plaque rupture

intraluminal thrombus

Plaque Characterization by OCT

OCT could well identify the features of three distinct plaque types.

Fibrous

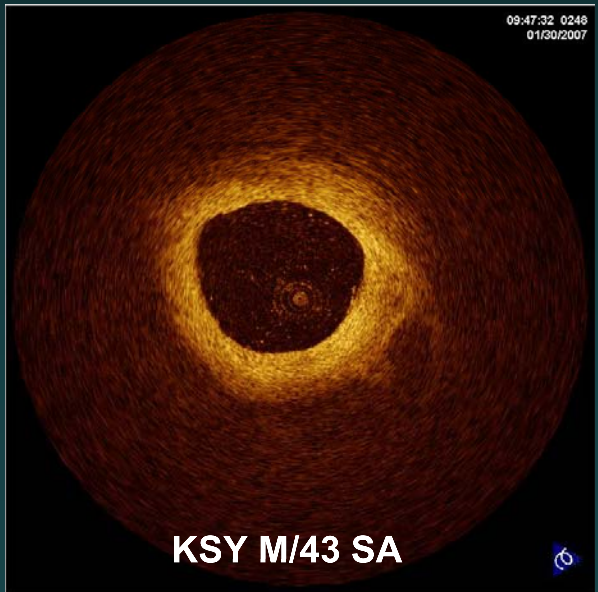
• High reflectivity
• Homogenous
• Finely textured

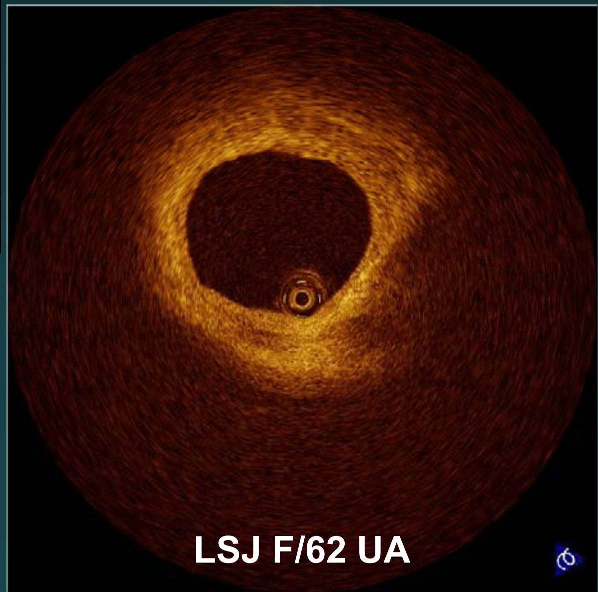
Lipid-rich

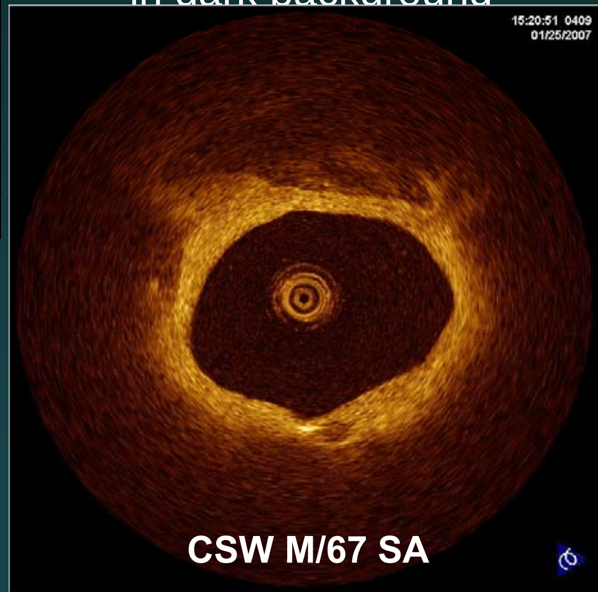
• Low reflectivity
• Homogenous
• Diffuse margins

Calcified

• Low reflectivity
• Inhomogeneous
• Sharp margins
• Isolated, strong reflections in dark background







Presented in Ajou University Medical Center

Plaque Characterization by OCT

Ex Vivo Study

Excised plaques of these three types could be differentiated with sensitivity greater than 87% and specificity greater than 94 %.
There was a good concordance in interobserver and intraobserver analysis.

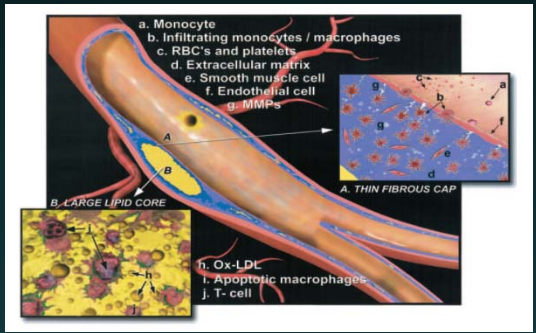
	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Fibrous	0.87	0.97	0.88	0.96
Calcific	0.95	1.0	1.0	0.95
Lipid pool	0.92	0.94	0.81	0.97

Accuracy Statistics: Interobserver k=0.88, Intraobserver k=0.91

H Yabushita, IK Jang, et al. Circulation. 2002;106:1640-45

Criteria for Defining Vulnerable Plaque

Based on previously presented autopsy study



The vulnerable plaque characterized by thin fibrous cap, extensive macrophage infiltration, and large lipid core.

Circulation. 2003;108:1664-1672

Major criteria

- **Active inflammation (monocyte/macrophage and T-cell infiltration)**
- **Thin cap with large lipid core**
- **Endothelial denudation with superficial platelet aggregation**
- **Fissured plaque**
- **Stenosis 90%**

Minor criteria

- **Superficial calcified nodule**
- **Glistening yellow**
- **Intraplaque hemorrhage**
- **Endothelial dysfunction**
- **Outward (positive) remodeling**

Criteria for Defining Vulnerable Plaque

OCT could detect most of this criteria of VP…

Major criteria

- Active inflammation (monocyte/macrophage and T-cell infiltration)
- Thin cap with large lipid core
- Endothelial denudation with superficial platelet aggregation
- Fissured plaque
- Stenosis 90%

Minor criteria

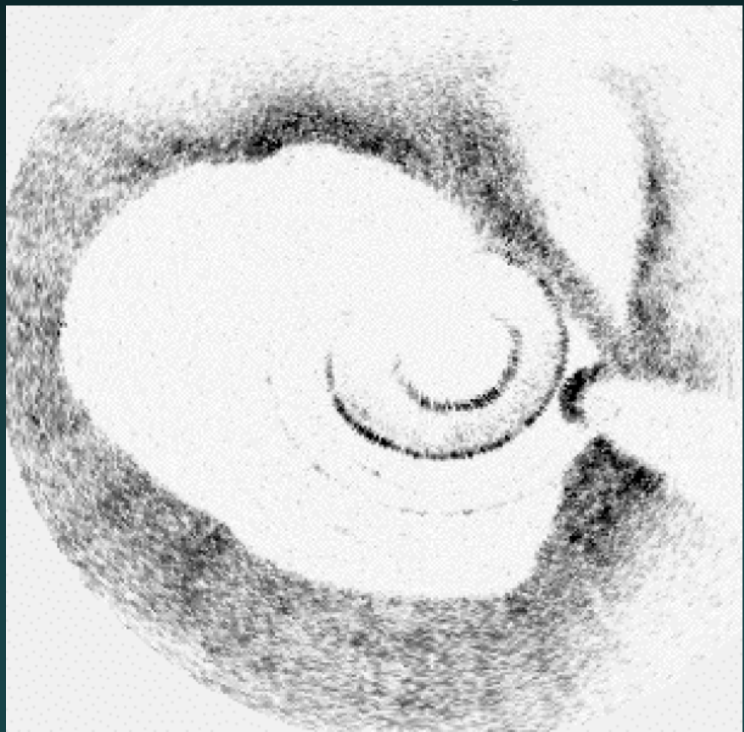
- Superficial calcified nodule
- Glistening yellow
- Intraplaque hemorrhage
- Endothelial dysfunction
- Outward (positive) remodeling

Detection of VP in OCT

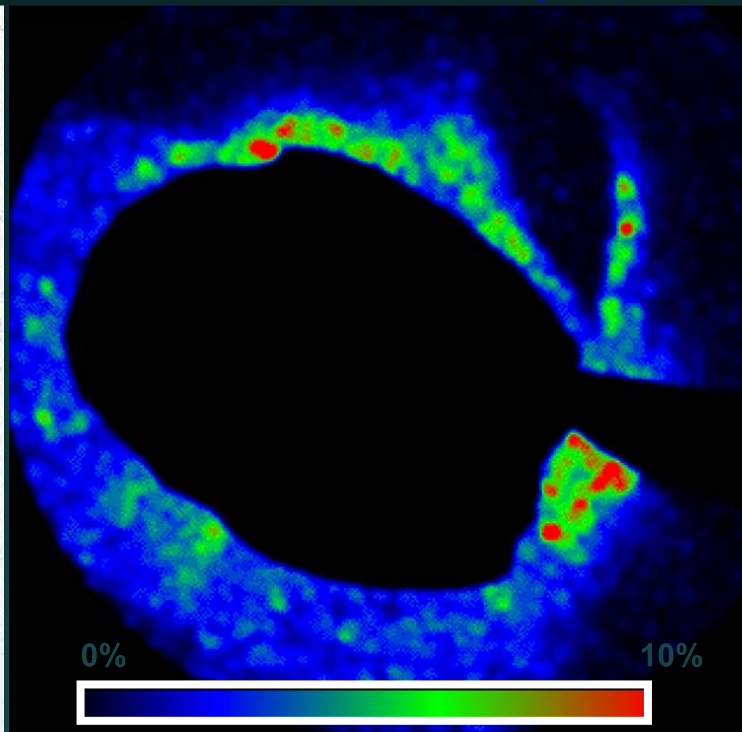
Macrophage Accumulation

There was a high degree of positive correlation between OCT and histological measurements of fibrous MQ density r=0.84, p<0.0001.

OCT Image



MQ Density



GJ Tearney, et al. Circulation 2003;107:113-9

Briain D. MacNeill, et al. J Am Coll Cardiol 2004;44:972–9

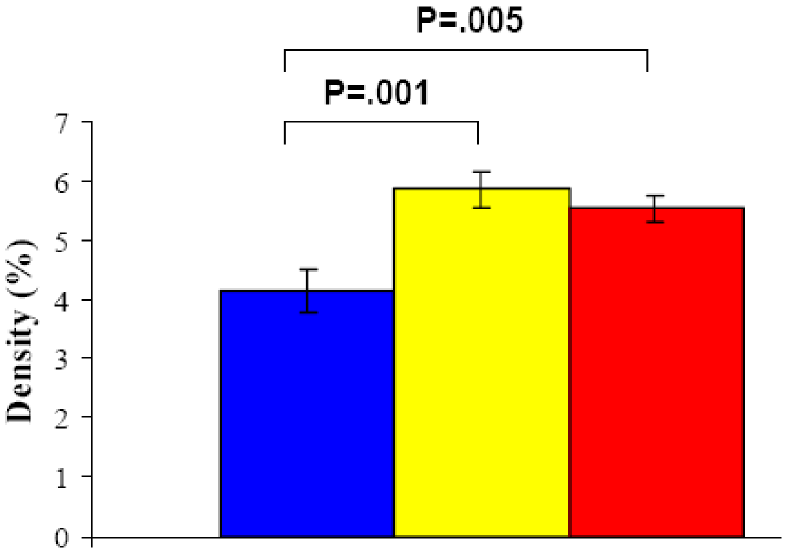
Detection of VP in OCT

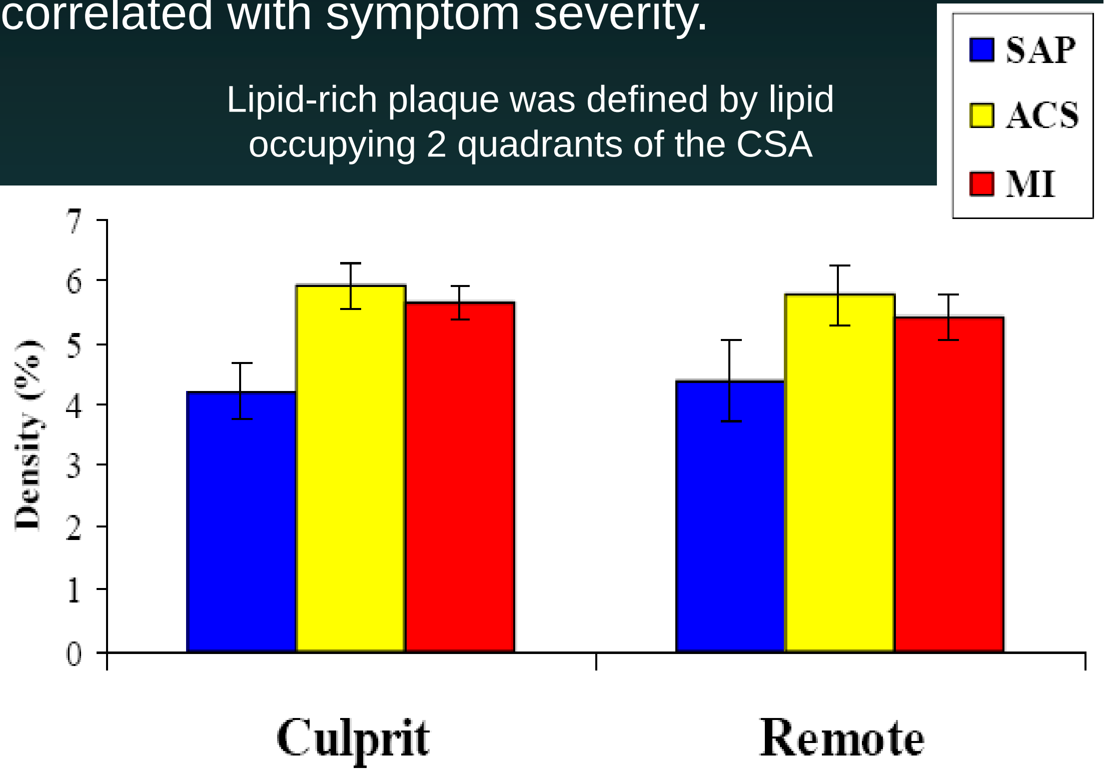
119 lipid rich plaques in 49 patients

49 AMI; 46 ACS; 24 SAP

The increases in both multi-focal and focal macrophage densities are highly correlated with symptom severity.

Lipid-rich plaque was defined by lipid occupying 2 quadrants of the CSA



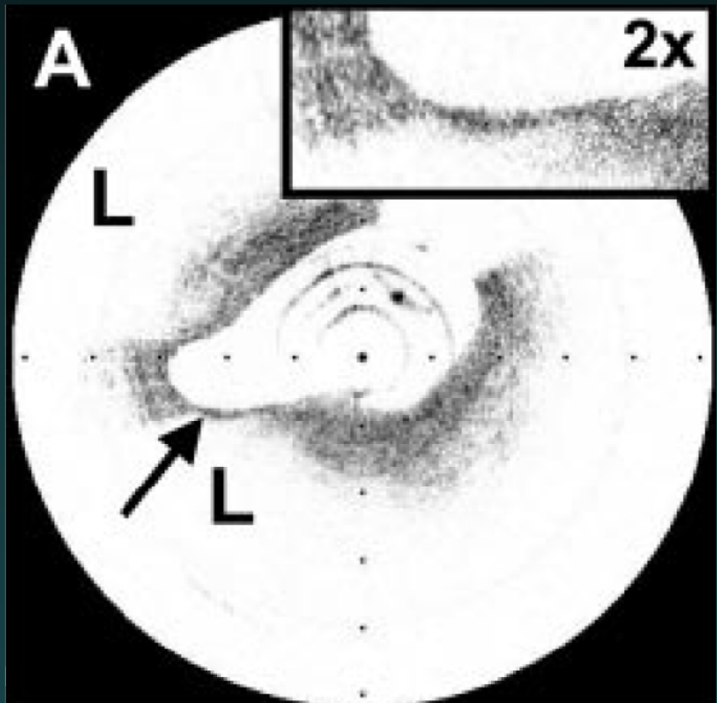


Briain D. MacNeill, et al. J Am Coll Cardiol 2004;44:972–9

Detection of VP in OCT

Thin Fibrous Cap

57 patients: 20 AMI, 20 ACS, 17 SAP



Thin-cap fibroatheroma was defined by lipid-rich plaque with cap thickness 65 μm

Thin-cap Fibroatheroma

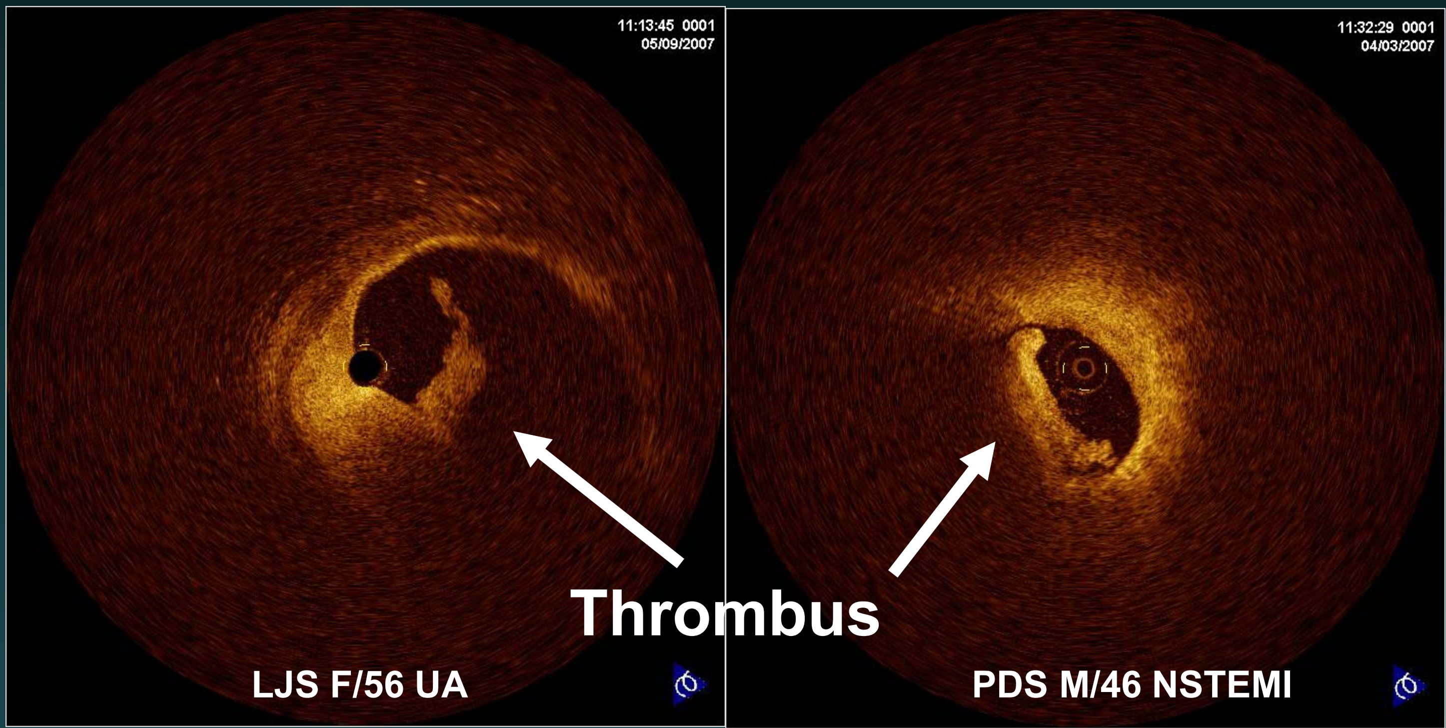
Thin-cap fibroatheroma was more frequently observed in patients with AMI or ACS than SAP.

IK Jang, et al. Circulation. 2005;111:1551-5

Detection of VP in OCT

Thrombus

OCT allowed us not only to estimate plaque morphology but also to distinguish thrombus from the plaque.



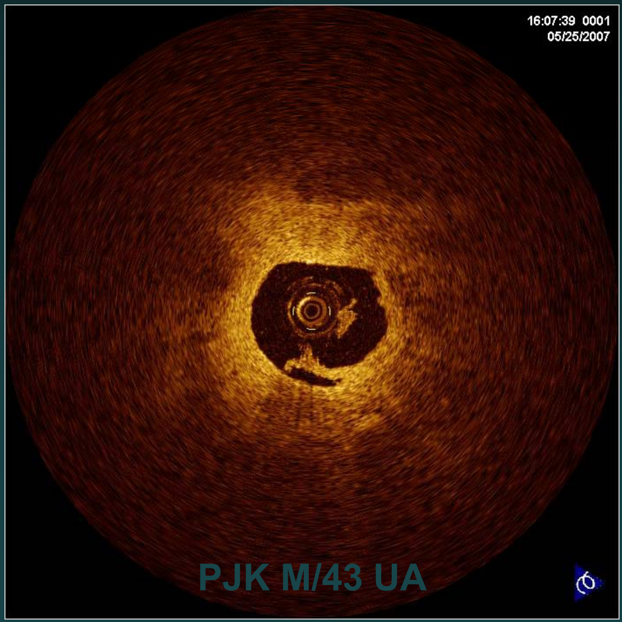
Presented in Ajou University Medical Center

Detection of VP in OCT

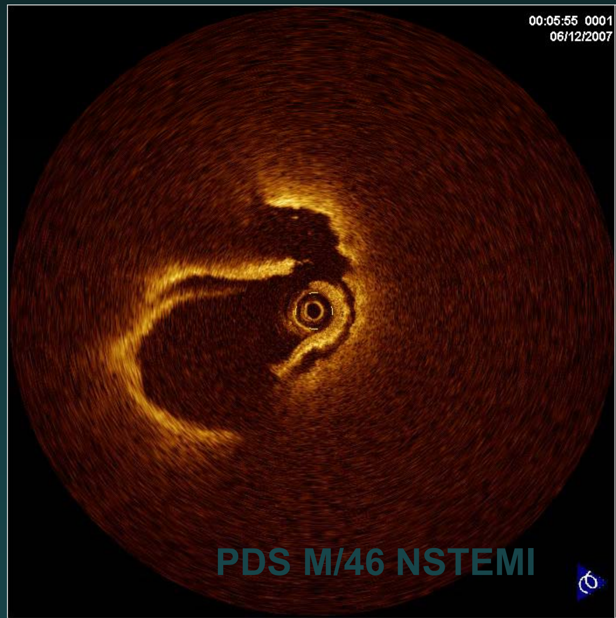
Superficial lesion of Plaque

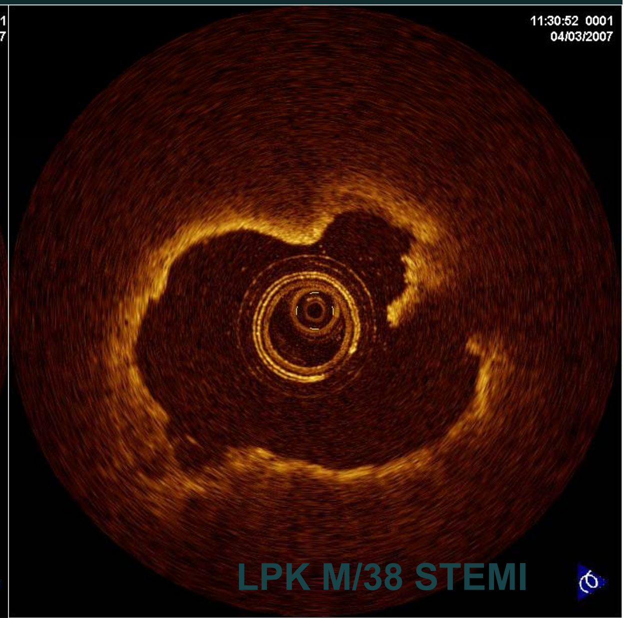
OCT also provided superficial information of the plaque.

Intimal Tear



Plaque rupture





Presented in Ajou University Medical Center

Comparison among intravascular modalities for detection vulnerable plaque

conventional ultrasound vs. virtual histology vs. optical coherence tomography

So-Yeon Choi, Seung-Jea Tahk, Sung-Il Woo, Hyung-Mo Yang, Hong-Seok Lim, Byoung-Joo Choi, Myeong-Ho Yoon, Soo-Jin Kang, Gyo-Seung Hwang, Joon-Han Shin

Department of Cardiology
Ajou University School of Medicine, Suwon, Korea

Background

Study Purpose

- We hypotheses that OCT might have a potential to detect vulnerable plaque by demonstrating thin fibrous cap, lipid-rich plaque and thrombi because of its high resolution imaging capability.

- We performed Intravascular Imaging studies with conventional IVUS(Grayscale), VH-IVUS and OCT in patient with coronary disease.
  1. To compare qualitative and quantitative parameters of each imaging modalities between patient with stable angina pectoris (SAP) and acute coronary syndrome (ACS).
  2. To compare the ability of modalities to detect specific morphology according to the given criteria for vulnerable plaque in all lesions.

Methods

Patients

- Patients undergoing cardiac catheterization were enrolled and categorized according to their clinical presentation into SAP and ACS.

Inclusion Criteria

Patients who have >50% coronary lesion

Lesion: reference vessel size 4~2.5mm

length <40mm

Exclusion Criteria

Cardiogenic shock

Severe LV dysfunction EF <25%

Previous PCI

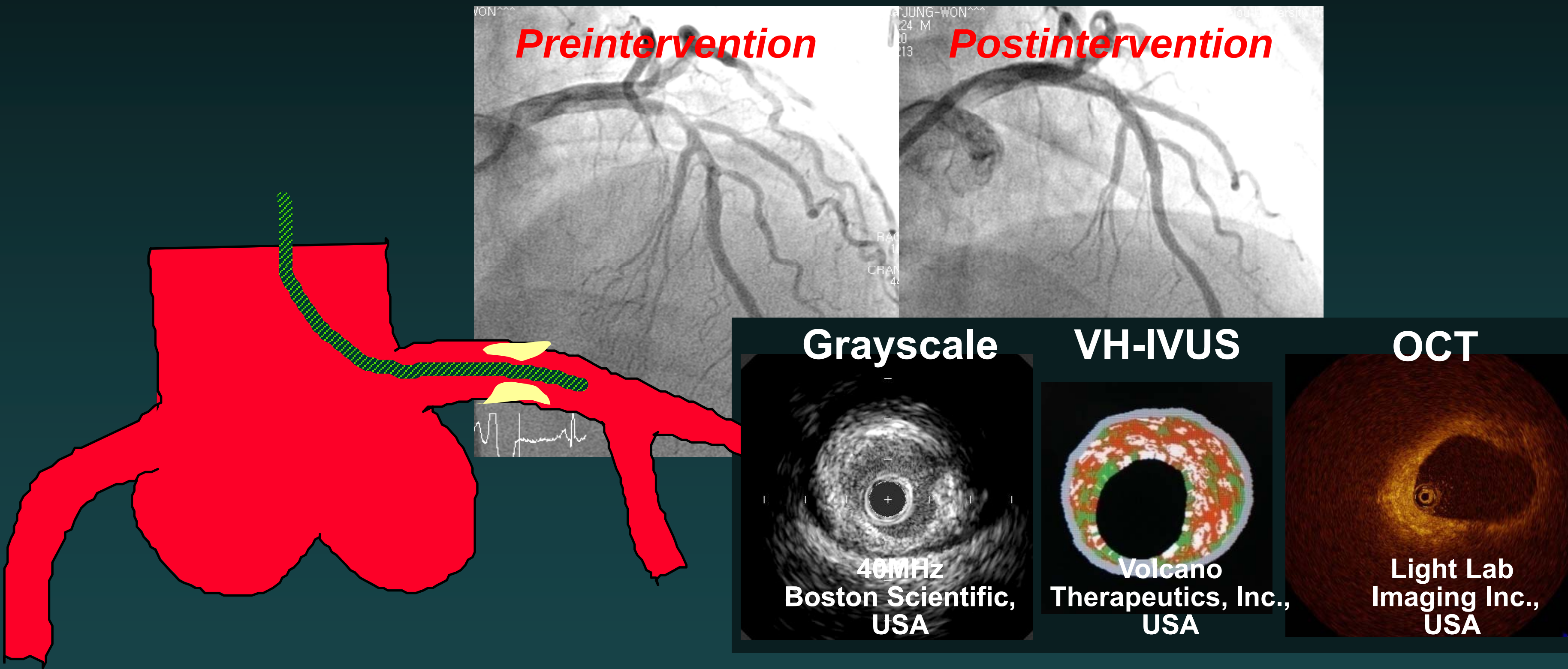
Saphenous vein graft lesion or arterial graft lesion

Lesion: Left main disease, ostial disease, chronic total occlusion

Methods

Intravascular Imaging Study

Assessment for Quantitative and Qualitative Parameters



- The Parameters were assessed by two independent observers, and when the findings were different between the two observers, the findings in accordance with the third observer were adopted.

Methods

Definitions

Specific morphology according to the given criteria for VP

Finding	Grayscale	VH-IVUS	OCT
Thin cap	NA	Red area being in contact the lumen	<65µm
Lipid core	Echolucent area ≥ 3mm	Red area ≥10%	Low reflectivity with h omogenous, diffuse m argins ≥2 quadrants
Thrombus	Intraluminal mass	NA	Intraluminal mass
Rupture /fissure /erosion	A recess or ulceration with a tear detected in surface	NA	A recess or ulceration with a tear detected in surface
90%stenosis	Compromise of lumen by 90% by CSA compared with proximal reference lumen		
SCN	Echogenic material with acoustic shadow being in contact with the lumen	White nodule being in contact the lumen	Isolated, strong reflections in dark background
Positive remodeling	Lesion EEM CSA / prox. ref. EEM CSA >1.0		NA

Methods

Definitions

Thin cap fibroatheroma (TCFA) was defined as

In VH-IVUS
≥10% Necrotic core
No evident overlying fibrous tissue
>40% plaque burden

In OCT
Lipid rich plaque (≥2 quadrants) with a
Thin fibrous cap (<65 μm)

Results

Baseline Clinical Characteristics

- 41 target lesions in 41 patients (24 with ACS and 17 with SAP) were enrolled.

	ACS n=24	SAP n=17	p value
Age, yr	58±12	60±9	0.148
Male sex	17(71)	14(82)	0.405
Risk factors			
Diabetes mellitus	10(42)	8(47)	0.730
Hypertension	13(54)	10(59)	0.685
Dyslipidemia			
Total cholesterol >220mmHg	9(37)	8(47)	0.282
Smoking	14(58)	10(59)	0.895
LV EF, %	56±18	64±12	0.027

Results

Baseline Angiographic Characteristics

- 41 target lesions in 41 patients (24 with ACS and 17 with SAP) were enrolled.

	ACS n=24	SAP n=17	p value
LAD involvement	17(71)	12(71)	0.888
Reference vessel, mm	3.5±0.7	3.4±0.4	0.277
Lesion length, mm	18.6±4.0	19.8±4.8	0.258
MLD, mm	1.07±0.41	1.02±0.33	0.963
%DS, %	67.8±13.6	69.6±10.8	0.876

Results

Baseline Clinical Characteristics

- 41 target lesions in 41 patients (24 with ACS and 17 with SAP) were enrolled.

	ACS n=24	SAP n=17	p value
Age, yr	58±12	60±9	0.148
Male sex	17(71)	14(82)	0.405
Risk factors			
Diabetes mellitus	10(42)	8(47)	0.730
Hypertension	13(54)	10(59)	0.685
Dyslipidemia			
Total cholesterol >220mmHg	9(37)	8(47)	0.282
Smoking	14(58)	10(59)	0.895
LV EF, %	56±18	64±12	0.027

Results

Conventional IVUS Analysis

Quantitative Parameters

	ACS n=24	SAP n=17	p value
Lesion length, mm	21.2±9.7	24.7±7.9	0.082
Proximal reference			
LA, mm^2	10.6±3.7	12.1±4.0	0.405
VA, mm^2	15.1±4.9	17.7±5.6	0.130
PB, %	30.2±12.6	31.7±10.4	0.685
Narrowest segment			
LA, mm^2	3.5±1.9	3.1±2.0	0.118
VA, mm^2	15.9±4.6	14.7±6.1	0.215
PA, mm^2	12.2±4.5	13.7±5.5	0.106
PB, %	72.3±14.5	73.7±12.2	0.529
Eccentric index	0.19±0.18	0.20±0.14	0.438
Remodeling index	0.89±0.26	0.84±0.20	0.262

Results

Conventional IVUS Analysis

Qualitative Parameters

	ACS n=24	SAP n=17	p value
Positive remodeling	13(58)	5(23)	0.049
Soft plaque	10(42)	7(41)	0.807
Lipid core			
at the most narrowest CSA	3(13)	1(6)	0.196
within the whole lesion	6(25)	1(6)	0.039
Rupture/Fissure	3(13)	0(0)	0.278
Thrombus	1(4)	0(0)	0.823

Results

Virtual Histology-IVUS Analysis

Parameters in the Most Narrowest CSA

	ACS n=24	SAP n=17	p value
Quantitative Analysis			
Lumen area, mm^2	3.8±1.8	3.2±2.1	0.214
Vessel area, mm^2	14.7±3.4	13.9±5.1	0.215
Plaque area, mm^2	12.2±4.6	10.8±5.4	0.133
% Plaque burden, %	74.1±12.2	73.6±13.2	0.438
% Fibrous area, %	64±10	66±8	0.637
% Fibro-fatty area, %	16.0±8	14±9	0.524
% Dense calcium area, %	8±5	12±3	0.089
% Necrotic core area, %	16±18	13±10	0.137
Qualitative Analysis			
TCFA	9(38)	3(24)	0.252
SCN	5(21)	2(12)	0.161

Results

Virtual Histology-IVUS Analysis

Parameters in the Most Largest NC CSA

	ACS n=24	SAP n=17	p value
Quantitative Analysis			
Lumen area, mm^2	4.1±1.2	3.9±1.4	0.457
Vessel area, mm^2	13.6±5.4	12.6±4.3	0.684
Plaque area, mm^2	9.8±6.6	9.2±7.4	0.543
% Plaque burden, %	64.1±9.9	61.6±11.1	0.838
% Fibrous area, %	58±11	69±7	0.047
% Fibro-fatty area, %	19±4	17±6	0.524
% Dense calcium area, %	11±3	18±6	0.075
% Necrotic core area, %	24±21	18±10	0.001
Qualitative Analysis			
TCFA	10(42)	3(24)	0.087
SCN	9(38)	3(24)	0.261

Results

OCT Analysis

Quantitative and Qualitative Parameters

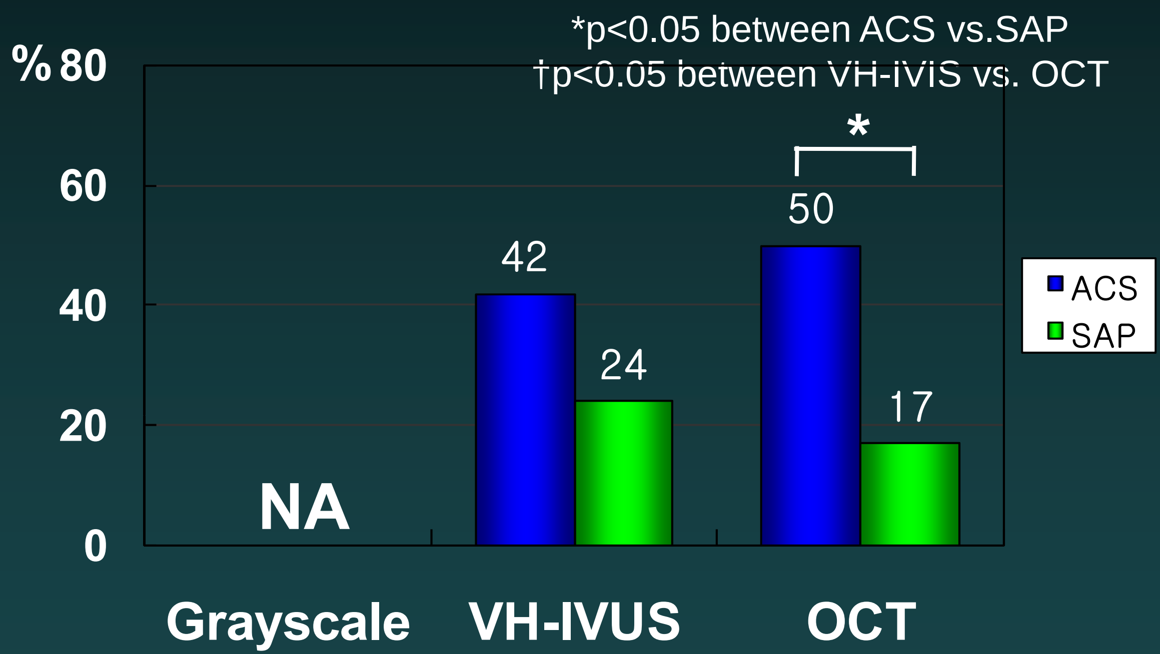
	ACS n=24	SAP n=17	p value
The Most Narrowest Segment			
Lumen area, mm^2	3.8±1.8	3.2±2.1	0.452
Intimal thickness, mm	0.23±0.26	0.24±0.26	0.214
TCFA	3(13)	0(0)	0.165
Lipid rich plaque	3(13)	0(0)	0.272
Within the Whole Lesion			
Intimal thickness, mm	0.08±1.35	0.23±0.21	0.016
TCFA	12(50)	2(17)	0.027
Surface lesion	10(42)	3(18)	0.161
Thrombus	10(42)	1(6)	0.001
Lipid rich plaque	7(35)	1(6)	0.019

In OCT analysis, thickness of fibrous cap, the frequency of TCFA, lipid-rich plaque and the presence of thrombus were significantly correlated with clinical presentation.

Results

The Incidence of TCFA
Comparison between ACS and SAP

Thin cap fibroatheroma (TCFA) was defined as a Lipid rich plaque (≥2 quadrants) with a thin fibrous cap (<65 μm)

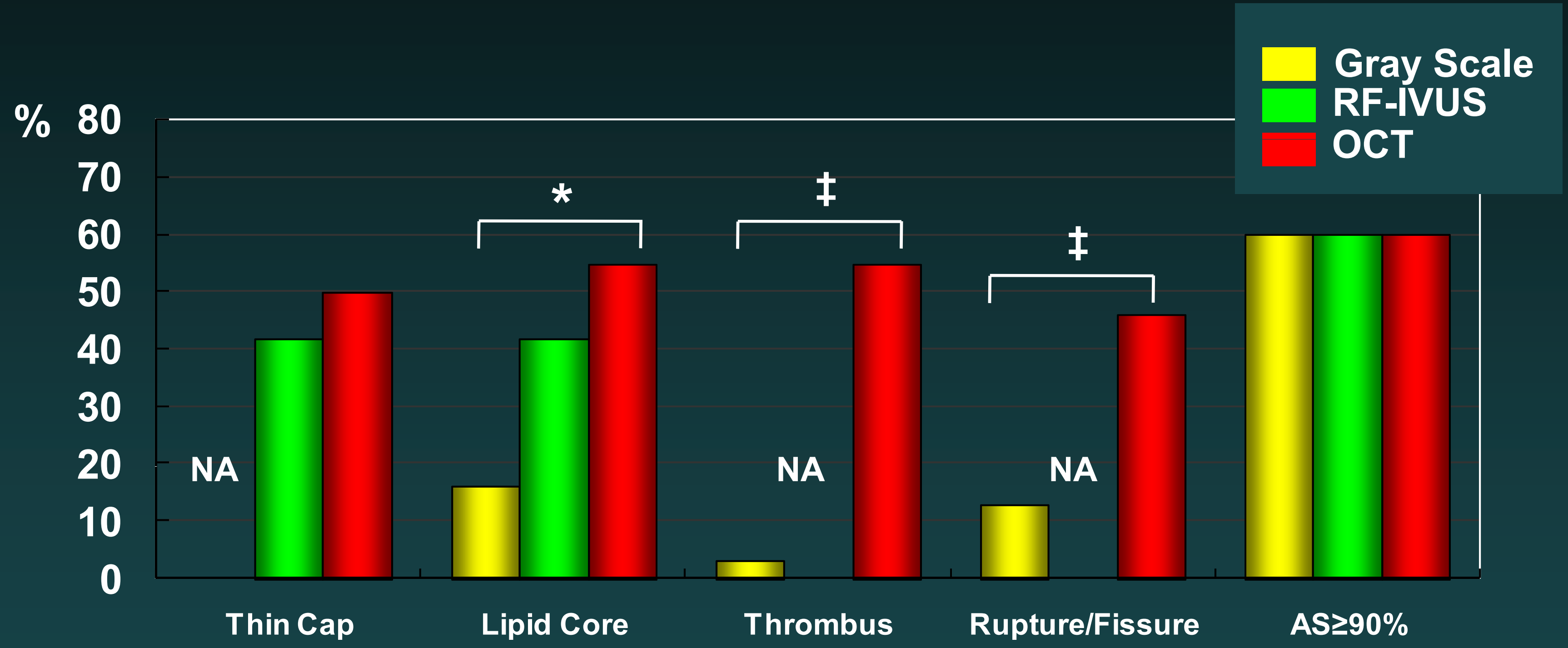


41 lesions of 41 patients were evaluated. VH-IVUS has a higher tendency TCFA in ACS, in OCT, TCFA was significantly correlated with clinical presentation.

Results

Comparison among Imaging Modalities

The Major Criteria for Vulnerable Plaque



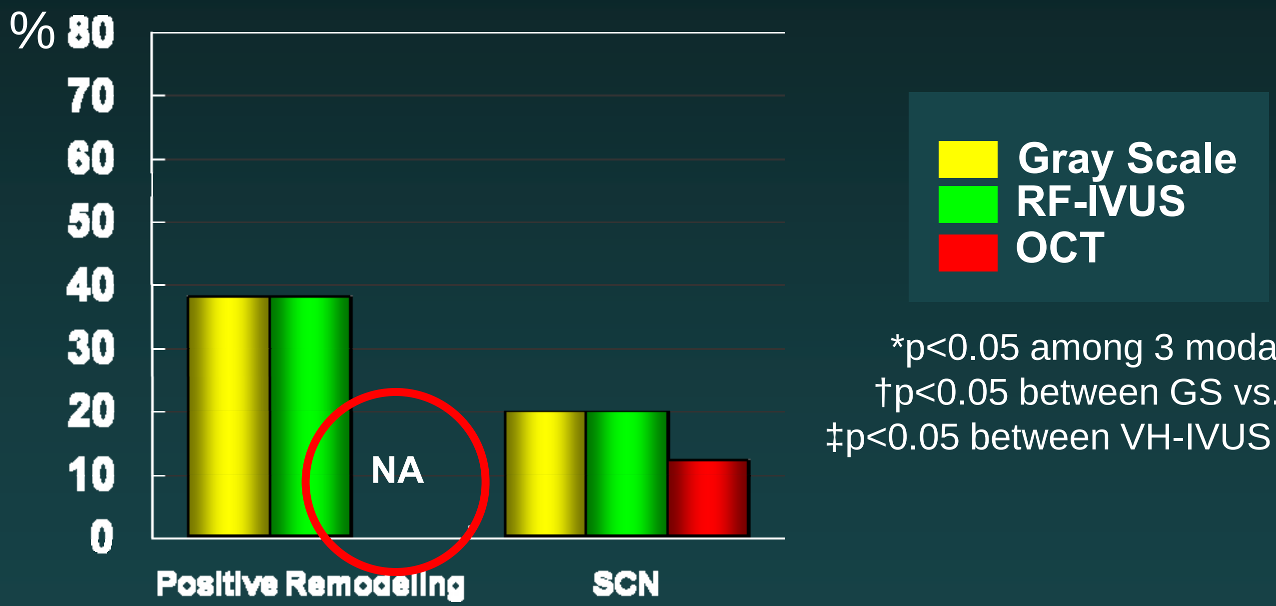
*p<0.05 among 3 modalities, †p<0.05 between GS vs. OCT, ‡p<0.05 between VH-IVUS vs. OCT

The detection of lipid core is different among three groups, and thrombus and rupture of plaque were more frequently identified in OCT than conventional IVUS.

Results

Comparison among Imaging Modalities

The Minor Criteria for Vulnerable Plaque



*p<0.05 among 3 modalities
†p<0.05 between GS vs. OCT
‡p<0.05 between VH-IVUS vs. OCT

Results

Multivariate Determinants of Clinical Symptom

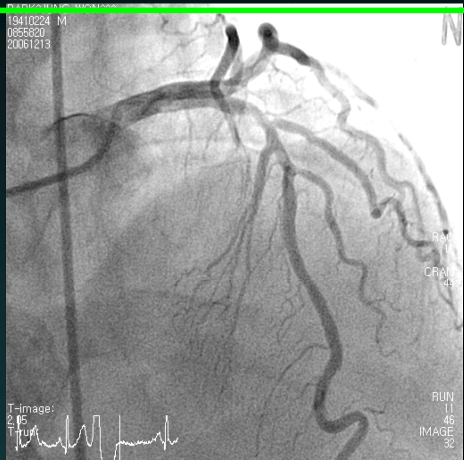
Regression Analysis

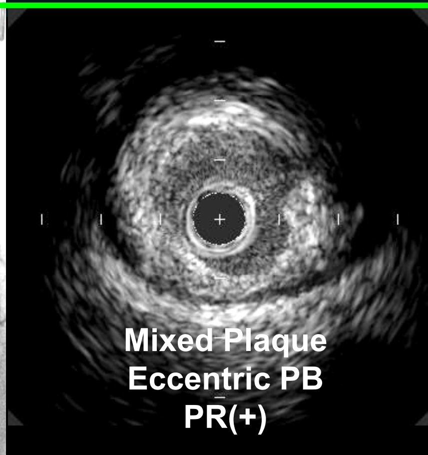
Variables	OR	95% CI	p value
Grayscale			
Positive remodeling	0.742	−0.103~0.024	0.225
VH-IVUS			
%NC area in VH	1.893	0.531~1.060	0.038
OCT			
TCFA in OCT	2.451	6.403 ~28.734	0.005
Thrombus	1.952	2.759~12.701	0.045
Fissure/erosion	0.443	−1.952~1.181	0.628

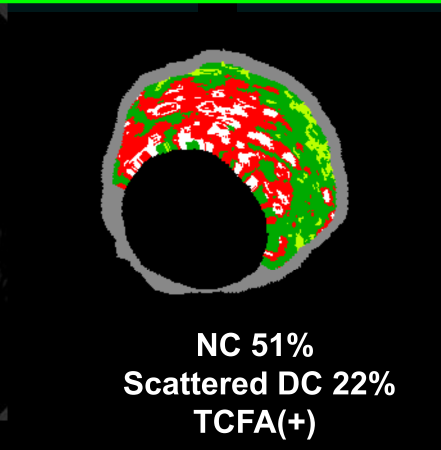
After adjusting for confounding factors, %NC area in VH, TCFA and thrombus in OCT were independent risk factors for predicting clinical presentation.

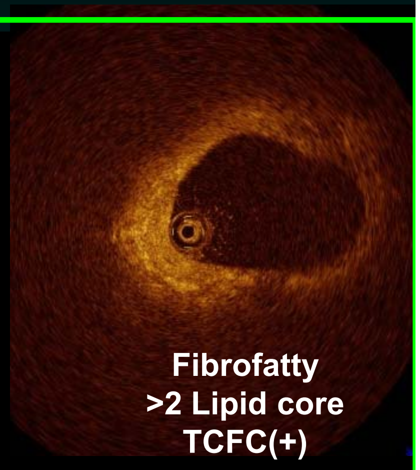
Case

Case 1
PJW
0855820
65/M
UAIIIB



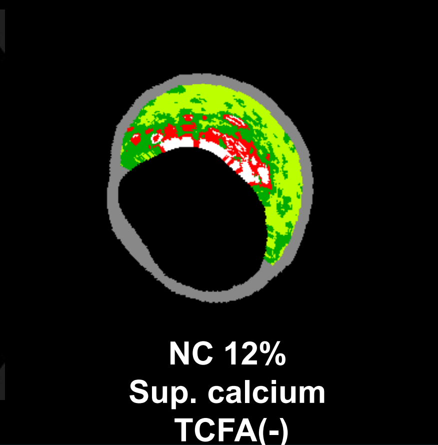


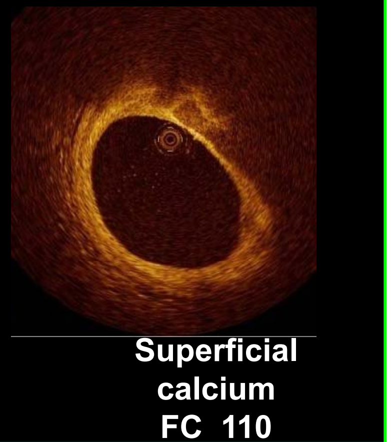




Angiogram | **Grayscale** | **VH -IVUS** | **OCT**

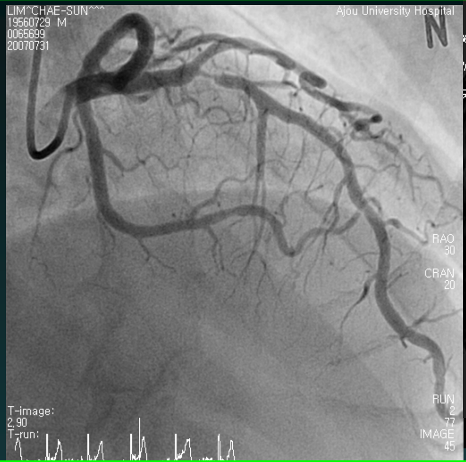
Case 2
JMA
0473319
51/F
SA

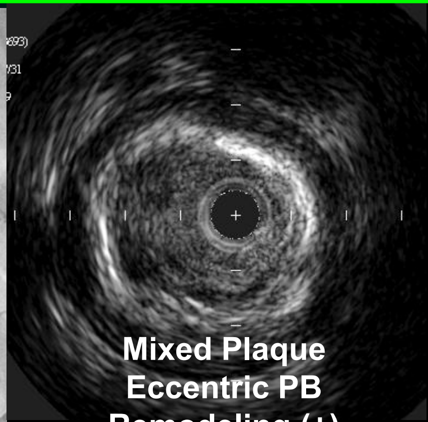




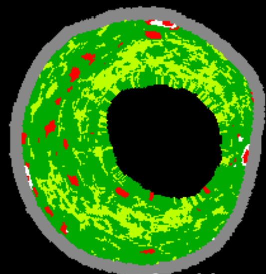
Case

Case 3
LCS
065699
56/M
NSTEMI

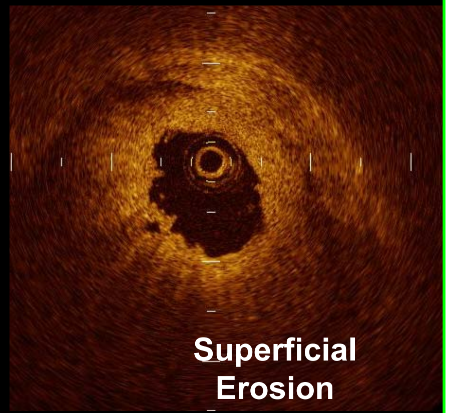




Mixed Plaque
Eccentric PB
Remodeling (+)



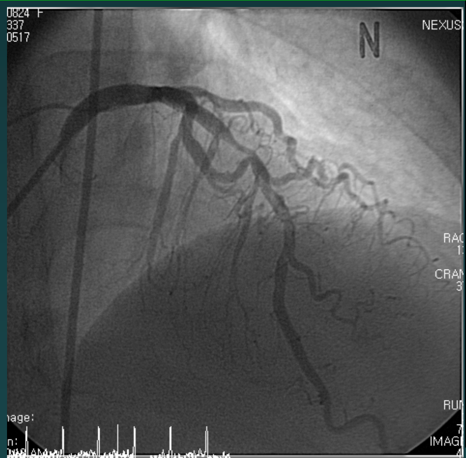
NC 5%
FF 20%
TCFA(-)

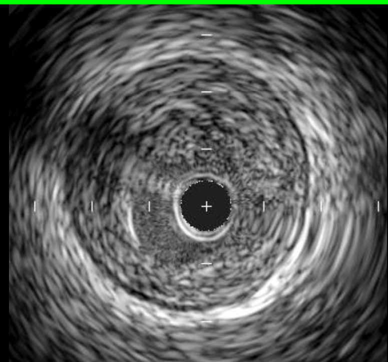


Superficial
Erosion
FC <65

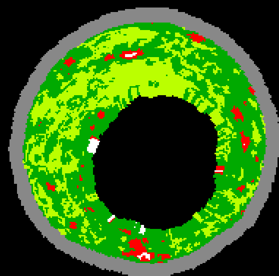
Angiogram	Grayscale	VH -IVUS	OCT

Case 4
SJW
0247337
59/F
UA





Soft Plaque
Remodeling (-)



NC 2%
FF 37%
TCFA(-)

Fibrofatty
>2 Lipid core
Erosion, FC<65

Summary

- The positive remodeling and presence of lipid core in IVUS are related to clinical presentation.
- In VH-IVUS, the frequency of thin-cap fibroatheroma had a higher tendency in ACS and ACS had significantly smaller fibrous area and larger NC area at the largest NC CSA compared to SAP.
- In OCT analysis, lipid-rich plaque, thickness of fibrous cap and the presence of thrombus in OCT were significantly correlated with clinical presentation.

- After adjusting for confounding factors, NC area in VH, and TCFA and thrombus in OCT were independent risk factors for predicting clinical presentation.

Conclusion

- This study was prospectively performed to compare currently available intravascular modalities for detailed in vivo plaque morphology in patients with different clinical presentations.
- OCT for vulnerable plaque is feasible and provides superior contrast and resolution of arterial pathology than other modalities.
- Understanding natural process of atherosclerosis is needed and the role of diagnostic tools should be further studied in clinical setting.

Imaging Modalities for Detection of VP

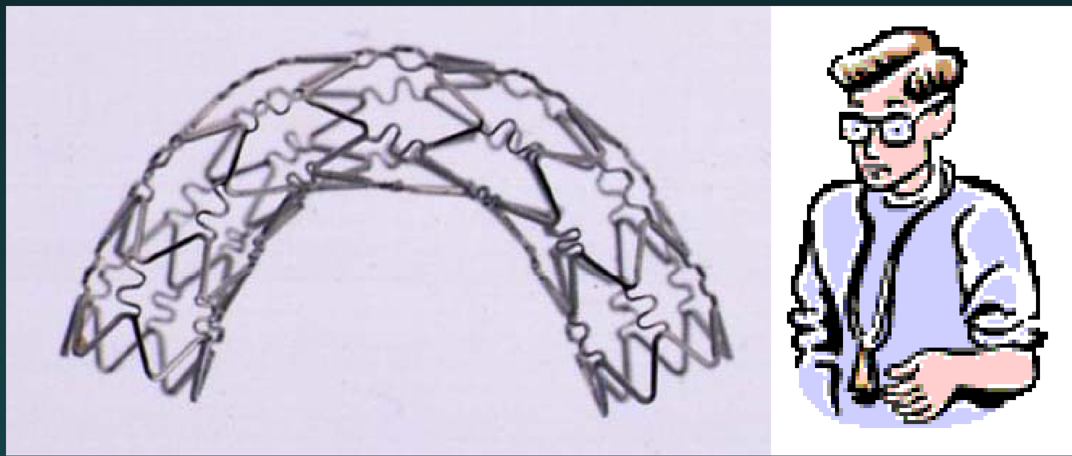
Imaging Modality	Resolution	Penetration	Fibrous Cap	Lipid Core	Inflammation	Calcium	Thrombus	Current Status
IVUS	100 μm	Good	+	++	–	+++	+	CS/CA
Angioscopy	UK	Poor	+	++	–	–	+++	CS/CA*
OCT	10 μm	Poor	+++	+++	+	+++	+	CS
Thermography	0.5 mm	Poor	–	–	+++	–	–	CS
Spectroscopy	NA	Poor	+	++	++	++	–	PCS
Intravascular MRI	160 μm	Good	+	++	++	++	+	PCS

NA indicates not applicable; CS, clinical studies; CA, clinically approved for commercial use; CA*, clinically approved commercial use in Japan; PCS, preclinical studies; UK, unknown.

+++=sensitivity>90%; ++=sensitivity 80% to 90%; +=sensitivity 50% to 80%; [en]=sensitivity <50%.

- OCT might allow us to identify tissue characterization more accurately than other modalities.
- OCT has a potential benefit to identify vulnerable plaques by detecting of thin fibrous cap, lipid core, surface pathology of plaque and presence of thrombus, and measuring the accumulation of macrophages.

OCT as a Tool for PCI
Evaluation of Therapeutic Results



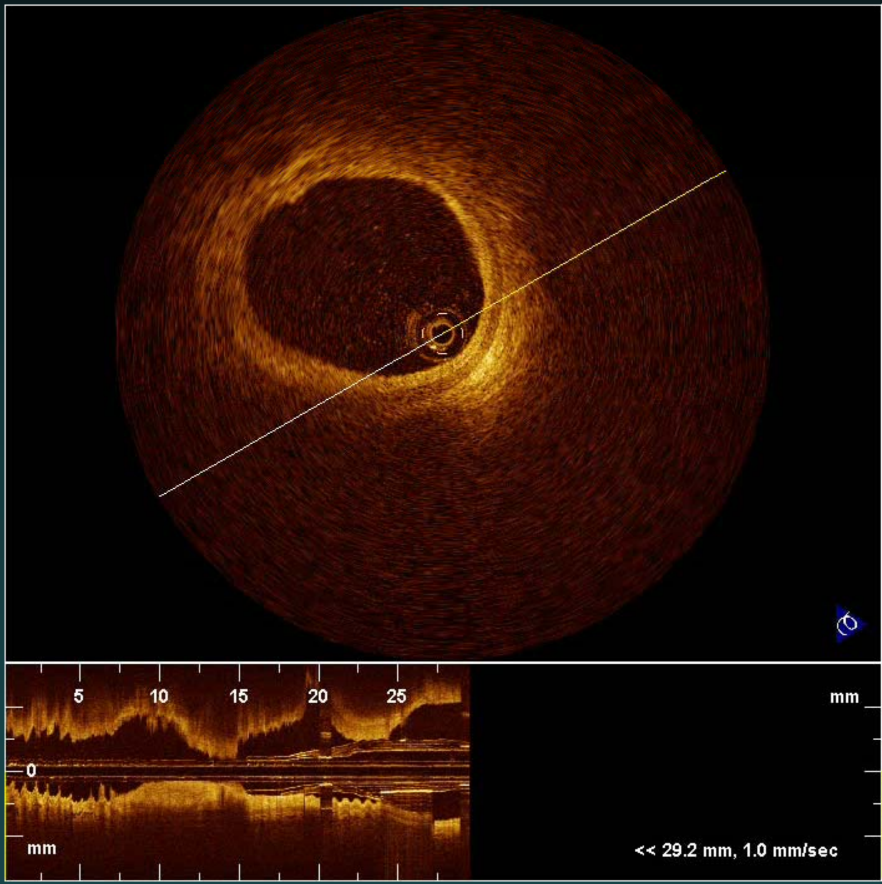
OCT as a Tool for PCI

Ideal Intravasular Image for PCI

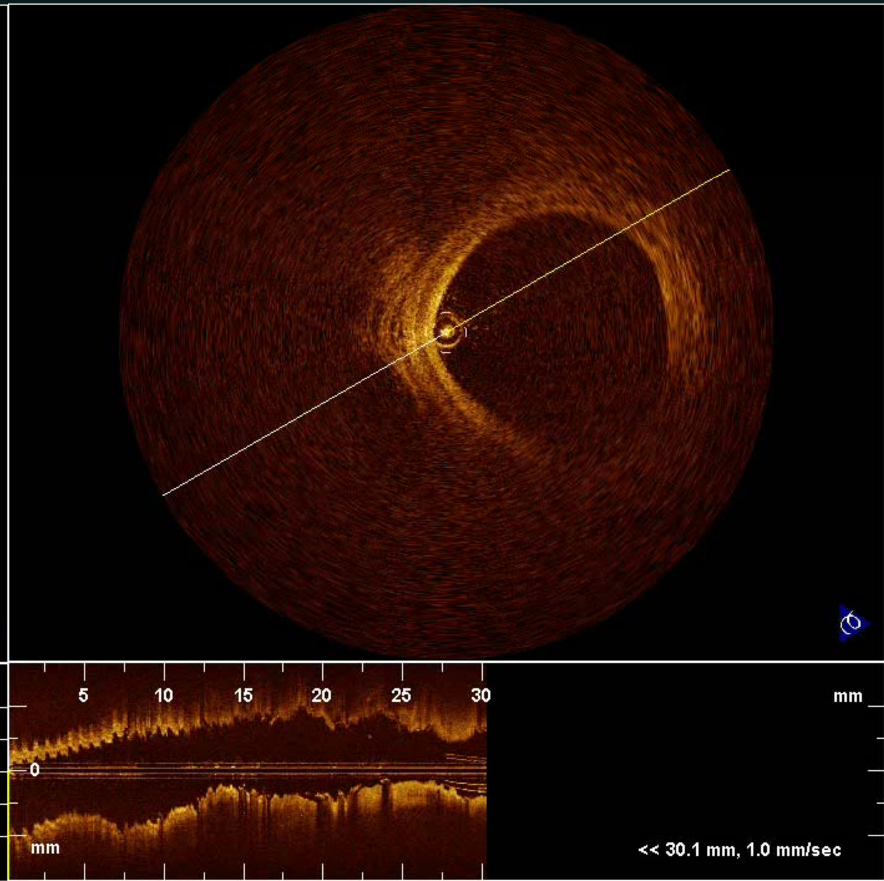
- Lesion assessment
- Device sizing
- Decision of strategies for the lesion
- Understanding mechanism of intervention
- Decision of ending of predecure
- Recognition of complications
- F/U

Case

Pre-intervention



Post-intervention



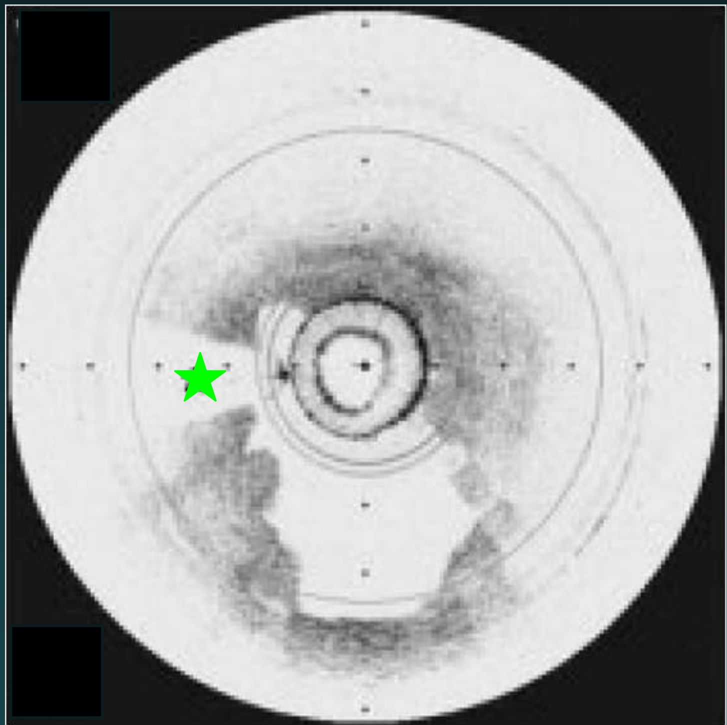
Presented in Ajou University Medical Center

OCT as a Tool for PCI

Understanding PCI Mechanism

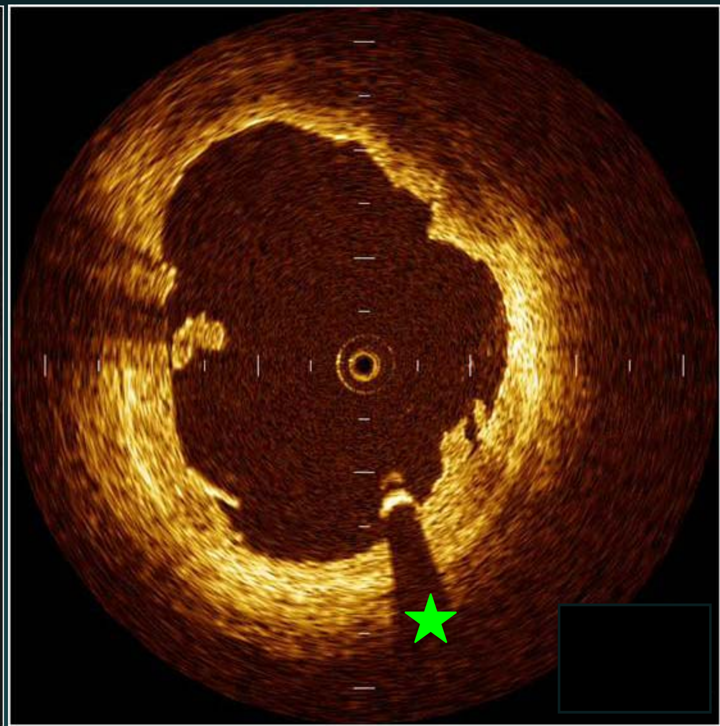
OCT provides a information to understand the mechanism after various PCI.

After Cutting Balloon



LJ. Diaz-Sandoval, IK Jang et al.
Cath Cardio Interv. 2005:65:492-6

After DCA



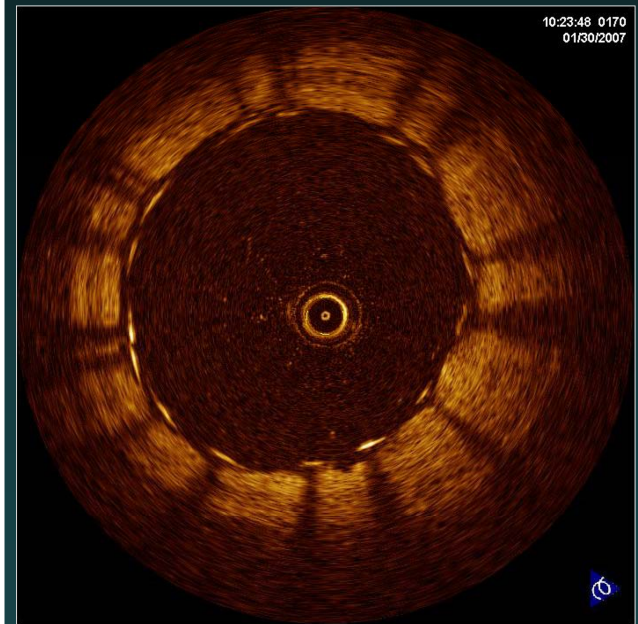
Presented by Suzuki
Toyohashi Heart Center, Japan

OCT as a Tool for PCI

Evaluation Just After Stenting

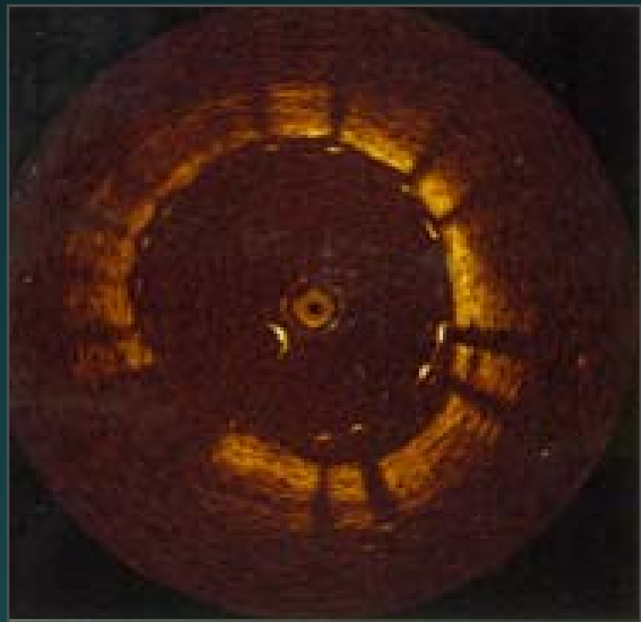
OCT also provides a information about the result just after stenting.

Well-apposed stent



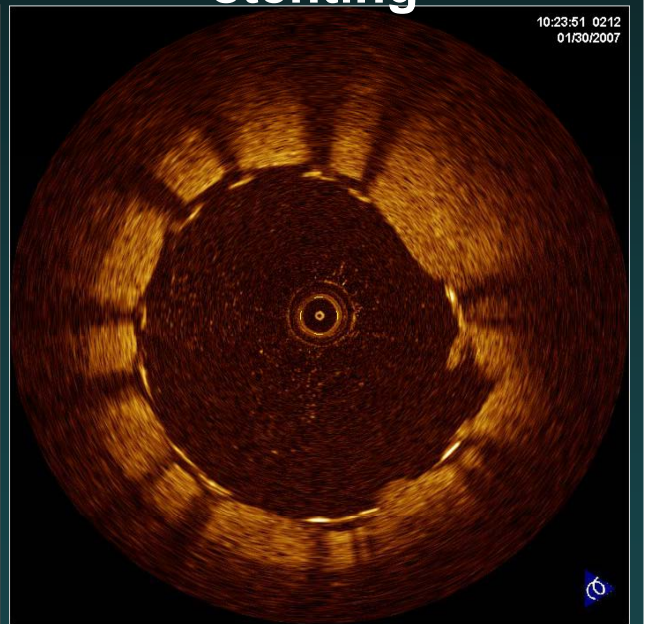
BJK M/48 Cypher 4.0 x 23 mm

Mal-apposed stent



Cypher 3.5 x 28 mm
Presented by Suzuki

Minor prolapse of plaque after stenting

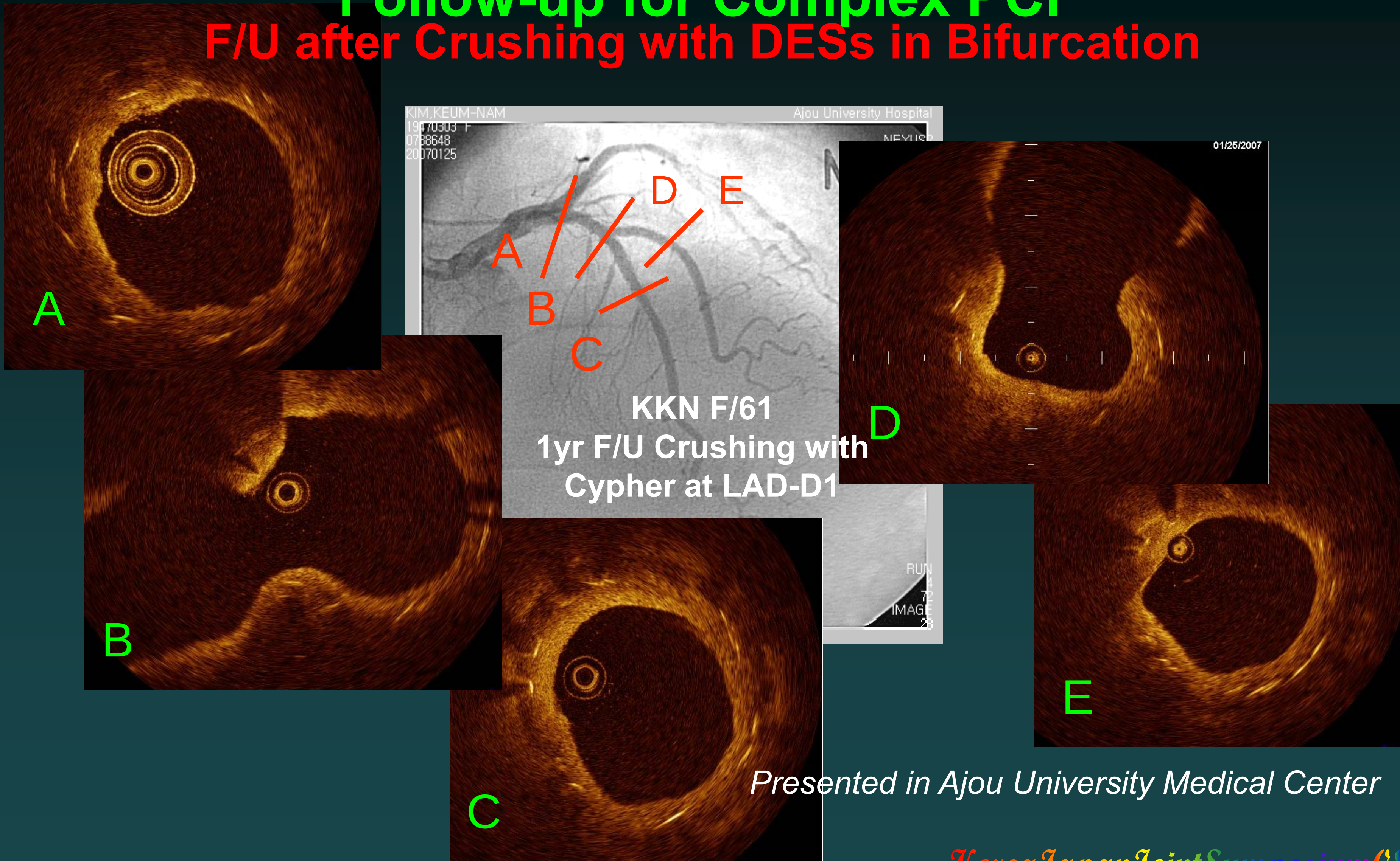


BJK M/48 Cypher 4.0 x 23 mm

Evaluation of Therapeutic Results

Follow-up for Complex PCI

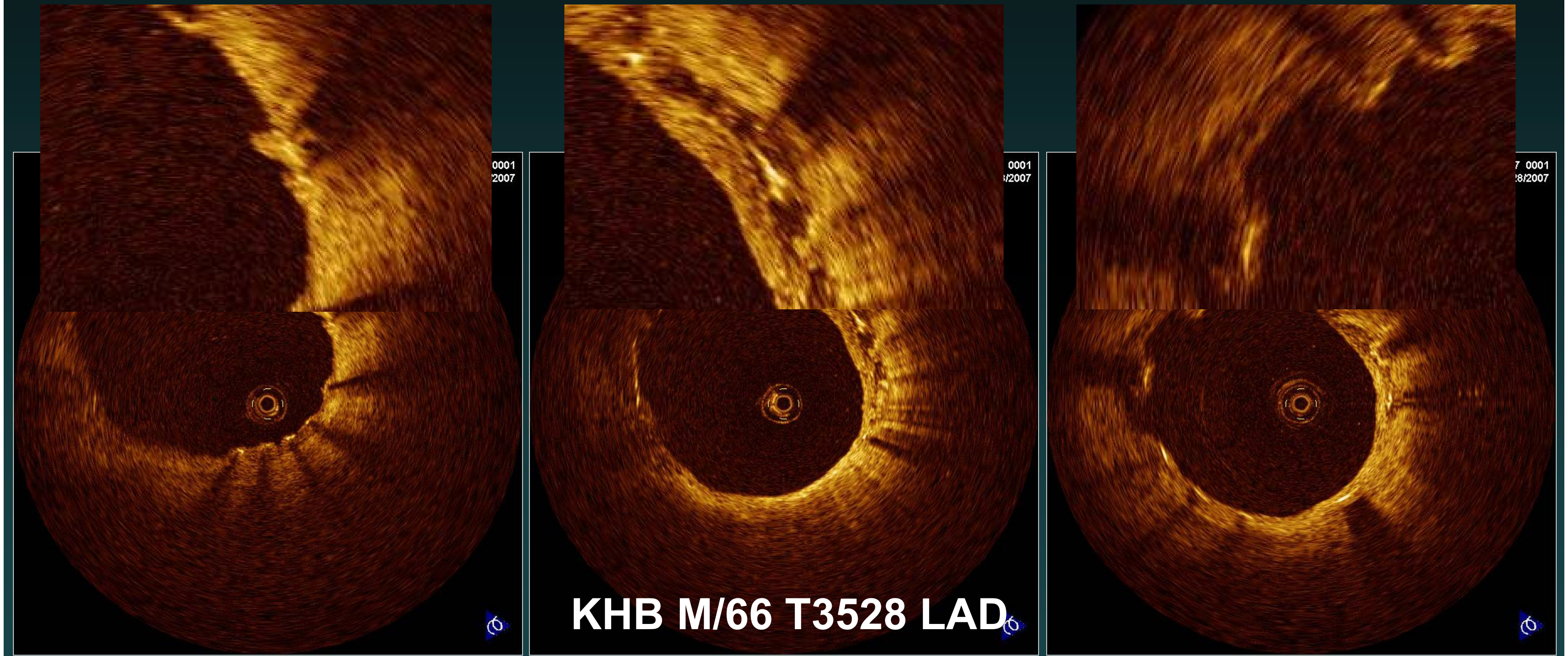
F/U after Crushing with DESs in Bifurcation



Presented in Ajou University Medical Center

Evaluation of Therapeutic Results

Tissue Reaction after Stenting



Presented in Ajou University Medical Center

Incomplete tissue coverage of stent at 1 year follow-up after coronary intervention with DES:

optical coherence tomography findings

So-Yeon Choi, Seung-Jea Tahk, Sung-Il Woo, Hyung-Mo Yang,
Hong-Seok Lim, Byoung-Joo Choi, Myeong-Ho Yoon,
Soo-Jin Kang, Gyo-Seung Hwang, Joon-Han Shin

Department of Cardiology
Ajou University School of Medicine, Suwon, Korea

Background

- Stent thrombus following PCI is related to serious clinical outcomes including myocardial infarction and sudden cardiac death.
- Incomplete endothelialization of stent has been considered as one of the pathogenesis of chronic stent thrombus in DES era.
- OCT has outstanding high resolution property, and recent study presented absence of tissue strut coverage was properly identified by corresponding OCT cross-section on a rabbit model.

Methods

Patient Enrollment

- Patients received PCI with DES for proximal stenotic lesion more than 1 year before were enrolled for this study.
- We excluded patient with malapposition of stent by assessing of initial intravascular ultrasound images and the instent restenosis on f/u angiogram was also excluded.

Inclusion criteria

- Lesion: reference vessel size ≥2.5mm
- Possible lesion: bifurcation, overlapping stent

Exclusion criteria

- Cardiogenic shock
- Severe LV dysfunction EF <25%
- Lesion: Left main disease, ostial disease, bifurcation lesion

Methods

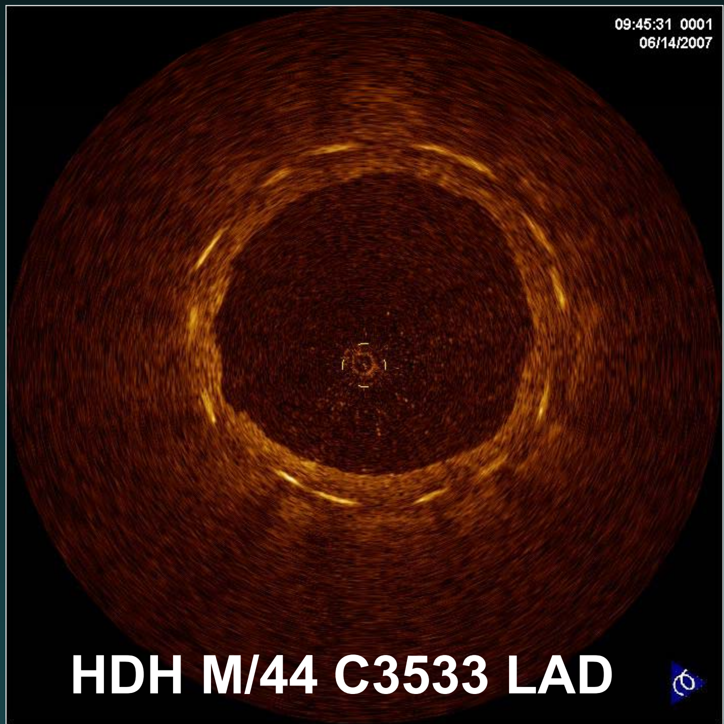
Measurement Parameters

- The OCT image was obtained by constant pullback mechanics and analyzed each 1mm slice from center of stent.
- The uncovered strut was defined as a protruding strut without any reflective tissue layer on the luminal side of strut.
- The uncovered strut index of a stent was defined as the ratio of the number of uncovered strut and the number of total observed struts.
  - The uncovered strut index (USI)
    = non-endothelialization strut (n) / evaluated strut (n)
    (analysis: each 1mm slice from center of stent)
    - » Cypher 0.0052 inch, 5 μm
    - » TAXUS 0.0038 inch, 25.6 μm
    - » Endeavor 0.0036 inch, 9.2 μm

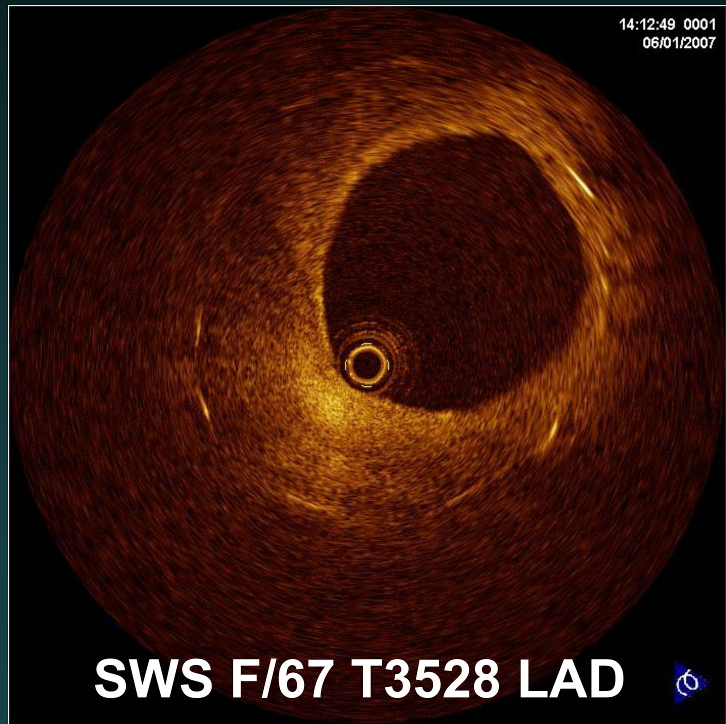
Results

Complete Tissue Coverage

Cypher



Taxus

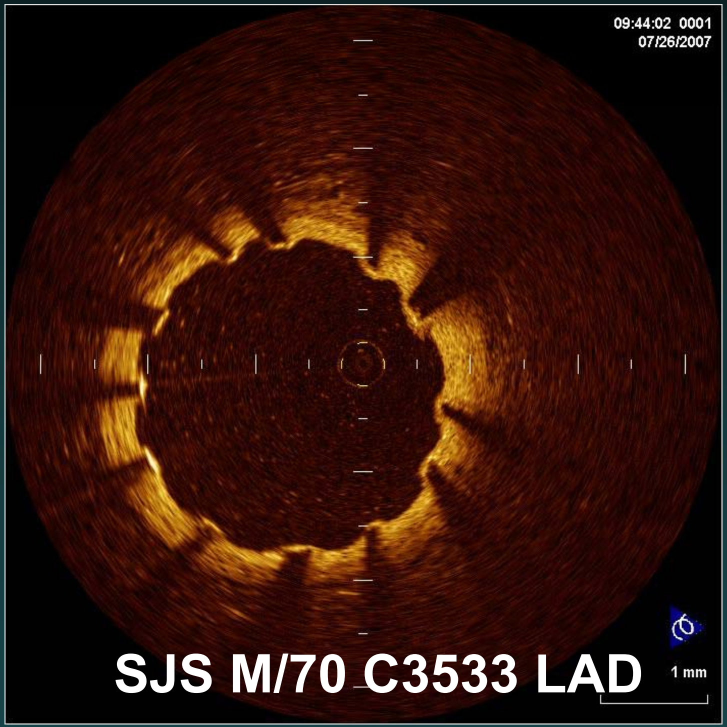


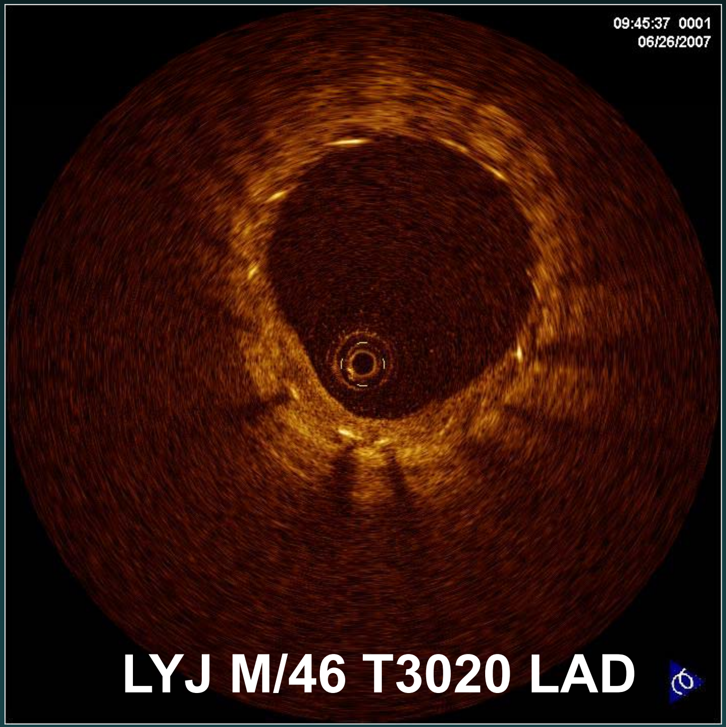
Presented in Ajou University Medical Center

Results

Incomplete Tissue Coverage

Cypher	Taxus





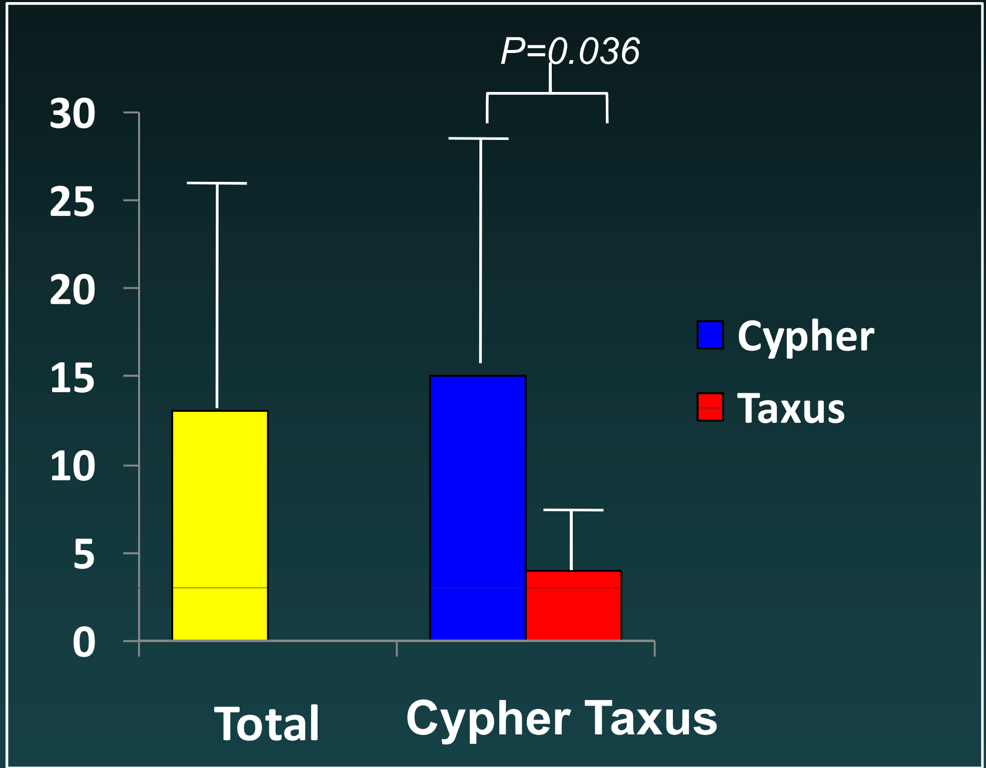
Presented in Ajou University Medical Center

Results

Incomplete Tissue Coverage

748 Cross Sectional Images
32 patients

Age 56±11, 18 males
(23 Cypher, 11 Taxus)
Average follow up period:
13.4±1 months



The uncovered strut index (USI) of total observed stent strut was 0.13±0.12.
The USI of Cypher stent was significantly increased than Taxus stent
(Cypher 0.15±0.21, Taxus 0.04±0.08, p=0.036).

Conclusion

- OCT is useful for detecting the coverage of a stent with neointima following PCI.
- There was a difference of tissue coverage between two DESs.
- Although the relationship between incomplete tissue coverage of the stent and clinical events is not clear, we should consider long-term antiplatelet treatment for more than one year.

OCT and PCI

	IVUS	OCT
Preinterventional lesion assessment		
Assessment of severity and clinical impact	☺	😐
Detect Vulnerable Plaque	😐	☺
During intervention		
Device sizing	☺	☹
Decision of strategies for the lesion	☺	😐
Understanding mechanism of intervention	☺	☺
Decision of ending of predecure	☺	☺
Recognition of complications	☺	☺
Serial follow-up		
Understanding for atherosclerosis	☺	☺
Mechanisms, prevention and Tx of restenosis	☺	☺
Assessment for long-term complication	☺	☺

OCT also might be used as a tool for PCI like IVUS by providings useful informations in detection VP and PCI complication and stent f/u.

Complications of OCT

Experience in Ajou University Medical Center

Total 95 patients (male 73, age 57±9), 107 lesions
Successful image acquisition : 102 lesions (95%)
(3 wire passage failure, 2 incomplete occlusion)

Complication	number	%
Air embolization	0	0
Transient ischemia : ECG change with pain	51	54
Pulmonary edema due to volume overloading	0	0
Ventricular arrhythmia	1	0.01
Post PCI Infarction	0	0
Death	0	0

Limitation of OCT

1. OCT imaging is attenuated by blood and needs to create blood free zone.

2. Penetration through the arterial wall is in the range of 2–3 mm. The entire plaque cannot be imaged and only superficial anatomic information is obtained.

3. OCT could not detect lipid pools or calcium behind thick fibrou s caps, and by an inability to distinguish calcium deposits from lipid pools or the opposite.

4. OCT devices has some technical limitation, so there are some limited lesions including left main disease, ostial disease, very tortuous lesion and so on.

Currently Evolving OCT

Toward easy practice with OCT

- Next generation OCT has imaging acquisition speeds of 10 times faster and resolution 3 times greater than the existing product. It dose not require occlusion of the patient's blood flow during the imaging procedure.

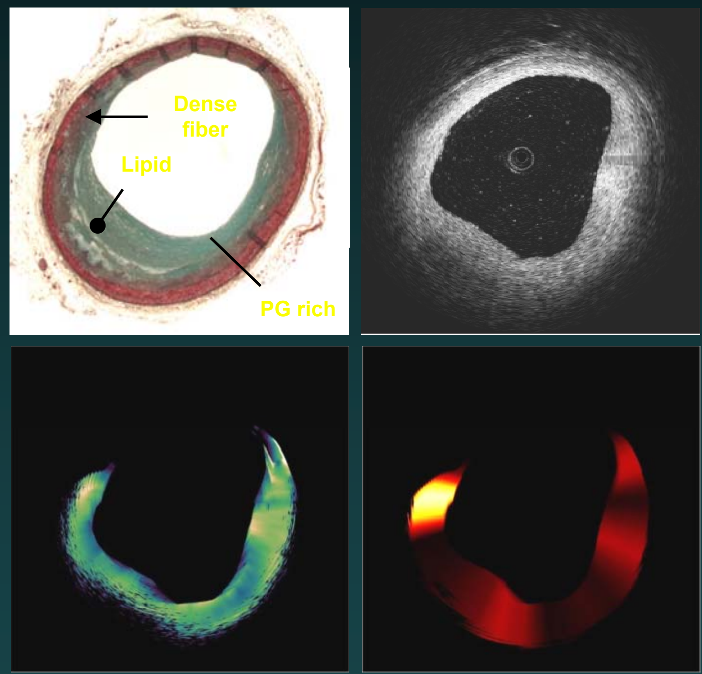
  - *Successfully completion of preclinical study on Aug. 2007*
  - *Live broadcast of first-in-man case by Dr. E Grube in TCT, 2007, " …This is a huge step up in ease of use."*

Currently Evolving OCT

Toward complete lesion characterization with OCT

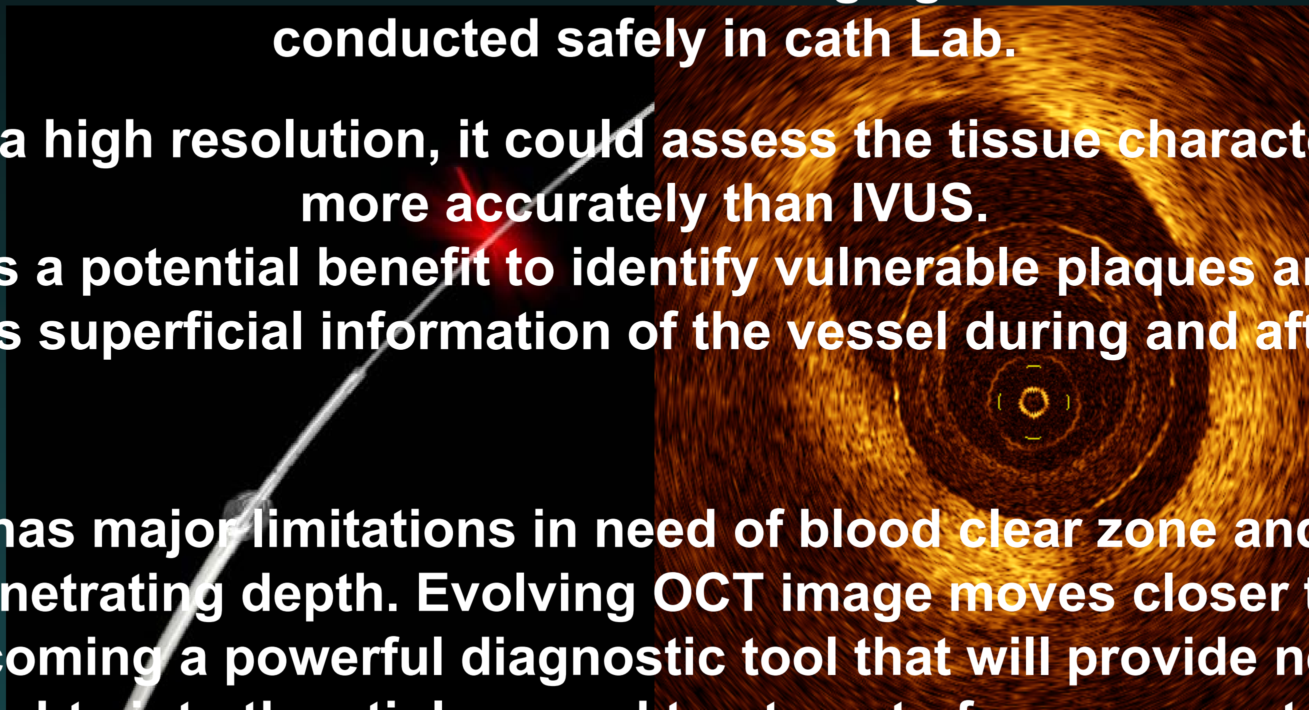
New platform modality and combine with other modality are also promising.

Morphological	Lesion size Lesion shape % stenosis Cap thickness	Backscatter/ Gray Scale
Biochemical composition	Lipid, collagen, proteoglycans, calcium	Spectroscopy Polarization
Physiological	Flow disturbances CFR, FFR	Doppler
Mechanical	Plaque stiffness	Elastography



Renu Virmani, MD, Erik Mont, MD AFIP

Take Home Massages



OCT is feasible as an intravascular imaging tool and it could be conducted safely in cath Lab.

OCT has a high resolution, it could assess the tissue characterization more accurately than IVUS.
OCT has a potential benefit to identify vulnerable plaques and also provides superficial information of the vessel during and after PCI.

OCT has major limitations in need of blood clear zone and low penetrating depth. Evolving OCT image moves closer to becoming a powerful diagnostic tool that will provide new insights into the etiology and treatment of coronary artery disease.