Advantages of Second Generation OCT: OCT Is Useful to Assess Complex Coronary Lesions

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	OCT	OFDI (FD-OCT)
Resolution (axial)	15-20 μm	15-20 μm
(lateral)	25 - 30 μm	25 - 30 μm
Size of imaging core/catheter	0.019”	2.7Fr
A lines	240/frame	450/frame
Frame rate	20 frames/s	100 frames/s
Scan area	6-7 mm	8.3 mm
Max. penetration	1.5 mm	1.5 mm
Blood clearing	Required	Required
Balloon Occlusion	Required	Not required
Flushing	Required	Required
Pullback	1mm/s (35mm)	20mm/s (90mm)

Advantages (and some disadvantages)

- Easier set-up and catheter positioning
- Faster pullback. However, real-time imaging is so fast that studies must be reviewed in slower “play-back” mode
- Flushing and vessel visualization area more complete. However, the larger size of the OFDI catheter (vs the OCT ImageWire) means that some lesions will be occlusive or near occlusive. Blood clearing may be difficult or impossible, and pre-dilatiion may be necessary before optical imaging.
- Faster procedure time. Longer segments can be studied with less ischemia and arrhythmia (also no balloon occlusion).

Multicentre evaluation of the safety of intracoronary TD-OCT

- **468 consecutive pts (510 vessels) from 6 centers were retrospectively included.**

	Occlusive	Non-occlusive	p
Chest pain	69.9%	20.8%	<0.001
QRS sidening or ST depression	54.3%	25.0%	<0.001
ST elevation	6.6%	1.9%	0.01
Ventricular fibrillation	1.1%	0.9%	0.8

Barlis et al. EuroIntervention. 2009;5:90-5

Comparison study of FD-OCT vs TD-OCT in 20 stents in 14 pts

	FD-OCT	TD-OCT	p
Segments analyzed	518	520	
Clear images*	99.4%	80.8%	<0.01
Set-up to completion	5.1±1.7	16.0±3.8 min	<0.01
Sew-up artifact**	2.7%	16.9%	<0.01
Complications, #			
ST elevation	0	6	0.010
Bradycardia	0	4	0.083
Chest pain	1	14	<0.01

*including guidewire artifact

**a function of temporal resolution

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Takarada et al. Catheter Cardiovasc Interv. 2010;75:202-6

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- In one cardiac cycle antegrade-retrograde catheter motion averages 1.50±0.80mm - range 0.5 to 5.5mm with no difference among LAD, LCX, and RCA (Am Heart J. 1999;138:865-72.)
- With rapid pullback, longer segments are assessed during a single cardiac cycle
  - Nearby structures are viewed (and measured) only once – especially important when assessing struts every 0.3mm (or so).
  - Improved reproducibility of analysis – hopefully allowing fewer struts or cross-sections per stent to be analyzed
  - Better 3-D reconstruction

- While ease of use and safety are improved, most of the observations made with the first generation OCT system – that represent the vast majority of the OCT literature – are still valid when using the second generation system. . . with the possible exception of lumen dimensions - balloon occlusion may decrease lumen dimensions while flushing may increase lumen dimensions.

In-stent Neoatherosclerosis after BMS

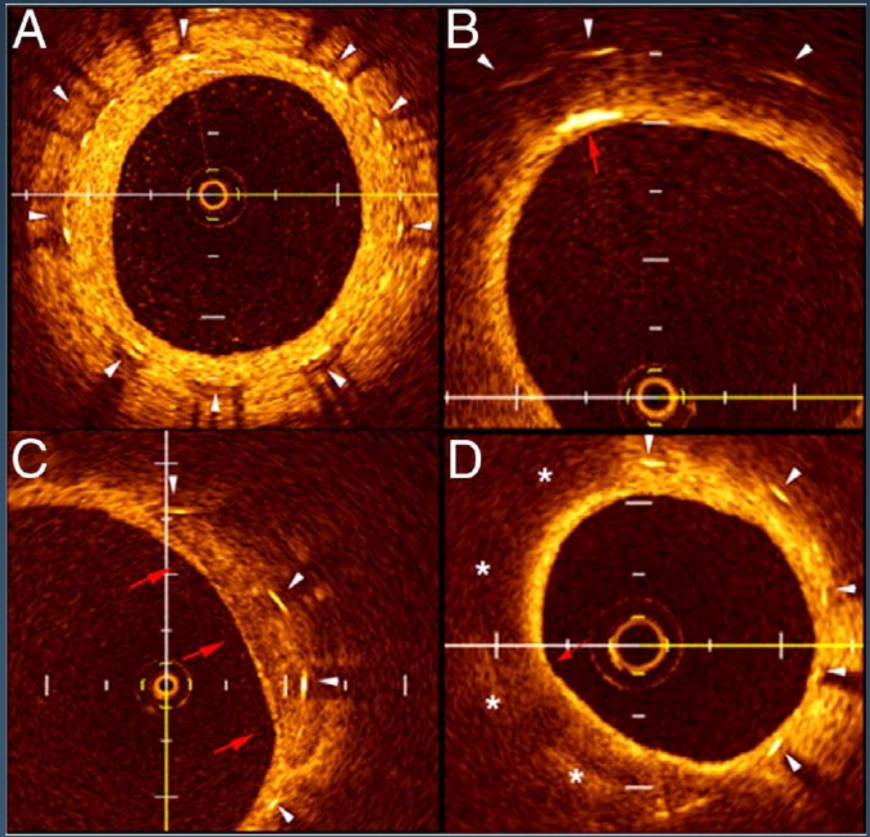
	<6months	>5years
Lipid laden intimal	0	67%
Intimal disruption	0	38%
Thrombus	5%	52%
Intraintimal neovasacularization	0%	62%

Takano et al. J Am Coll Cardiol 2009;55:33-4

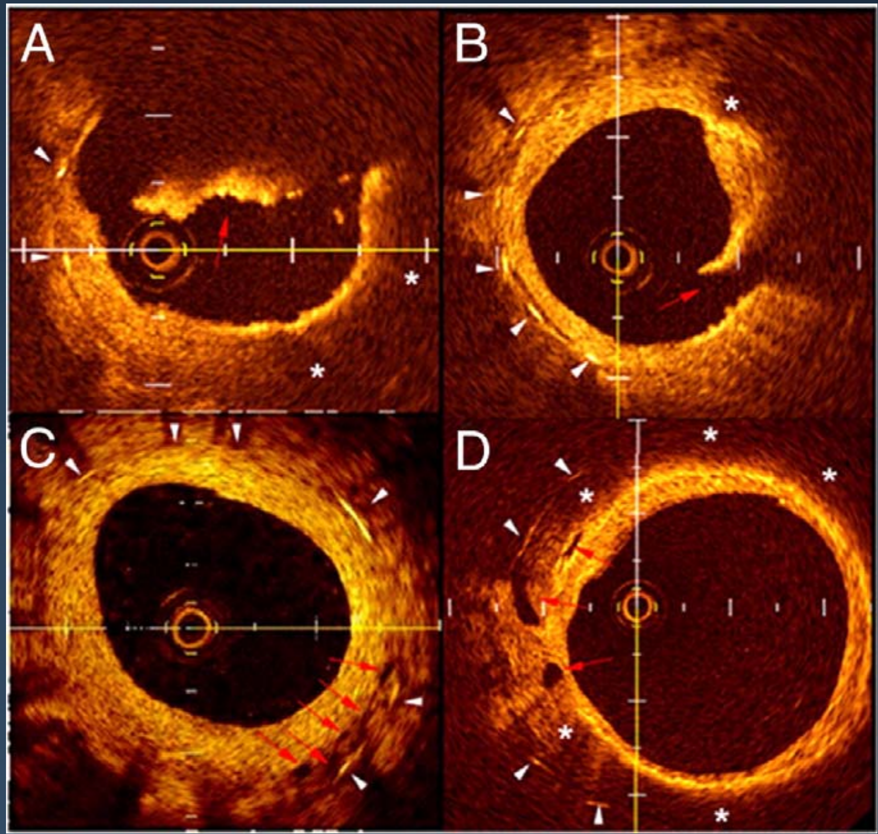
In 39 pts (60 BMS) who underwent OCT imaging 6.5±1.3ys after BMS implantation, lipid-rich neointima was found in 20 stents (33.3%) in 16 pts (41%) with an average fibrous cap thickness of 56.7±5.8μ. Six pts had plaque disruption and 6 patients had mural thrombus.

Hou et al. Heart. 2010;96:1187-90.

Normal Intima and Atherosclerotic Intima



Thrombus, Intimal Disruption, and Neovascularization



Takano et al. J Am Coll Cardiol 2010;55:26-32

In-stent Neoatherosclerosis after DES (n=50, median follow-up of 32 months)

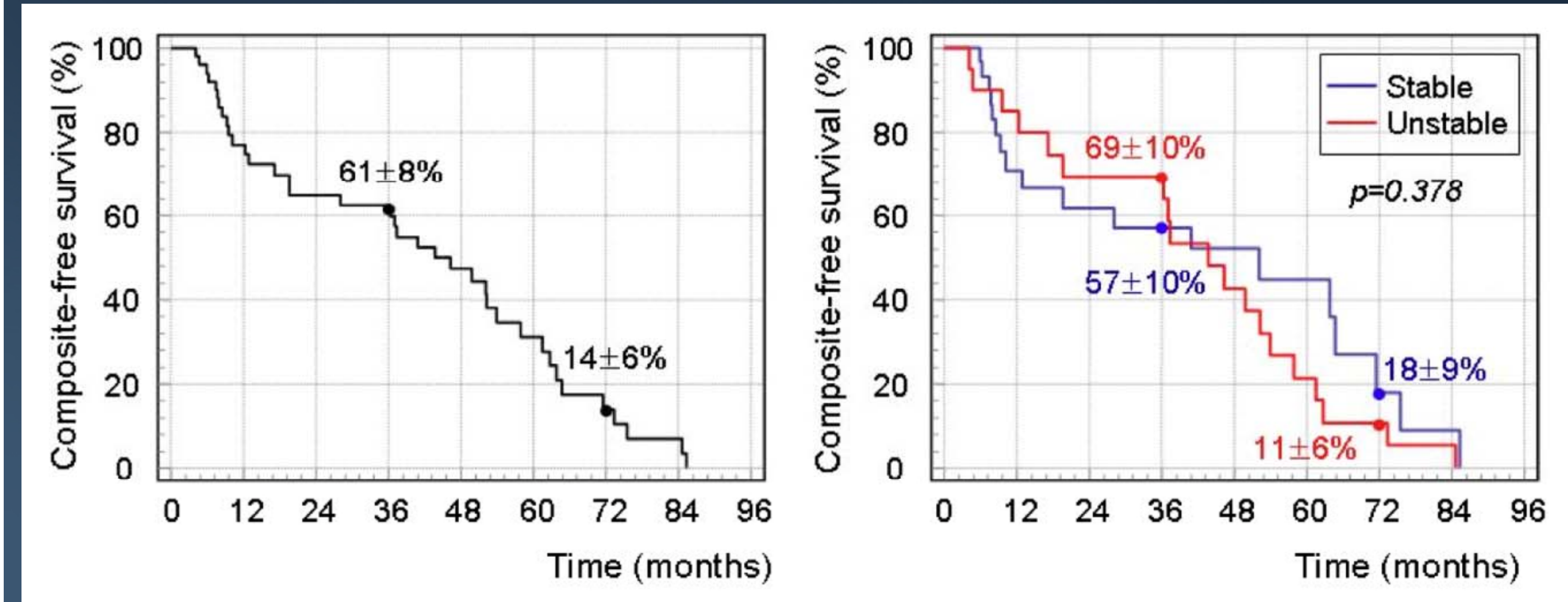
- 52% lesions had at least one in-stent TCFA-like neointima
- 58% had at least one in-stent neointimal rupture.
- Patients presenting with unstable angina showed
  - Thinner fibrous cap (55μ vs. 100μ, p=0.006)
  - Higher incidence of TCFA-like neointima (75% vs. 37%, p=0.008)
  - Higher incidence of neointimal rupture (75% vs. 47%, p=0.044)
  - Higher incidence of thrombi (80% vs. 43%, p=0.010) and red thrombi (30% vs. 3%, p=0.012)

Kang et al. Circulation, in press

In-stent Neoatherosclerosis after DES (n=50, median follow-up of 32 months)

- Fibrous cap thickness negatively correlated with follow-up time (r=-0.318, p=0.024).
- 20 months post-implantation was the best cut-off to predict TCFA-like neointima).
- Stents ≥20 months post-implantation had
  - Higher incidence of TCFA-like neointima (69% vs. 33%, p=0.012)
  - Higher incidence of red thrombi (27% vs. 0%, p=0.007).
- Post-intervention CK-MB was significantly higher in intimal rupture vs. no intimal rupture (p=0.025).

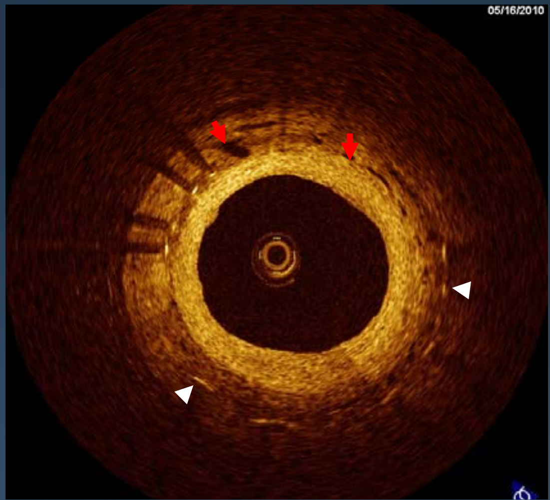
In-stent Neoatherosclerosis after DES (n=50, median follow-up of 32 months)



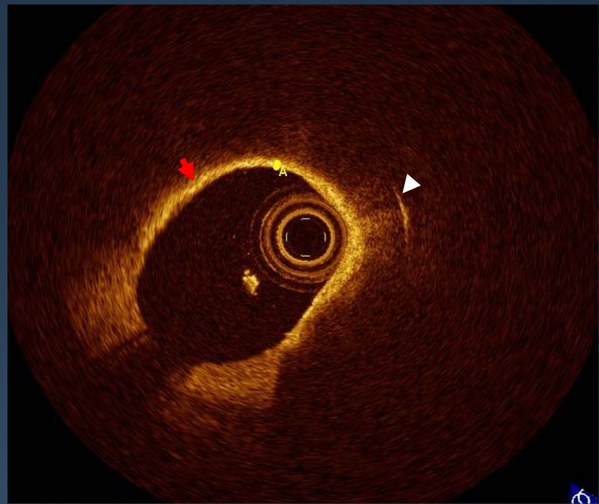
(composite of TCFA-like neointima, neointimal rupture, and red thrombus)

Late in-stent neoatherosclerosis in DES

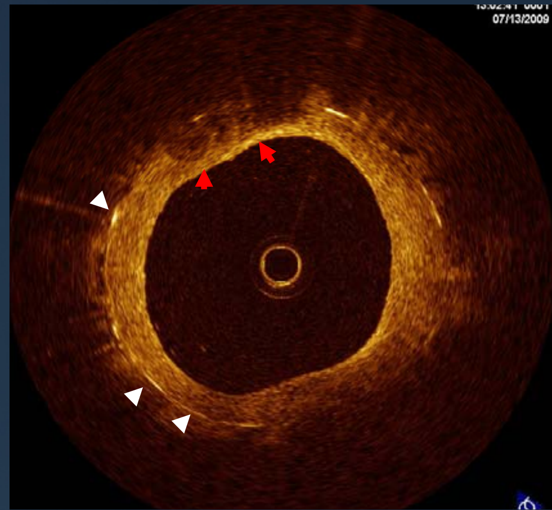
Microvessel



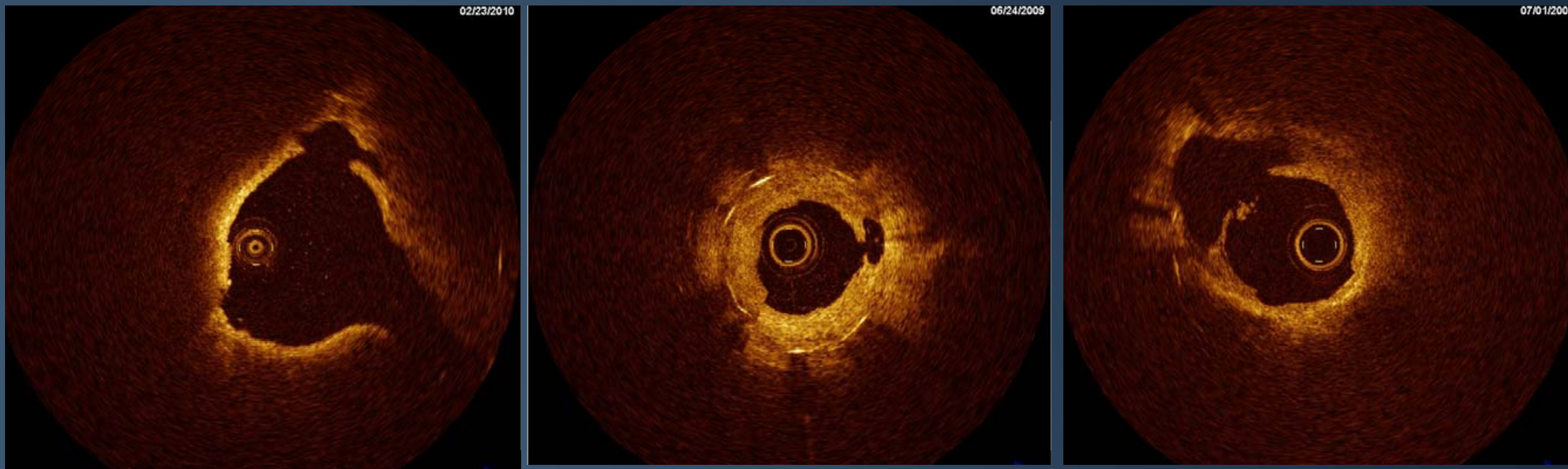
TCFA-like neointima



Calcium



Neointimal rupture



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Kang et al. Circulation, in press

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Red thrombus

White thrombus

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Recent OCT studies from have shown the frequent in-stent thrombi at follow-up.

	F/U (mos)	BMS	SES	PES	EES	ZES
Kim. Circ J. 2010;74:320-6	9		10 (33.3%)	5 (18.5%)		
Kim. Am Heart J 2010;159:278-83	3-66 (11)		27 (28%)	7 (11%)		
Murakami. Circ J 2009;73:1627-34	6		3 (15%)	10 (50%)		
Davlouros. Int J Cardiol 2011, in press	6			16 (21.7%)		
Inoue. Heart 2010, in press	8				30 (0%)	
Kim. JACC Cardiovasc Interv 2009;2:1240-7	3					1 (3.2%)
Yamamoto. Int J Cardiol 2010, in press	3-8	10 (33%)				
Choi. Int J Cardiovasc Imaging 2011, in press	9		24 (34.3%)		8 (5.0%)	