Optical Coherence Tomographic Analysis of Sirolimus-Eluting Stent

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Toyohashi Heart Center
**Lightlab OCT Imaging System**

**OCT image wire (ImageWire®)**
- 1310 nm broadband light source
- 0.014 inch at the tip, 0.016 inch at the lens
- resolution: 10 ~ 15\(\mu\text{m}\)
- frame rate: 15fps

**Balloon occlusion-flushing catheter**
- 4Fr. catheter with high compliance balloon
- balloon size: 3.8mm @ 0.3 atm
Implantation of SES
Near infrared light used in OCT cannot penetrate the metallic stent strut, so stent is visualized as highly reflective structures of the stent strut surface with typical dorsal shadowing in OCT.

**Complete stent apposition (CSA)**

- Stent Strut
- ≤ thickness of struts

**Incomplete stent apposition (ISA)**

- Stent Strut
- > thickness of struts

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Incomplete apposition

After stenting of the mid-LAD with inflation pressure at 10 atm

BX 3.5*33mm

Incomplete apposition
Post Dilatation of Incompletely Apposed Stent

10 atmosphere

Adjunctive ballooning at 20 atmosphere

Incomplete apposition
Findings after Stent Implantation

Dissection

Tissue prolapse
Neointimal Coverage of SES

Recently, stent thrombosis following DES implantation is a hot issue. Incomplete neointimal coverage of stent struts is responsible for stent thrombosis.
IVUS and OCT image of SES at 3-month follow-up

✓ OCT provides detailed visualization of the individual stent struts and a thin neointimal layer over DES struts that IVUS can not detect.
**Male 87 y.o.**

**Diagnosis:**
Stable AP

**Risk Factor:**
HT

**Target Lesions:**
LCX  seg.11 75%
seg.13 90%

**Bx Velocity**
4.0 * 18mm

**Cypher**
3.0 * 18 mm
Follow-up CAG

2-Month Follow up

7-Month Follow up
Comparison of IVUS and OCT images between BMS and SES

2-month follow up

BMS

DES

7-month follow up

BMS

DES
Optical Coherence Tomographic Analysis of Neointimal Stent Coverage in Sirolimus-eluting Stent, Compared with Bare Metal Stent

Toyohashi Heart Center, Toyohashi, Japan

Tatsuya Ito, Mitsuyasu Terashima, Yoshihiro Takeda, Osamu Katoh, Tetsuo Matsubara, Etsuo Tsuchikane, Mariko Ehara, Yoshihisa Kinoshita, Kenya Nasu, Jean-François Surmely, Nobuyoshi Tanaka, Akira Murata, Hiroshi Fujita, Koyo Sato, Takahiko Suzuki

Ito t, et al, 2006 ACC
Subjects

2-month follow-up

- SES
  - 12 stents
  - 1727 struts

- BMS
  - 9 stents
  - 1545 struts

8-month follow-up

- SES
  - 12 stents
  - 1849 struts

- BMS
  - 9 stents
  - 1206 struts

Ito t, et al, 2006 ACC
OCT Analysis of Stented segment

at intervals of 1mm

Ito t, et al, 2006 ACC

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Pattern of “Intimal Stent Strut Coverage”

Uncovered Struts

Stent Strut

Dorsal Shadowing

Covered Struts

Ito T, et al, 2006 ACC

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Neointimal Stent Coverage (%)

<table>
<thead>
<tr>
<th></th>
<th>2M</th>
<th>8M</th>
<th>2M</th>
<th>8M</th>
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<tbody>
<tr>
<td>SES</td>
<td>86.8</td>
<td>93.1</td>
<td></td>
<td></td>
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<tr>
<td>BMS</td>
<td></td>
<td></td>
<td>98.7</td>
<td>99.5</td>
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P<0.05

Ito t, et al, 2006 ACC
Neointimal Stent Coverage (\%)
Neointimal Coverage of SES struts Crossing a Side-branch
Neointimal Growth on SES Struts Crossing a Side Branch on Porcine Model
Representative Case

After 2 months

Incomplete neointimal coverage of a strut

After 8 months

Complete neointimal coverage of a strut

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A Time-course Analysis of Neointimal Growth on the Sirolimus-Eluting Stent Struts Crossing a Side Branch Using Optical Coherence Tomography

Mitsuyasu Terashima
Tatsuya Ito, Yoshihiro Takeda, Jean-François Surmely, Osamu Katoh, Tetsuo Matsubara, Etsuo Tsuchikane, Mariko Ehara, Yoshihisa Kinoshita, Kenya Nasu, Nobuyoshi Tanaka, Takahiko Suzuki

Toyohashi Heart Center, Toyohashi, Japan

Terashima M, et al, 2006 TCT
OCT Analysis

- 24 struts of 9 SES crossing a side branch
- At 2 months and 8 months after SES implantation
Definition of Neointimal Coverage of Stent Struts Crossing a Side Branch

Incomplete Coverage
- Uncovered
- Partially covered

Complete Coverage
- Completely covered

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Neointimal Coverage of Struts Crossing a Side Branch at 2 and 8 months After SES Implantation

2-month
- Uncovered: 17 (70.8%)
- Partially covered: 4 (16.7%)
- Completely covered: 3 (12.5%)

8-month
- Completely covered: 17 (70.8%)
- Partially covered: 5 (20.8%)
- Uncovered: 2 (8.3%)

Terashima M, et al, 2006 ACC
Comparison of Frequencies of Complete Neointimal Coverage between Side-branch and Attached struts

2-month

<table>
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<tr>
<th>Branch</th>
<th>Attached</th>
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<tr>
<td>16.7%</td>
<td>86.8%</td>
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8-month

<table>
<thead>
<tr>
<th>Branch</th>
<th>Attached</th>
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<td>70.8%</td>
<td>93.1%</td>
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</table>
Neointimal Coverage of Malapposed Stent Struts
Follow-up of Struts with Incomplete apposition

Post PCI

Incompletely Apposed Struts

270µm

210µm

140µm

2Mo. FU

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Summary

✓ Thin neointimal layers over SES struts can be detected by OCT.

✓ Neointimal coverage of SES struts is delayed, especially on the struts not attached to the vessel wall.

✓ Dual antiplatelet therapy should be continued >3 months after SES implantation.
Conclusion

✓ OCT provides various information of DES.

✓ OCT might be a powerful imaging tool in DES era.