Title
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Flare spots in IVOCT images of bioabsorbable stents

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Flare spots (Figure 1, a-b) are observed in IVOCT images of bioabsorbable stent struts in patients and have no analog in metallic stents. Gutiérrez-Chico et al [1] proposed that flare spots were located at hinge points where the highest strain is experienced during deployment, suggesting that they represent micro-crazes (fine lines) in the polymer. Nonetheless, the mechanism for the presence of flare spots in IVOCT images, and the large variation in their appearance where no two are alike is not known. In this study, micro-CT and IVOCT images of a bioabsorbable stent deployed in a cylindrical phantom blood vessel were co-registered and compared to investigate the underlying mechanism for presence of flare spots in IVOCT images. A 3 mm lumen diameter phantom vessel was made out of polydimethylsiloxane (PDMS) with elastic properties comparable to that of arteries. Titanium dioxide was added to PDMS to simulate light scattering properties of the arterial wall. A 3.0×18 Absorb™ stent (Abbott Vascular, Santa Clara, CA) was deployed within the phantom vessel at 16 atm pressure with a balloon while submerged in a water bath at body temperature (37 °C) to minimize any structural changes to the polymer. IVOCT images of the Absorb stent (Figure 1, c-d) were acquired using a frequency domain IVOCT system (CorVue, Volcano Corporation) while the phantom vessel was flushed with saline. The IVOCT catheter was pulled back at a slow speed of 1.5 mm/sec over a 15 mm length of vessel recording at a frame rate of 30/sec. After stent deployment and IVOCT imaging, micro-CT images of the phantom vessel at resolution of 6μm were recorded as a gold image standard. Each recorded IVOCT image was registered to a sequence of eight micro-CT images due to the spiral pattern associated with a pullback and relatively larger longitudinal spacing between IVOCT images. Figure 1 illustrates two successive IVOCT images (c-d) along with the corresponding co-registered micro-CT images (e-f). The change in

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appearance of groups of struts (indicated with green and yellow ovals) can be observed in successive IVOCT and micro-CT images. From the micro-CT image sequence (Figure 1, e-f), adjacent struts are observed to merge (separate) at the arterial side of the stent and form a micro-sized gap at the vessel wall, with a different appearance at every gap. Flare spots in the IVOCT images are only generated when gaps appear in the micro-CT images on the arterial side.

The micro-CT data set was used to create a three dimensional representation of the entire stent demonstrating that micro-crazes are formed on the arterial side of the stent and therefore result in micro-gaps at the vessel wall. There were two types of crazing which correspond to locations where two or three struts merge (separate). During a pullback, the IVOCT beam propagates through the vessel lumen, where portions of light reflect from and transmit across the strut edge. Light reflected from the strut edge forms an outline of the outer surface of the strut in IVOCT images. When the IVOCT beam enters a gap region with micro-crazes, reflections at the gap boundary occur before light returns to the catheter. The reflections at gap boundaries produce flare spots of higher intensity inside struts in IVOCT images (Figure 1g). Since each crazing site is different at every hinge point, as demonstrated by the micro-CT images (Figure 1, e-f), the pattern of light reflections is expected to vary consistent with the observation that no two flare spots appear identical in recorded IVOCT images.

In conclusion, we have completed imaging experiments of an Absorb™ stent deployed in a phantom vessel to investigate the origin of flare spots observed in IVOCT images of bioabsorbable stents. Flare spots observed in IVOCT images correspond to gaps observed in micro-CT images formed by micro-crazes on the arterial side of the stent. The appearance of flare spots in IVOCT images is consistent with light reflecting from surfaces formed at these gap boundaries before returning to the catheter.

References

1. Gutiérrez-Chico JL, Radu MD, Diletti R MD, Sheehy A, Kossuth MB, Oberhauser JP, Glauser T, Harrington J, Rapoza RJ, Onuma Y, Serruys PW. Spatial Distribution and Temporal Evolution of Scattering Centers by Optical Coherence Tomography in the Poly(L-Lactide) Backbone of a Bioresorbable Vascular Scaffold. Circulation Journal. 2012; 76:342–350. [PubMed: 22104034]

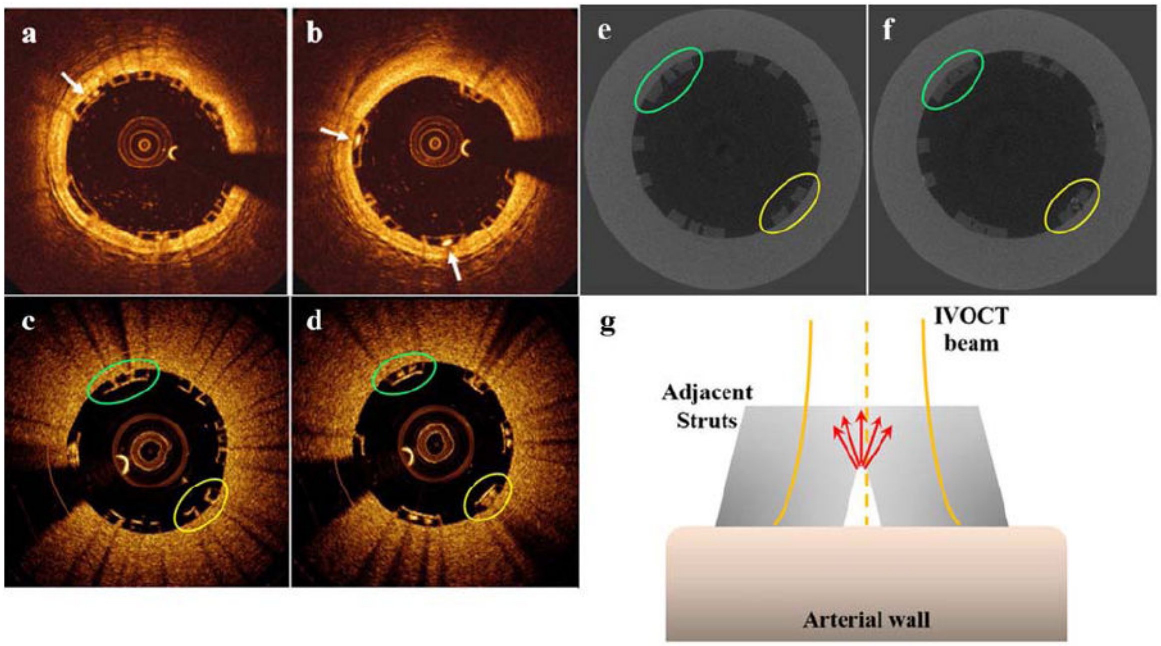

Figure 1. Flare spots observed in IVOCT images of ABSORB stent

Deployed in a patient coronary artery (indicated by arrows, a-b), c-d: phantom vessel with successive IVOCT images at 100 micron intervals, and e-f: corresponding micro-CT images at 50 micron intervals. Adjacent struts (green and yellow ovals) merge at the luminal side of the stents and form a gap at the vessel wall. g: reflections at gap boundaries result in flare spots.