

## IMAGES IN INTERVENTION

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# First Presentation of 3-Dimensional Reconstruction and Centerline-Guided Assessment of Coronary Bifurcation by Fusion of X-Ray Angiography and Optical Coherence Tomography

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Correct characterization of coronary bifurcations by optical coherence tomography (OCT) is essential for evaluation of lesions and treatment. Assessment is limited by the need for acquiring images in both the main branch (MB) and the side branch (SB) and the risk of OCT cross sections not being perpendicular to the true vessel centerline due to imaging wires being nonparallel to the centerline. We present a new method for evaluation of coronary bifurcations by fusion of x-ray angiography (XA) and OCT acquired in the MB. XA in 2 projections was reconstructed in 3 dimensions (3D) and fused

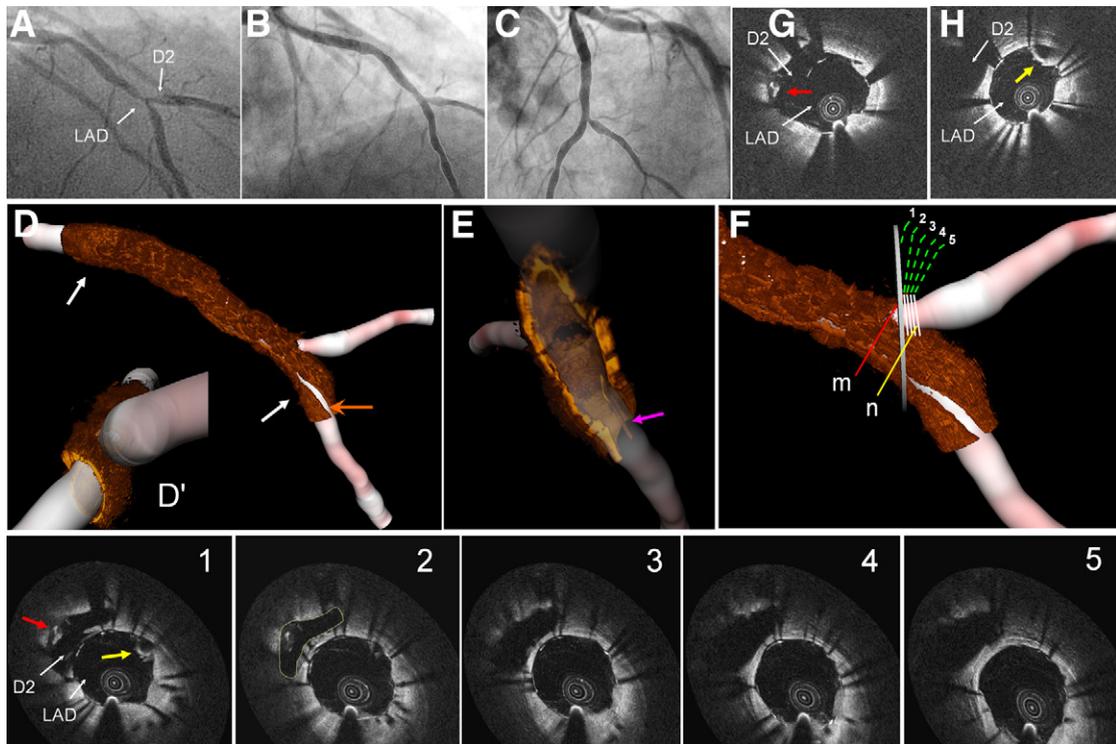
with OCT using Medis prototype software (1). Evaluation of the SB ostium (Fig. 1, panels 1 to 5) was performed by reconstructed OCT cross sections perpendicular to the XA-constructed SB vessel centerline. In the presented case, the area of the SB ostium was 1.78 mm<sup>2</sup> by 3D quantitative coronary angiography and was 1.67 mm<sup>2</sup> by OCT in the plane perpendicular to the SB centerline (Fig. 1, panel 2).

Fusion of 3D-reconstructed XA and centerline-adjusted OCT may improve evaluation of tortuous vessels and ostial lesions, and might limit the need for SB acquisitions in bifurcation lesion assessments.

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**Figure 1. 3D Assessment of Coronary Bifurcation by Fusion of XA and OCT**

(A) X-ray angiography (XA) of bifurcation lesion. (B) and (C) Angiographic projections for 3-dimensional (3D) reconstruction. (D) Fusion of X-ray angiography with optical coherence tomography (OCT) in naturally bent 3D shape. The 2 **white arrows**: stent edges. Guidewire artifact: **orange arrow**. (D') Distal-to-proximal view of the bifurcation demonstrating that 3D angiography corresponds well with 3D OCT at the carina. (E) Cut-through view showing the opening of the side branch and the well-aposed struts; note the half-transparent angiographic lumen and the well-visualized guidewire (**pink arrow**). (F) Centerline-guided side branch assessment from OCT acquired in the main vessel. The 5 numbered lines correspond to the 2D OCT frames in the **bottom panels**. The first frame (**panel 1**) shows a piece of intimal tissue (**red arrow**) that corresponds to the **red arrow** in G. In **panel 1**, a bulge of fibrotic tissue (**yellow arrow**) is also identified in panel H (**yellow arrow**) from the original OCT pullback. **Red line (m)** and **yellow line (n)** in F indicate where G and H were acquired.

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**REFERENCE**

1. Tu S, Xu L, Ligthart J, et al. In-vivo comparison of arterial lumen dimensions assessed by co-registered three-dimensional (3D) quantitative coronary angiography, intravascular ultrasound and optical coherence tomography. *Int J Cardiovasc Imaging* 2012 Jan 20 [E-pub ahead of print].