



Echocardiography–X-Ray Image Fusion

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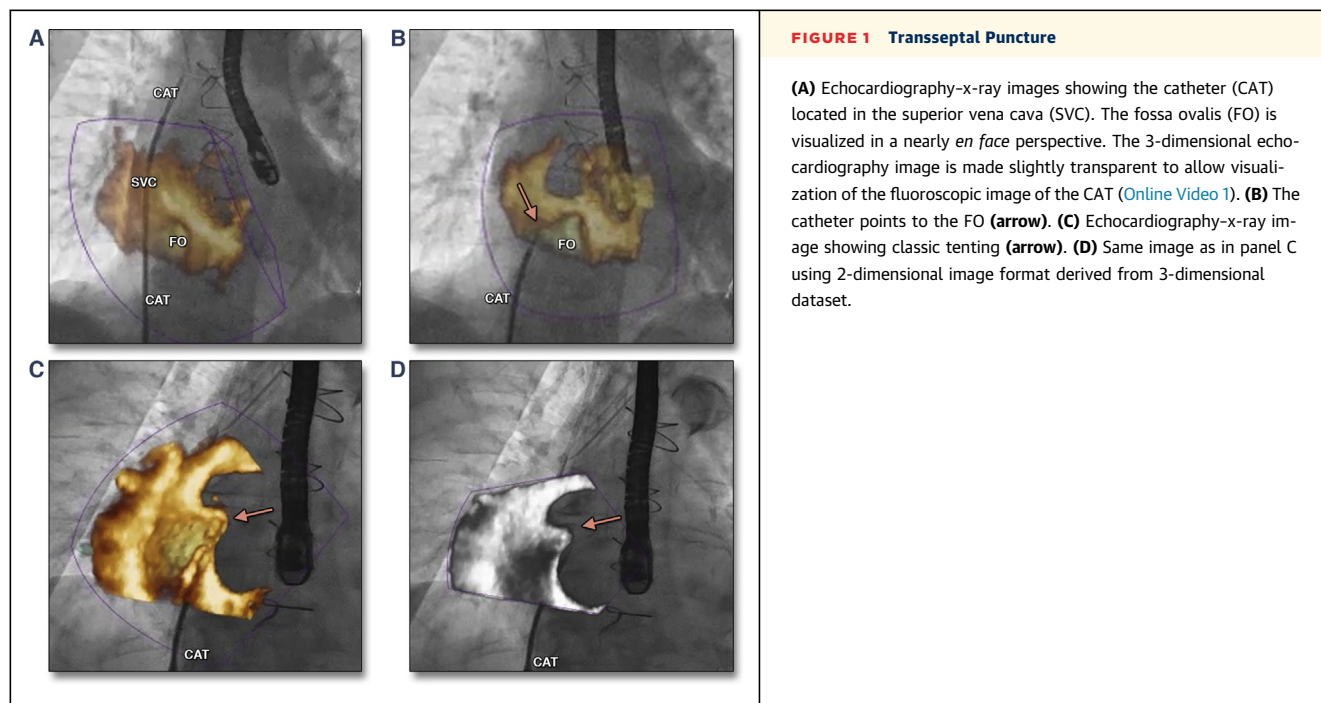
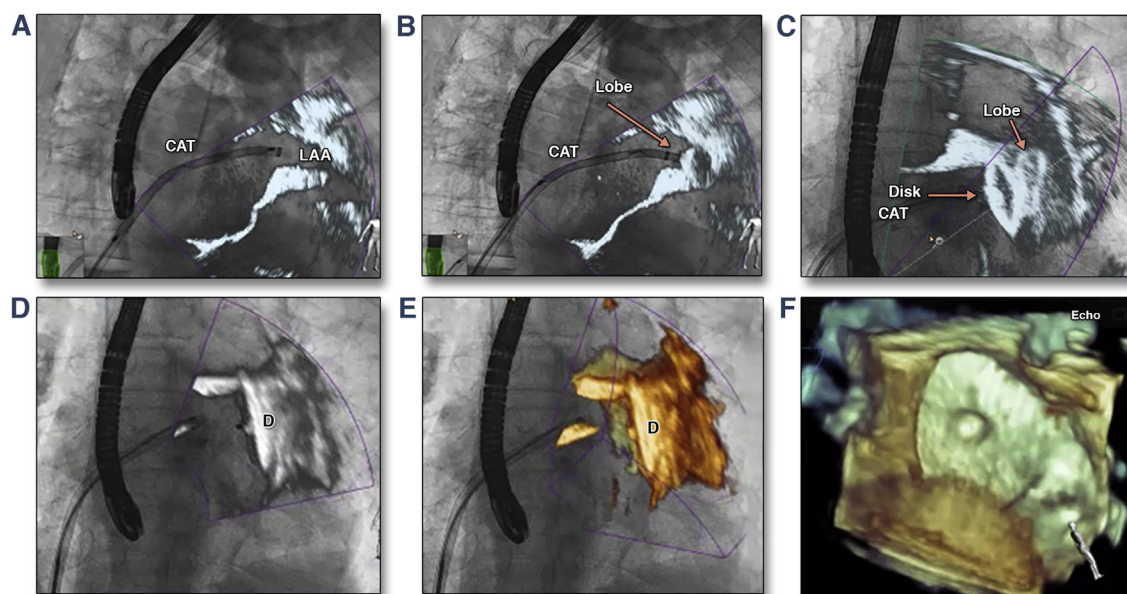
AN ECHOCARDIOGRAPH X-RAY FUSION ALLOWS FOR SUPERIMPOSING OF 2-DIMENSIONAL (2D)/ 3-dimensional (3D) transesophageal echocardiography (TEE) images on a fluoroscopic screen. This approach aligns 2D/3D TEE images into an x-ray fluoroscopic coordinate system. Any time the C arm of fluoroscopy moves, the 3D TEE image is automatically relocated according to the new x-ray projections (image-based tracking). Moreover, by means of a table-sided mouse, the echocardiographer can crop, rotate, or make the 3D TEE images more transparent.

Echocardiography-x-ray images are presented for several percutaneous procedures for structural heart disease, including transseptal puncture ([Figure 1](#), [Online Video 1](#)), left atrial appendage occlusion ([Figure 2](#), [Online Video 2](#)), transcatheter aortic valve replacement (TAVR) ([Figure 3](#), [Online Videos 3 and 4](#)), balloon valvuloplasty in mitral stenosis ([Figure 4](#), [Online Video 5](#)), and mitral valve repair ([Figure 5](#), [Online Videos 6, 7, and 8](#)). For each step of the above-mentioned procedures, we illustrate echocardiography-x-ray fusion images and describe the current limitations using the traditional x-ray projections.

Echocardiography-x-ray imaging can help guide percutaneous procedures. However, it is still unclear whether this technique should have a “niche” application in a few complex procedures or whether it might be useful in all procedures. The poor resolution of 3D TEE images and the inability to display *en face* perspectives remain the main limitations.

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Manuscript received June 9, 2015; revised manuscript received September 15, 2015, accepted September 23, 2015.

**FIGURE 2 Occlusion of LAA**

(A) Two-dimensional echocardiography-x-ray image of the catheter (CAT) in the left atrial appendage (LAA). (B) Deployment in the lobe (arrow). (C) Magnified echocardiography-x-ray image showing the disk and the lobe of the occluder in situ (arrows). (D) The deployed device (D) visualized in 2-dimensional image format derived from 3-dimensional (3D) dataset and (E) in 3D format. (F) 3D transesophageal echocardiography image of the occluder *en face*. The limited rotation of the C arm of fluoroscopy prevented a fused image from being obtained using this perspective. [Online Video 2](#) shows the echocardiography-x-ray fused image of the LAA in the anteroposterior fluoroscopic projection. The echocardiographer cropped the 3D dataset to obtain the LAA long-axis view.

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