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## Editorial

## Editorial: Do we need real-time assistance for stent positioning and assessment from live fluoroscopic images?



## Keywords:

Percutaneous coronary interventions  
Stent  
Fluoroscopy

Detailed visualization of coronary stents during their positioning from live fluoroscopic images is critical for successful percutaneous coronary intervention (PCI). Coronary stent under-expansion is a major contributor to in-stent restenosis and stent thrombosis, even in the drug-eluting stent era [1,2]. Coronary stent implantation is monitored by X-ray fluoroscopy where imaging quality of the guidewires, markers, and stent struts is often low. Physicians are keen to know whether the stent is located at precise desired lesion or whether the stent has expanded properly against the vessel wall. However, they often have difficult situations making a precise judgement from live fluoroscopic images due to rapid motion of coronary arteries and poor contrast.

The current gold standard for detection of stent under-expansion is intravascular ultrasound (IVUS) [3] and optical coherence tomography (OCT) [4,5]. IVUS and OCT improve adequate stent expansion and decrease rates of target vessel revascularization compared to conventional angiography. However, IVUS and OCT are limited by cost, non-simultaneous assessments of stent deployment, and procedural time.

The report by Biscaglia et al. [6] presents clinical examples of enhanced stent visualization (ESV) during PCI in several clinical situations and an overview of several articles on ESV. The authors concluded that ESV systems can be utilized along with or instead of intracoronary imaging techniques during stent implantation, to assess stent expansion, overlapping, and integrity.

ESV is an emerging method that relies on two balloon markers to enable real-time enhanced visualization and detection of precise positioning and expansion. A novel and robust image-based tracking framework for image-guided intervention is proposed such that physicians do not need manually to initialize the tracking [7]. ESV systems provide a high quality and real-time fluoroscopic assessment during PCI.

Stent design advances have led to thinner stent struts, resulting in deployed stents that are difficult to visualize. Motion-corrected X-ray stent visualization is a significant advance in X-ray technique that allows assessment of stent expansion. Several systems have been developed as advanced fluoroscopic imaging alternatives to IVUS, superior to conventional angiography alone for assessing stent deployments. These include StentBoost Subtract system<sup>®</sup> (Philips Healthcare, Best, The Netherlands), 18-21, ClearStent Live system<sup>®</sup> (Siemens Healthcare, Munich, Germany), and StentViz<sup>®</sup> (GE Healthcare, Milwaukee, WI, USA) [8].

ESV is an excellent X-ray imaging modality that provides enhanced stent visualization by eliminating motion artifact. These systems are time-efficient and cost-effective compared to IVUS or OCT. It is important for physicians to assess the precise stent location under real-time fluoroscopy after observations of IVUS or OCT. However, there are few clinical or outcome data for ESV techniques. IVUS or OCT remain the gold standard for evaluation of adequate stent expansion, stent overlapping, and stent integrity. However, ESV can be an alternative or adjunctive and user-friendly tool in several situations during PCI.

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