Advances in intravascular imaging have provided important insights into the factors that influence outcomes following percutaneous coronary interventions (PCI). Ultrasonic imaging within the coronary arteries defined the vascular response to angioplasty and stenting, guiding the use of more aggressive approaches to the percutaneous treatment of complex atherosclerotic lesions. Intravascular ultrasound (IVUS) has played a seminal role in illustrating the recoil, remodeling and restenosis phenomena following angioplasty and has prompted the use of greater inflation pressures in order to achieve optimal vascular expansion. In fact, the lessons learned from early IVUS imaging in the setting of PCI have influenced practice to the point that its routine use is not required during the majority of procedures.

With ongoing developments in intravascular imaging, it has now become possible to directly visualize individual components of atherosclerotic plaque. This provides the opportunity to further extend observations of factors influencing clinical outcomes following PCI. Although various reports on radiofrequency analysis of ultrasound backscatter and near-infrared spectroscopy imaging suggest that underlying plaque composition portends a higher rate of myocardial infarction following PCI, it remains to be determined whether the use of these techniques in the catheterization laboratory would alter management and patient outcomes. Furthermore, these modalities focus on characterization of plaque and provide limited incremental information with regard to coronary stents.

Generating high-resolution vascular imaging with optical coherence tomography (OCT) delivers the potential to image superficial aspects of plaque, apposition of stents against the artery wall and ultimately the development of early neointimal thickening within the stent. As a result, the use of OCT imaging in both research and clinical applications has widely proliferated. By virtue of the widespread use and additional information that can be derived, OCT has the potential to enhance our ability to more optimally target complex coronary lesions.

In this issue of the Journal, Maejima and colleagues report their observations of serial OCT imaging of vascular wall responses following complex PCI in calcified lesions. They studied 36 patients who underwent serial OCT imaging following rotational atherectomy, angioplasty and stent implantation of 37 calcified lesions. Their primary analysis focuses on the extent of calcification following rotational atherectomy, with subsequent incidence of calcium cracks and vascular expansion post procedure. Calcium cracks were more likely to form in segments that contained thin calcium deposits spanning a greater arc within the plaque. This appears to be important, given the additional finding that segments demonstrating calcium cracks following angioplasty achieved a greater stent cross-sectional area and lumen gain. These findings have important implications by suggesting that the ability to more effectively disrupt plaque calcification can lead to more optimal stent expansion in complex PCI of heavily calcified lesions.

This report reflects meticulous analysis of 625 segments imaged on 3 separate occasions, representing a considerable amount of work to deliver these findings. However, a number of important caveats should be noted with regard to this report. This is a single-center experience involving a small number of patients; it would therefore be interesting to see if similar findings were observed across a broader range of operators. Although OCT imaging was comprehensive in these patients, it was not performed prior to atherectomy. This is unlikely to be any consequence, given that rotational atherectomy is typically reserved for patients with substantial calcification. The small cohort precludes the ability to investigate whether different clinical settings (acute vs. chronic ischemic syndromes) and comorbidities (diabetes, chronic kidney disease) influence these findings. Similarly, other plaque features defined by OCT and other modalities have not been integrated into this analysis, precluding the ability to understand how they may have contributed to the ability to achieve optimal stent expansion.

Ultimately, the effect of achieving calcium disruption on clinical outcomes is unknown. A much larger study with long-term follow-up would be required to determine how much disruption is required to prevent subsequent clinical events. The likelihood that such a benefit would most likely be realized by a reduction in further revascularization procedures, as opposed to hard ischemic endpoints. Given the economic resources consumed by recurrent revascularization procedures, the benefits in the absence of reducing hard ischemic events may still be considerable.

This report by Maejima and colleagues continues to support the importance of applying novel intravascular imaging in the setting of PCI, in terms of its ability to provide a greater understanding of the factors that influence periprocedural outcomes. The impending wave of hybrid imaging techniques may overcome some of the limitations of performing OCT alone and enable elucidation of how a range of plaque features...
influence its response to PCI. Beyond the ability to provide important contributions to the scientific literature and potentially change routine approaches to clinical practice, the question of whether routine imaging should be applied during complex PCI requires demonstration that it influences management and outcomes. This report using OCT shines some light on that potential. The ability to demonstrate a lack of calcium disruption may potentially alter the next step in the percutaneous approach to management of highly calcified lesions. This provides an elegant example of the need for large, prospective trials of how to apply the technology we have. Technology has enhanced our ability to visualize; it will ultimately be what we see and how we respond that will improve the health outcomes of our patients.

References