Short- and Long-term Evaluation of Bioresorbable Scaffolds by Optical Coherence Tomography

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KEYWORDS

• Bioresorbable scaffolds • Optical coherence tomography • Drug-eluting stents

KEY POINTS

- The analysis of bioresorbable scaffolds (BRSs) by optical coherence tomography (OCT) requires a dedicated methodology, as the polymeric scaffold has a distinct appearance and undergoes dynamic structural changes with time, unlike metallic stents.
- The high resolution of OCT allows for the detailed assessment of scaffold implantation, rupture, discontinuity, and strut integration.
- OCT does not provide reliable information on the extent of scaffold degradation, as it cannot differentiate between polylactide polymer and the provisional matrix of proteoglycan formed by connective tissue.
- Three-dimensional OCT reconstruction can aid in the evaluation of BRS in special scenarios such as overlapping scaffold segments and bifurcations.

INTRODUCTION

BRSs represent a novel approach in the treatment of coronary artery disease. They support the vessel transiently to maintain patency after intervention, deliver antiproliferative drug to the vessel wall, and then gradually degrade.[1,2] BRS technology has matured, and there are numerous devices that are commercially available outside the United States or are undergoing preclinical or clinical evaluation (Fig. 1). BRS has required new imaging modalities, methodologies, and strategies, because scaffold design, degradation rate, loss of mechanical properties (Table 1), coating, and drug deliverability may affect BRS safety and efficacy.[3,4] OCT has played a central role in understanding the short and long term BRS performance, OCT provides more detailed and precise morphologic information about BRS than does intravascular ultrasonography (IVUS) because of its higher resolution.[5,6] This review summarizes the methodology and clinical application of OCT in the assessment of BRS, in particular for the commercially available Absorb Bioresorbable

The authors have nothing to disclose.

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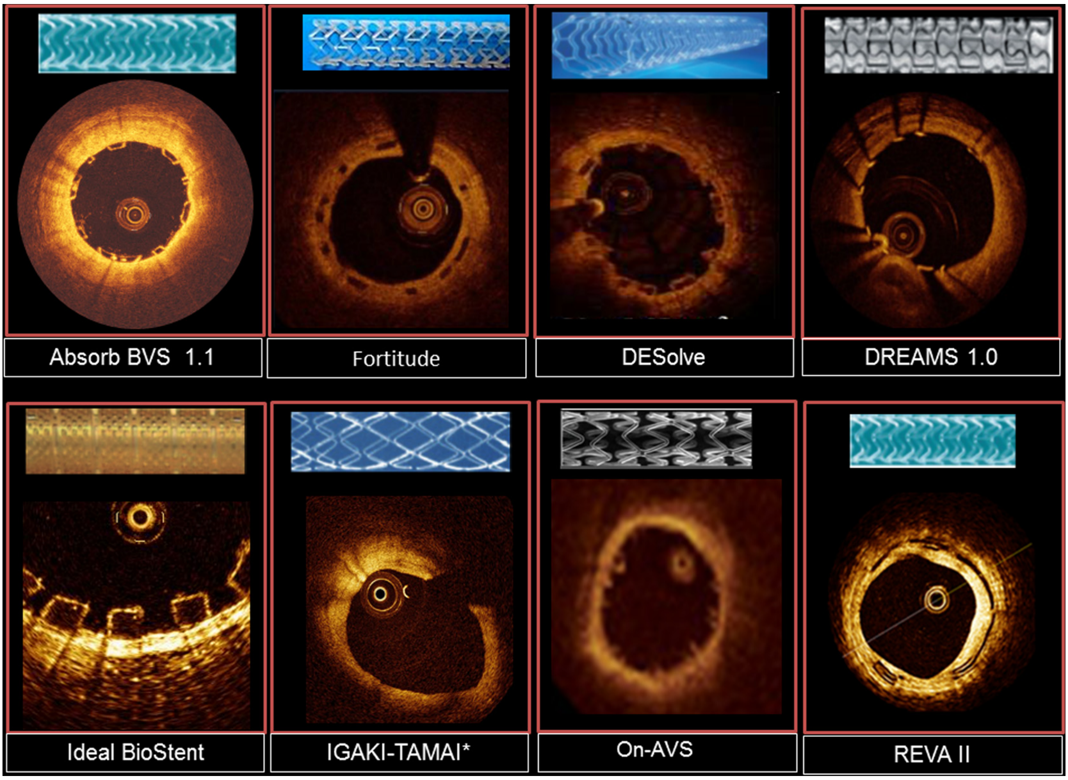

Fig. 1. Optical coherence tomography images of different bioresorbable vascular scaffolds. Absorb BVS 1.1 (Abbott Vascular, Santa Clara, CA, USA); Fortitude (Amaranth Medical, Mountain View, CA, USA); DESolve BRS (Elixir, Sunnyvale, CA, USA); DREAMS 1.0 absorbable metallic scaffold (Biotronik, Berlin, Germany); Ideal II BioStent (Xenogenics, Philadelphia, PA, USA); Igaki-Tamai scaffold (Kyoto Medical Planning Co, Kyoto, Japan); On-AVS (Orbus Neich, Wanchai, Hong Kong); REVA (REVA Medical Inc, San Diego, CA, USA). An OCT image for Igaki-Tamai was not available at baseline.

Table 1
Mechanical properties and degradation rate of different material candidates for bioresorbable coronary scaffolds

Material	Tensile Strength (MPa)	Elongation (%)	Degradation Time
Poly(L-lactide)	60–70	2–6	24 mo[a]
Poly(DL-lactide)	45–55	2–6	12–16 mo[a]
Poly(glycolide)	90–110	1–2	6–12 mo[a]
50/50 DL-lactide/glycolide	40–50	1–4	1–2 mo[a]
82/18 L-lactide/glycolide	60–70	2–6	12–18 mo[a]
70/30 L-lactide/ε-aprolactone	18–22	>100	12–24 mo[a]
Pure Fe	200	40	0.19 mm/y
Fe-35 Mn alloy	430	30	0.44 mm/y
WE43 alloy	280	2	1.35 mm/y

[a] Degradation time depends on geometry.
Data from Moravej M, Mantovani D. Biodegradable metals for cardiovascular stent application: interests and new opportunities. Int J Mol Sci 2011;12:4250–70; and van Alst M, Eenink MJ, Kruft MA, et al. ABC's of bioabsorption: application of lactide based polymers in fully resorbable cardiovascular stents. EuroIntervention 2009;5(Suppl F):F23–7.