

Atherectomy for calcified plaques: orbital for most? Pros and cons

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Introduction

Plaque modification techniques are crucial for the optimal treatment of calcified coronary lesions. Among these techniques, atherectomy plays an important role by enabling the crossing of very tight stenoses and facilitating stent implantation and optimal expansion. Currently, two atherectomy tools are available in clinical practice: rotational atherectomy (RA), which has been extensively investigated for nearly four decades; and orbital atherectomy (OA), a more recent addition to the field. Orbital atherectomy consists of a drive shaft eccentrically mounted on a diamond-coated crown, offering technical advantages over rotational atherectomy, including, but not limited to, its bidirectional ablating potential. However, the evidence supporting orbital atherectomy is still relatively limited, and no head-to-head comparisons with RA have been conducted to evaluate clinical outcomes. The question of whether OA should be the preferred option for atherectomy in most patients with calcified coronary lesions remains open and subject to ongoing debate.

Pros

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Coronary atherectomy devices are essential adjunctive tools for modifying severely calcified lesions in percutaneous coronary intervention (PCI). Originally developed decades ago to work in lieu of balloon angioplasty, these devices aim to ablate calcified plaque into fine particulate debris, thereby increasing the luminal size. Beyond creating a bigger luminal channel, these devices can also alter vessel compliance, rendering heavily calcified areas of a vessel more prone to fracture, which can ultimately lead to better stent expansion.

In the current stent era, the use of adjunctive atherectomy has evolved away from a standalone technique into a facilitating one: atherectomy of severely stenotic and calcified lesions can aid smoother delivery of balloons and drug-eluting stents. Further, because the use of atherectomy can facilitate calcium fracture, utilisation of these devices as part of an initial preparatory lesion strategy can not only increase procedural efficiency¹ but can also facilitate better stent expansion², a key arbiter of clinical outcomes.

Among the currently available tools for coronary atherectomy, OA was introduced into practice more recently than the predicate device, RA. Several design elements of coronary OA are noteworthy and represent incremental improvements over RA (**Table 1**). First, the OA system consists of a single device that is compatible with a 6 French guiding catheter even if a 6 French guide extension is used. Despite this smaller size, the 1.25 mm OA crown can create a lumen up to 1.75 mm given the orbital rotation of the device. Due to the device's rotation and tapered nose proximal to the ablative element, it is able to cross many lesions that may have been deemed "uncrossable". Second, the current version of the device utilises a nitinol-based 0.012" wire tapering to 0.008" with a flexible 0.014" tip, which allows primary wiring in many cases and facilitates repositioning if necessary. Third, the design of the OA crown allows bidirectional ablation (significantly limiting device entrapment and offering advantages in angulated segments), lower overall rotational speeds (80,000 rpm for most cases), as well as a greater flow rate of the lubricating/cooling solution (up to 20 mL/min). The latter two features are likely reasons why OA is associated with a very low rate of haemodynamic compromise or bradyarrhythmia during atherectomy runs. Finally, the off-table

Table 1. Relative advantages of OA and RA.

Orbital atherectomy advantages (0.012" wire, 2 choices)	Rotational atherectomy advantages (0.009" wire, 2 choices)
Single device for all lesions/diameters	Front cutting for uncrossable lesions/subintimal wire crossing
Full 6 Fr compatibility (including guide extension)	Vessels with severe angulation/bias
Haemodynamic stability (low rates of slow flow/bradyarrhythmia)	Specific scenarios with need for 2.0+ mm burr
Easier access to distal/multiple lesions using glide assist (5,000 rpm)	In-stent restenosis/underexpansion with stent ablation
Hardware/setup without adjunctive gas	Lower cost of single device

Fr: French; OA: orbital atherectomy; RA: rotational atherectomy

console is easy to set up and does not require the use of any adjunctive gas, and all controls for the OA device are “on the table”, including the selection of two different ablation speeds (allowing a single device to be used for various vessel sizes). The on-table controller also allows the selection of a 5,000 rpm glide-assist mode, which can be operated with the brake engaged or disengaged and facilitates non-ablative advancement/removal of the OA device or wire repositioning with reduced frictional forces.

While a discussion of the clinical data for OA is beyond the scope of this piece, there is a growing body of evidence supporting its use. There are several real-world observational series including lesion subsets that were thought to be relatively contraindicated for OA (e.g., ostial lesions)³ as

Cons

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Since the dawn of PCI, the presence of abundant calcium in plaques emerged as an unfavourable characteristic that limited the feasibility and safety of angioplasty. Such limitation primed pioneers to develop one of the most ingenious and futuristic devices ever conceived and developed in cardiology: the good old RA device, known worldwide as Rotablator (Boston Scientific).

Based on the drilling concept largely applied in industrial work, the air-powered burr penetrates the calcified wall of an atherosclerotic plaque whilst rotating at a very high speed (>150,000 rpm). The burr’s design will lead it to become the only device able to drill a channel in “stony” (or calcified) vascular plaque. Since the early 1980s, when it was used in patients for the first time, Rotablator has been present in the market and available in all high-volume laboratories worldwide, even before the availability of coronary stents.

In almost 40 years, the device has undergone technological improvements, but essentially, it has remained the same as when it was conceived. The reader will agree with the author that there are very few devices indeed that have survived the

well as the recent completion of a 2,000-patient randomised trial comparing OA with conventional balloon angioplasty⁴. These data support the use of OA for most cases of severe calcium that require coronary atherectomy, which in fact represents my own individual practice, despite my having been “brought up” and trained on RA. The OA system is ideally suited for transradial operators and – assuming that atherectomy is indicated and safe to perform – is a very effective treatment provided meticulous technique is employed. No device is perfect, however, and a complete coronary operator requires expertise in RA as well, which is still needed for truly uncrossable lesions (especially with a subintimal wire position), extremely tortuous vessels, and for cases of stent ablation. Nonetheless, the introduction of OA has represented a distinct technological advance, which is always welcome in the ever-evolving field of modern-day PCI.

Conflict of interest statement

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race of evolution and development, unmutated for almost 40 years. This simple reasoning is the strongest element in favour of the unarguable importance of RA and what makes this device, still today, simply irreplaceable and indisputable for the treatment of calcified lesions.

With the advent of OA, interventionalists have a new “drill” in their armamentarium against calcified vessels. The device has several interesting characteristics that offer theoretical advantages, derived from its most recent design and advanced technology. Among these are a unique crown drill that can be used in a large range of vessel diameters, a combined rotational and translational movement that exerts different ablation mechanisms on the plaque and artery wall, and the possibility of ablating the plaque in a back and forth motion.

Nevertheless, despite all these attractive characteristics, OA has gained only relative acceptance compared to its rotational ancestor. The reasons for the slow adoption of OA and the undisputed supremacy of RA may have several explanations:

- A head-to-head comparison of the clinical outcomes of the two atherectomy devices has never been conducted, and the potential advantages of OA over RA remain only hypotheses. On the contrary, a recently published randomised head-to-head study revealed that RA yields

significantly better tissue modification, a larger lumen area and better stent expansion compared to OA⁵.

- In 40 years of clinical application, the accumulated scientific evidence and the extensive clinical use in daily practice worldwide (the manufacturer declared that more than 1,000,000 cases had been performed after 30 years of commercialisation) have revealed practically all the potentials and limitations of RA, while OA still has open questions that require answers derived from more extensive use.
- The data on the feasibility, safety and efficacy of OA are promising⁶; however, this is not indicative of a superiority over RA, as no advantage has been demonstrated.
- Despite the lack of adequate evidence-based studies, the latest consensus of European experts dedicated to the treatment of severely calcified lesions still recognises the unique role of RA when facing uncrossable and undilatable lesions, one of the most challenging scenarios of PCI that, so far, remains the domain of RA⁷.

The lack of evidence-based support in the specific field of calcified lesions precludes the possibility of providing net recommendations, such as “class I, supported by level of evidence A” for any calcium-specific device, and whether an operator decides to use RA or OA remains an individual choice. However, lots of progress has been achieved with the aid of intravascular ultrasounds or optical coherence tomography as well as the availability of newer technologies that are emerging for the treatment of calcified lesions, such as lithotripsy and dedicated balloons. Indeed, such new devices have significantly improved the results of PCI in calcified lesions and have strongly revitalised the interest of our community in this important topic. Nevertheless, at present, it is unarguable that RA is the most widely tested device in calcified lesions worldwide, and for this simple reason, RA remains the rotational device of choice for most patients with calcified lesions.

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