

CORONARY, PERIPHERAL, AND STRUCTURAL INTERVENTIONS

CLINICAL CASE

Right Coronary Artery Calcified Nodule Pre-TAVI Treatment Facilitated by ELCA Atherectomy



Marco Lombardi, MD,^{a,b} Luca Paolucci, MD,^a Antonio Fernández Ortiz, MD, PhD,^a Iván J. Núñez-Gil, MD, PhD^{a,c,d}

ABSTRACT

BACKGROUND Managing calcified nodules remains a clinical challenge.

CASE SUMMARY A 77-year-old man underwent coronary angiography during pre-transcatheter aortic valve implantation workout, showing a severe middle right coronary artery stenosis associated with a suspicious angiographic calcified nodule. Excimer laser was used for plaque preparation and for facilitating subsequent optical coherence tomography intracoronary imaging-guided percutaneous coronary intervention (PCI). Excimer laser coronary angioplasty was successfully performed, with a good final PCI result.

DISCUSSION This case illustrates the practical application of a niche device (eg, excimer laser coronary angioplasty) as a useful tool to tackle calcified nodules and to allow a state-of-the-art PCI. (JACC Case Rep. 2025;30:103029) © 2025 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Calcified atherosclerosis poses a clinical challenge for interventional cardiologists embarking in a percutaneous coronary intervention (PCI), particularly due to stent underexpansion, a strong predictor of stent failure.¹

Calcified nodules (CNs) represent an advanced stage of coronary calcification and are recognized as a hallmark of plaque vulnerability.²

The following case report describes the use of excimer laser coronary angioplasty (ELCA) in a patient with a CN associated with severe angiographic stenosis, guided by intracoronary imaging with optical coherence tomography (OCT).

TAKE-HOME MESSAGE

- Excimer laser coronary angioplasty is effective in calcified nodules and represents a safe and useful alternative to other debulking devices for plaque preparation before stent implantation.

PAST MEDICAL HISTORY

A 77-year-old man with severe aortic stenosis, dyslipidemia, history of smoking, and colorectal cancer in remission underwent coronary angiography as part of pre-transcatheter aortic valve implantation workout.

From the ^aInterventional Cardiology Unit, Hospital Clínico San Carlos IDISSC, Complutense University of Madrid, Madrid, Spain; ^bDepartment of Internal Medicine, University of Genova, Genova, Italy; ^cCardiology Department, Hospital Universitario de Torrejón, Madrid, Spain; and the ^dFaculty of Biomedical and Health Sciences, Universidad Europea de Madrid, Villaviciosa de Odón, Madrid, Spain.

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**ABBREVIATIONS
AND ACRONYMS****CN** = calcified nodule**ELCA** = excimer laser coronary angioplasty**OCT** = optical coherence tomography**PCI** = percutaneous coronary intervention**RCA** = right coronary artery

The patient's main clinical complaint was mild exertional dyspnea (NYHA functional class III).

INVESTIGATIONS

The diagnostic coronary angiography revealed extensive calcification of the right coronary artery (RCA) with severe stenosis in the middle segment, along with an angiographic suspicion of CN. Additionally, a focal and eccentric 70% stenosis was observed in the middle-distal segment (**Figure 1A**, **Videos 1 and 2**). The left coronary tree presented mild and diffuse calcifications without significant epicardial stenoses.

MANAGEMENT

After heart team discussion, we decided to perform PCI of the RCA before transcatheter aortic valve implantation procedure to reduce the periprocedural risk of aortic valve intervention.

The RCA was engaged with a 7-F Amplatz Left 1 guide catheter (Cordis), which provided strong backup support and good coaxial alignment. The lesion was crossed with an extrasupport guidewire which was positioned distally at the level of the posterolateral branch.

ELCA was then performed with the intent of disrupting the plaque and facilitating subsequent intracoronary imaging assessment with OCT and PCI optimization.

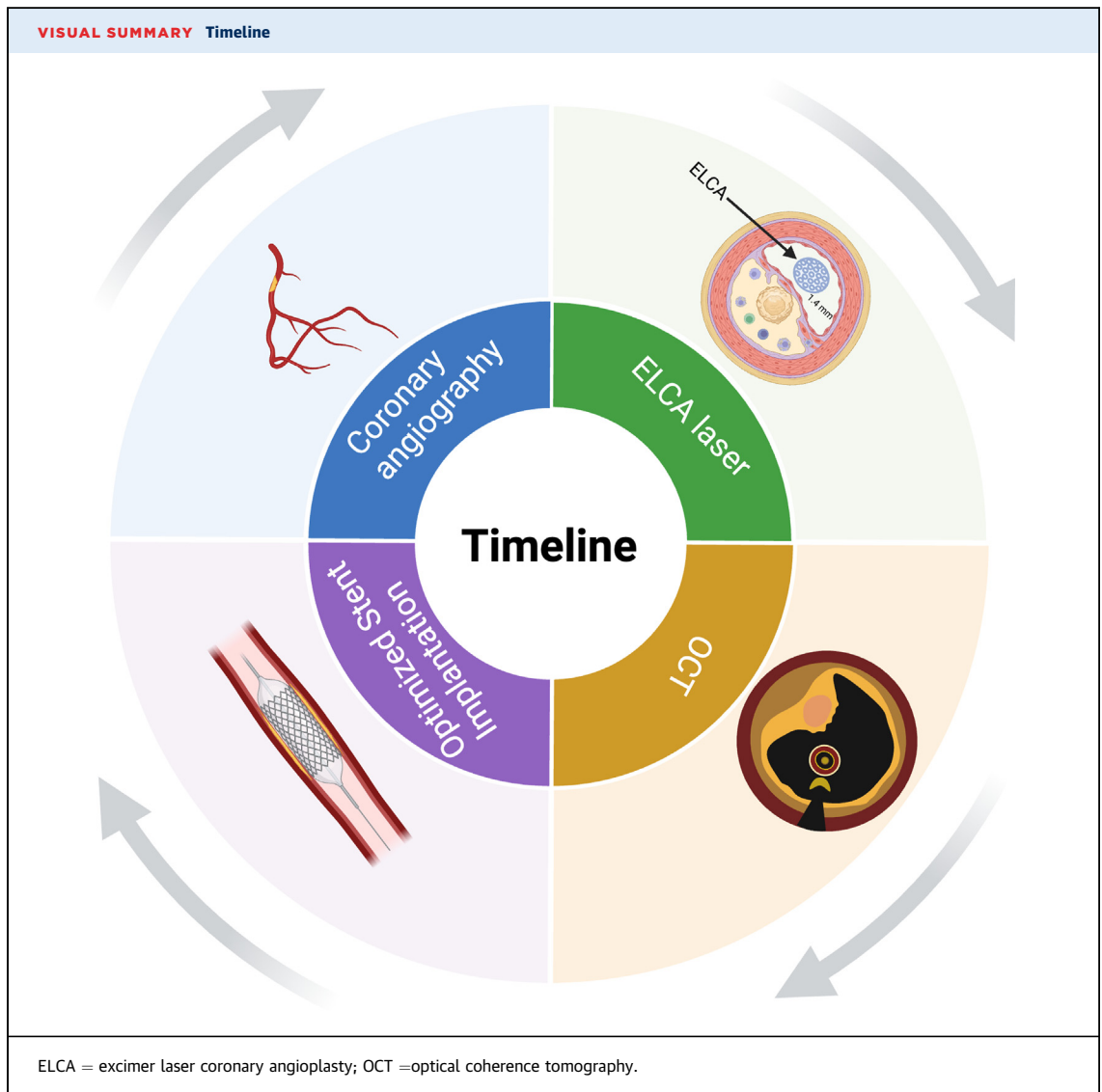
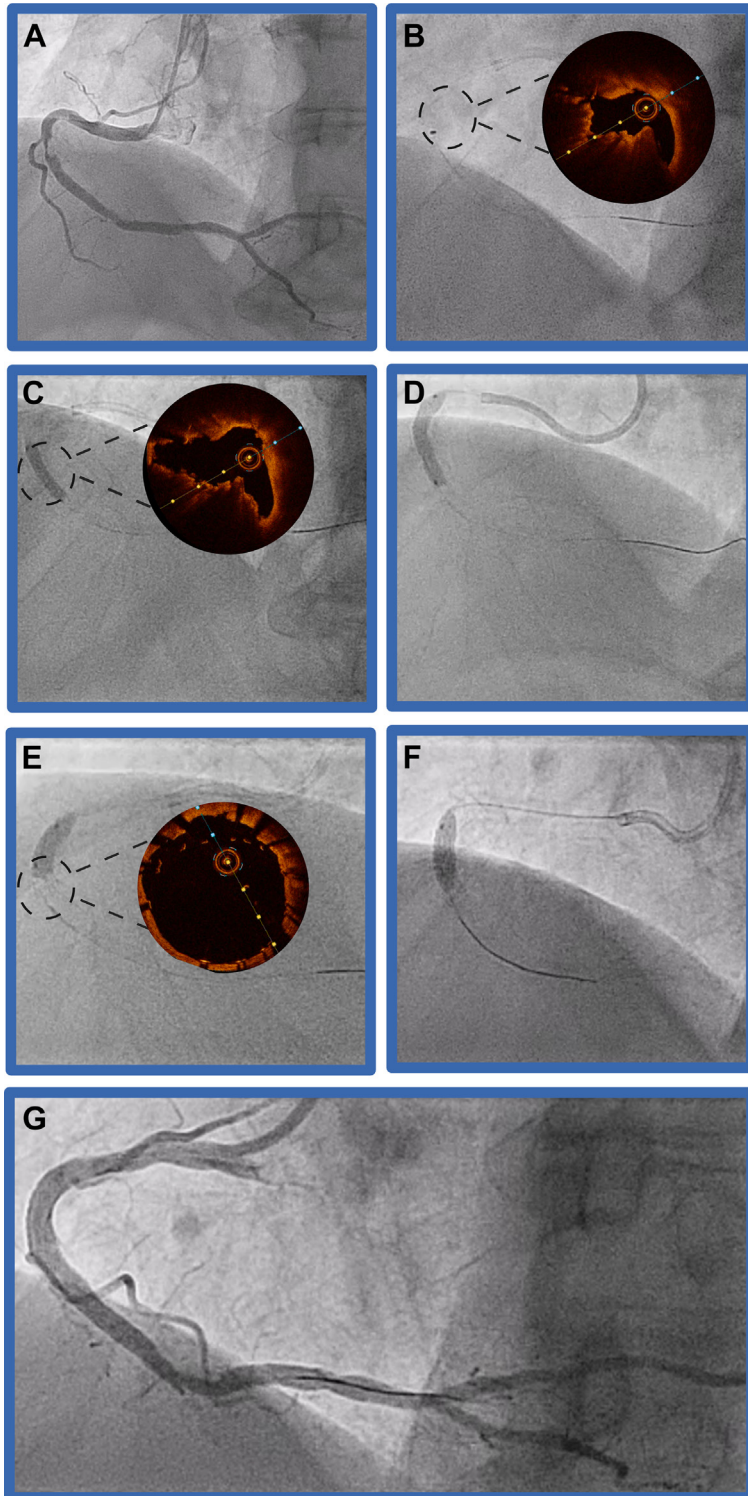
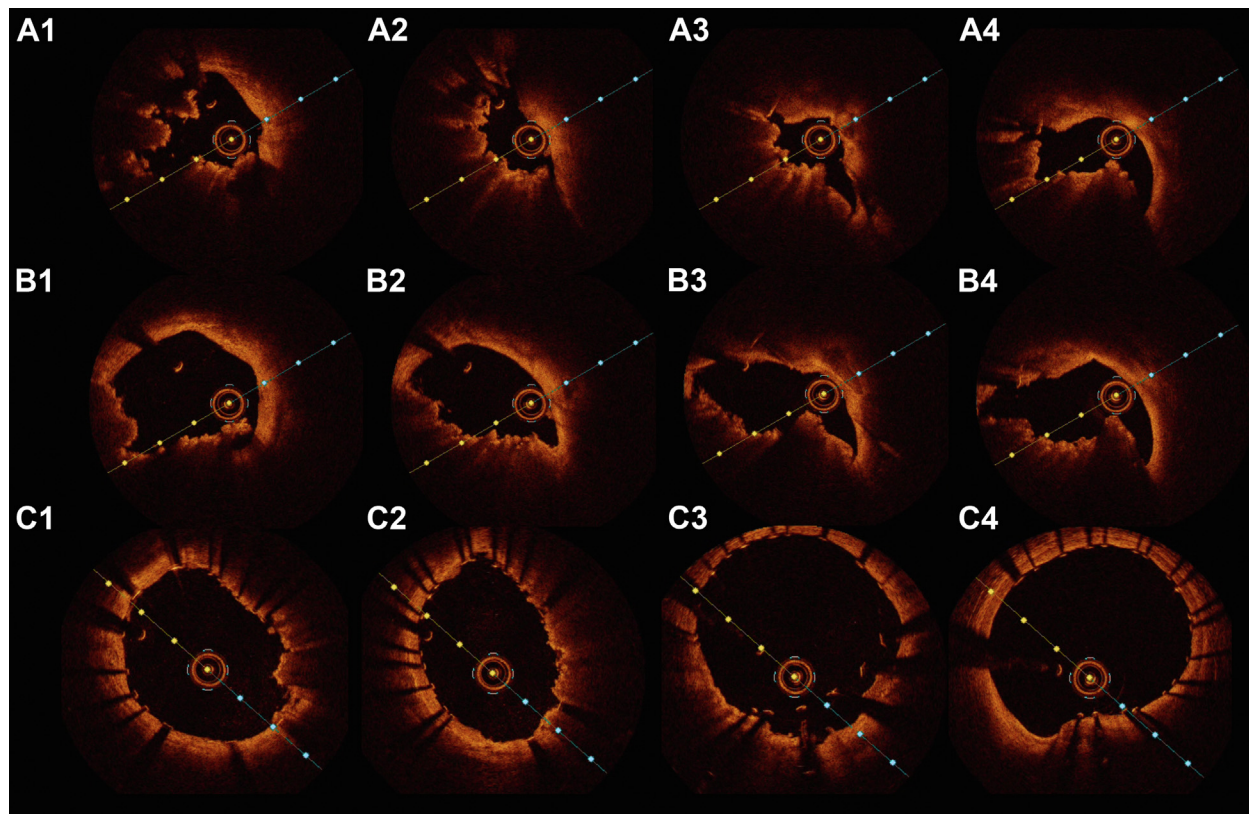


FIGURE 1 Right Coronary Artery Calcified Nodule treatment With ELCA Atherectomy



(A) Diagnostic coronary angiography showing a suspicious calcified nodule. (B) Excimer laser coronary angioplasty (ELCA) laser use and optical coherence tomography (OCT) post-ELCA showing the presence of a calcified nodule with some post-ELCA fractures. (C) Predilatation with noncompliant balloons guided by the sizing of the previous OCT and subsequent OCT showing an increased lumen area. (D) Stent implantation. (E) Proximal optimization and OCT post-percutaneous coronary intervention showing the presence of minor malapposition at the level of the non-post-dilatated zone. (F) Optimization according to the previous OCT. (G) Final angiographic result.

FIGURE 2 OCT Findings

(A1 to A4) OCT eruptive nodular calcification with underlying fibrocalcific plaque without overlying thrombus post-ELCA laser with the presence of some fractures along the pullback. (B1 to B4) OCT characteristics post-predilatations with noncompliant balloons 3.0 and 3.5 mm. (C1 to C4) OCT characteristics poststent implantation; C3 highlights the presence of a minor malapposition. Abbreviations as in [Figure 1](#).

The decision to perform ELCA was based on several reasons: ease of use, wire compatibility, operator experience, a higher probability of successfully crossing the lesion (compared with intravascular lithotripsy), and a lower risk of hemodynamic instability due to no-reflow (which is more common with orbital and rotational atherectomy), particularly in the context of aortic stenosis.

Using a 1.4-mm ELCA catheter, a total of 8 applications were made (4 applications with 45 mJ·mm², 40 Hz, and an additional 4 applications with 60 mJ·mm², 40 Hz) ([Figure 1B](#), [Video 3](#)).

Subsequent OCT revealed the presence of a calcified eccentric lesion (~180°) with a superficial distribution of calcium and severe back shadowing, compatible with an eruptive CN without thrombus. Minimal lumen area was 1.85 mm², and proximal and distal landing zones were 4.5 and 3.8 mm, respectively ([Figures 2A1 to 2A4](#), [Video 4](#)).

Based on the OCT findings, consecutive predilatations with 2 noncompliant 3.0- and 3.5-mm balloons achieved a good angiographic result without any notching ([Figure 1C](#), [Videos 5 and 6](#)). OCT showed a fracture of the calcium nodule and an improvement in minimal lumen area, confirming the landing diameters previously evaluated, associated with a stent length of 20 mm ([Figures 2B1 to 2B4](#), [Video 7](#)).

Subsequently, a drug-eluting stent of 4.0 × 20 mm was implanted, with proximal optimization using a semicompliant balloon and a noncompliant balloon 4.5 mm ([Figure 1D](#), [Videos 8 and 9](#)).

The post-PCI OCT showed an optimal result of the implanted stent according to the minimum stent area, with a proximal edge dissection limited to the intimal layer, <2 mm and spanning <60°, which was left untreated ([Video 10](#)). Additionally, there was a minor area of malapposition (<100 μm) at the mid-distal level with

TABLE 1 Pros and Cons of Plaque Modification Technique Devices, With a Particular Focus in the Context of Aortic Stenosis

Plaque Modification Technique	Mechanism of Action	Pros	Cons
Excimer laser coronary angioplasty laser	Emits ultraviolet light pulses to vaporize plaque, calcium, and thrombus via photochemical, photothermal, and photomechanical ablation.	<ul style="list-style-type: none"> • Ease-to-use • Compatible with conventional 0.014 guidewires/allows to keep a wire in the side branch • Possibly useful in uncrossable/undilatable lesions • Lower risk of embolization and no-reflow 	<ul style="list-style-type: none"> • Setup time • Ultraviolet protection • Possible thermal injury
Intravascular lithotripsy	Emits acoustic waves which cause compressive and decompressive forces when calcium is found resulting in fractures.	<ul style="list-style-type: none"> • Ease-to-use • Compatible with conventional 0.014 guidewires/allow to keep a wire in the side branch • Effective at cracking both superficial and deep calcium 	<ul style="list-style-type: none"> • Difficult delivery for its bulky profile
Rotational atherectomy	Uses a high-speed rotating burr (diamond-coated) to ablate calcified plaque into microparticles (<10 μm).	<ul style="list-style-type: none"> • Useful in uncrossable/undilatable lesions • More effective in CNs 	<ul style="list-style-type: none"> • Specific wire • Risk of no-reflow leading to hemodynamic instability (risk for AS) • Risk of wire bias/burr entrapment/wire fracture • Risk of atrioventricular block
Orbital atherectomy	Uses a rotating, diamond-coated crown that orbits at high speed resulting in calcium sanding.	<ul style="list-style-type: none"> • Possibly useful in uncrossable/undilatable lesions • More effective in CNs • Ablation in both forward and backward motion • Smaller particles in comparison with rotational atherectomy 	<ul style="list-style-type: none"> • Specific wire • Risk of no-reflow leading to hemodynamic instability (risk for AS) • Crown entrapment

AS = aortic stenosis; CN = calcified nodule.

an oval lumen shape, which was the area that was not previously optimized with the 4.5-mm balloon (Figures 1E and 2C1 to 2C4, Video 10). Consequently, according to the MLD-MAX algorithm, an additional stent optimization was performed with a non-compliant 4.0- × 8-mm balloon (Figure 1F, Video 11), achieving a good final result (Figure 1G, Video 12).

DISCUSSION

This clinical case highlights the potential challenges in treating CNs, a frequent finding as revealed by the PROSPECT (A Prospective Natural-History Study of Coronary Atherosclerosis) study, which showed that at least 1 nonculprit CN was present in 30% of patients included.³ The presence of CNs has also been related to a high incidence of cardiovascular events at 1-year follow-up, especially when disruption of the superficial intimal fibrous layer was present.² Specifically, eruptive CNs have been associated with a significant increase of target lesion revascularization at 6 months post-PCI compared with noneruptive CNs.⁴

The use of conventional noncompliant balloons, which may seem like a straightforward first-line strategy, is often ineffective in achieving a correct pre-stent implantation result. Conversely, the contemporary use of debulking devices (eg, rotational or orbital atherectomy) in calcified coronary lesions

has shown that the presence of CNs is the factor most associated with a higher rate of clinically driven target lesion revascularization.⁵ Table 1 summarizes the mechanism of action, and pros and cons of various calcium modification devices, particularly in the context of aortic stenosis.

Over the last decade, laser coronary angioplasty, particularly ELCA, has seen a resurgence in specific complex scenarios (eg, in-stent restenosis, debulking thrombotic occlusions of saphenous vein grafts) due to the high risk of distal embolization and no-reflow.⁶

However, the use of ELCA in calcified coronary artery disease is limited and its effectiveness is debated. Some ELCA series have reported a direct correlation between severe calcification and ELCA failure⁷; however, a recent retrospective study showed that in severe calcific lesions, ELCA had a technical success rate of 91.25%.⁸

The use of ELCA in CNs is not well documented, with only a few cases demonstrating its feasibility and efficacy.^{9,10}

Herein, we demonstrate the feasibility and clinical utility of ELCA in tackling CN lesions.

Indeed, ELCA uses a mixture of rare gas and halogen to generate brief pulses of high-frequency ultraviolet light, which disrupts atherosclerotic plaque through 3 mechanisms: photochemical, photothermal, and photomechanical. Fluence (energy

measured in $\text{mJ}\cdot\text{mm}^2$) and pulse frequency can be adjusted to enhance its effectiveness. Thus, for fibrotic lesions higher fluence is recommended, whereas for calcium more pulse frequency is warranted. Continuous saline infusion is mandatory to prevent thermal injury during laser application. The short wavelength ($\sim 308\text{ nm}$) of ultraviolet light used reduces the depth of penetration, thus minimizing damage to healthy tissues. It is also noteworthy that ELCA can be performed over any type of guidewire, a crucial factor and its main advantage over other strategies.¹

CONCLUSIONS

This case report illustrates the practical use of contemporary ELCA as a debulking device. It has been

proven to be an easy-to-use and safe tool, facilitating the utilization of OCT intracoronary imaging which has been pivotal in diagnosing CNs and guiding a state-of-the-art PCI procedure, thereby enhancing both the safety and effectiveness of PCI.

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ADDRESS FOR CORRESPONDENCE: Dr Iván J. Núñez-Gil, Interventional Cardiology, University Hospital of Torrejón, Calle Mateo Inurria, 28850 Madrid, Spain. E-mail: ibnsky@yahoo.es.

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KEY WORDS calcified nodule, coronary artery disease, ELCA, laser therapy, OCT

APPENDIX For supplemental videos, please see the online version of this paper.