The patient did fine after the surgery, was successfully extubated, and eventually discharged from the hospital. Prior to being discharge, an echocardiogram confirmed the presence of preserved systolic function (left ventricular ejection fraction of 55%) with mild hypokinesis of the anterior septum and proper positioning and functioning of the valved conduit.

In conclusion, this patient was initially treated of an anterior ST-segment elevation acute coronary syndrome (KK-IV). During coronary angiography, however, he was diagnosed with a type A aortic dissection that led to coronary malperfusion due to the protrusion of the dissection flap into the left main coronary artery. An urgent decision was made for drug-eluting stent implantation into the LMCA, which improved perfusion to the left coronary tree and provided enough hemodynamic stabilization to proceed with cardiac surgery.

In a series by Uchida et al.[1] of 25 patients with type A aortic dissection and signs and symptoms of coronary malperfusion, 11 underwent preoperative coronary angiography while 9 went to surgery right away. In those treated with coronary angiography, if coronary flow was compromised following dissection, a drug-eluting stent was implanted. If ventricular function improved, emergency surgery was performed. Otherwise, veno-arterial extracorporeal membrane oxygenation cannulation was used after surgery. Patients who underwent coronary angiography had a better prognosis.

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None whatsoever.

AUTHORS' CONTRIBUTIONS

C. Morante Perea, T. Cantón Rubio, and J.A. Buendía Miñano were all involved in the patient healthcare process, bibliographic search, and manuscript drafting. L.M. Hernando Romero, J. Moreu Burgos, and L. Rodríguez Padial participated in the rewiew process and final approval of the manuscript.

CONFLICTS OF INTEREST

None reported.

SUPPLEMENTARY DATA

Supplementary data associated with this article can be found in the online version available at https://doi.org/10.24875/RECIC.M23000392.

REFERENCES

1. Uchida K, Karube N, Minami T, et al. Treatment of coronary malperfusion in type A acute aortic dissection. *Gen Thorac Cardiovas Surg.* 2018;66:621-625.
2. Czerny M, Schoenhoff F, Etz C, et al. The impact of pre-operative malperfusion on outcome in acute type A aortic dissection. Results from the GERAADA registry. *J Am Coll Cardiol.* 2015;65:2628-2635.

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Co-registration assisted 3-vessel orbital atherectomy in de novo calcified multivessel coronary artery disease

Aterectomía orbital a 3 vasos guiada por corregistro en enfermedad coronaria multivaso calcificada

Asad Shabbir, David Chipayo, Adrián Jerónimo, Alejandro Travieso, Nieves Gonzalo, and Javier Escaned*

Unidad de Cardiología Intervencionista, Hospital Clínico San Carlos IDISSC, Universidad Complutense de Madrid, Madrid, Spain

To the Editor,

Treatment of heavily calcified coronary artery disease (CAD) remains a technical challenge since a significant number of patients require some type or form of advanced plaque modification procedure in the cath lab. Therefore, interventional cardiologists should be aware of the complete array of plaque modification techniques available to prepare vessels to facilitate optimal stent deployment and expansion.[1] In the presence of proximal calcified disease in tortuous vessels, orbital atherectomy can be used as an alternative to rotational atherectomy thanks to its greater stability with reverse ablation, improved ease of use, and convenience as a result of a single-size burr that can be used to treat a wide range of vessel profiles. In addition, it appears to have a similar safety profile compared to rotational atherectomy.[2] We herein describe a case of 3-vessel proximal heavily calcified CAD where we demonstrate the feasibility of using orbital atherectomy to prepare all 3 epicardial vessels using a one-size burr guided by co-registered intravascular ultrasound (IVUS) and physiology prior to complete percutaneous revascularization in a single-staged procedure.

This is the case of a 73-year-old man with hypertension, type II diabetes mellitus, severe chronic obstructive pulmonary disease (forced expiratory volume in 1 second [FEV_1] of 29%), and atrial

* **Corresponding author.**
E-mail address: escaned@secardiologia.es (J. Escaned).
@AsadKShabbir @JEscaned

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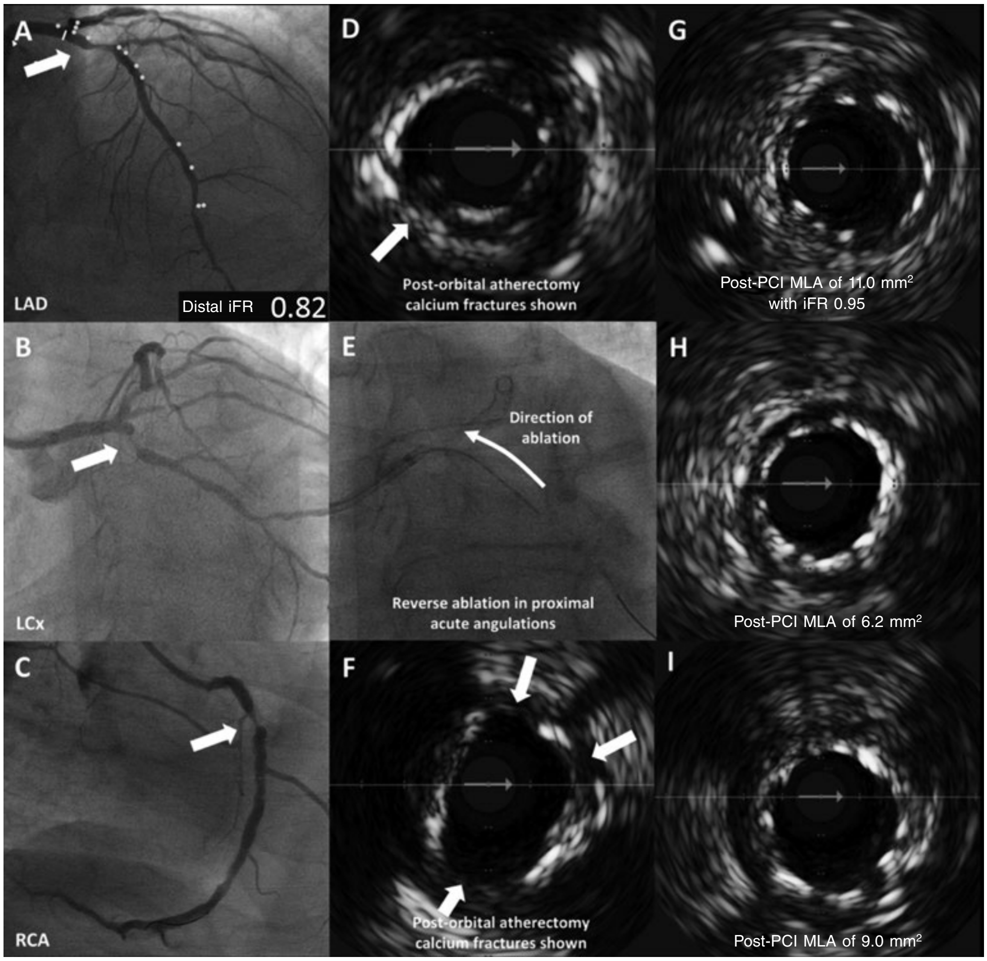

Figure 1. Baseline angiography with IVUS-guided orbital atherectomy showing the mechanisms of calcium modification with stent deployment and strut apposition. **A:** lesion in proximal LAD with iFR of 0.82. **B:** lesion in proximal LCx. **C:** lesion in proximal RCA. **D:** post-orbital IVUS-guided atherectomy with presence of calcium fractures (asterisks). **E:** reverse orbital atherectomy shown. **F:** post-orbital IVUS-guided atherectomy with presence of calcium fractures (asterisks). **G:** stent apposition in LAD with post-PCI MLA of 11.0 mm^2 and iFR of 0.95. **H:** stent apposition in LCx with MLA of 6.2 mm^2. **I:** stent apposition in RCA with MLA of 9.0 mm^2. iFR, instantaneous wave-free ratio; IVUS, intravascular ultrasound; LAD, left anterior descending coronary artery; LCx, left circumflex artery; MLA, minimum lumen area; PCI, percutaneous coronary intervention; RCA, right coronary artery.

fibrillation that presented with exertional chest tightness. Clinical examination was unremarkable, and the clinical hematology and biochemistry were normal except for an N-terminal pro-B-type natriuretic peptide of 1365 pg/mL (normal reference range, < 125 pg/mL) and troponin I levels of 351 ng/L [normal reference range, 3-58 ng/L]. The electrocardiogram confirmed the presence of atrial fibrillation. The transthoracic echocardiography identified an impaired left ventricular systolic function with an ejection fraction of 43% with inferior hypokinesia. After giving his informed consent, the patient underwent invasive coronary angiography that revealed the presence of heavily calcified proximal 3-vessel CAD with diffuse atheroma (left anterior descending coronary artery [LAD] figure 1A; left circumflex artery [LCx] figure 1B; right coronary artery [RCA] figure 1C; diseased segments are highlighted with arrows). Disease distribution was anatomically complex (SYNTAX score, 30) and considering the patient's clinical status, the SYNTAX score II predicted a 4-year mortality rate associated with percutaneous coronary intervention (PCI) or coronary artery bypass graft of 8.3% and 17.7%, respectively. The patient eventually underwent a PCI as advised by the heart team.

Via right radial artery, the pre-PCI instantaneous wave-free ratio (iFR) of the least angiographically severe lesion in the LAD was positive at 0.82. Longitudinal vessel analysis was performed using IVUS with co-registration to better characterize the extent of the calcified disease in the LAD and the RCA. The LCx stenosis was uncrossable with the IVUS catheter before calcium modification. Therefore, intracoronary imaging prior to the procedure was not performed in this vessel. Given that > 270° of heavy calcification was present in the target vessel landing zones in both the LAD and the RCA, upfront orbital atherectomy was performed in all 3 arteries using a 1.25 mm burr (Diamondback 360, CSI, United States). The use of orbital atherectomy produced significant calcium debulking and fractures (LAD, figure 1D; RCA, figure 1F; calcium fractures are shown with arrows). After additional treatment with non-compliant balloons, sirolimus-eluting stents were deployed both to the LAD and the LCx (3.5 mm × 35 mm and 3.0 mm × 15 mm, respectively; Osiro, Biotronik, Germany) and an everolimus-eluting stent was deployed to the RCA (3.5 mm × 33 mm; XIENCE, Abbott, United States). The post-PCI IVUS of all 3 vessels confirmed complete strut apposition, and good minimum stent areas and lesion coverage. In addition to the post-PCI physiology of the LAD that confirmed good functional outcomes with an iFR of 0.95 (LAD, figure 1G; LCx, figure 1H; RCA, figure 1I) the final angiographic outcomes of the 3 target vessels are shown on figure 2 (LAD, figure 2A; LCx, figure 2B; RCA, figure 2C). A summary of the devices used to perform the procedure is shown on table 1.

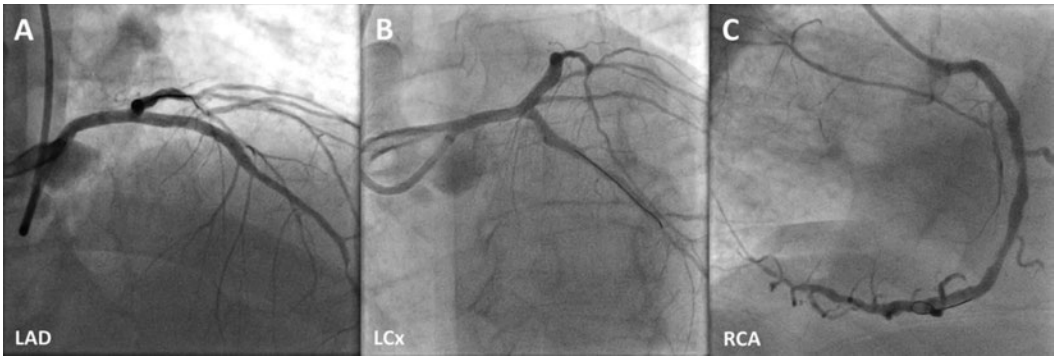

Figure 2. Final angiographic outcomes of LAD (A), LCx (B), and RCA (C) are shown. LAD, left anterior descending coronary artery; LCx left circumflex artery; RCA, right coronary artery.

Table 1. Devices used to perform PCIs

Vessel	Device
LAD	3.5 mm 7-Fr EBU guide catheter
	ViperWire coronary wire (Cardiovascular Systems Inc., United States)
	Sion Blue coronary wire (ASAHI Intecc Inc., Japan)
	OmniWire physiology and coronary guidewire (Philips, the Netherlands)
	FineCross microcatheter (Terumo Corporation, Japan)
	Diamondback 360 coronary orbital atherectomy system with 1.25 mm burr (Cardiovascular Systems Inc., United States of America)
	Eagle Eye IVUS catheter (Philips, the Netherlands)
	2.5 mm x 15 mm Trek balloon (Abbott, United States)
	NC Xperience 3.5 mm x 10 mm balloon (iVascular, Spain)
	3.5 mm x 35 mm Orsiro drug-eluting stent (Biotronik, Germany)
LCx	ViperWire coronary wire (Cardiovascular Systems Inc., United States)
	Sion Blue coronary wire (ASAHI Intecc Inc., Japan)
	Diamondback 360 coronary orbital atherectomy system with 1.25 mm burr (Cardiovascular Systems Inc., United States)
	Eagle Eye IVUS catheter (Philips, the Netherlands)
	2.5 mm x 15mm Trek balloon (Abbott, United States)
	3.0 mm x 15 mm NC Xperience balloon (iVascular, Spain)
	3.0 mm x 15 mm Orsiro drug-eluting stent (Biotronik, Germany)
RCA	ViperWire coronary wire (Cardiovascular Systems Inc., United States)
	Sion Blue coronary wire (ASAHI Intecc Inc., Japan)
	Diamondback 360 coronary orbital atherectomy system with 1.25mm burr (Cardiovascular Systems Inc., United States)
	Eagle Eye IVUS catheter (Philips, the Netherlands)
	3.0 mm x 12 mm Trek balloon (Abbott, United States)
	3.5 mm x 10 mm NC Xperience balloon (iVascular, Spain)
	3.5 mm x 33 mm XIENCE Skypoint drug-eluting stent (Abbott, United States)

EBU, extra-back up; IVUS, intravascular ultrasound; LAD, left anterior descending coronary artery; LCx, left circumflex artery; NC, non-compliant; PCI, percutaneous coronary intervention; RCA, right coronary artery.

This case is an example of the feasibility of plaque modification with orbital atherectomy to multiple vessels in a patient with calcified CAD through intravascular imaging and physiology guidance, calcified plaque preparation with orbital atherectomy, and post-PCI assessments. These technologies are key to guarantee durable results and, collectively, add prognostic value.[3] Atherectomy in all 3 coronary vessels was justified given the extent of calcification. In addition, the use of orbital atherectomy (rather than rotational atherectomy) was carefully considered due to its unique features, specifically, reverse ablation (figure 1E) and variable debulking diameter thereby allowing the management of vessels of different diameters with the use of a one-size burr.[4,5] In selected cases, these features of orbital atherectomy can be particularly useful in ostial and/or angulated vessels particularly in the LCx as in this case where tortuosity may prevent adequate plaque modification of heavily calcified lesions, be subject to burr bias or limited by solely antegrade ablation, thus impacting guide catheter support and the overall procedural success.

Herein we highlighted the feasibility of performing co-registration assisted 3-vessel orbital atherectomy in heavily calcified proximal lesions, and demonstrated the performance of this technique in the management of complex disease with effective calcium ablation and fracture.

Informed and written consent from the patient were deemed necessary for publication purposes.

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AUTHORS' CONTRIBUTIONS

A. Shabbir, and D. Chipayo both drafted the manuscript and prepared the images. A. Jerónimo conducted a critical review of the manuscript intellectual content and contributed substantially to it. A. Travieso also conducted a critical review of the manuscript intellectual content and contributed substantially to it. N. Gonzalo, and J. Escaned conceptualized the manuscript and conducted its critical review. All co-authors gave their final approval to the version that would eventually be published, and all take full responsibility for all aspects of the manuscript.

CONFLICTS OF INTEREST

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REFERENCES

1. Riley RF, Henry TD, Mahmud E, et al. SCAI position statement on optimal percutaneous coronary interventional therapy for complex coronary artery disease. *Catheter Cardiovasc Interv.* 2020;96:346-362.
2. Khan AA, Murtaza G, Khalid MF, et al. Outcomes of rotational atherectomy versus orbital atherectomy for the treatment of heavily calcified coronary stenosis: A systematic review and meta-analysis. *Catheter Cardiovasc Interv.* 2021;98:884-892.
3. Escaned J, Collet C, Ryan N, et al. Clinical outcomes of state-of-the-art percutaneous coronary revascularization in patients with de novo three vessel disease: 1-year results of the SYNTAX II study. *Eur Heart J.* 2017; 38:3124-3134.
4. Chambers JW, Feldman RL, Himmelstein SI, et al. Pivotal trial to evaluate the safety and efficacy of the orbital atherectomy system in treating de novo, severely calcified coronary lesions (ORBIT II). *JACC Cardiovasc Interv.* 2014;7:510-518.
5. Lee M, Genereux P, Shlofmitz R, et al. Orbital atherectomy for treating de novo, severely calcified coronary lesions: 3-year results of the pivotal ORBIT II trial. *Cardiovasc Revasc Med.* 2017;18:261-264.