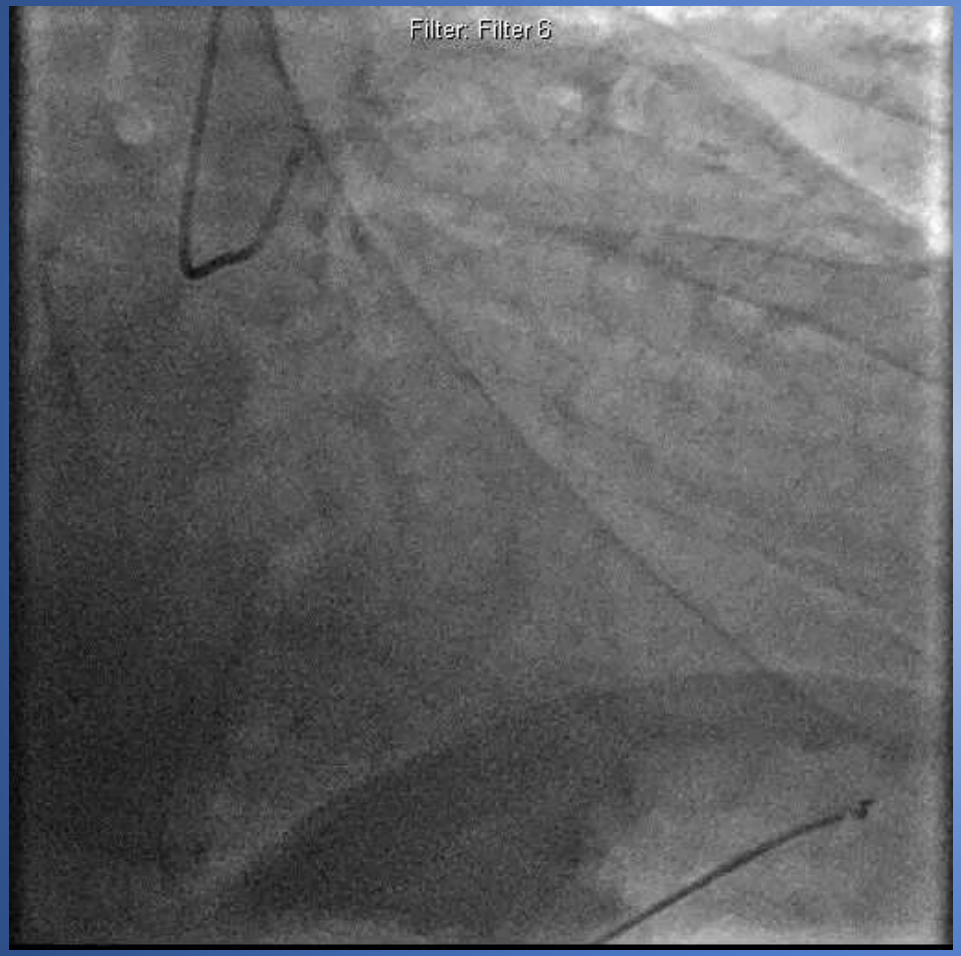
Weapons for Crushing the Rock: Atherectomy Devices

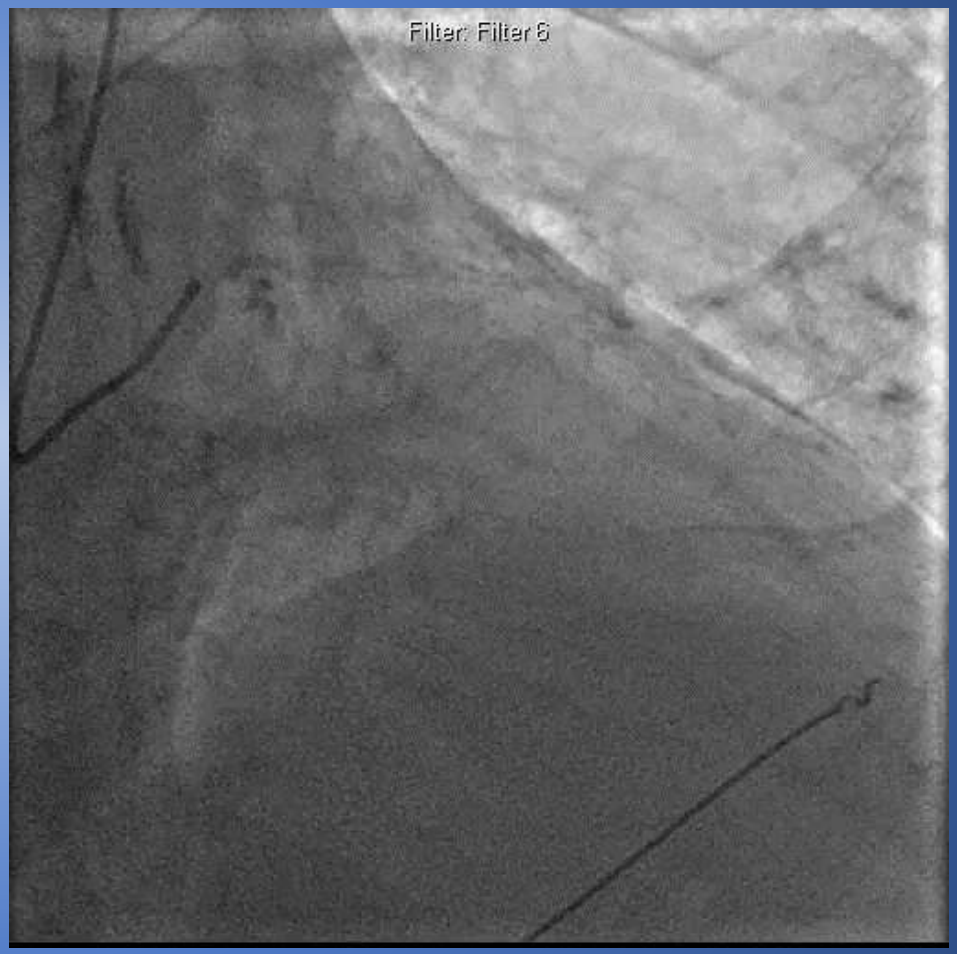
David Geffen School of Medicine

UCLA Health

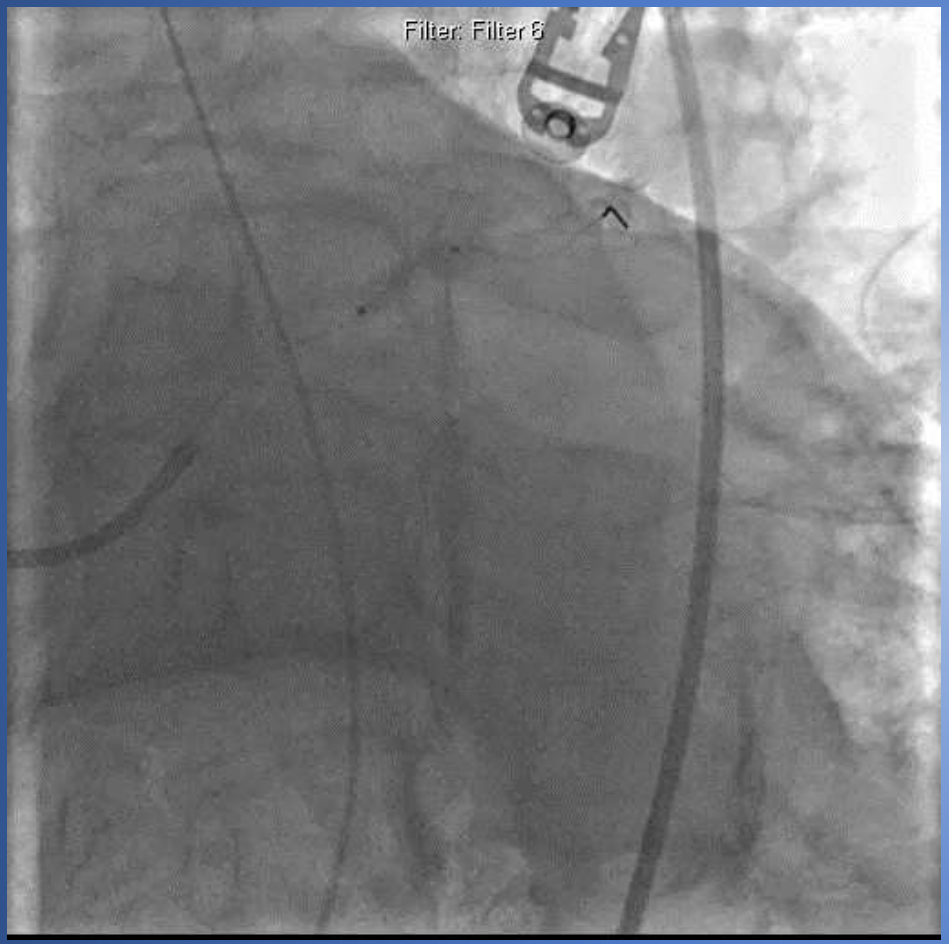
Michael S. Lee, MD, FACC, FSCAI
Interventional Cardiology

80 year-old diabetic with ACS

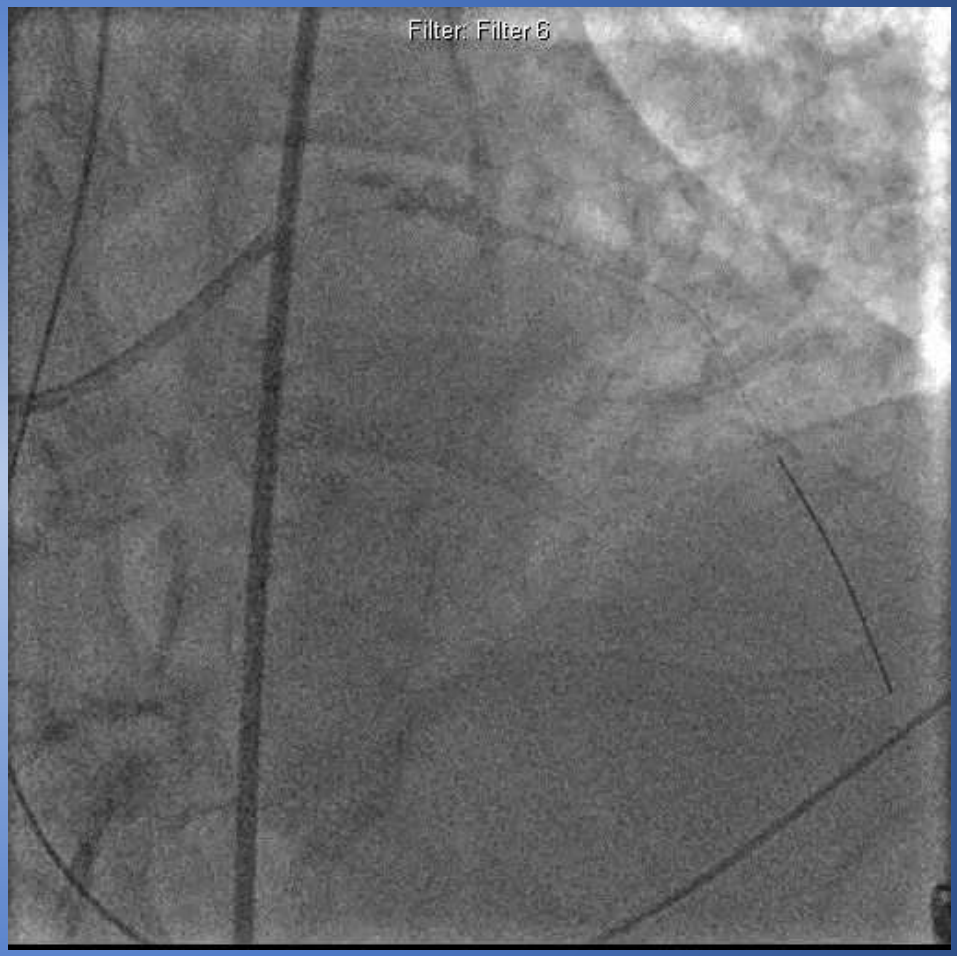




Severely calcified proximal LAD



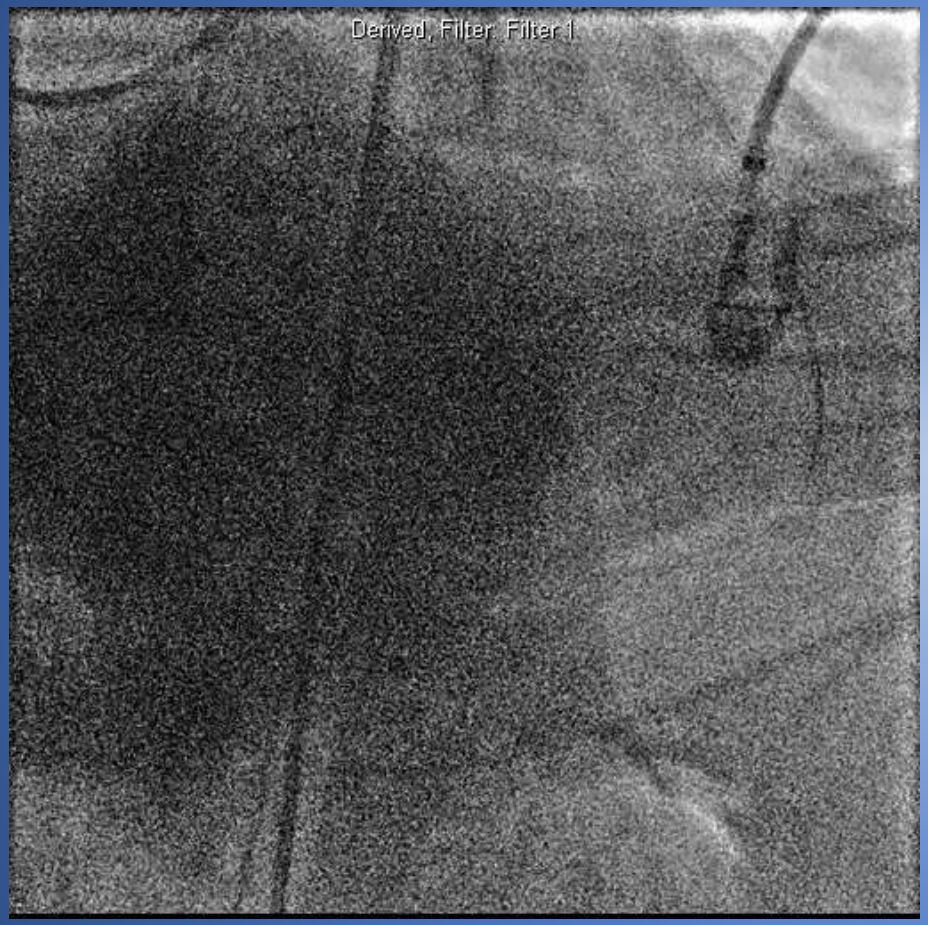
- Multiple, prolonged, high-pressure inflations
- Unable to fully dilate balloon



- Slow flow
- Ischemia
- Contrast staining c/w dissection

- Cardiac arrest
- CPR

- Impella insertion
- Rotational atherectomy



- Intubated, multiple vasopressors
- Hemo-metabolic shock, septic shock, mult-organ failure
- Died

Coronary Artery Calcium
a 40-year old problem

The New England
Journal of Medicine

Volume 301 JULY 12, 1979 Number 2

NONOPERATIVE DILATATION OF CORONARY-ARTERY STENOSIS

Percutaneous Transluminal Coronary Angioplasty

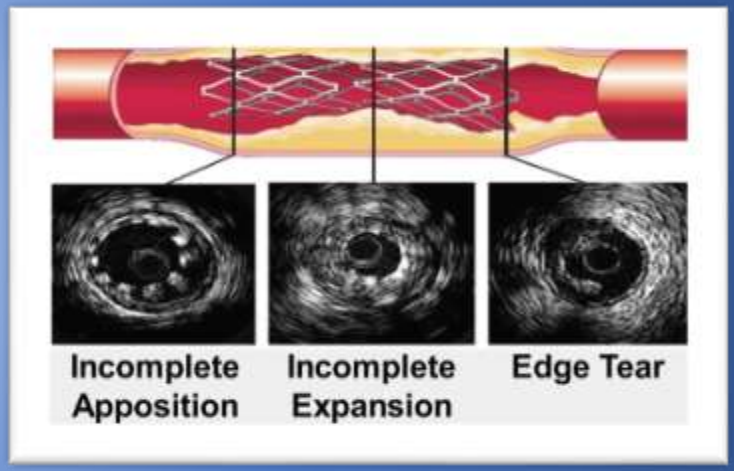
ANDREAS R. GRÜNTZIG, M.D., ÅKE SENNING, M.D., AND WALTER E. SIEGENTHALER, M.D.

'At present, the [balloon-dilatation] technique is limited by anatomic factors, such as … calcified stenoses.'[1]

1. Gruntzig AR, et al. *NEJM*. 1979;301:61-68.

Challenges with Calcified Lesions

- Difficult to treat
  - Difficult to dilate
  - Prone to dissection during angioplasty
  - Difficulty delivering stent
  - Prevent adequate stent expansion
- Poor clinical outcomes, including higher MACE
  - Most trials excluded calcified lesions

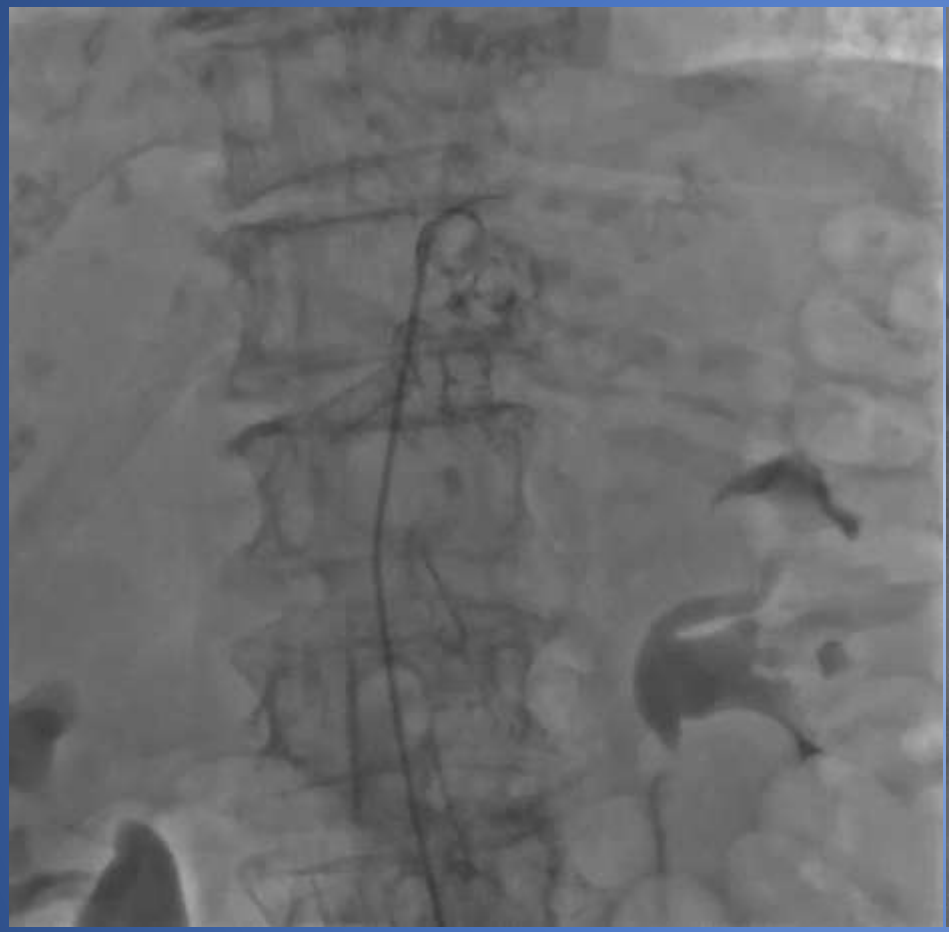


Lee MS, et al. J Invasive Cardiol 2015

Rationale for Plaque Modification with Coronary Atherectomy

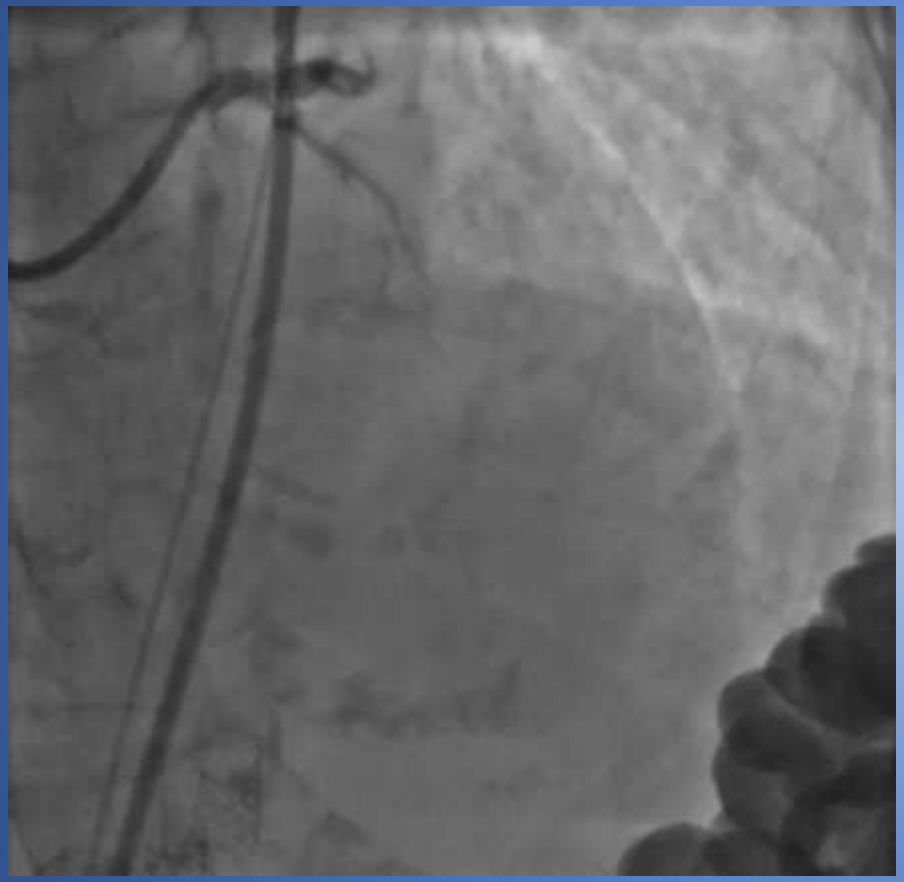
- Improve procedural success
- Change morphology of lesion
- Facilitates optimal stent expansion
- Reduce complications

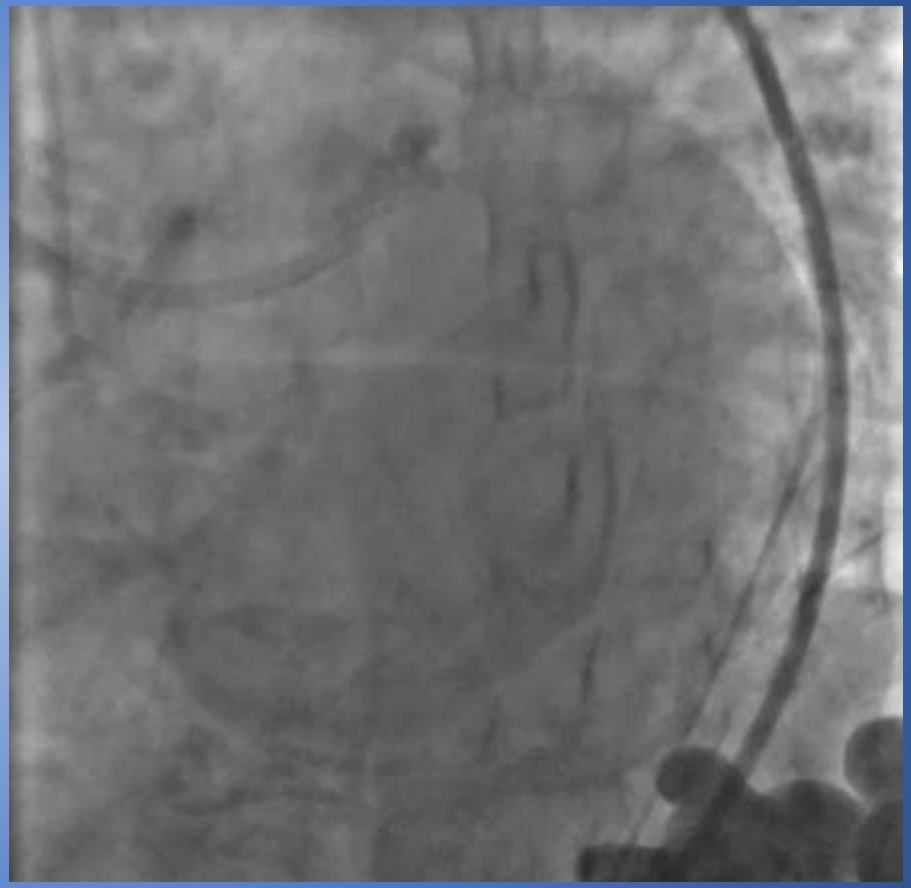
86 y.o. female with bronchiectasis, CMP with EF 35% presents with NSTEMI



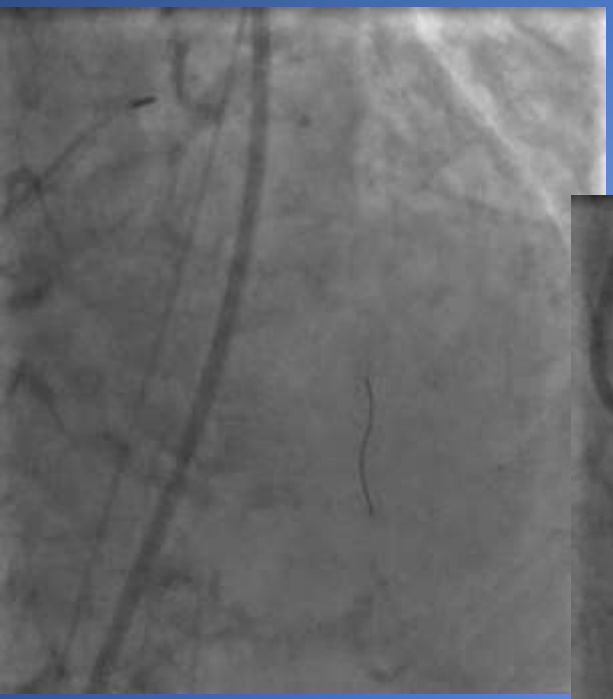
Severe mesenteric ischemia
s/p stent
Renal artery stenosis s/p stent

4F JL4
Severe ostial LM, LAD, and LCX



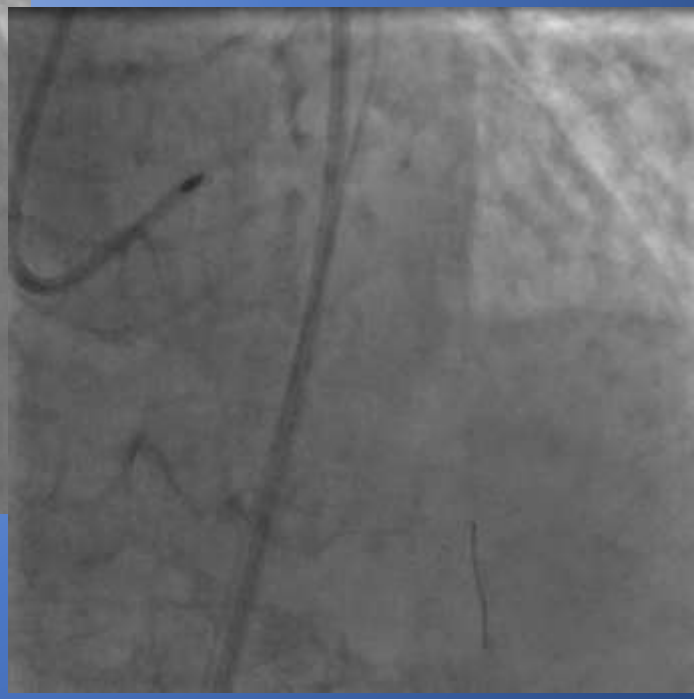


Rotational Atherectomy of LM and LAD



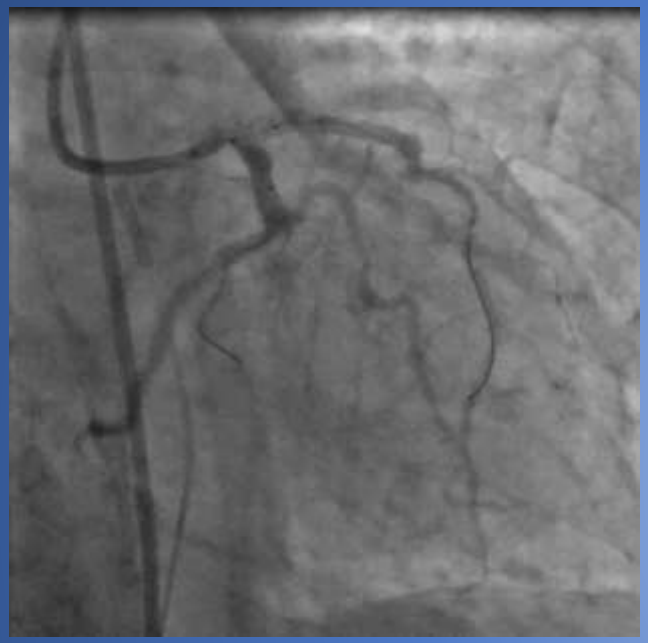
1.25 mm burr

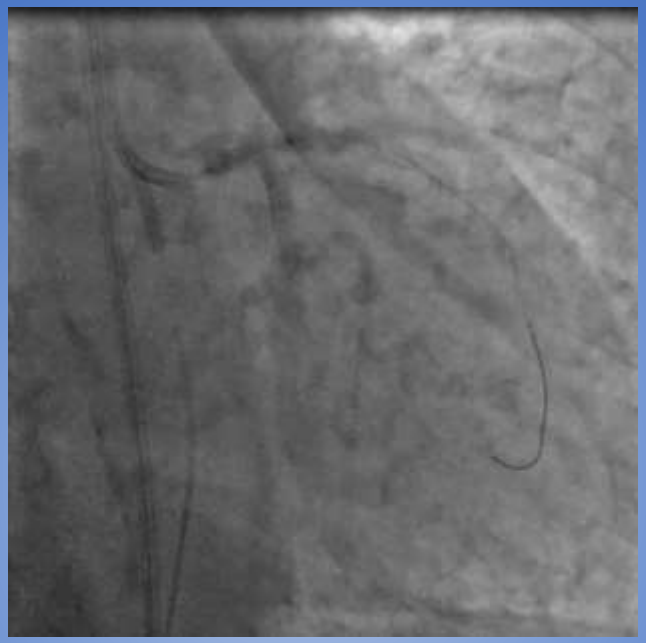
1.5 mm burr

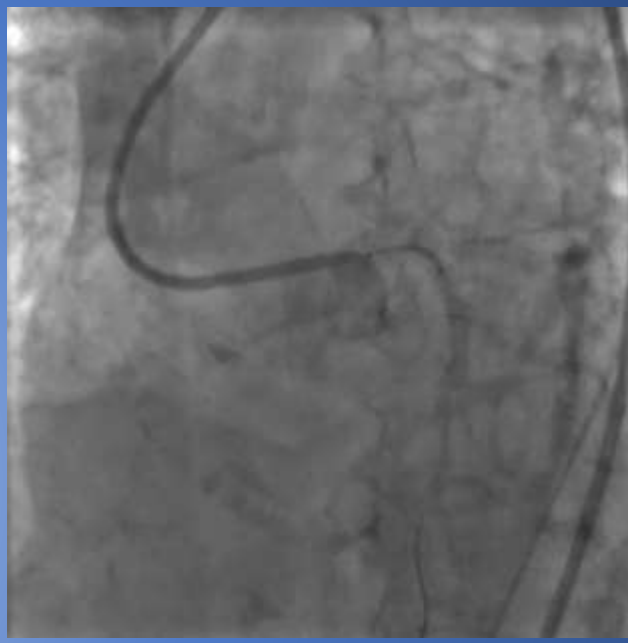


1.75 mm burr

3.5x28 mm EES



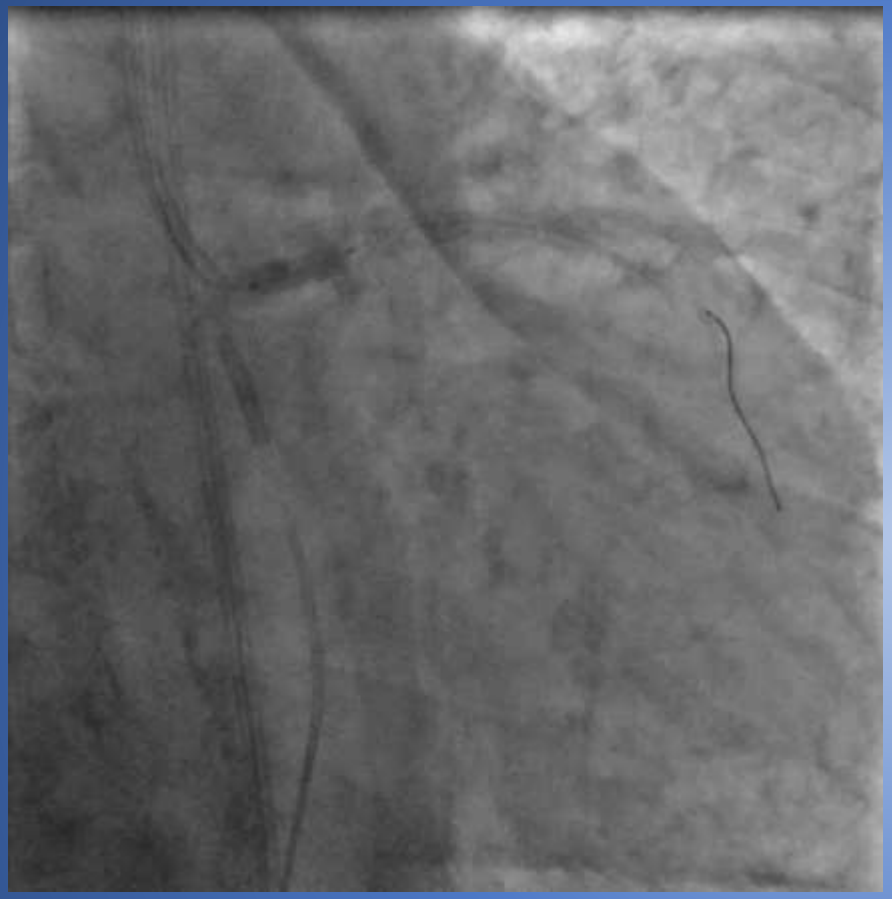




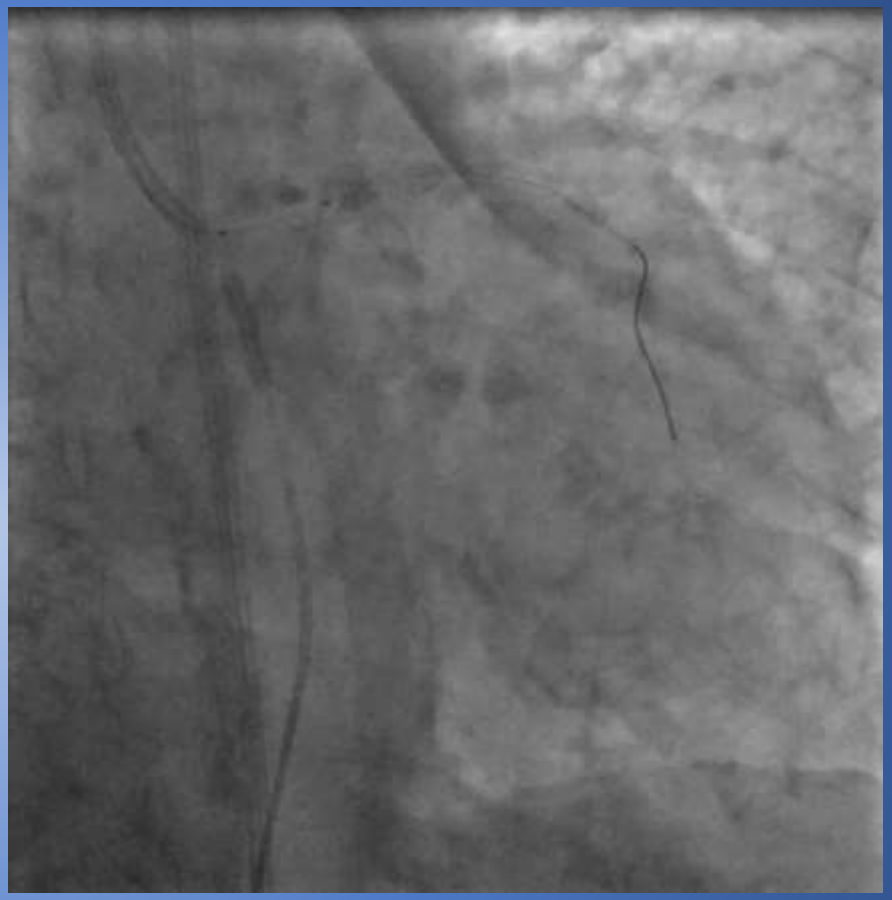
LCX: 3.5x15 mm EES
LAD: 3.5x15 mm balloon

Crush technique

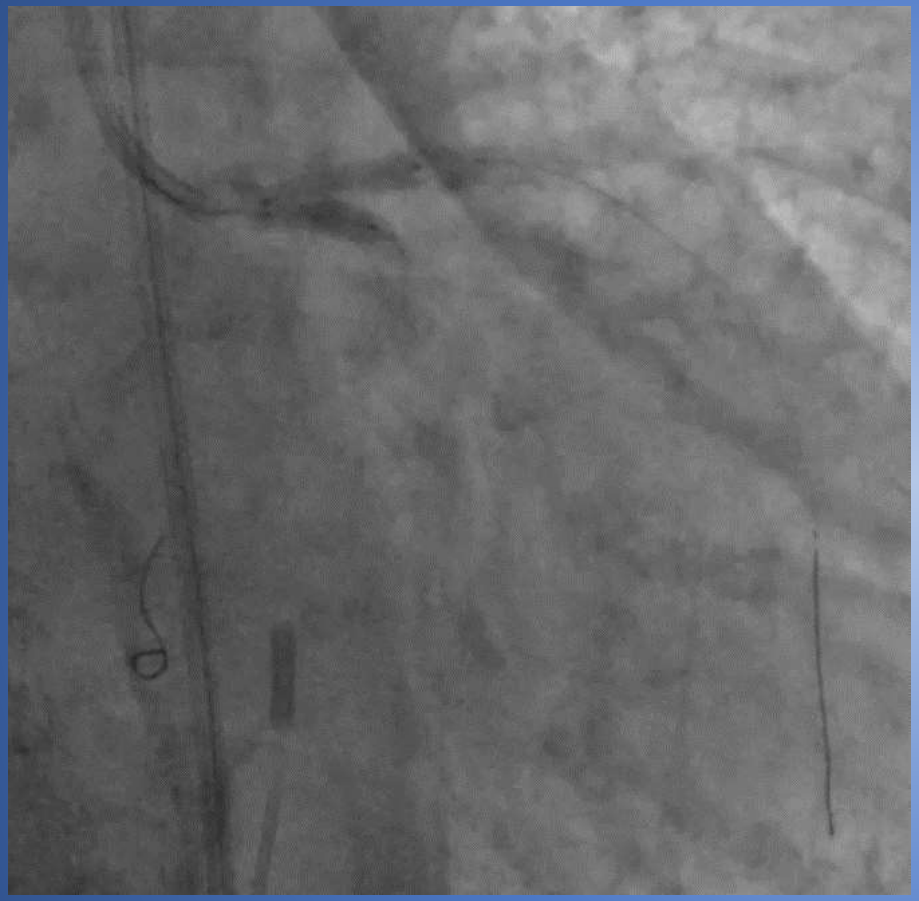
LM: 4.0x18 mm EES

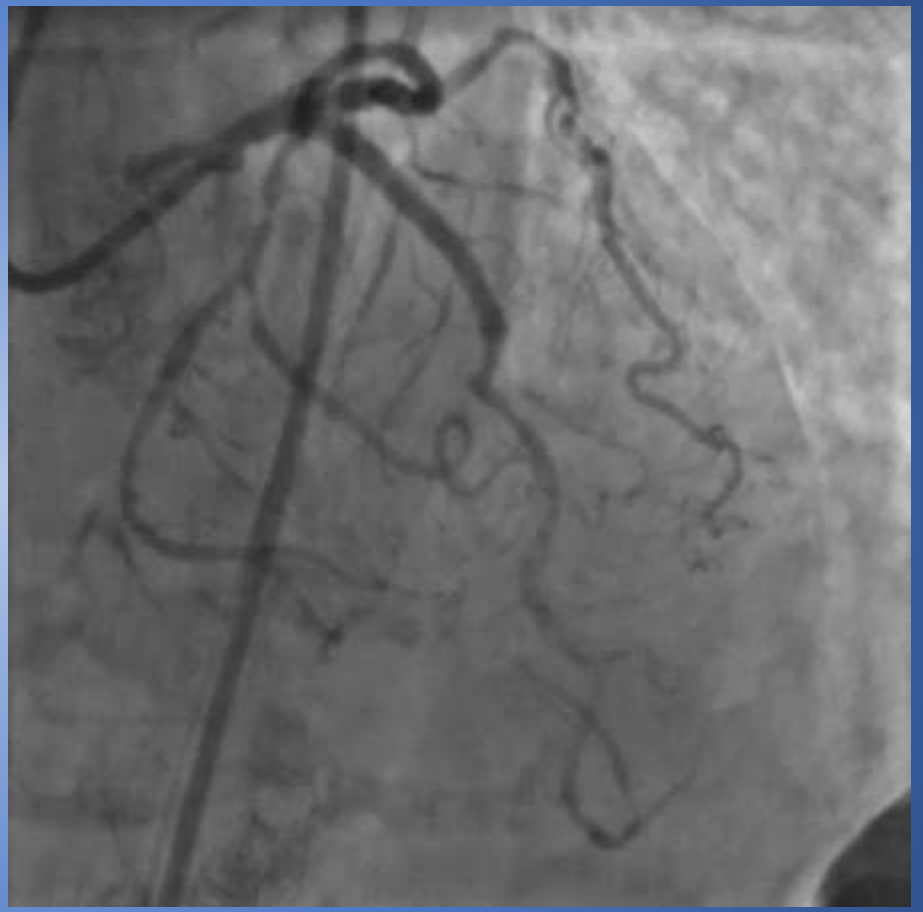


POT with 4.0x12 mm NC balloon



Flare of ostial LM



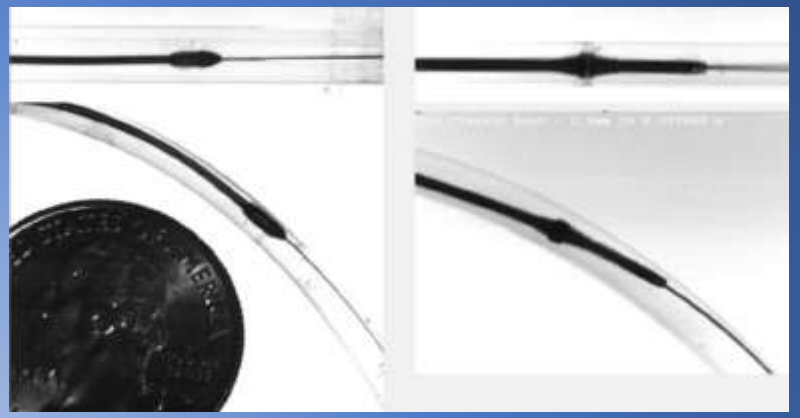


Kissing balloon:
LAD: 3.75x15 mm NC
LCX: 3.5x12 mm NC

Final angiogram

Orbital Atherectomy

Mechanism of Action



Differential Sanding:

- 30 micron diamond coating
- Bi-directional sanding, eccentric mounted crown
- Healthy elastic tissue flexes away minimizing damage to the vessel

Centrifugal Force:

- 360° crown contact designed to create a smooth, concentric lumen
- Allows constant blood flow and particulate flushing during orbit
- Increasing speed increases orbital diameter
- Ability to treat multiple vessel diameters with one crown (1.25 mm)
- Treat large vessels through small sheaths (6 French)

ORBIT II: Study Design

To evaluate safety and efficacy of the Diamondback Coronary OAS Classic Crown to prepare *de novo*, **severely calcified coronary lesions** for enabling stent placement

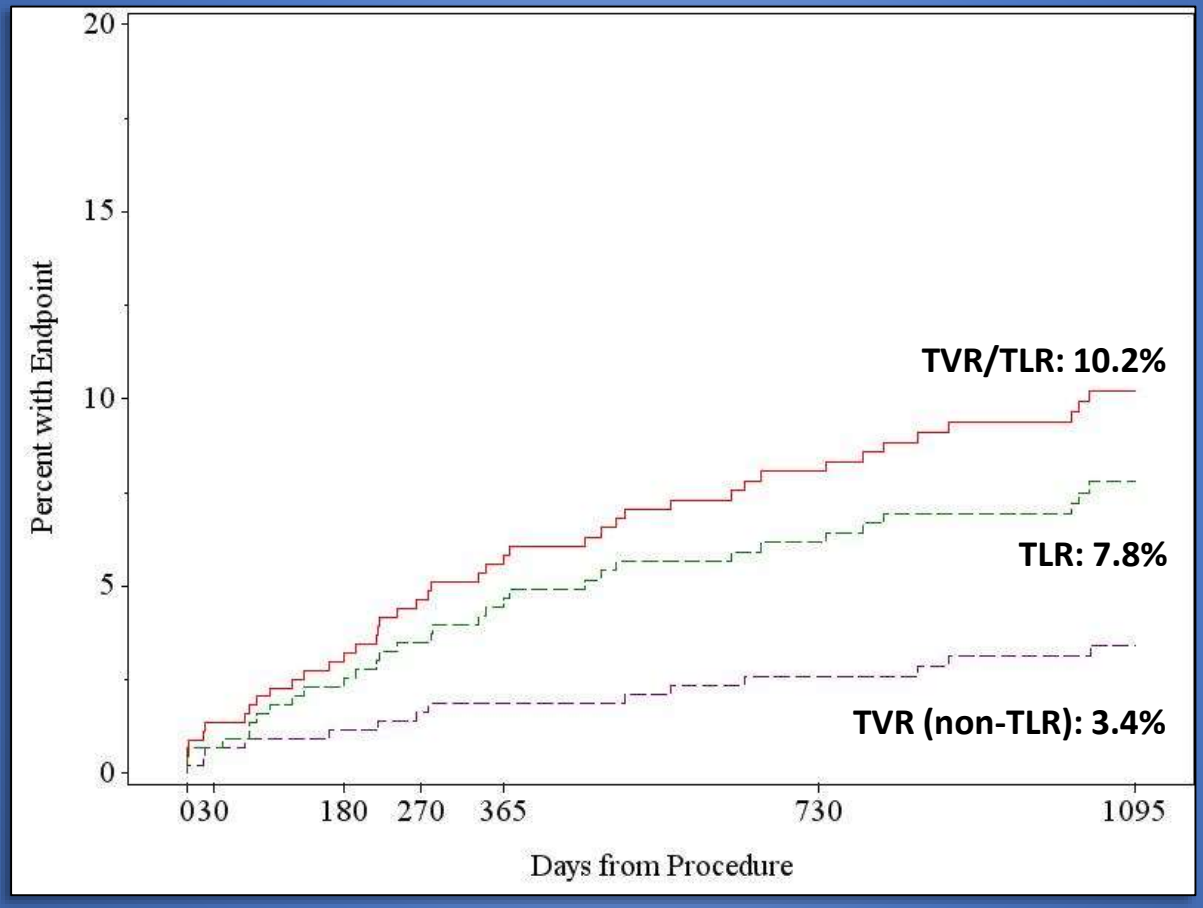
- Prospective, multi-center trial in the United States
- Single arm - As there were no FDA-approved percutaneous treatments specifically for patients with severely calcified coronary lesions.
- ***443 subjects enrolled at 49 U.S. Sites***

30 day follow-up* (N=437/440) → **1-year follow-up† (N=434/440)** → **2-year follow-up‡ (N=424/440)** → **3-year follow-up# (N=411/440)**

- **Primary Safety Endpoint: MACE (**MI= CK-MB>3x ULN, TVR, Cardiac Death)
- **Primary Efficacy Endpoint: Procedural Success**
  - Success in facilitating stent delivery with a final residual stenosis of <50% (as determined by Angiographic Core Lab) and free from in-hospital MACE

*438 subjects per Kaplan Meier were at risk/events for MACE
†432 subjects per Kaplan Meier were at risk/events for MACE
‡411 subjects per Kaplan Meier were at risk/events for MACE
#311 subjects per Kaplan Meier were at risk/events for MACE
Lee MS, et al. Cardiovasc Revasc Med. 2017;18:261-264.

ORBIT II
3-Year TVR/TLR

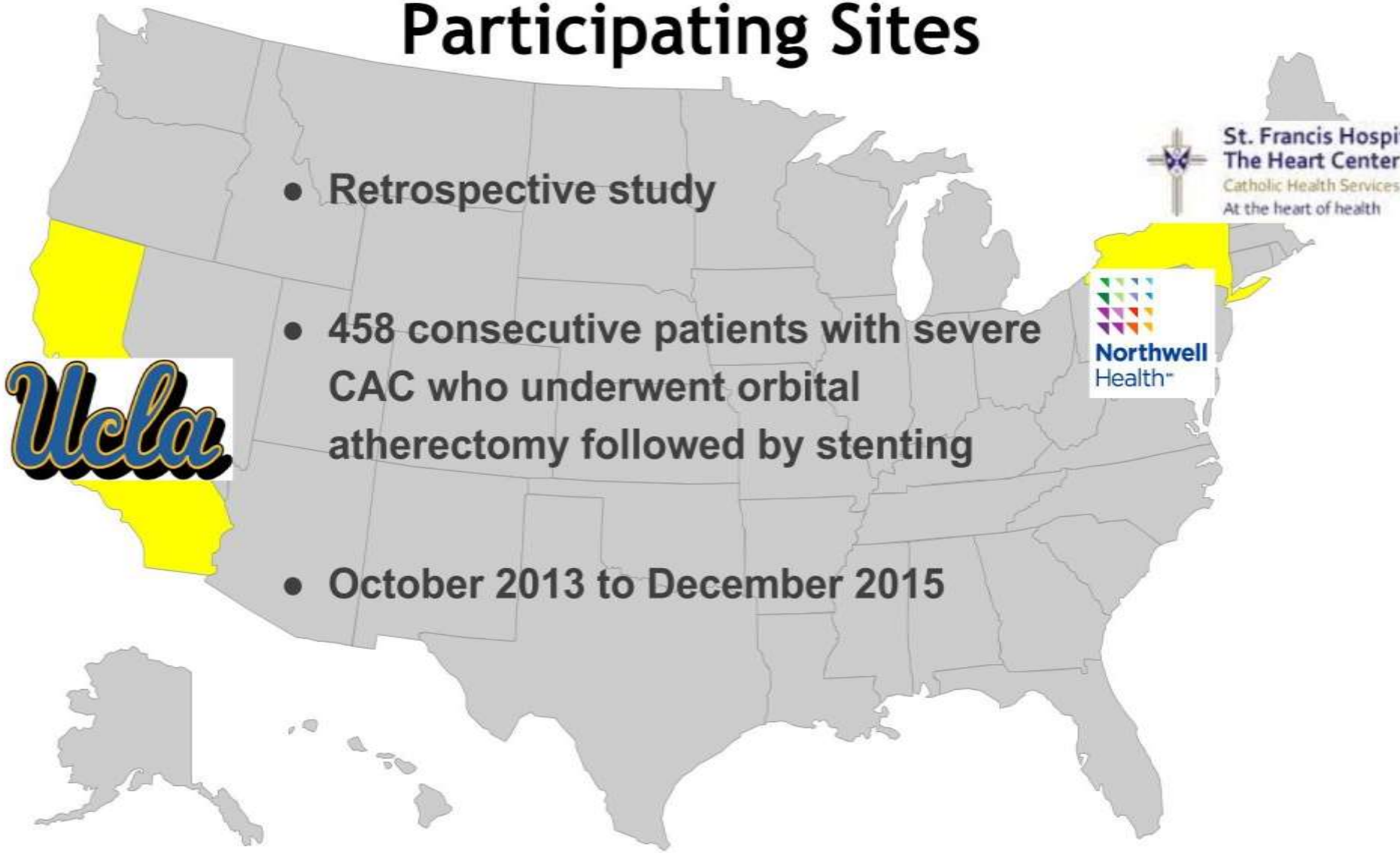


Number at risk (TVR/TLR)	443 430	413	403	392	356	228
Number at risk (TLR)	443 432	415	407	396	363	234
Number at risk (TVR)	443 433	421	416	407	377	242

Lee MS, et al. Cardiovasc Revasc Med. 2017;18:261-264

Real-World Multicenter Experience on Patients with Severe Coronary Artery Calcification Undergoing Orbital Atherectomy

Participating Sites



- Retrospective study
- 458 consecutive patients with severe CAC who underwent orbital atherectomy followed by stenting
- October 2013 to December 2015

Lee MS, et al. J Interv Cardiol 2016

Angiographic Complications

DOI: 10.1111/joic.12310

ORIGINAL INVESTIGATION

Real-World Multicenter Registry of Patients with Severe Coronary Artery Calcification Undergoing Orbital Atherectomy

MICHAEL S. LEE, M.D.,[1] EVAN SHLOFMITZ, D.O.,[2] BARRY KAPLAN, M.D.,[2] DRAGOS ALEXANDRU, M.D.,[2] PERWAIZ MERAJ, M.D.,[2] and RICHARD SHLOFMITZ, M.D.[3]

From the [1]Division of Interventional Cardiology, UCLA Medical Center, Los Angeles, California; [2]Division of Cardiology, Northwell Health, Manhasset, New York; and [3]Division of Cardiology, St. Francis Hospital, Roslyn, New York

Objectives: *We evaluated the safety and efficacy of orbital atherectomy in real-world patients with severe coronary artery calcification (CAC).*

Background: *The presence of severe CAC increases the complexity of percutaneous coronary intervention as it may impede stent delivery and optimal stent expansion. Atherectomy may be an indispensable tool for uncrossable or undilatable lesions by modifying severe CAC. Although the ORBIT I and II trials report that orbital atherectomy was safe and effective for the treatment of severe CAC, patients with kidney disease, recent myocardial infarction, long diffuse disease, severe left ventricular dysfunction, and unprotected left main disease were excluded.*

Methods: *This retrospective study included 458 consecutive patients with severe CAC who underwent orbital atherectomy followed by stenting from October 2013 to December 2015 at 3 centers.*

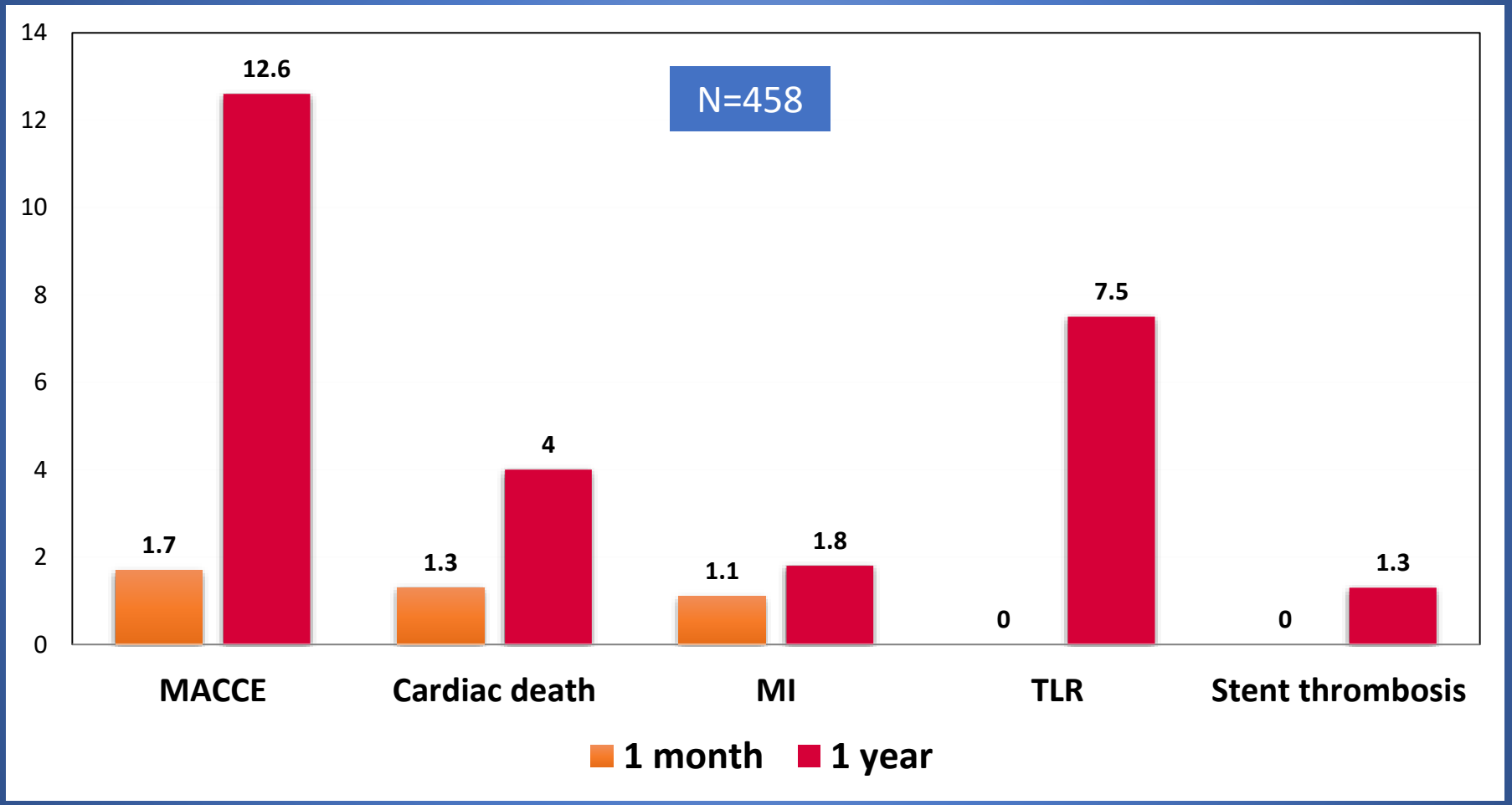
Results: *The primary endpoint of major adverse cardiac and cerebrovascular events at 30 days was 1.7%. Low rates of 30-day all-cause mortality (1.3%), myocardial infarction (1.1%), target vessel revascularization (0%), stroke (0.2%), and stent thrombosis (0.9%) were observed. Angiographic complications were low: perforation was 0.7%, dissection 0.9%, and no-reflow 0.7%. Emergency coronary artery bypass graft surgery was performed in 0.2% of patients.*

Conclusion: *In the largest real-world study of patients who underwent orbital atherectomy, including high-risk patients who were not surgical candidates as well as those with very complex coronary anatomy, acute and short-term adverse clinical event rates were low. A randomized clinical trial is needed to identify the ideal treatment strategy for patients with severe CAC.* (J Interven Cardiol 2016;9999:1–6)

	n=458
Perforation	3 (0.7%)
Dissection	4 (0.9%)
No reflow	3 (0.7%)

Lee MS, et al. J Interv Cardiol 2016.

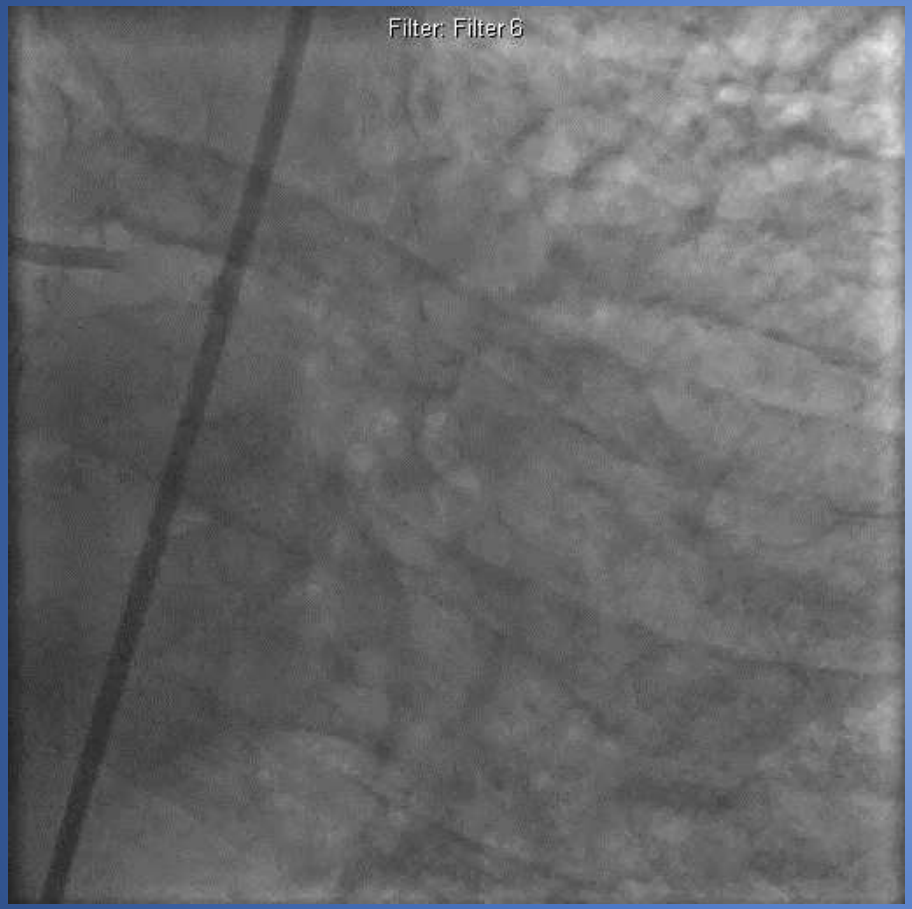
Orbital Atherectomy
30-day and 1-year follow-up

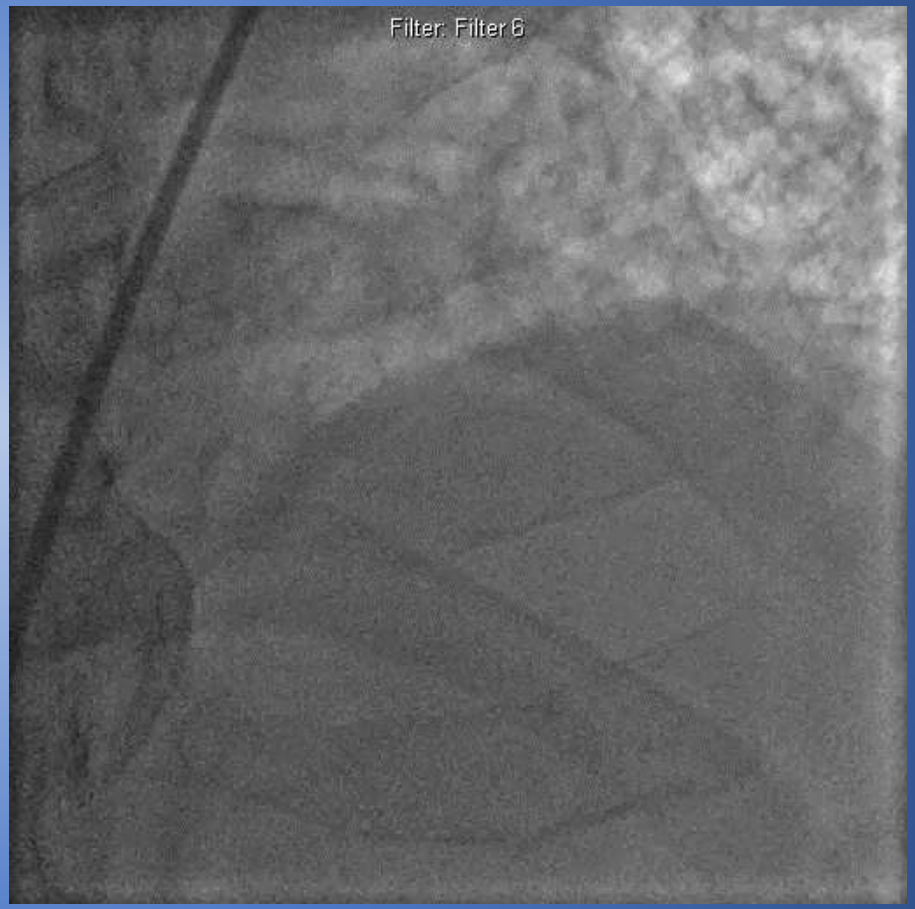


Lee MS, et al. J Interv Cardiol 2016
Lee MS, et al. J Invasive Cardiol 2018

UCLA Health

Calcified Left Main and LAD

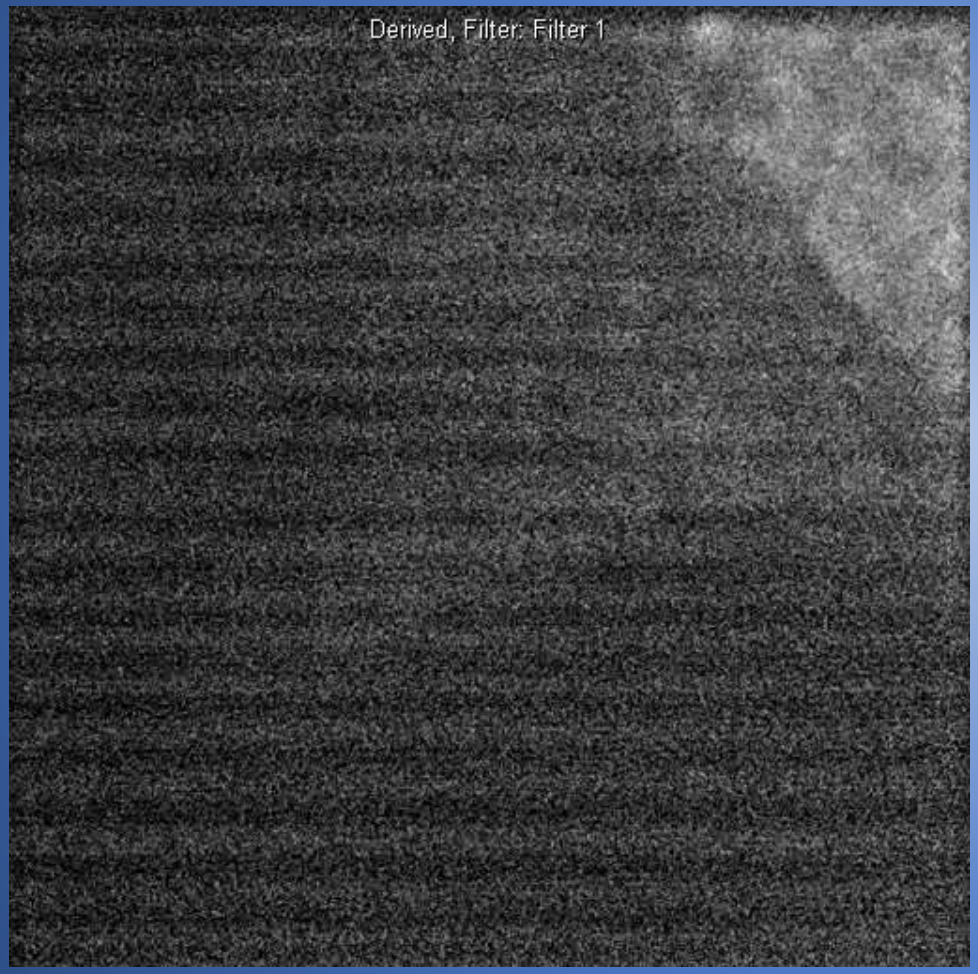




68 y.o. male pre-lung transplant

Calcified LM and LAD

Orbital Atherectomy
Left Main Artery

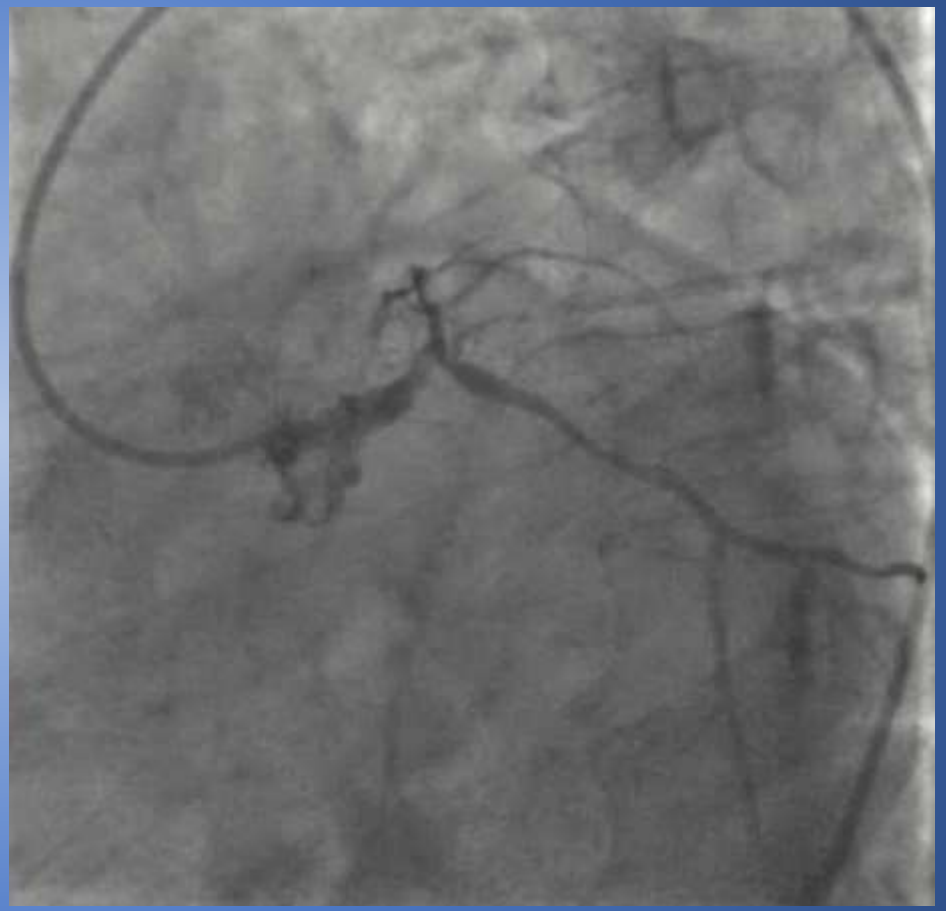


Treats 360˚ of the vessel. The diamond coated crown sands away calcium and allows healthy elastic tissue to flex away minimizing injury to the vessel.

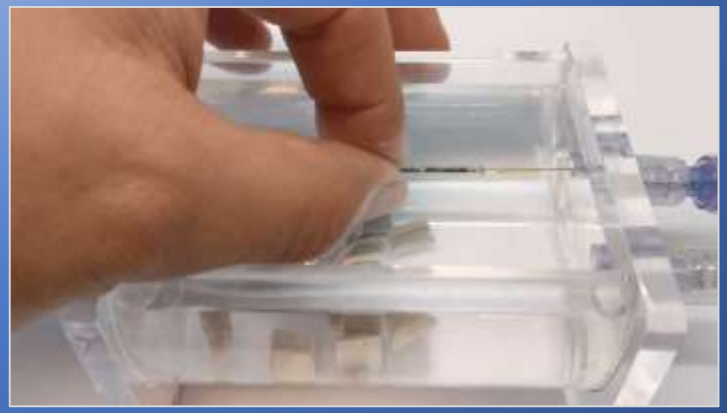
Final Angiography

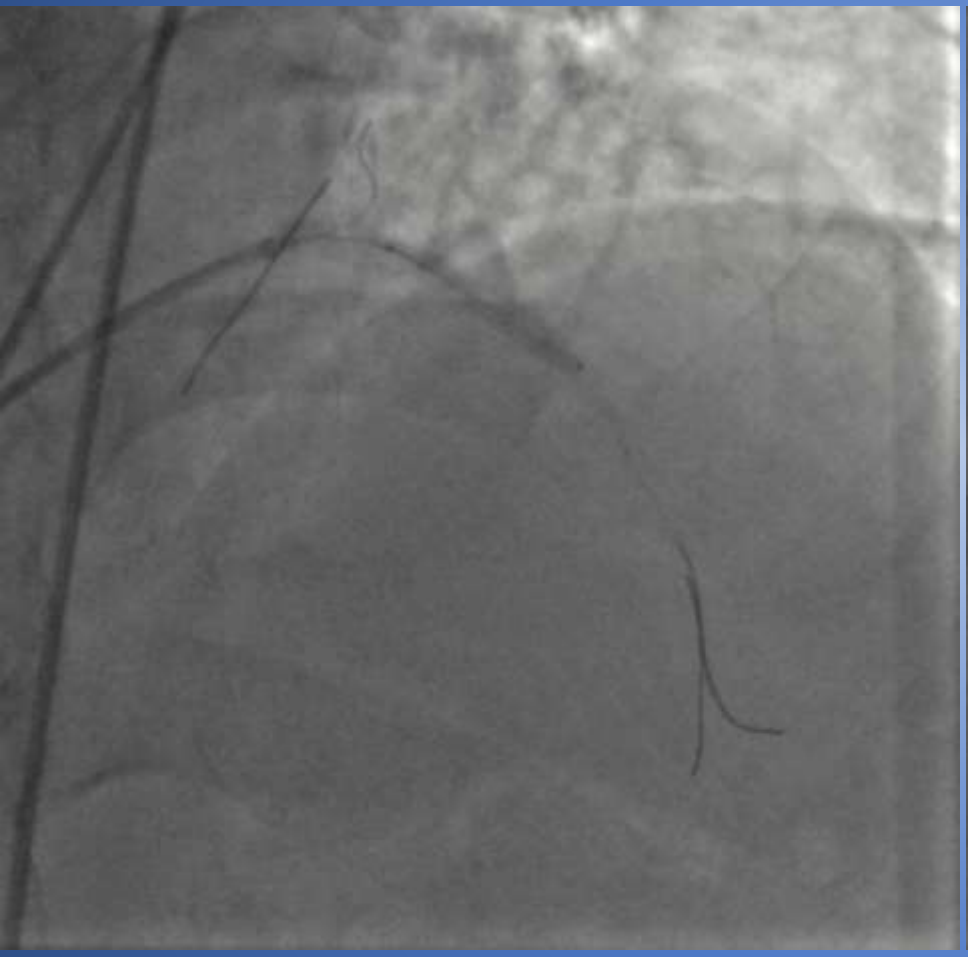
UCLA Health

62 y.o. male with cardiomyopathy EF 30%
Severe PAD

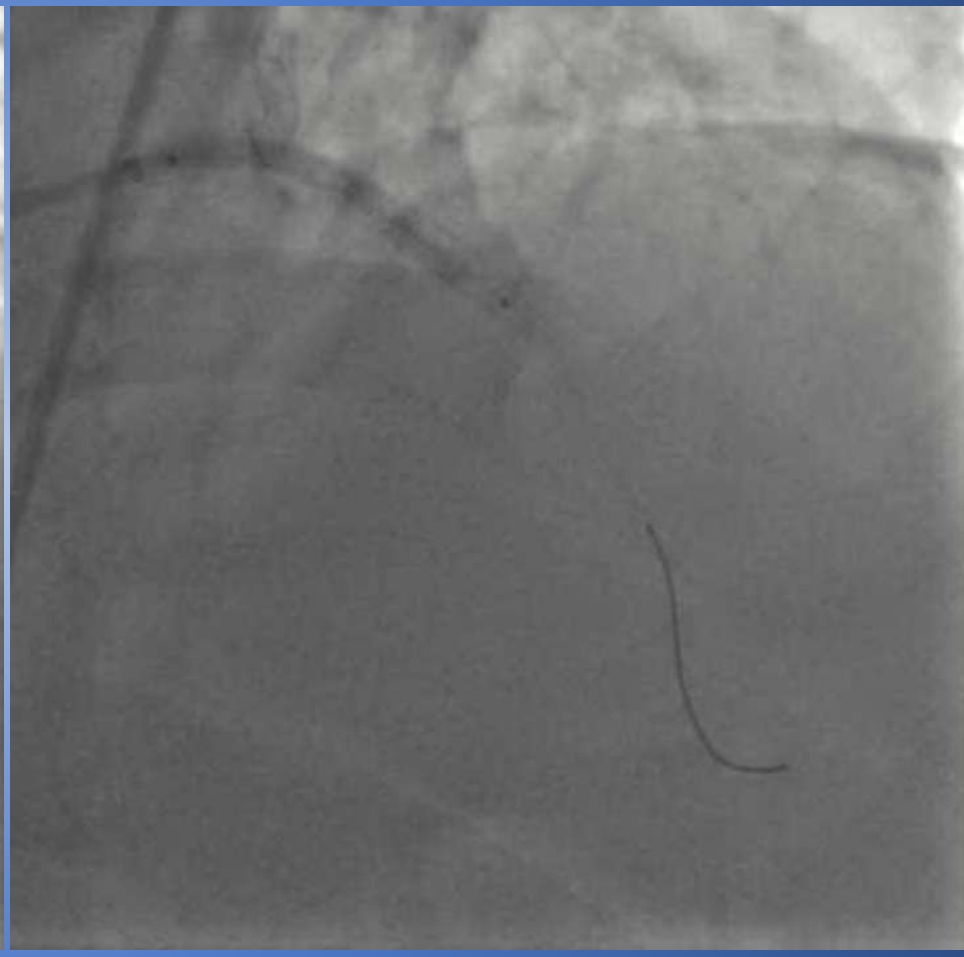


Shockwave Intravascular Lithotripsy

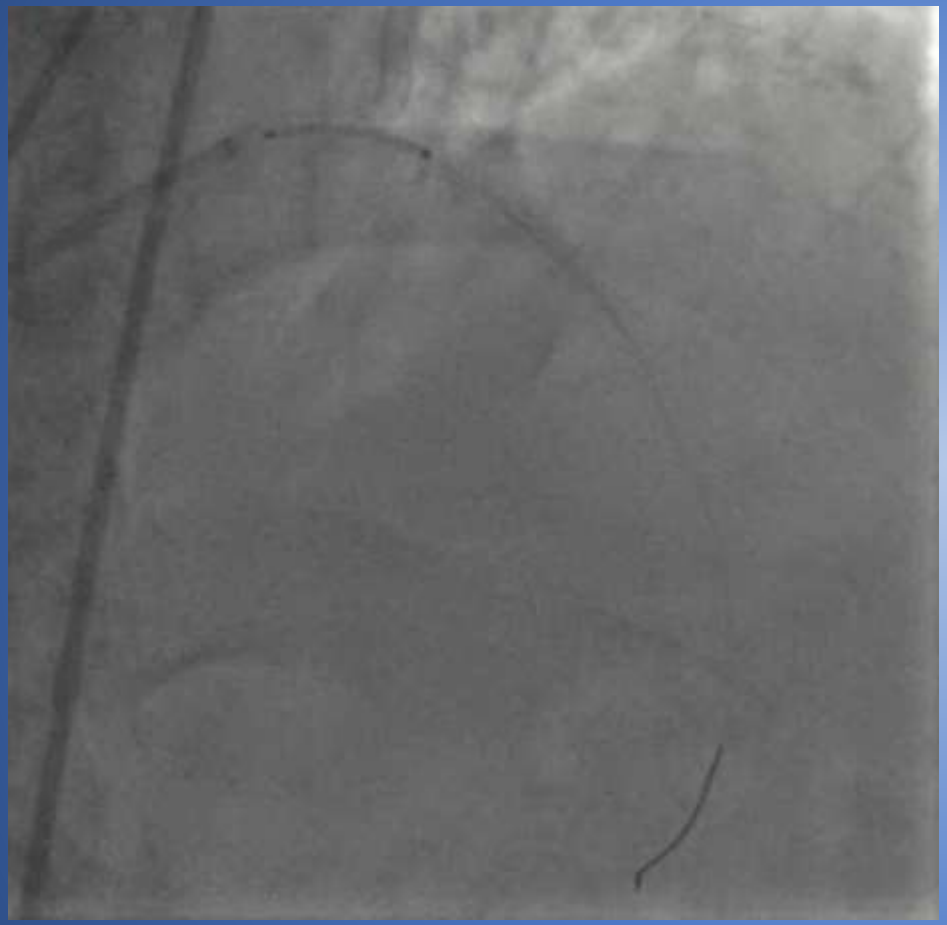


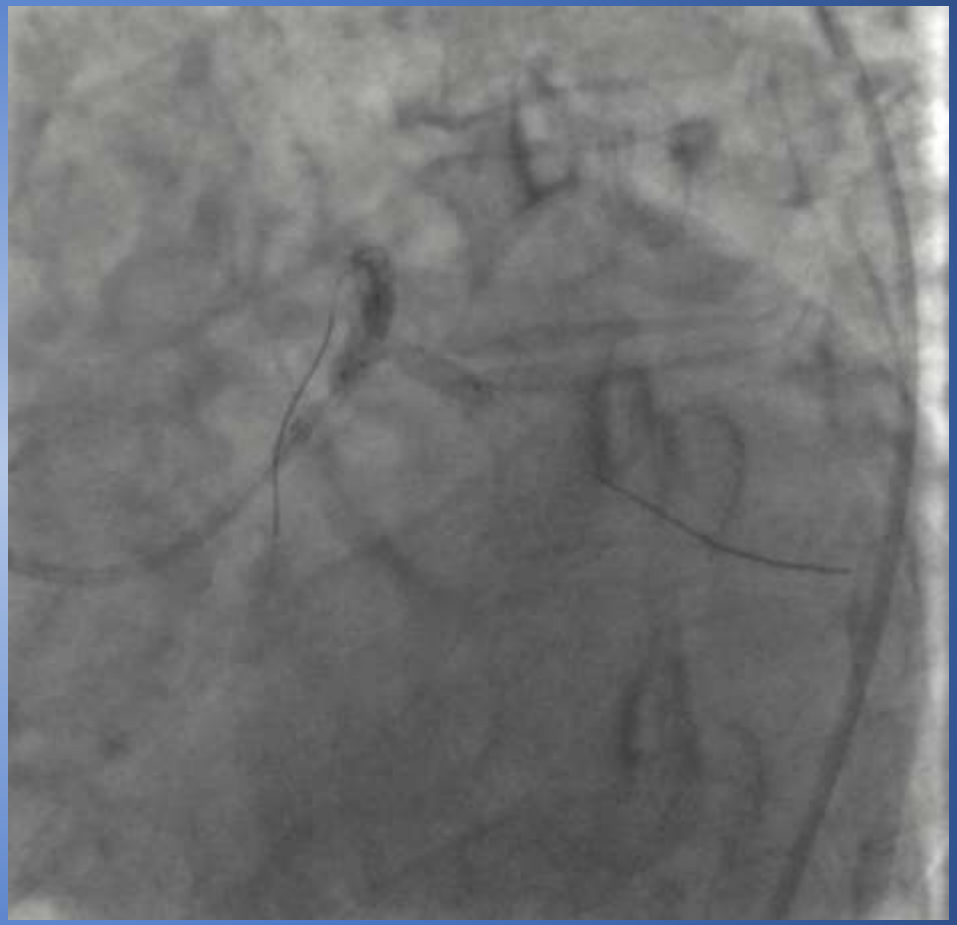


Unable to dilate 3.0x20 mm balloon



3.0x40 mm Shockwave Lithotripsy at 4 atm





LM: 4.0x18 mm Xience

Kissing balloon
LAD: 4.0x20 mm
LCX: 3.5x15 mm