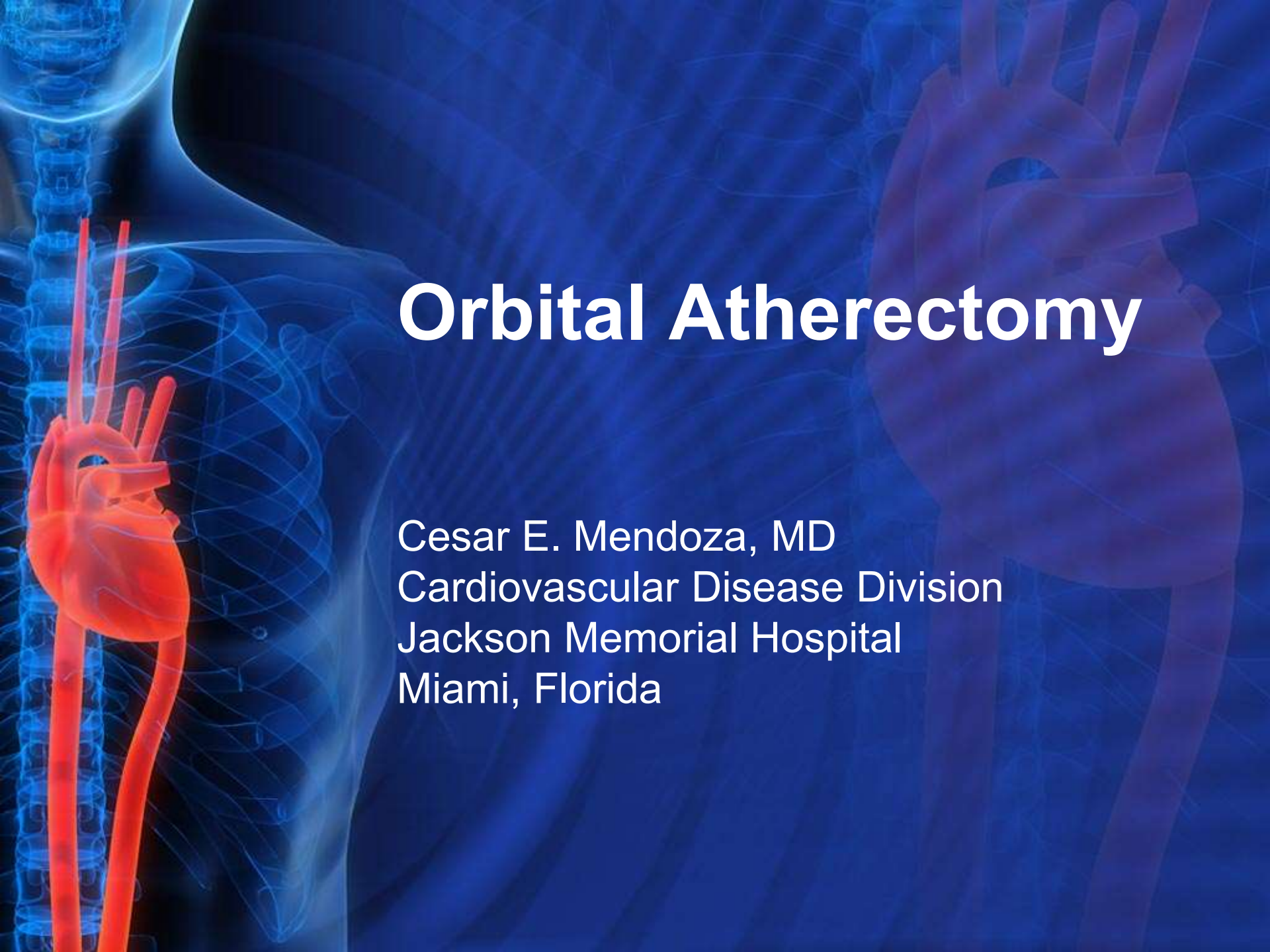
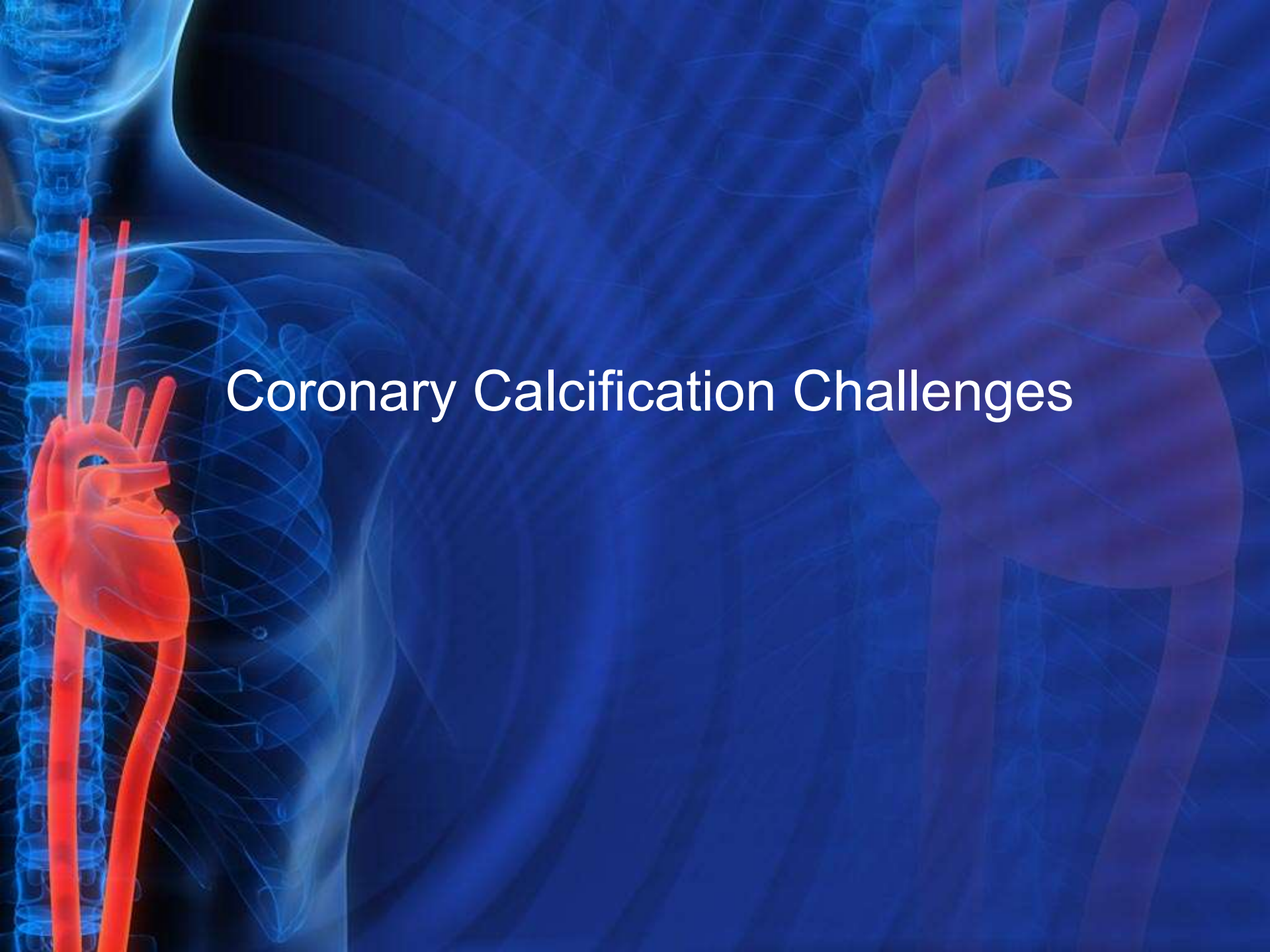
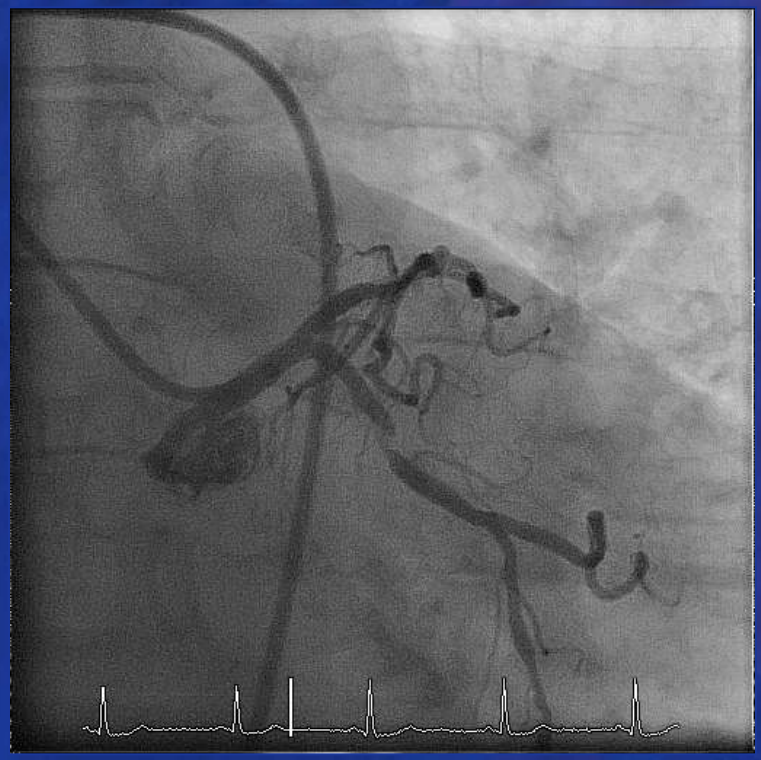


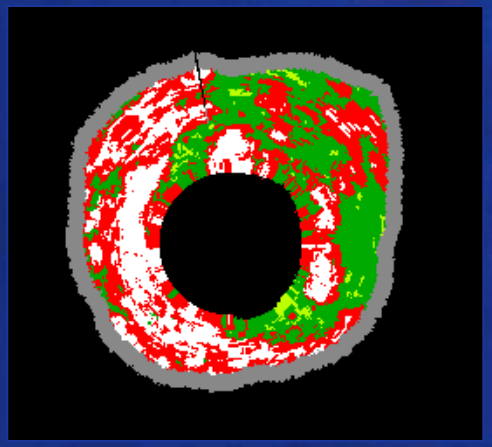
Orbital Atherectomy

Cesar E. Mendoza, MD
Cardiovascular Disease Division
Jackson Memorial Hospital
Miami, Florida

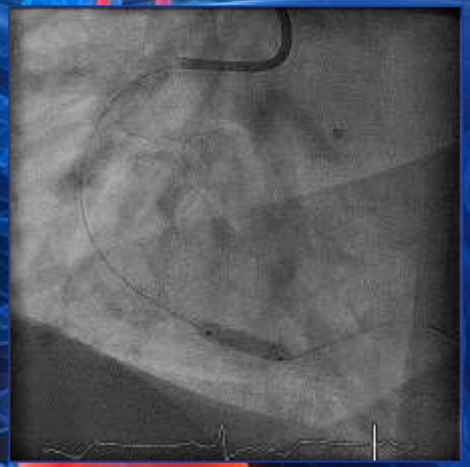

Coronary Calcification Challenges

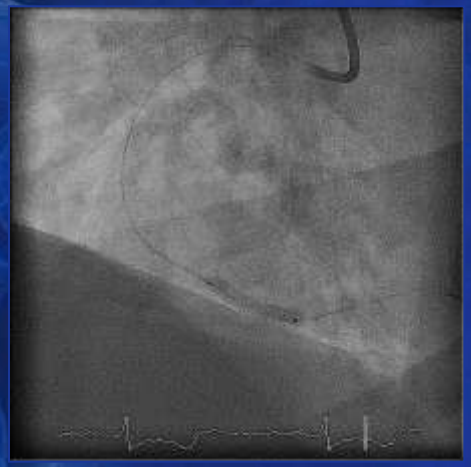
Severe Calcified Lcx Lesion

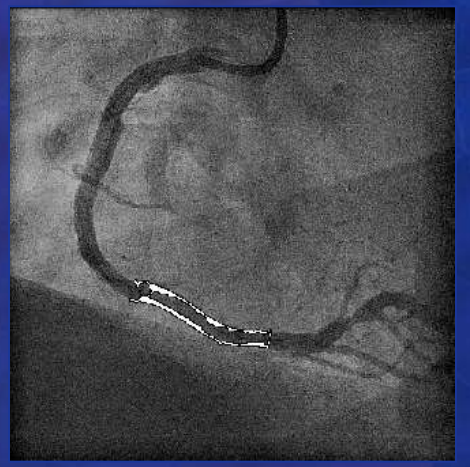


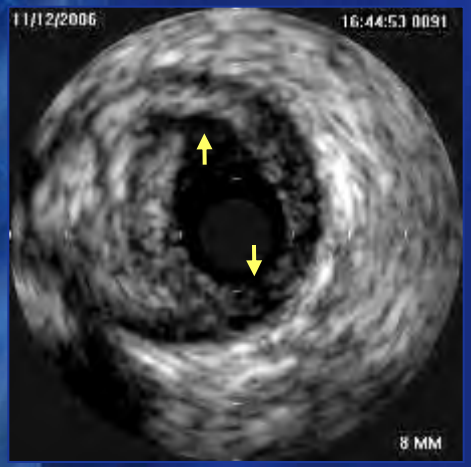


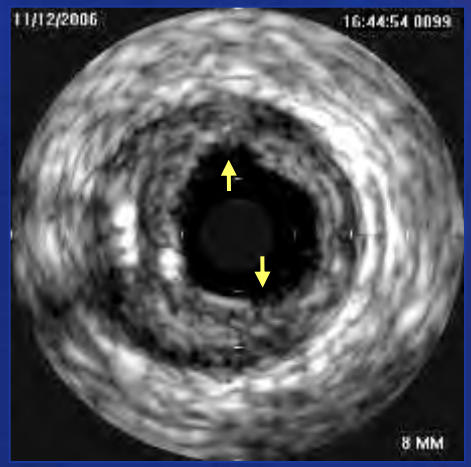
Calcified lesions are prone to dissection with pre-dilatation











Calcified lesion are difficult to completely dilate and lead to incomplete expansion of the stent

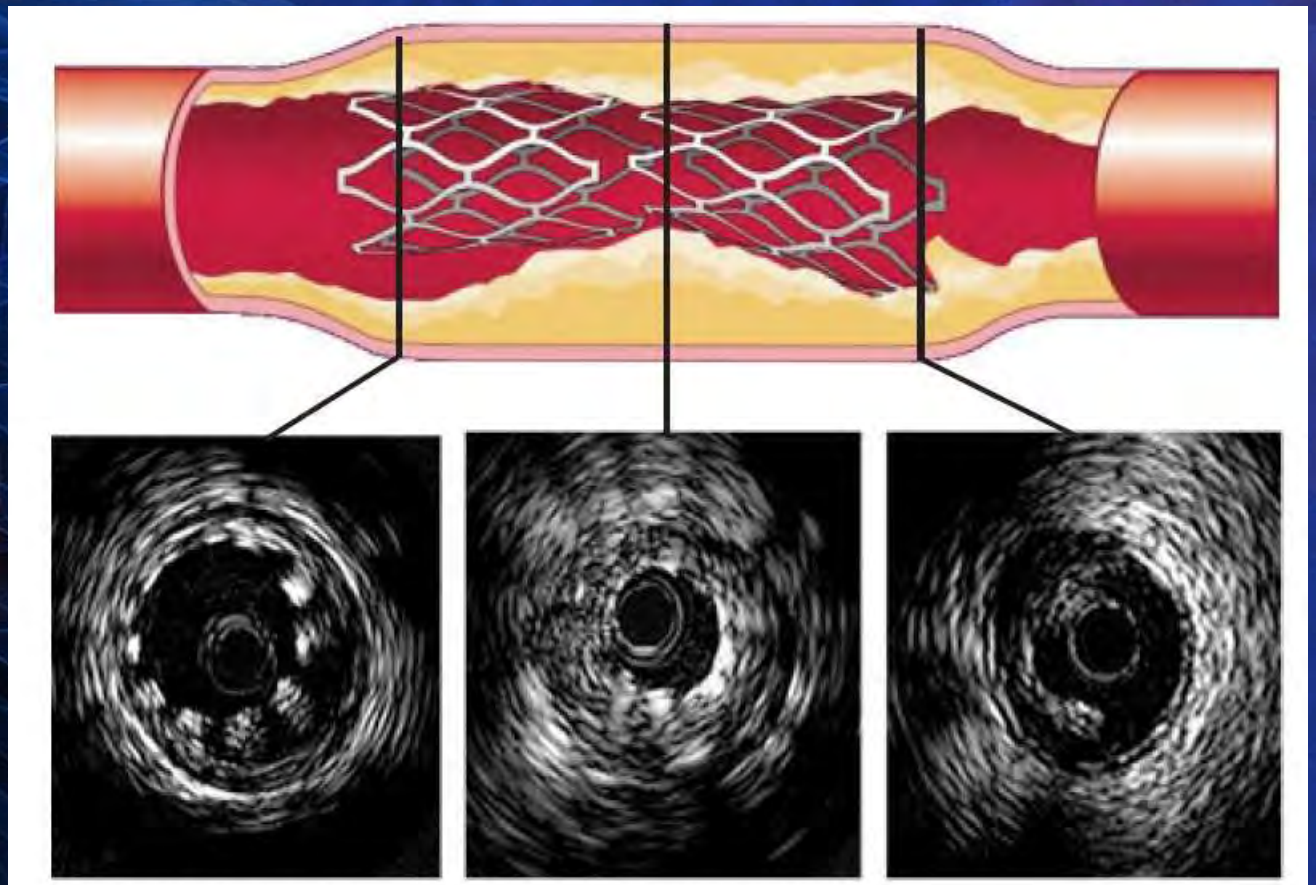


Figure 6. Shows incomplete apposition, incomplete expansion and an edge tear.

Vascular disease management ; Volume 8, issue 4 April 2010

Challenges With Calcified Coronary Lesions

Difficult to Treat:

- Difficult to completely dilate[2]
- Prone to dissection during balloon angioplasty or pre-dilatation[1]
- Can prevent adequate stent expansion[3]
- Preclude stent delivery to the desired location[4]

Result in poor clinical outcomes, including higher MACE and angiographic complications.

- Most stent trials excluded patients with moderate to severely calcified lesions
- BVS trials are excluding moderate and severe coronary calcification

1. Fitzgerald PJ, et al.. Circulation. 1992:86;64-70. Kahn J, et al. Cathet Cardiovasc Diagn. 1990;21:89-91.
2. Cavusoglu E, et al. Catheter Cardiovasc Interv. 2004;62:485-498.
3. Moussa I, et al. Circulation. 1997;96(1):128-136.
4. Gilutz H, et al. Cathet Cardiovasc Intervent. 2000;50:212-214.

Patterns Of Calcification In Coronary Artery Disease Intravascular Ultrasound And Coronary Angiography

N = 1155 Lesions in 1117 patients

Angiographic Core Lab

None/mild, moderate

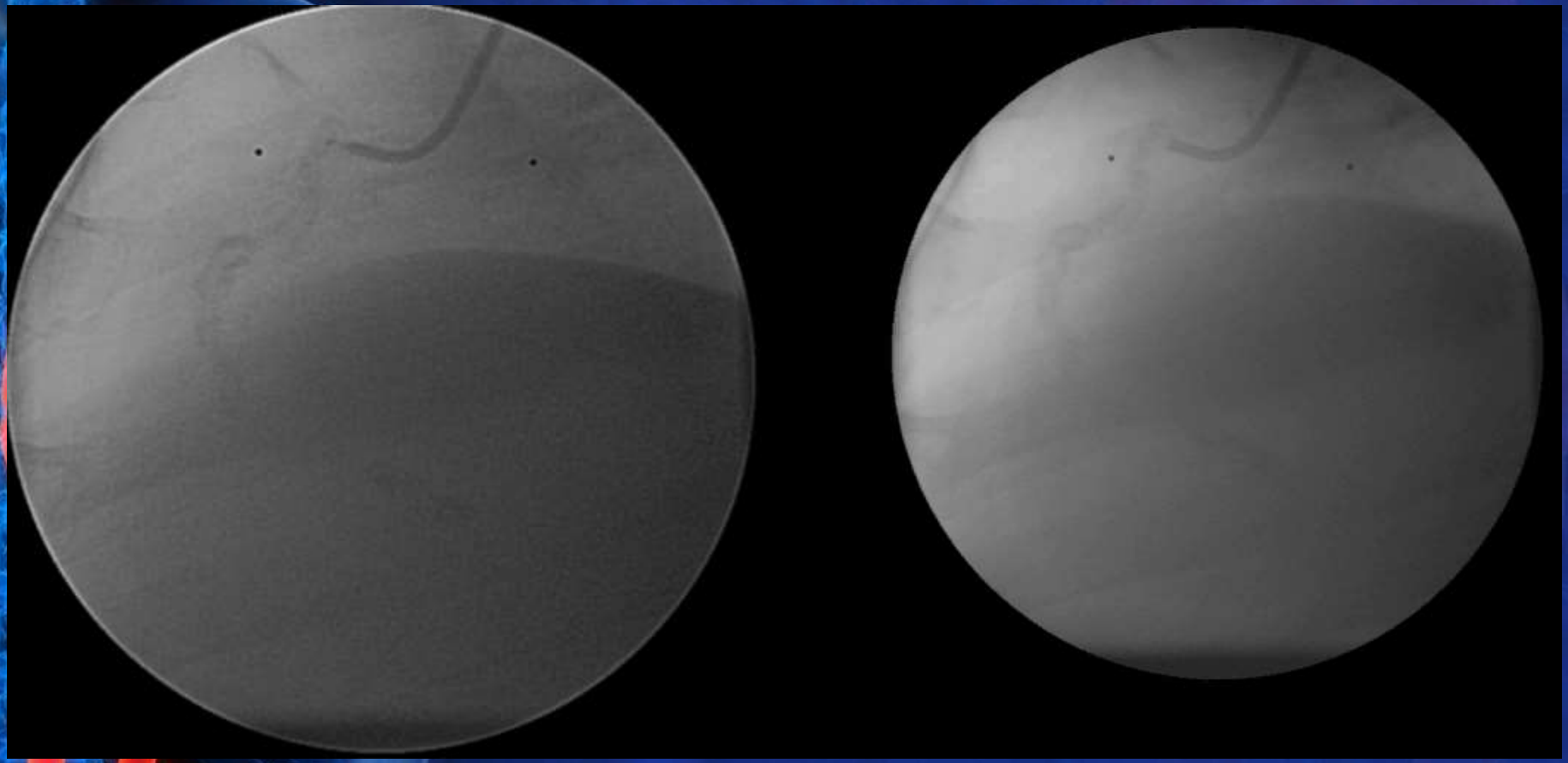
- Radiopacities noted only during the cardiac cycle before contrast injection

Severe

- Radiopacities noted without cardiac motion before contrast injection generally compromising both sides of the arterial lumen

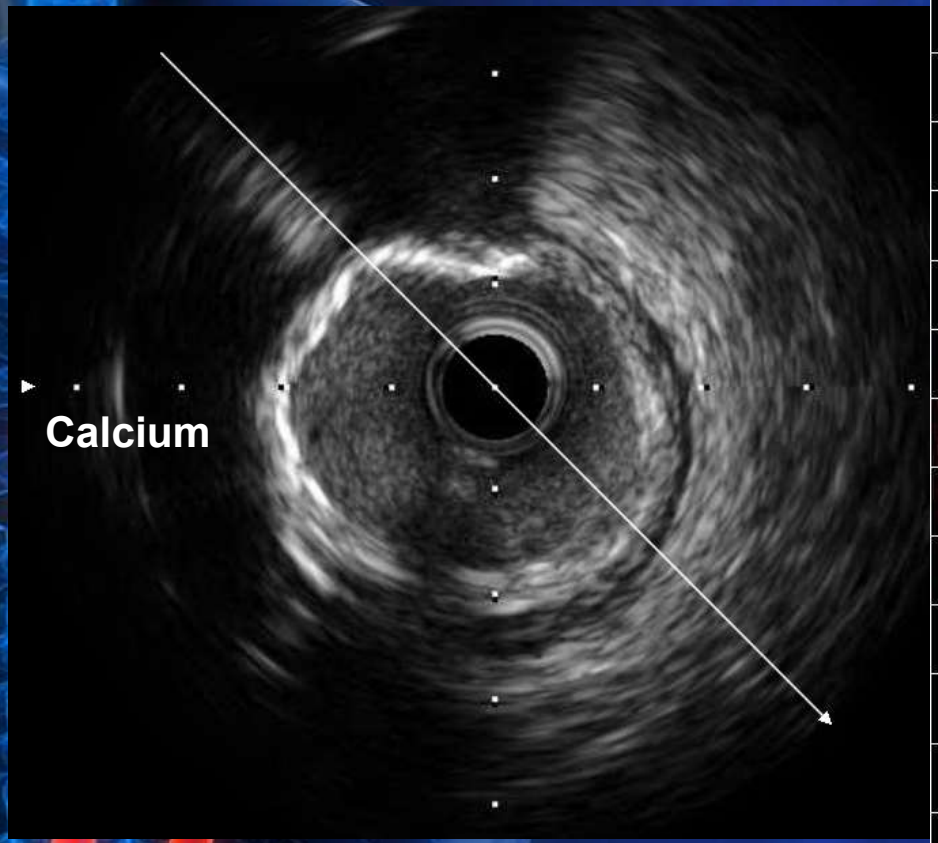
Mintz et al Circulation. 1995;91:1959-1965

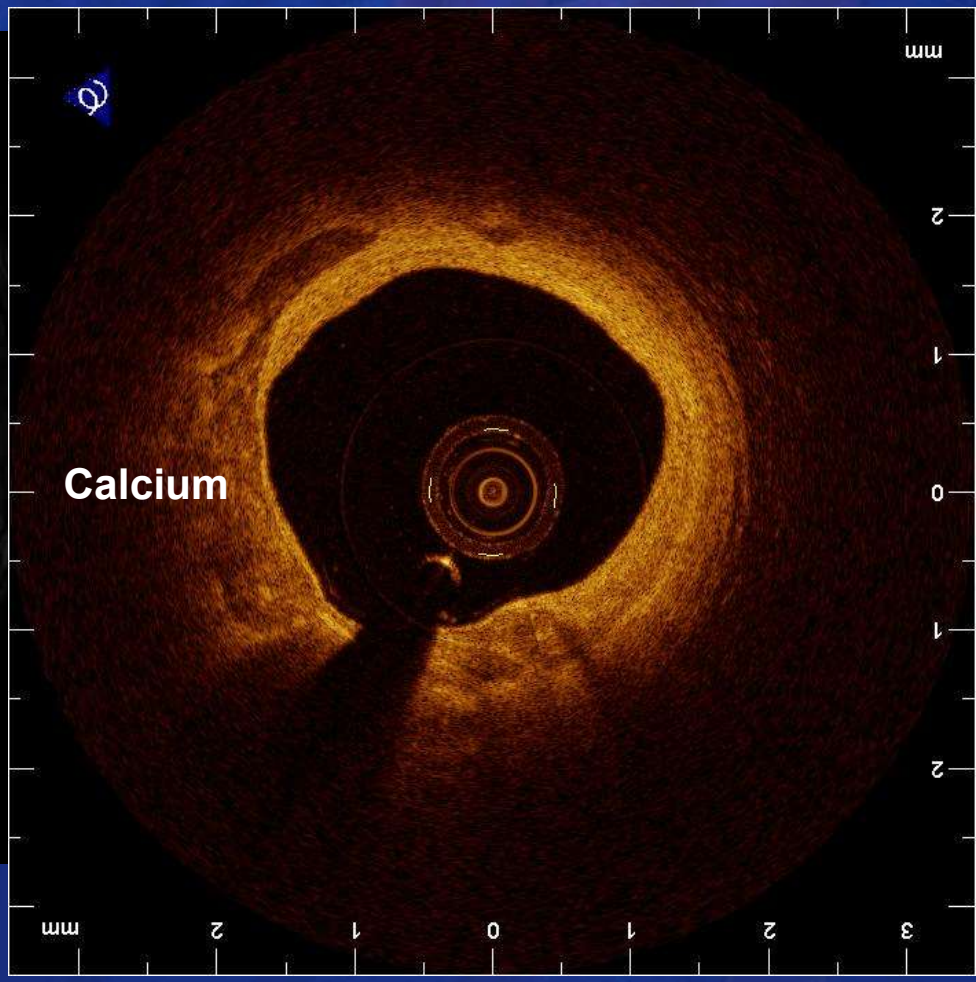
Severe Angiographic Calcification



Images courtesy of Jeff Chambers, MD

Calcified Plaque in IVUS and OCT





Images courtesy of Nabil Dib, MD

Coronary Calcification Is An Increasing Problem

Advanced Age

- 40.3M 65+ years old in U.S.[1]
- 85+ age group is fastest growing in U.S.[2]

Type I & II Diabetes

- Up to 26M in U.S.[3]
- Diabetes is fastest growing health problem in U.S.[4]

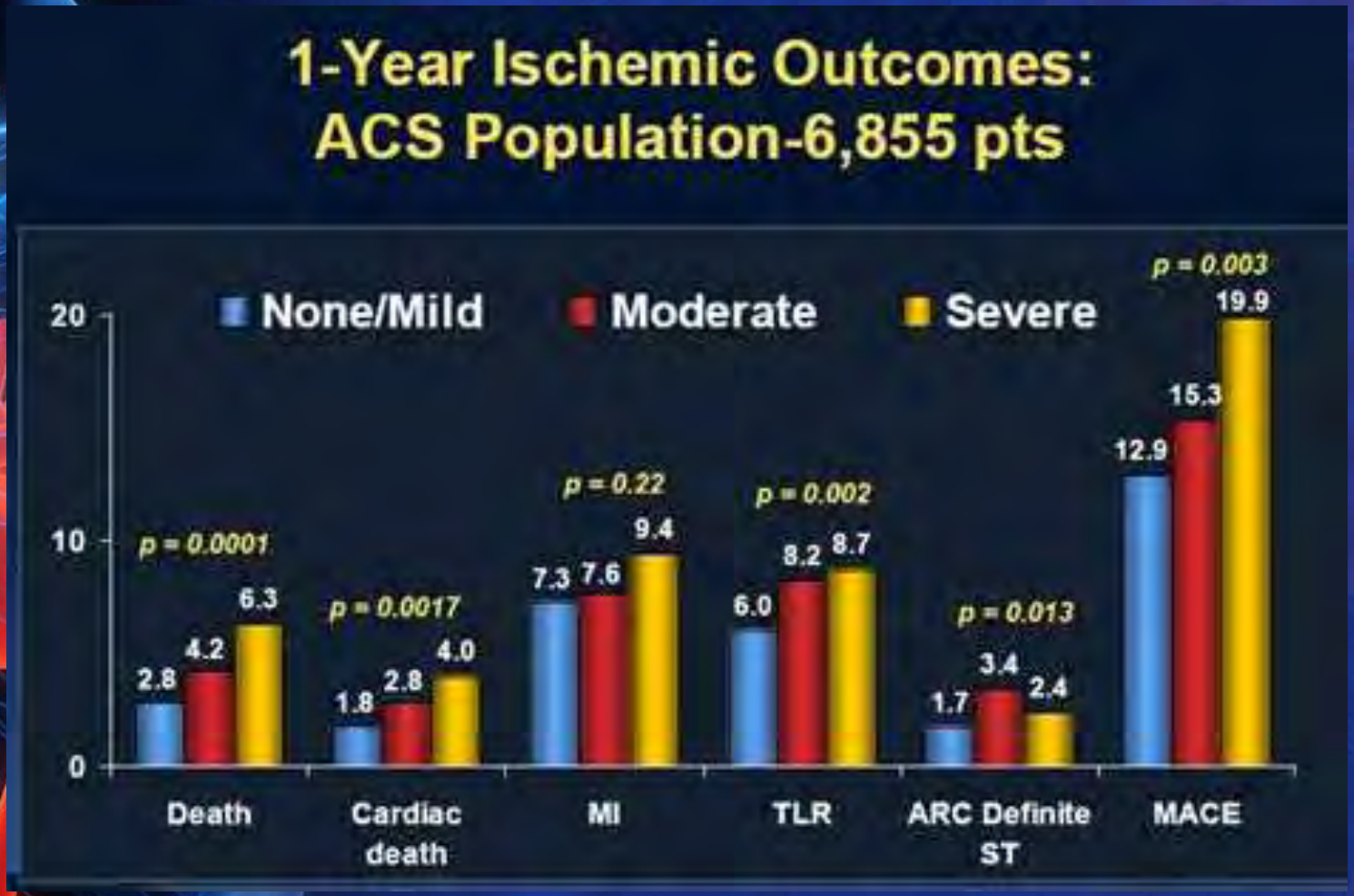
Kidney Disease

- Up to 31M in U.S.[5]
- Diabetes is leading cause of kidney failure

Intra-arterial Calcium

1. U.S. Census Bureau Website. http://www.census.gov/prod/cen2010/briefs/c2010br-03.pdf. Accessed July 30, 2013.
2. Older Americans 2012 Report Found on Federal Interagency Forum on Aging-Related Statistics Website. http://www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/Docs/EntireChartbook.pdf. Accessed August 14, 2013.
3. 2011 National Diabetes Fact Sheet Found on American Diabetes Association Website .http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf.Accessed August 14, 2013.
4. Diabetes Fact Sheet Fund on American Diabetes Association Website. http://main.diabetes.org/stepup/diabetes_facts.pdf. Accessed August 14, 2013.
5. American Kidney Fund Website. http://www.prnewswire.com/news-releases/american-kidney-funds-annual-gala-the-hope-affair-celebrates-40-years-of-caring-on-october-25-along-with-spokesperson-laila-ali-131975873.html. October 17, 2011. Accessed July 30, 2013.

Acuity/Horizon Trials



Images courtesy of Philippe Généreux, MD

Coronary Calcification Management (Risk –vs- Benefit)

Stent Delivery

Stent Expansion

Drug absorption

No Reflow

Dissection

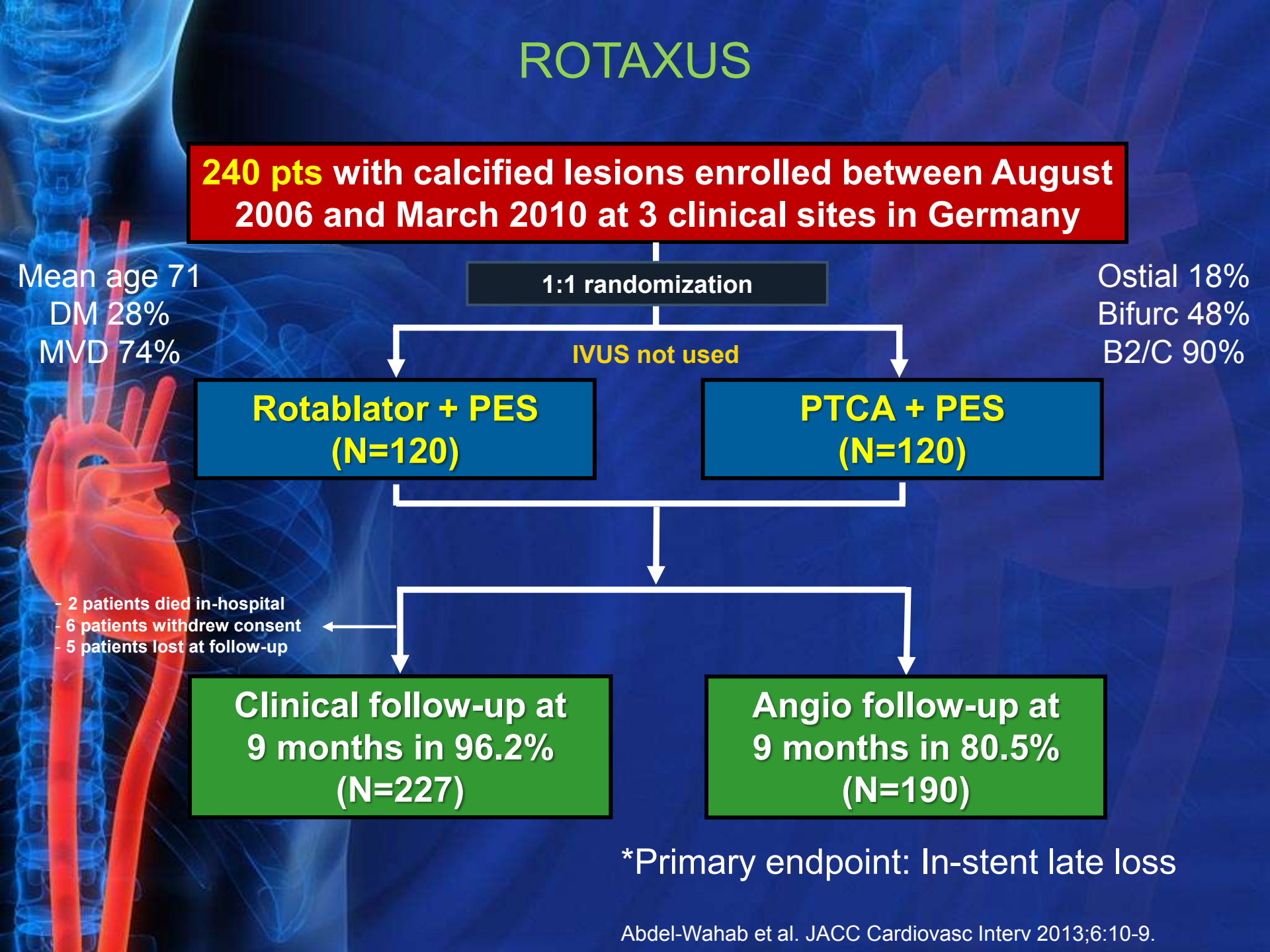
Perforation

Randomized Controlled Trials Of High-speed Rotational Atherectomy In Severe Calcified Coronary Lesions

Author	Year	N	Intervention	Outcomes
Dill et al.	2000	502	RA and PTCA	RA/PTCA vs. PTCA showed *comparable rates* of procedural success and adverse outcomes
Whitlow et al.	2001	500	RA ± PTCA	Aggressive RA with minimal ballooning offers *no advantage* over standard burr sizing followed by PTCA.
Abdel-Wahab et al.	2013	240	RA and DES	Greater acute gain but *no difference in 9-month outcomes*.

Madhavan MV, Généreux, P et al. J Am Coll Cardiol 2014 in Press

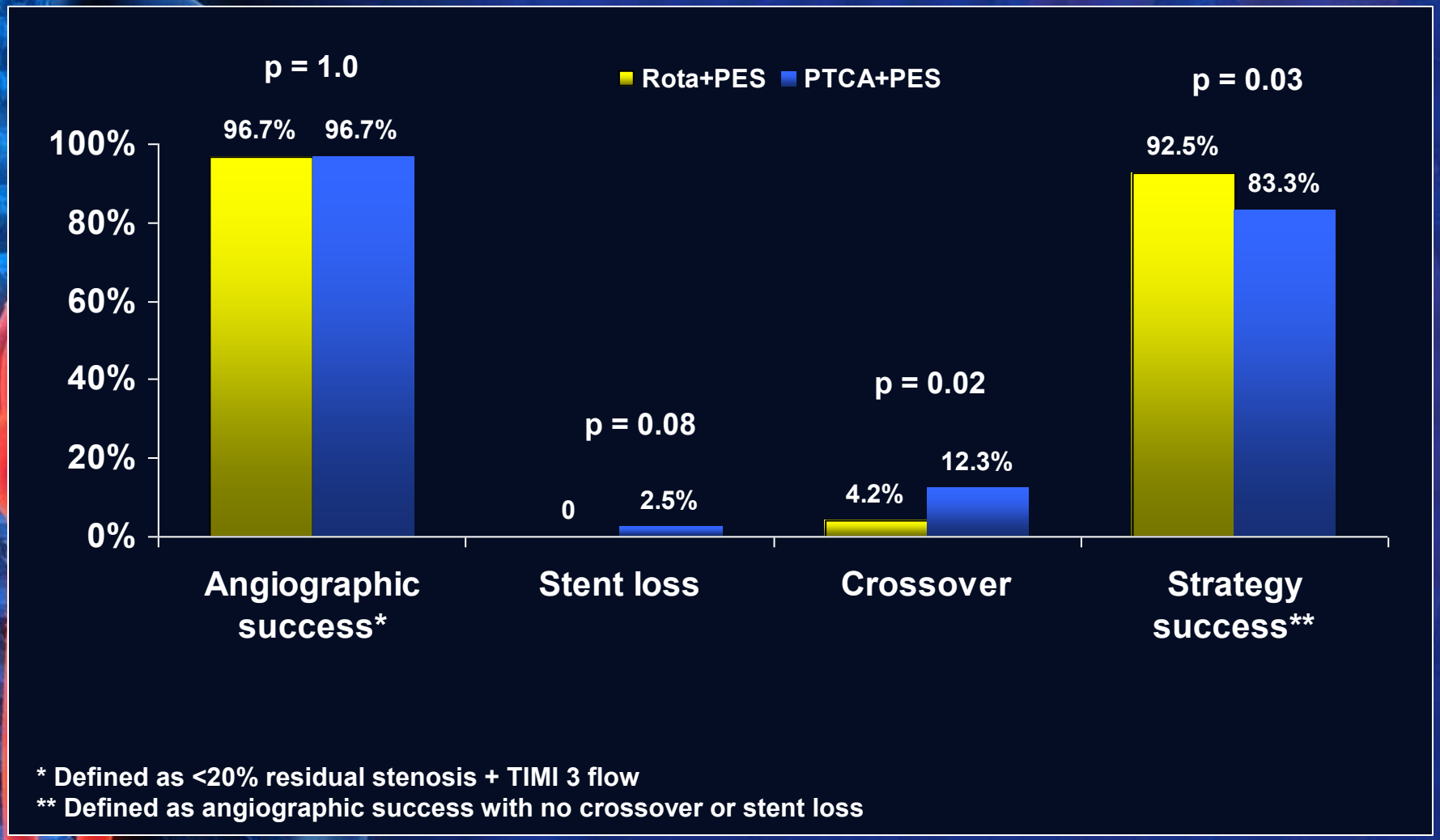
ROTAXUS



*Primary endpoint: In-stent late loss

Abdel-Wahab et al. JACC Cardiovasc Interv 2013;6:10-9.

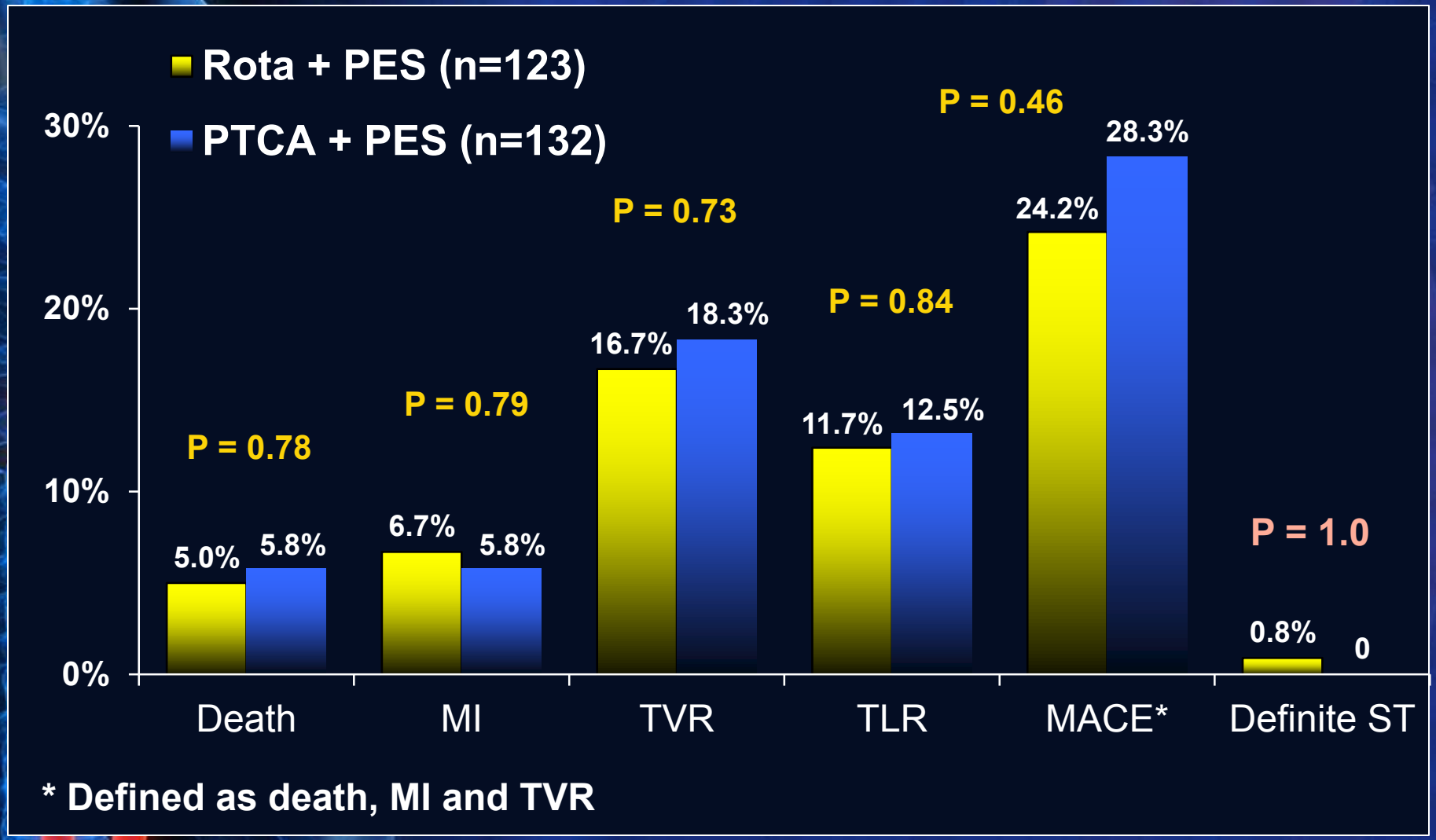
ROTAXUS: Procedural Outcomes



* Defined as <20% residual stenosis + TIMI 3 flow
** Defined as angiographic success with no crossover or stent loss

Abdel-Wahab et al. JACC Cardiovasc Interv 2013;6:10-9.

ROTAXUS: 9-month Follow-up



Abdel-Wahab et al. JACC Cardiovasc Interv 2013;6:10-9.

New Treatment for Severely Calcified Lesions

Diamondback 360®

coronary orbital Atherectomy system

Device Features

- Simple device setup
- Microsecond feedback to changes in loading
- 135cm usable length

On-handle speed control

- Low (80K) and High Speed (120K)

Power on/off switch

- 8 cm axial travel

6Fr Guide Compatible Saline Sheath

Electric motor powered handle

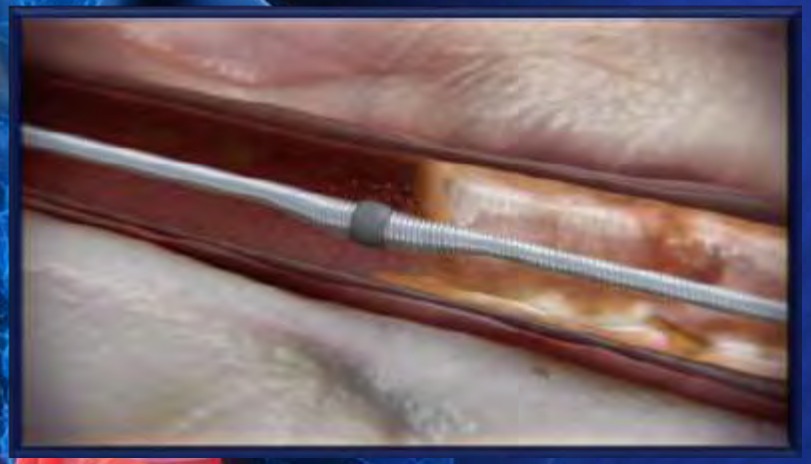
Saline Infusion Pump

- Mounts directly on to an IV pole
- Provides power
- Delivers fluid
- Includes saline sensor

ViperSlide® Lubricant

- ViperSlide reduces friction during operation
- 20ml ViperSlide per liter of saline

The Physics that Drive the System



Centrifugal Force

$$F_C = \frac{mv^2}{R}$$

F_C Centrifugal Force

- Moving the crown outward from its axis allowing it to treat lesions in different vessel diameters

m Mass

- The mass of the crown
- Directly proportional
  - As Mass increases, Centrifugal Force increases

v Velocity

- Device rotational speed
- Directly proportional
- Exponential relationship

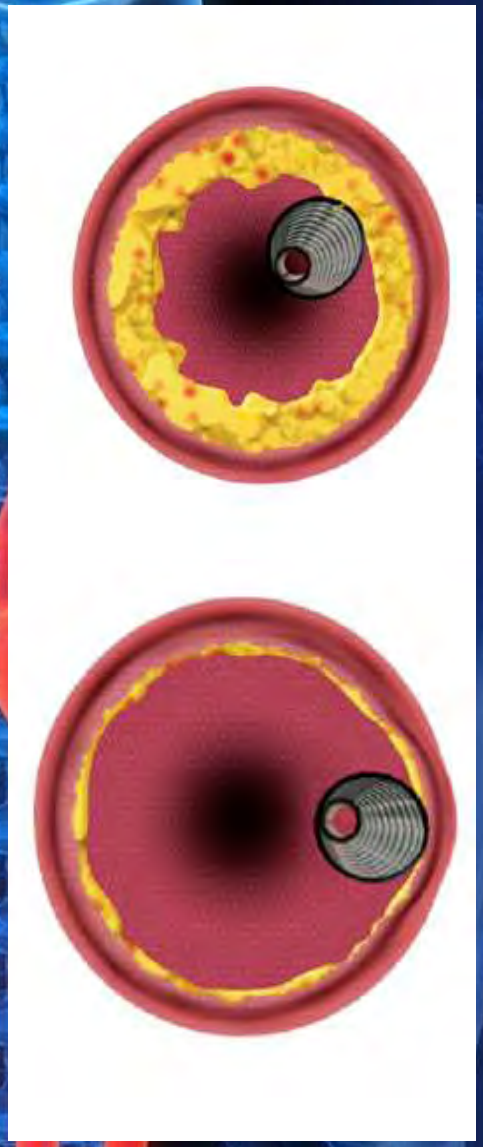
Classic	
Speed	Force Multiplier
80k rpm	Baseline
120k rpm	2.25x

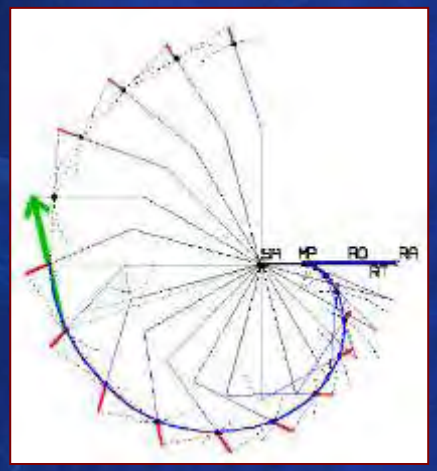
R Radius of Rotation

- Inversely proportional

- As Radius increases, Centrifugal Force decreases

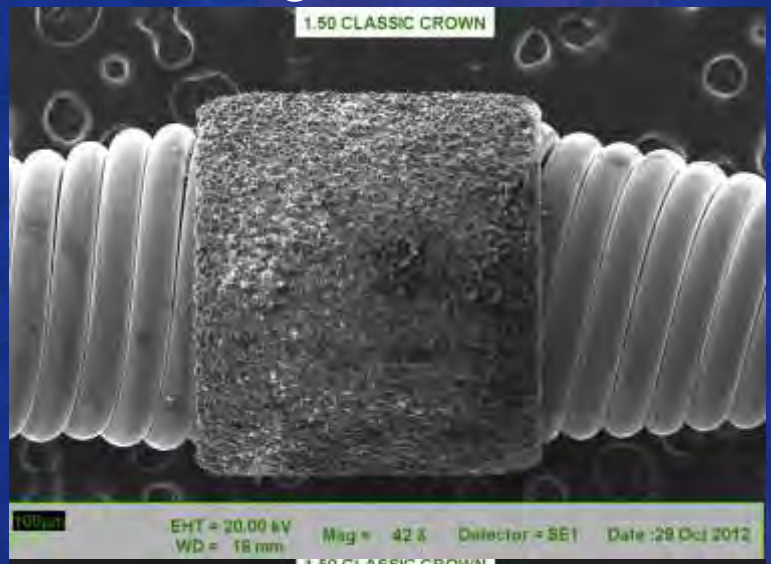
The Physics that Drive the System
10 Microns of Exposed Cutting Surface

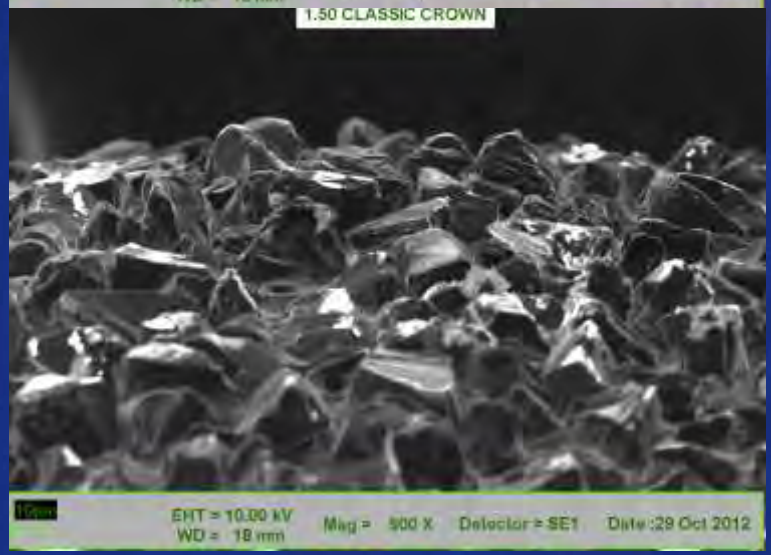




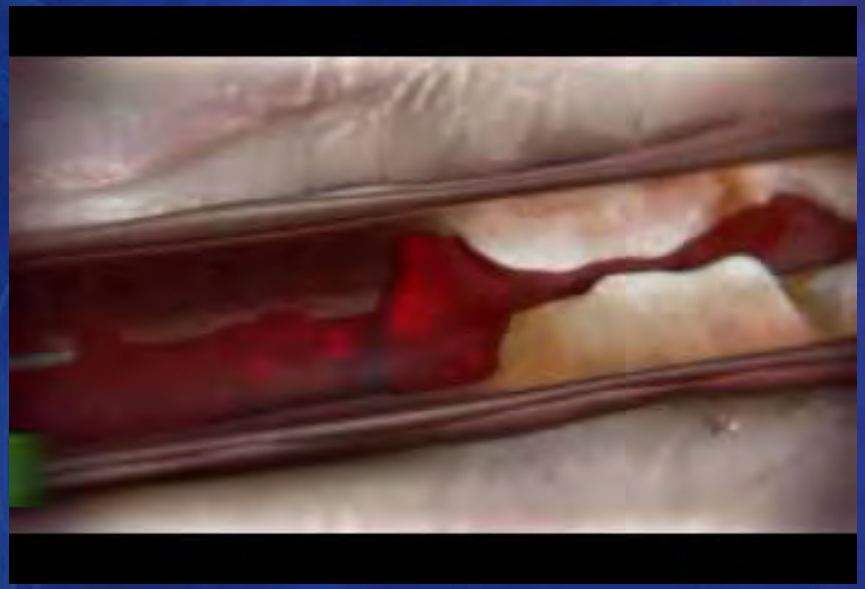
Differential Sanding

Healthy elastic tissue flexes away minimizing damage to the vessel.





Rotational Atherectomy



Orbital Atherectomy

Orbital Atherectomy Clinical Trials
ORBIT I, ORBIT II, MACE

ORBIT I: First In MAN

- The ORBIT I study
  - Prospective, non-randomized first in man trial, two centers in India
- 50 patients
  - At least >90 degrees of calcification via IVUS treated with the OAS prior to stent placement

	6 month Follow-up	3 Year Follow up Single center
MACE	**6.0% (3/50)**	**18.2% (6/33)**
Cardiac Death	**2.0% (1/50)**	**9.1% (3/33)**
Q-wave MI	**0**	**0**
Non Q-wave MI	**6.0% (3/50)**	**6.1% (2/33)**
TLR	**2.0% (2/50)**	**3.0% (1/33)**

ORBIT II Study Design

- To evaluate safety and efficacy of the Diamondback Coronary OAS to prepare *de novo*, **severely calcified coronary lesions** for enabling stent placement
  - Prospective, multi-center trial
  - Single arm - As there are no FDA-approved percutaneous treatments for patients with severely calcified lesions.

N=443 enrolled in 49 U.S. sites

↓

30 days follow-up
(N=437/440)

↓

1 year follow-up
(N=433/440)

Orbit II Inclusion/Exclusion Criteria

Key Inclusion:

- The target lesion must have fluoroscopic or IVUS evidence of severe calcium: Presence of radiopacities noted without cardiac motion prior to contrast injection involving both sides of the arterial wall with calcification length of at least 15 mm and extend partially into the target lesion or presence of ≥ 270° of calcium at one cross section via IVUS
- The target vessel reference diameter ≥ 2.5 mm and ≤ 4.0 mm and lesion must not exceed 40 mm in length

Key Exclusion:

- Diagnosed with chronic renal failure (CR >2.5 mg/dl) unless under hemodialysis
- Evidence of current LVEF ≤25%
- More than 1 lesion requiring intervention unless the lesions are staged
- In-stent treatment
- Target lesion is an ostial location, bifurcation or has a ≥ 1.5 mm side branch
- Target lesion has thrombus or dissection
- Angio evidence of dissection prior to initiation of OAD

ORBIT II Study Objective 1
Efficacy

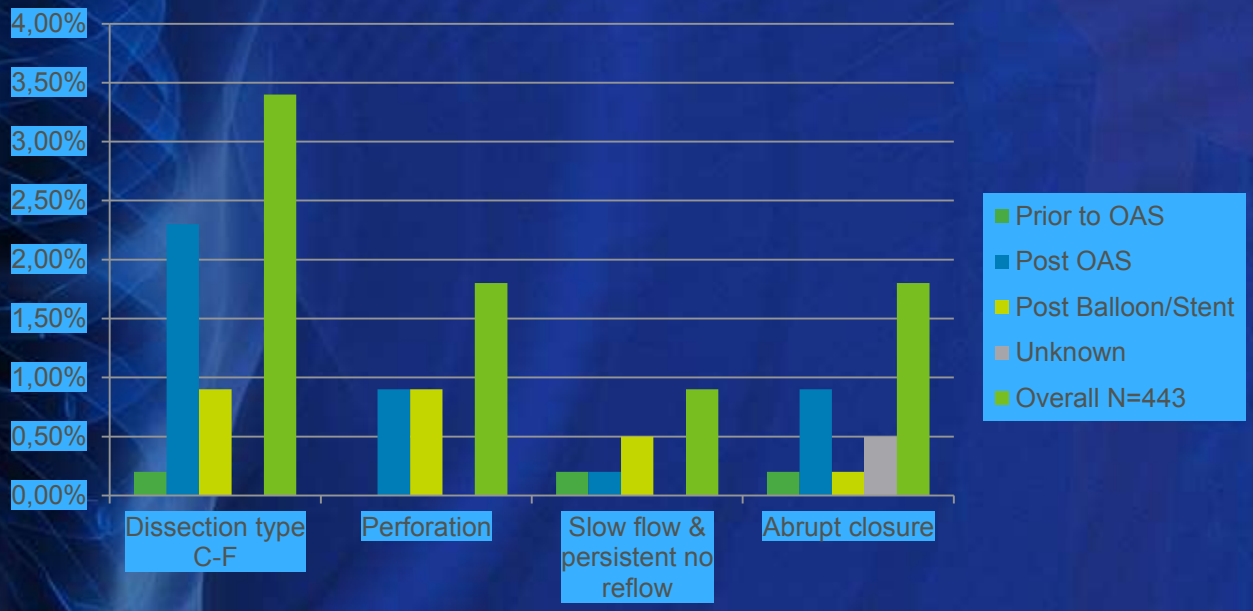
Demonstrate that the OAS successfully facilitates stent deployment in severely calcified coronary lesions

Successful Stent delivered:	**97.7%**
Less than 50% residual stenosis:	**98.6%**

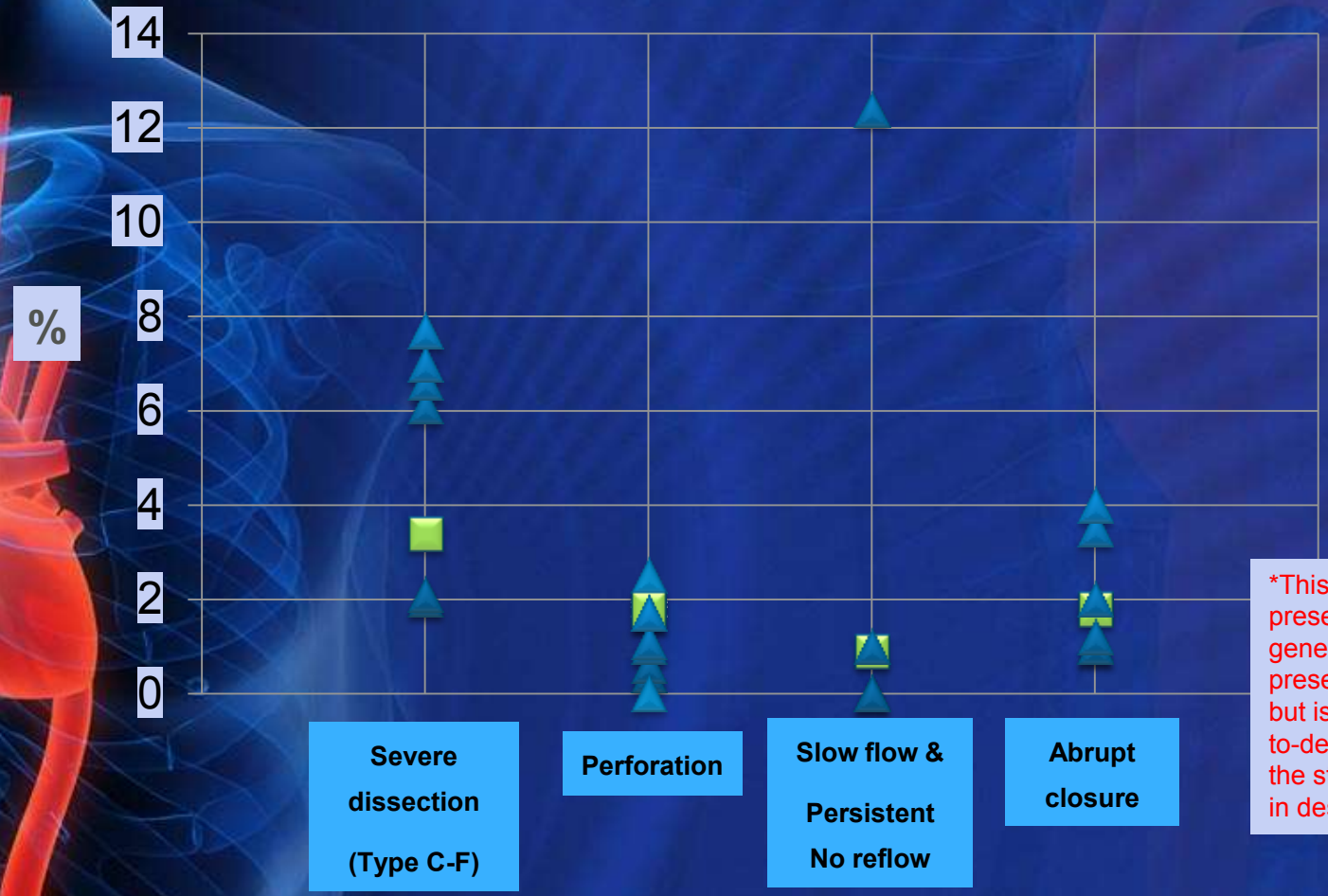
ORBIT II Angiographic Complications

Subjects with severe angiographic complications
Overall 7.2%

Criteria	Prior to OAS	Post OAS	Post Balloon/Stent	Unknown	Overall N=443
Subjects with severe angiographic complications					**7.2%**
Dissection Type C- F	0.2%	2.3%	0.9%	0.0%	3.4%
Perforation	0.0%	0.9%	0.9%	0.0%	1.8%
Slow flow & Persistent no reflow	0.2%	0.2%	0.5%	0.0%	0.9%
Abrupt closure	0.2%	0.9%	0.2%	0.5%	1.8%



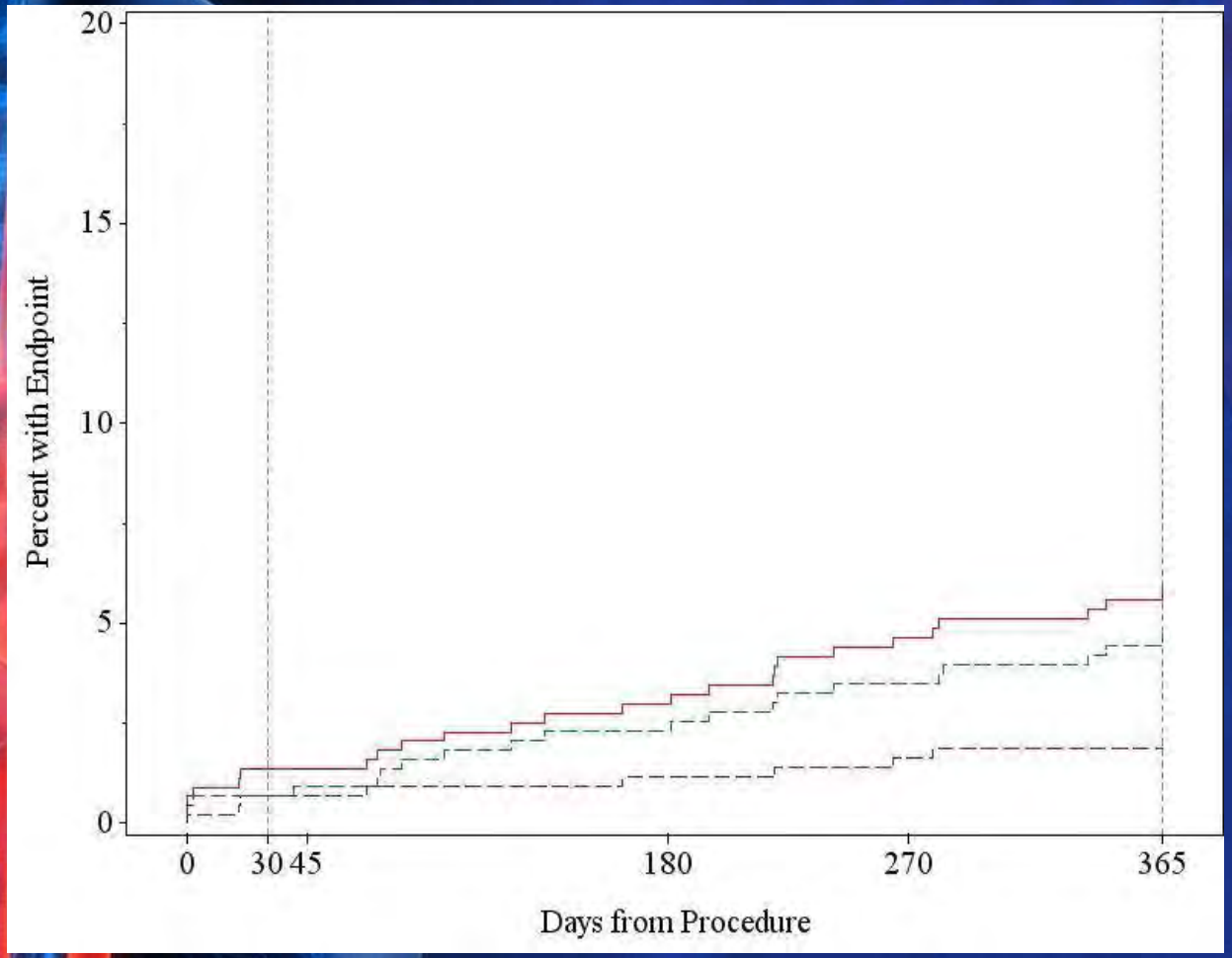
ORBIT II Angiographic Complications within Range of Rotablator Literature (RA)[1*]



*This summary presentation shows the general adverse events as presented in the literature, but is not a direct device-to-device comparison since the studies described vary in design.

1. RA References: Abdel-Wahab (2013), Bersin (1999),Brown (1997),Clavijo (2006), Furuichi (2009), Garcia de Lara (2010), Henneke (1999), Levin (1998), Mauri (2003), Rathore (2010), Reisman (1997), Tsubokawa (2003). Note: some references did not report all complications in scatter plot.

ORBIT II: 1-year Outcomes
TVR/TLR



TVR/TLR: 5.9%

TLR: 4.7%

TVR (non-TLR): 1.9%

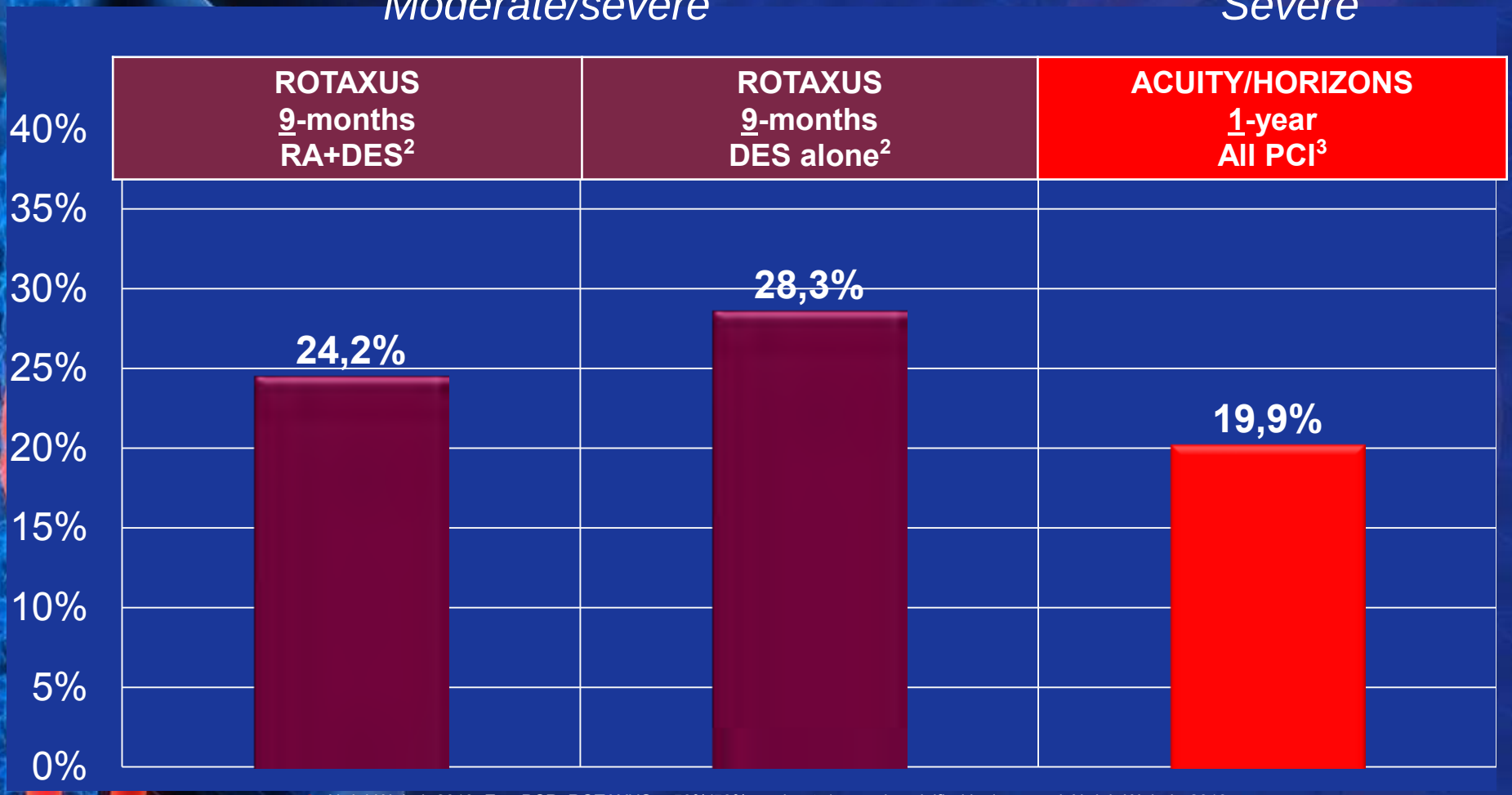
9-12 Months MACE In Patients With Severe Coronary Calcium

Severe

*This summary presentation shows results as presented in the literature, but is not a direct device-to-device comparison since the studies described vary in design.

1. Chambers, 2014, Data on file at CSI, ORBIT II, 100% severely calcified lesions

9-12 Months MACE In Patients With Coronary Calcium

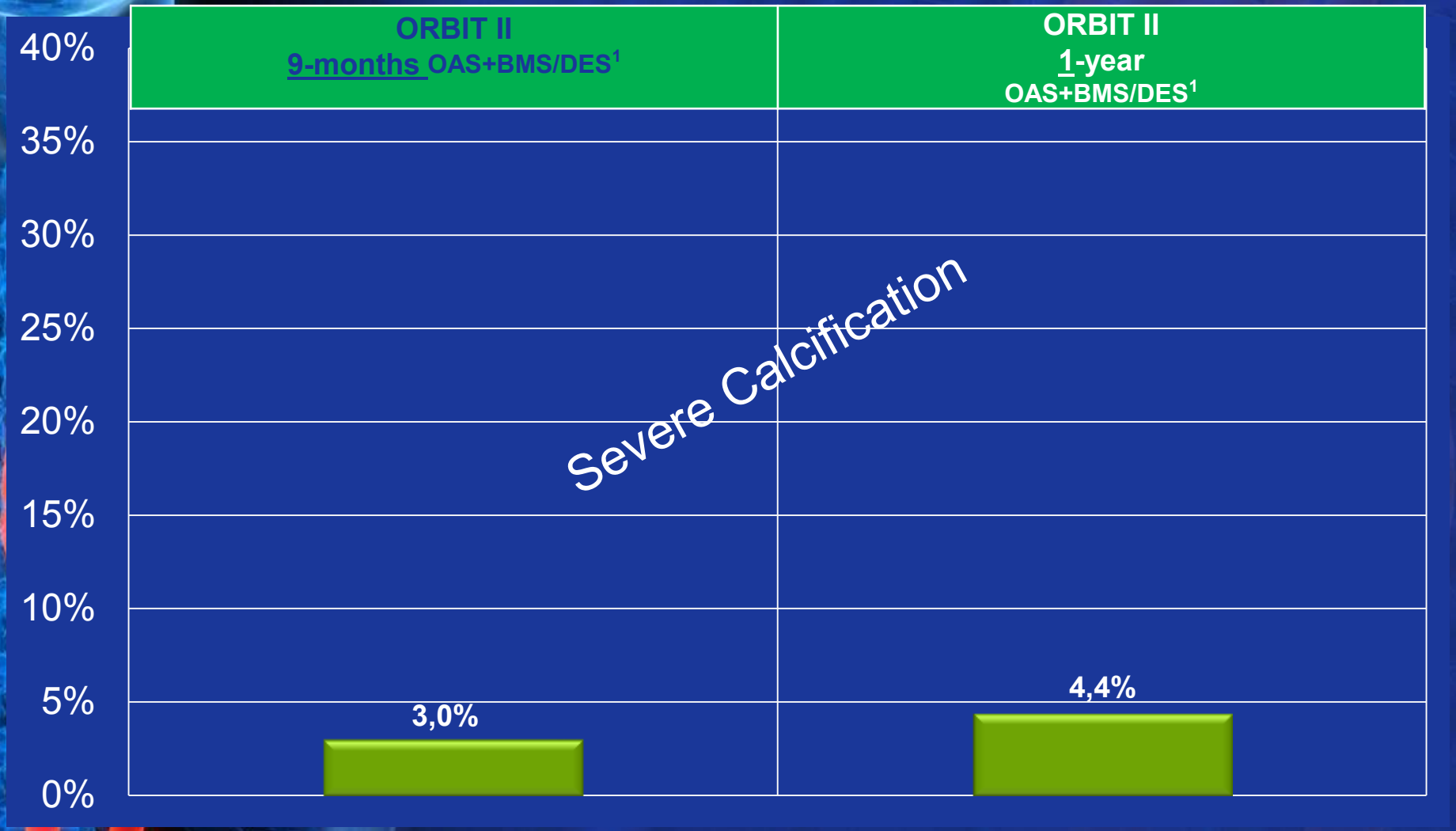


2. Abdel-Wahab 2013, EuroPCR, ROTAXUS, ~50%/50% moderate/severely calcified lesions, and Abdel- Wahab, 2013 JACC:CI

3. Genereux, 2013, TCT, ACUITY/HORIZONS Subanalysis, 100% severely calcified lesions

*This summary presentation shows results as presented in the literature, but is not a direct since the studies described vary in design.

Mortality

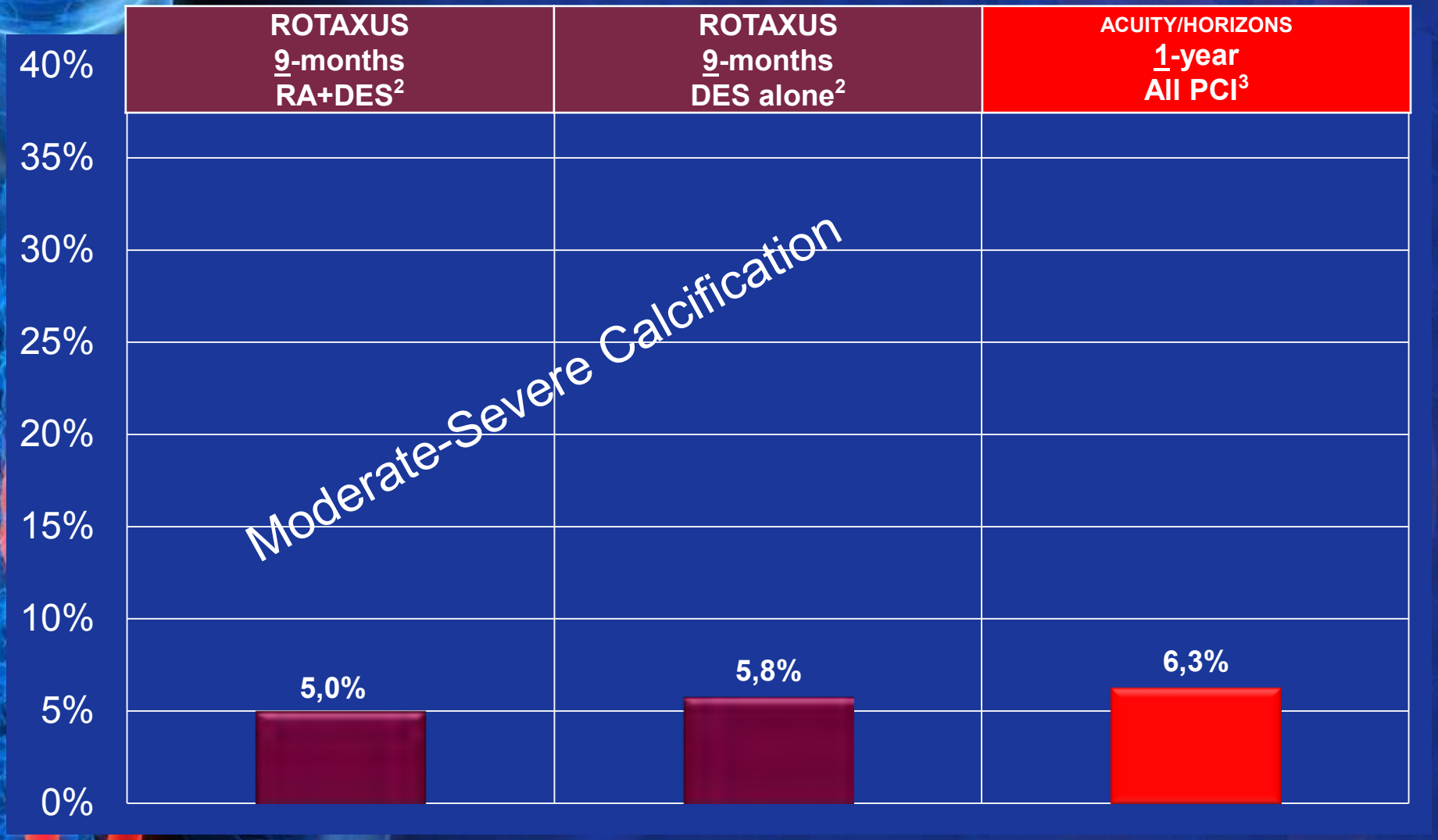


1. Chambers, 2014, Data on file at CSI, ORBIT II, 100% severely calcified lesions

This summary presentation shows results as presented in the literature, but is not a direct device-to-device comparison since the studies described vary in design.

Mortality

Severe

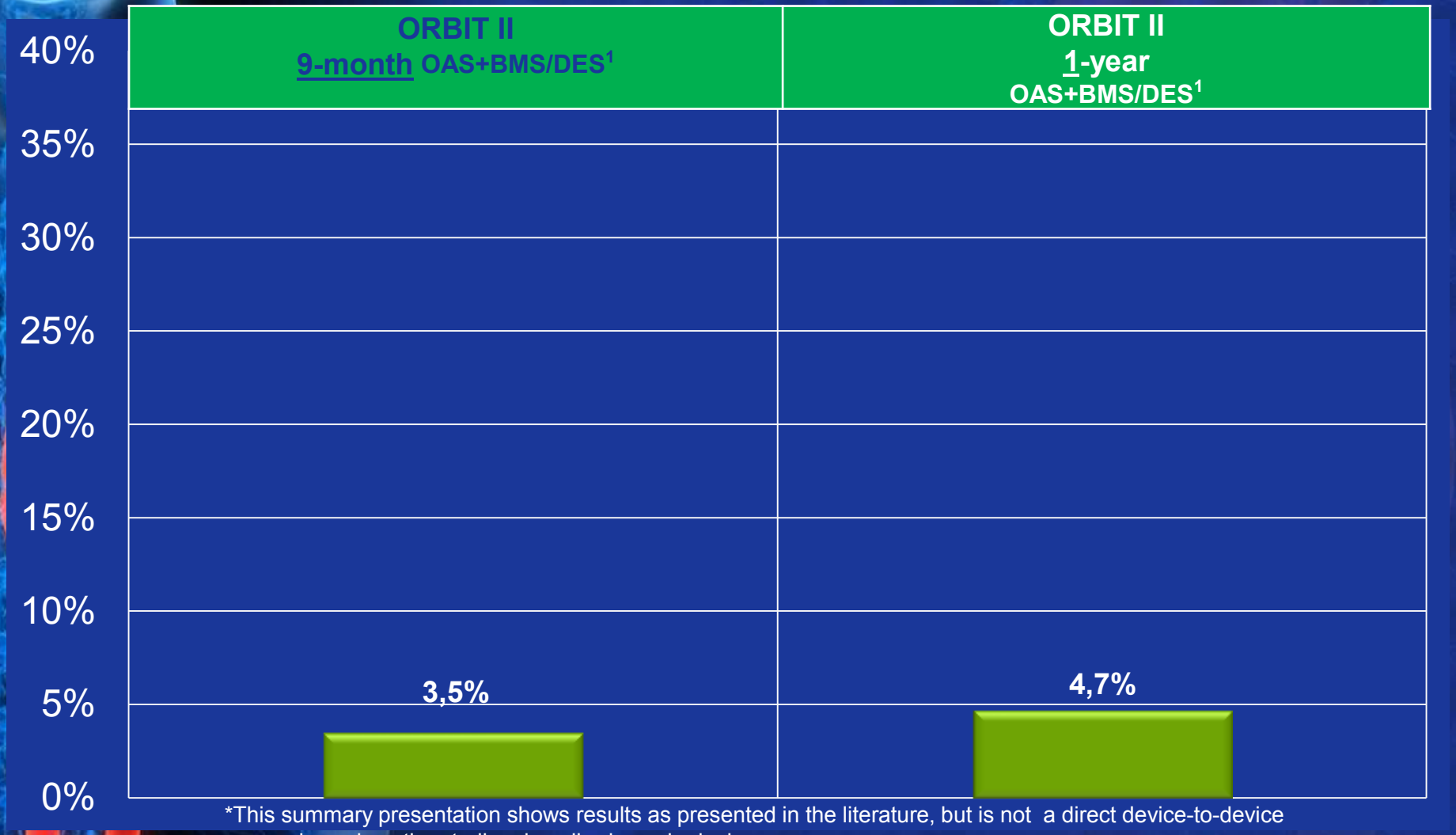


2. Abdel-Wahab 2013, EuroPCR, ROTAXUS, ~50%/50% moderate/severely calcified lesions, and Abdel- Wahab, 2013 JACC:CI
3. Genereux, 2013, TCT, ACUITY/HORIZONS Subanalysis, 100% severely calcified lesions

presented in the literature, but is not a
e-to-device comparison since the studies described vary in design.

TLR

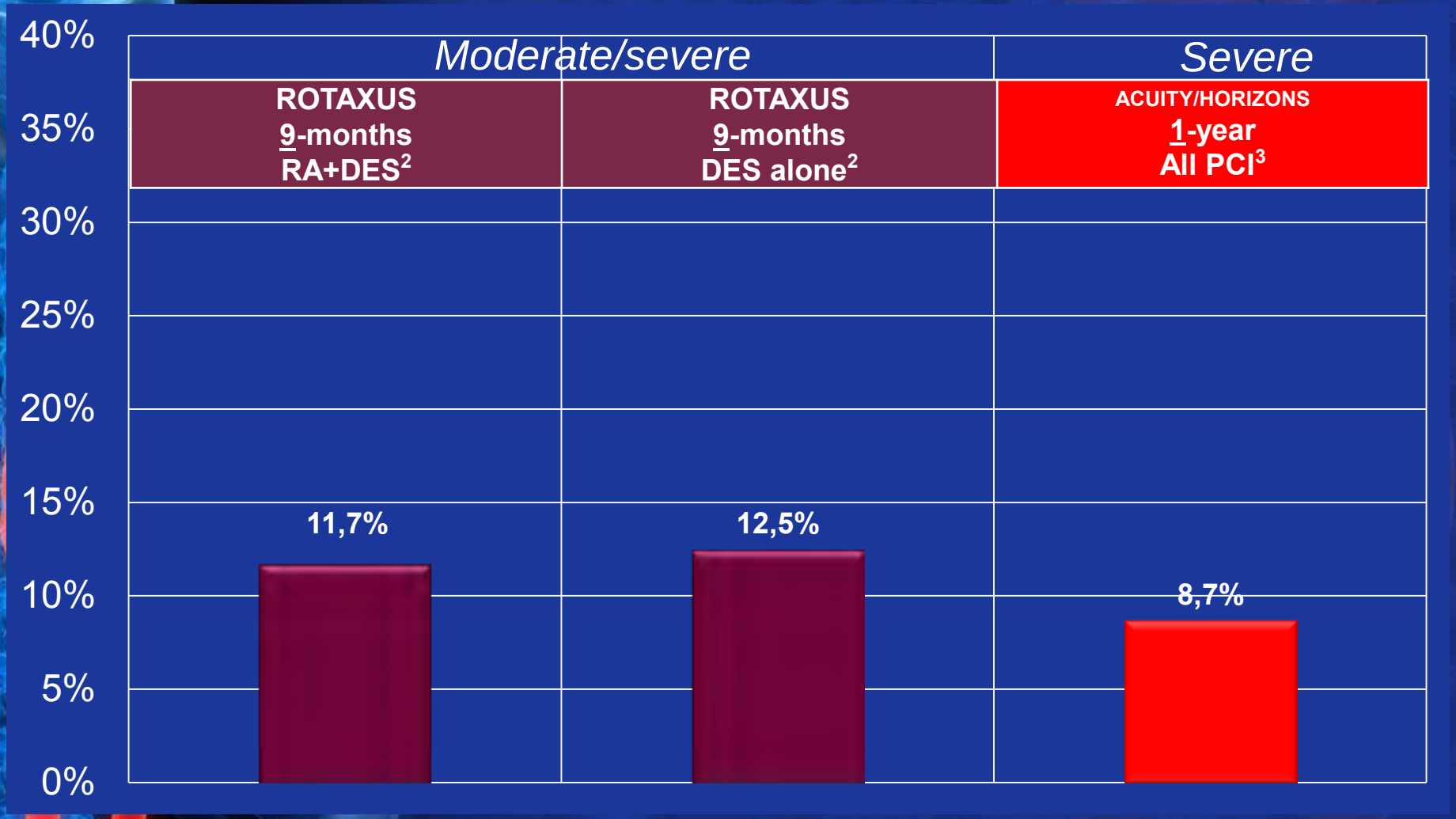
Severe



*This summary presentation shows results as presented in the literature, but is not a direct device-to-device comparison since the studies described vary in design.

1. Chambers, 2014, Data on file at CSI, ORBIT II, 100% severely calcified lesions

TLR



"This summary presentation shows results as presented in the literature, but is not a direct device-to-device comparison since the studies described vary in design."

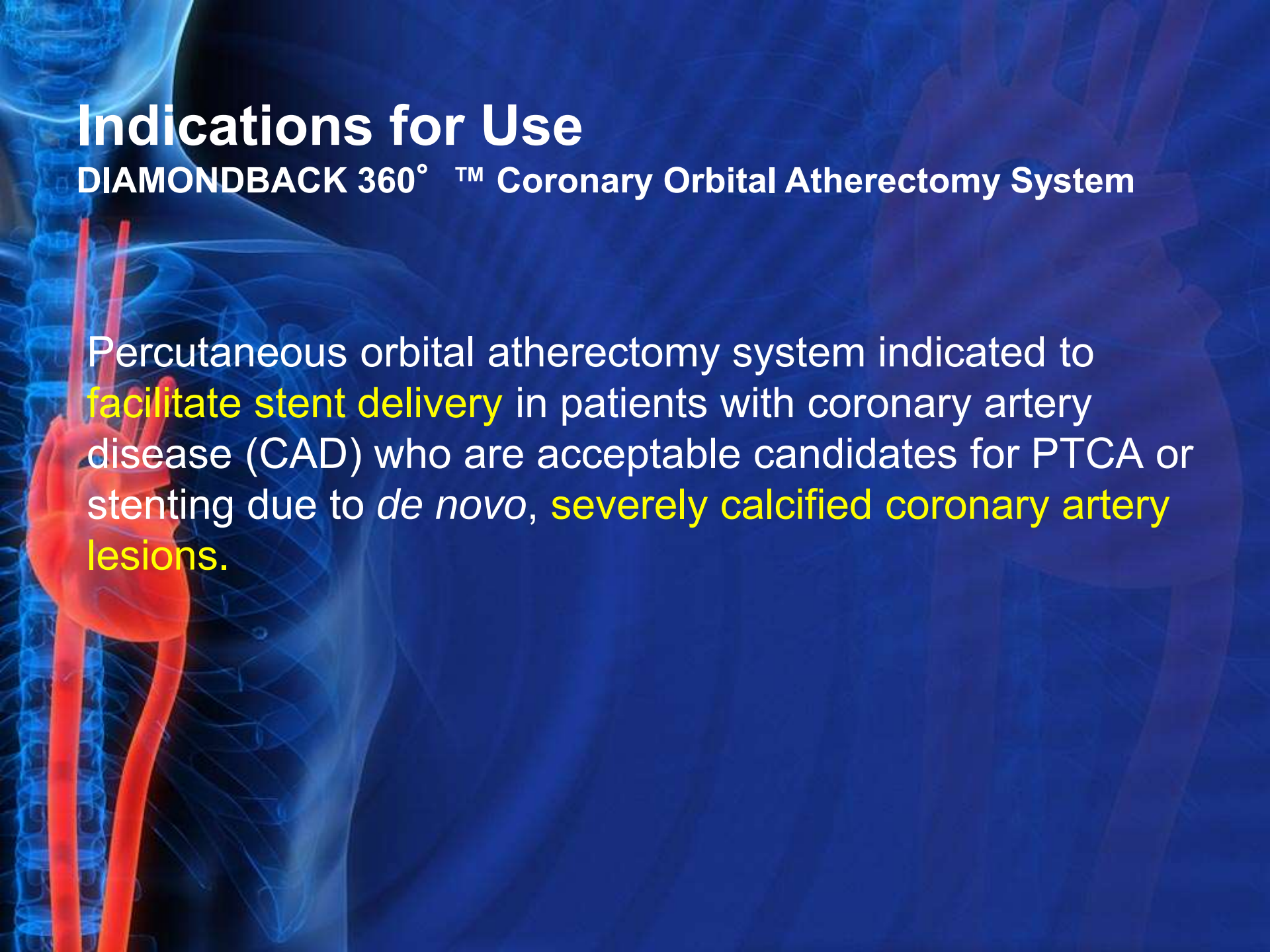
2. Abdel-Wahab 2013, EuroPCR, ROTAXUS, ~50%/50% moderate/severely calcified lesions, and Abdel- Wahab, 2013 JACC:CI
3. Genereux, 2013, TCT, ACUITY/HORIZONS Subanalysis, 100% severely calcified lesions

Conclusions

- The ORBIT II trial met the primary safety and efficacy endpoints by a significant margin
- ORBIT II demonstrated low MACE including mortality
- ORBIT II demonstrated low TVR rates
- The improvement in clinical outcomes might be attributed to the unique **mechanism of action** of OAS
- Using the Diamondback Coronary **OAS as a lesion preparation** tool prior to stent implantation offers patients with **severely calcified coronary lesions a new treatment option**

Indications for Use

DIAMONDBACK 360° ™ Coronary Orbital Atherectomy System



Percutaneous orbital atherectomy system indicated to facilitate stent delivery in patients with coronary artery disease (CAD) who are acceptable candidates for PTCA or stenting due to *de novo*, severely calcified coronary artery lesions.

Contraindications

DIAMONDBACK 360° ™ Coronary Orbital Atherectomy System

- **Contraindications Include**
  - The target lesion is within a bypass graft or stent.
  - The patient has angiographic evidence of thrombus.
  - The patient has only one open (patent) vessel.
  - The patient has angiographic evidence of dissection
- **Warning**: Performing treatment in excessively tortuous vessels or bifurcations may result in vessel damage:
    - take multiple views if unsure
    - May be unsuitable anatomy for atherectomy
- **Precaution:** A temporary pacing lead may be necessary when treating lesions in the right coronary and circumflex arteries due to the possible occurrence of electrophysiological alternations

Additional Considerations

- Lesion length: longer lesions will require additional runs, not longer runs
- Vessel diameter: 2.0mm* to 4.0mm**

*Based on minimum reference vessel diameter as determined by orbit testing in a carbon block model system

**Based on ORBIT II vessel range of 2.5mm to 4.0mm


Thank You