


State of the art lecture –
How to address highly calcified lesions

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Heart Centre, Lucerne Cantonal Hospital
LUCCA – Lucerne Complex and CALcified PCI Meeting 3.0
 Thursday, February 22, 2024 – Kultur- und Kongresszentrum AG, Lucerne
 14.30 – 17.30 – 5 Workshops, 18.00 opening session, 19.15 welcome dinner
 Friday, February 23, 2024 – Luzerner Kantonsspital, Lucerne
 8.30 – 12.00 – 4 Workshops

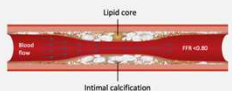
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Vascular calcification

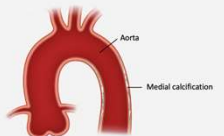
Intimal calcification

- Associated with atherosclerosis and plaque vulnerability:
- Forms in association with vascular smooth muscle cells (VSMCs), macrophages, and the necrotic lipid core
- More common in coronary arteries, aorta and peripheral arteries.
- Associated with luminal encroachment and downstream (direct) ischemia




Medial calcification

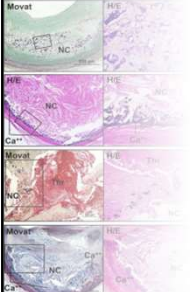
- Not associated with atherosclerosis:
- More common in aorta and peripheral arteries
- Not associated with luminal encroachment
- Associated with loss of "damping" function and rise in pulse pressure and "indirect" ischemia



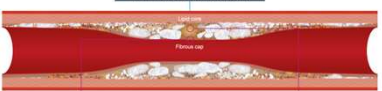
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Vascular calcification



Intimal calcification caused by




Vascular smooth muscle cells

- Associated with atherosclerosis and plaque vulnerability
- Microcalcification following apoptosis of vascular smooth muscle cells (VSMCs)
- Usually within fibrous cap

Macrophages

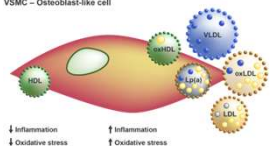
- Punctate calcification due to apoptosis of lipid laden macrophages
- Usually within lipid (necrotic) core (close to internal elastic lamina)

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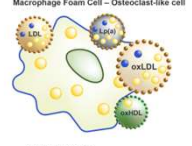
Vascular calcification

VSMC – Osteoblast-like cell



↓ Inflammation
 ↓ Oxidative stress
 ↓ Vascular calcification:
 ↓ ALP

Macrophage Foam Cell – Osteoclast-like cell

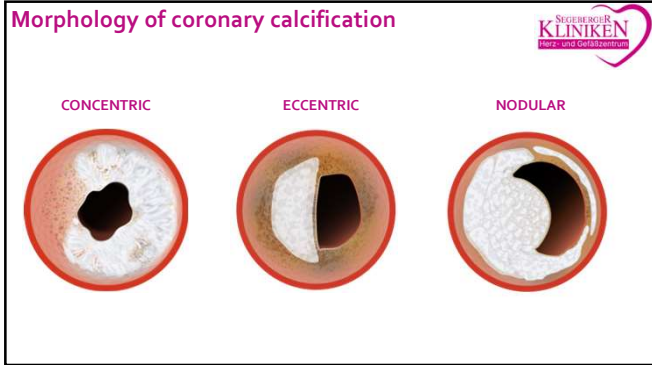


↑ Inflammation
 ↑ Oxidative stress
 ↑ Vascular calcification:
 ↑ RANKL, RANKL, ↑ OPG

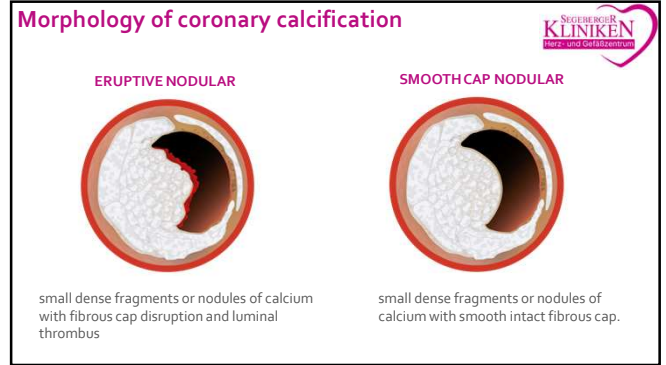
Impaired osteoclast functionalities
 ↓ Vascular calcification:
 ↓ Mineral receptors

Akers E et al. Atherosclerosis, Thrombosis, and Vascular Biology Volume 39, Issue 10, October 2019, Pages 1902-1910

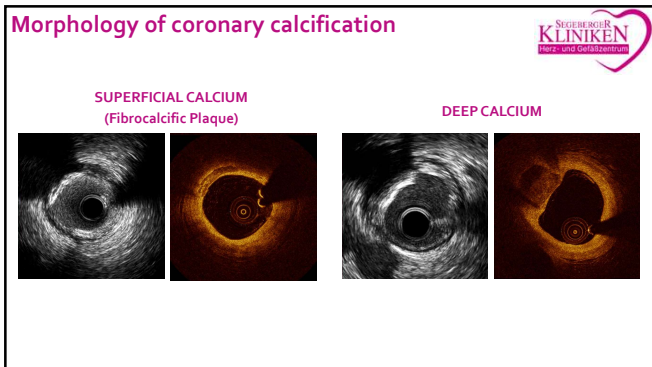
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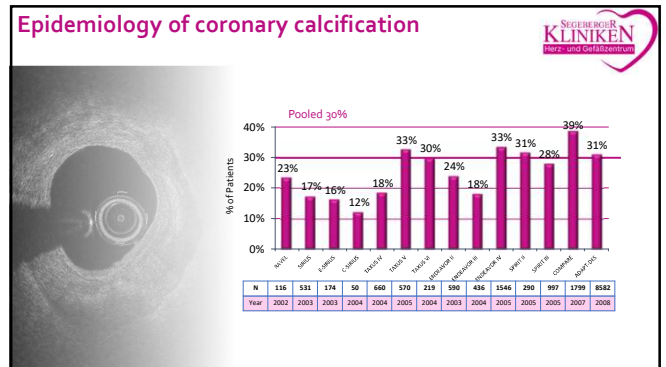
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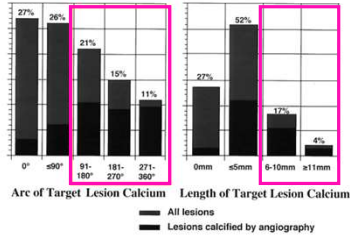
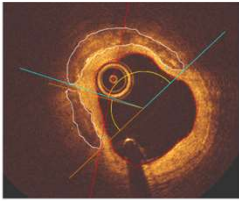


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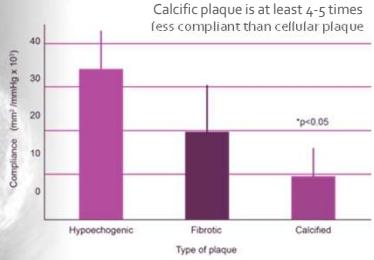
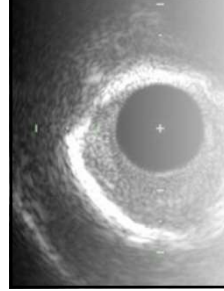
Distribution of coronary calcification



Mintz et al. Circulation 1995

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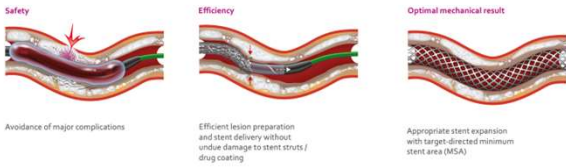
Effect of calcium on vessel compliance



Alfonso F et al. J Am Coll Cardiol. 1994

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Goals of PCI: The clinical need!



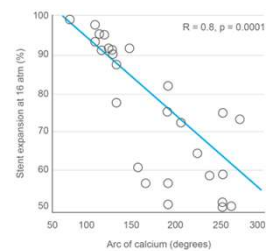
a) Fitzgerald et al. Circulation. 2000; b) Choi et al. Circ Cardiovasc Interv. 2011; c) Ahn et al. Am J Cardiol. 2014.

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Impact of calcium on PCI outcomes

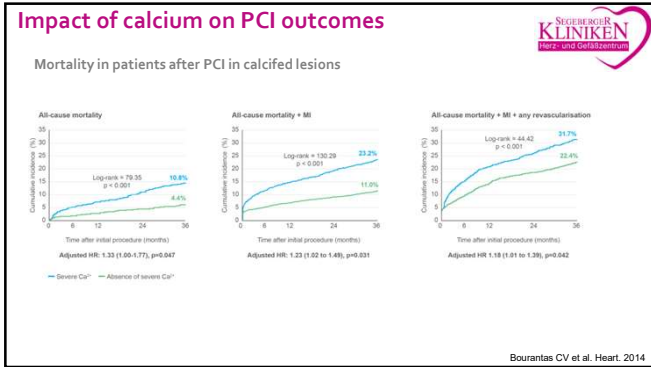


- ❖ The greater the arc of calcium and the less vessel compliance exists, the greater the likelihood of stent underexpansion
- ❖ Stent underexpansion is associated with MACE after PCI

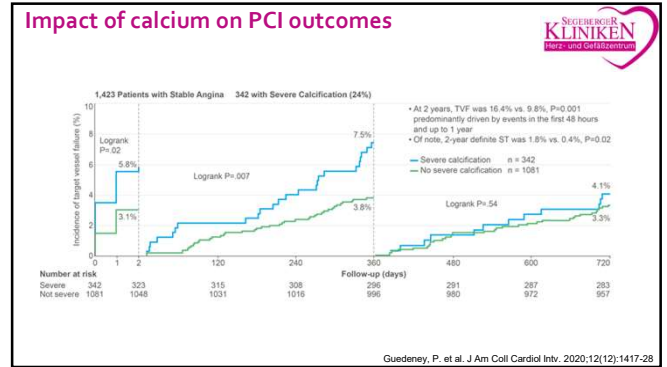


1. Mintz, G. I. J Am Coll Cardiol Imaging 2015;8(4): 461-71.
 2. Chambers JW, et al. J Am Coll Cardiol Intv 2014; 7:510-8.
 3. Généreux P, et al. JACC 2014; 63(18):1845-54

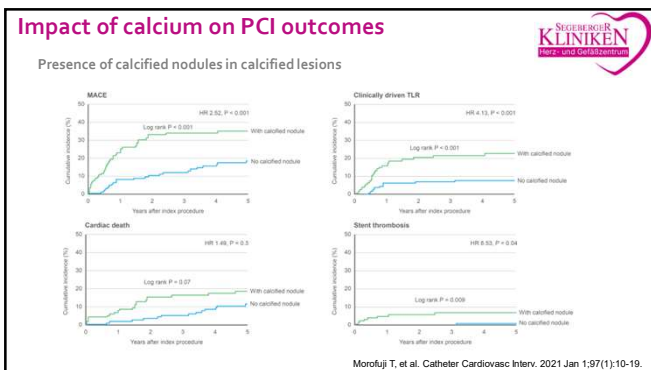
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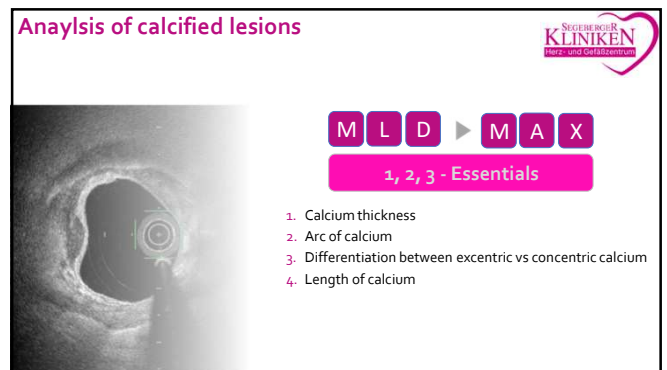
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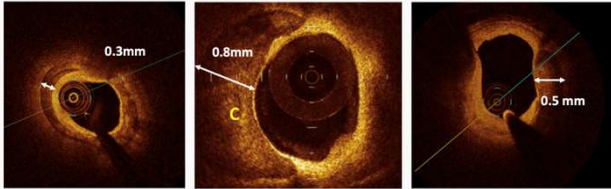


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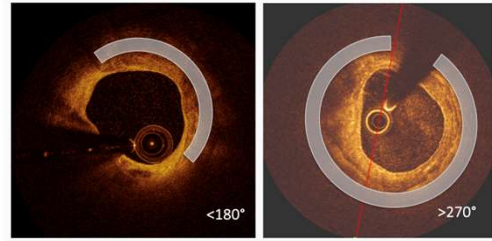
#1 Thickness of calcium



Nef et al. OCT Compendium 2018

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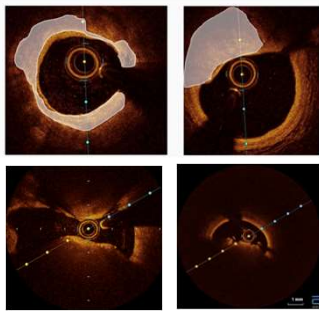
#2 Arc of calcium



Nef et al. OCT Compendium 2018

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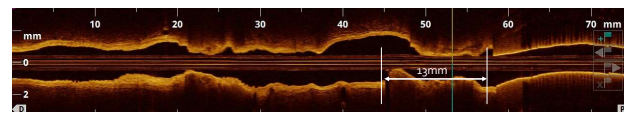
#4 Eccentric or concentric calcification



Nef et al. OCT Compendium 2018

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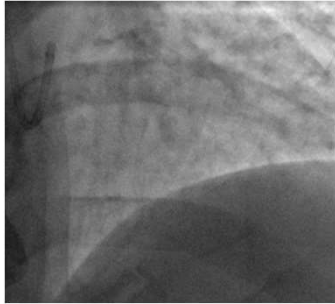
#5 Length of calcium



Nef et al. OCT Compendium 2018

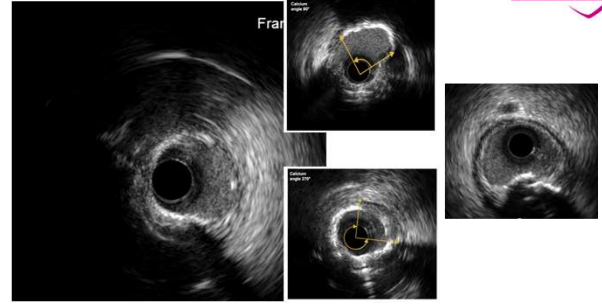
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Case example



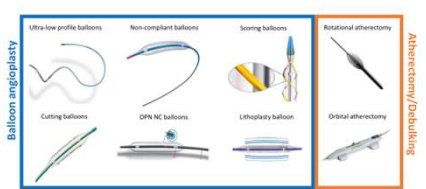
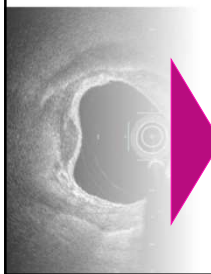
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Case example



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Tools of treatment



How to treat a calcified lesions first?



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Cutting-Balloon

Wolverine Cutting Balloon (Boston Scientific)

- Non-compliant Balloon

Stress distribution in the wall:

- Atherosclerotic Culprit Height: 127µm
- Human LAD Intima and Media Thickness: 300µm
- Human LAD Wall Thickness: 900µm

Stress distribution in the wall:

- Wolverine Stress: 0.25 MPa
- At Submax. Stress: 0.15 MPa
- At Submax. Stress: 0.10 MPa
- At Submax. Stress: 0.05 MPa
- At Submax. Stress: 0.00 MPa

Stress distribution in the wall:

- Maximum stress: 0.25 MPa
- Minimum stress: 0.00 MPa

Stress distribution in the wall:

- Stress distribution in the wall: 0.25 MPa
- Stress distribution in the wall: 0.15 MPa
- Stress distribution in the wall: 0.10 MPa
- Stress distribution in the wall: 0.05 MPa
- Stress distribution in the wall: 0.00 MPa



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Super high pressure balloon

OPN NC®
Offers economical and technical advantages to overcome a great number of your daily interventional challenges

TWIN-Wall Balloon design

- Unique balloon-in-balloon technology to withstand very high pressures for effective revascularization of complex lesions
- Providing uniform expansion

Folding Technology

- Trifold in all balloon diameters

Markers

- Dual PL/r markers for all balloon sizes

Low Lesion Entry Profile

- Lesion entry profile of OPN NC® is 0.035" comparable to standard lower RBP dilatation catheters
- Lesion entry profile* measured at the centre of the tip
- *Data on file

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Rotational Atherectomy

ROTAPRO®

1.25mm, 1.5mm, 1.75mm, 2.0mm

MASTER THE COMPLEX

Burr Diameter	Recommended Guide Catheter	Minimum ID Required
mm	cm	(cm)
1.25	0.13	6.0 (0.154)
1.50	0.15	6.0 (0.16)
1.75	0.18	7.0 (0.19)
2.00	0.20	8.0 (0.21)
2.15	0.22	8.0 (0.23)
2.25	0.23	9.0 (0.24)
2.38	0.24	9.0 (0.25)
2.50	0.25	10.0 (0.26)

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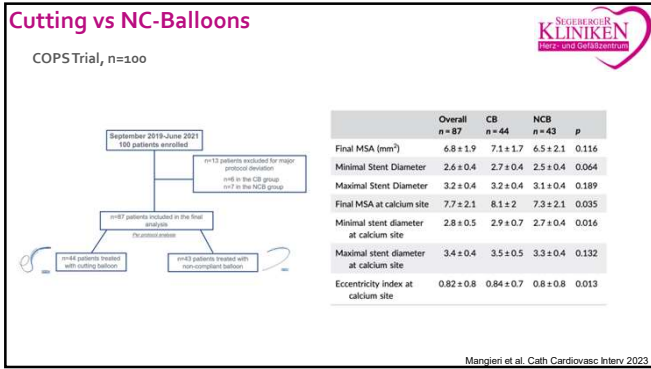
Intravascular Lithotripsy

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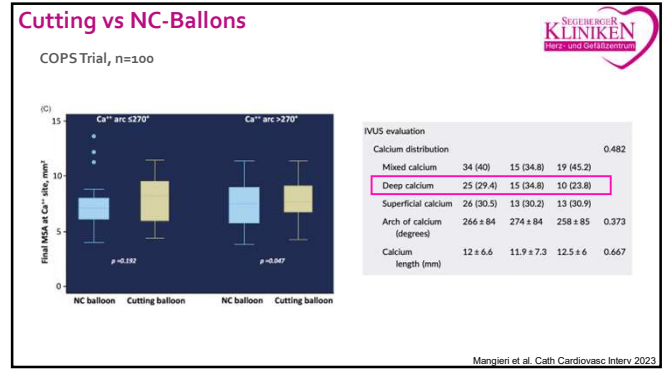
Orbital Atherectomy

GUIDE WIRE, HOSE CONE, CROWN (RADIAL WORK SURFACE), 8-FR GUIDE COMPATIBLE BORE TIP DESIGN, LEADING EDGE PROFILE, 0.037" ± 0.03 mm, 0.041" ± 0.02 mm, 0.027" ± 0.02 mm

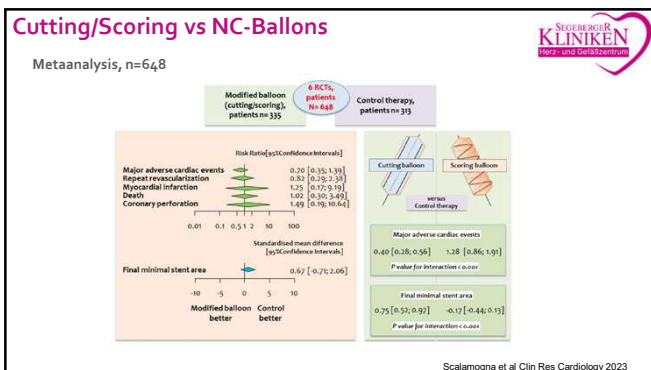
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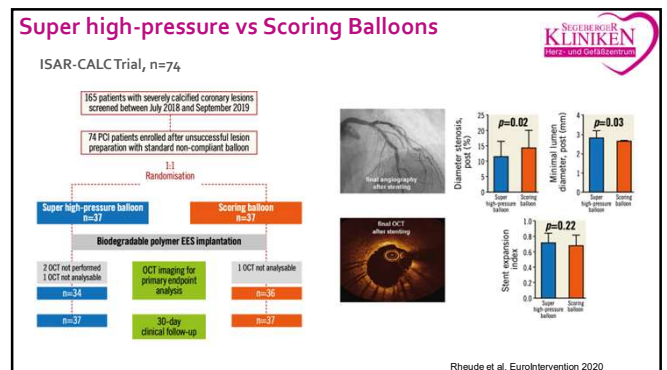
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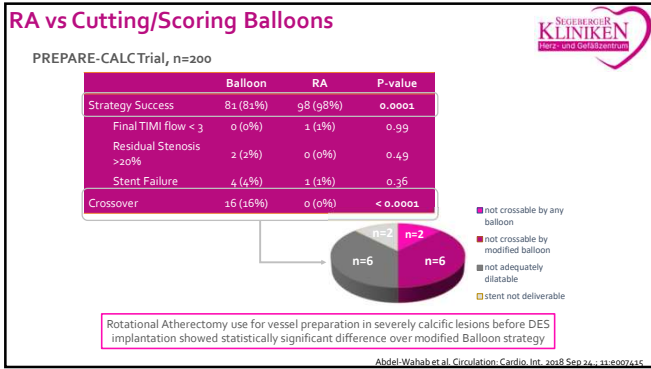
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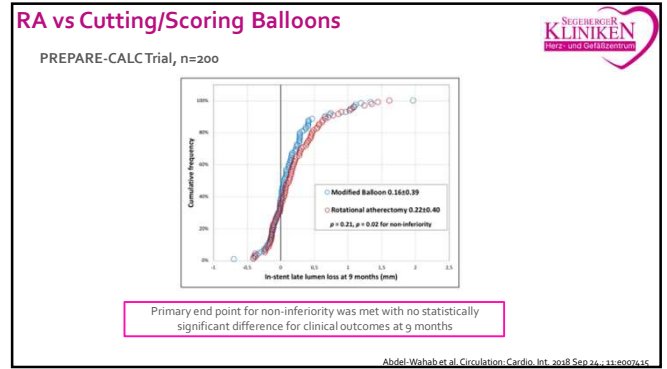
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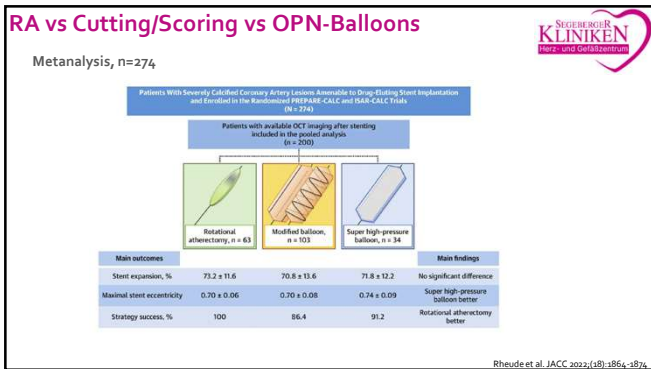
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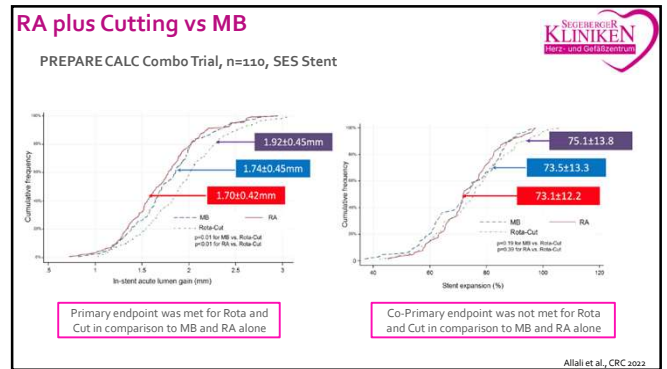
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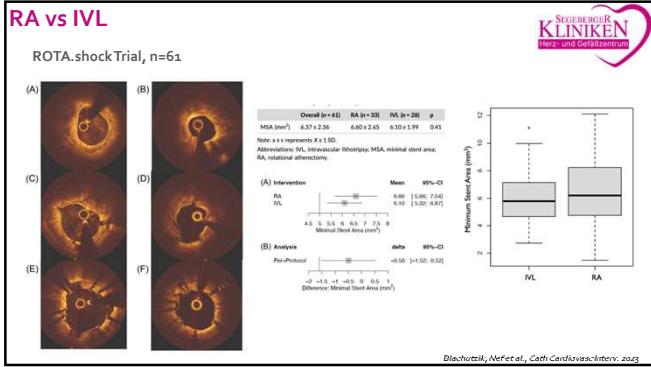
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Orbital Atherectomy vs NC Balloon

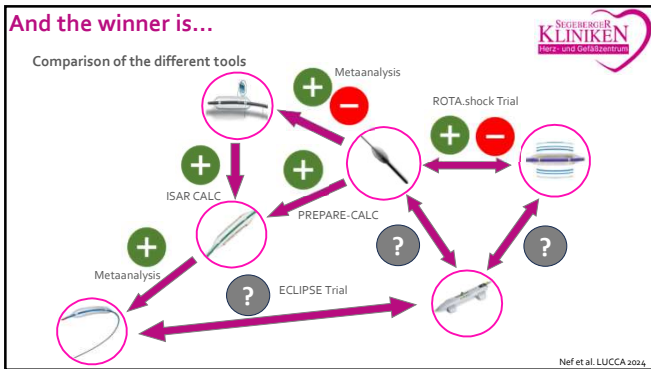
ECLIPSE Trial, n=2000 patients

Randomized evaluation of vessel preparation with orbital atherectomy prior to drug-eluting stent implantation in severely calcified coronary artery lesions: Design and rationale of the ECLIPSE trial

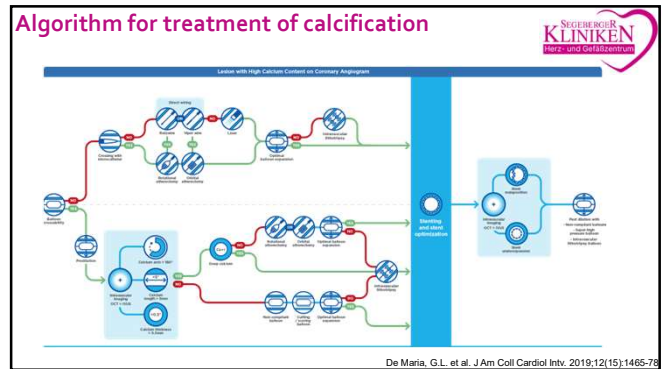
Philippe Généreux, MD¹, Ajay J. Kirtane, MDSM^{2,3}, David E. Kandzari, MD⁴, Ebrin J. Armstrong, MD⁵, Mitchell W. Krucoff, MD⁶, Bigna Bochara, MD PhD^{7,8}, Ori Ben-Yehuda, MD^{9,10}, Daria R. Lereu, PhD¹¹, Ziad A. Ali, MD PhD¹², Akhso Machara, MD¹³, William W. O'Neill, MD¹⁴, and Gregg W. Stone, MD¹⁵
¹Mount Sinai, NY; ²New York, NY; ³Atlanta, GA; ⁴Aurora, CO; ⁵Durham, NC; ⁶Gothenburg, Sweden; ⁷San Diego, CA; ⁸Paul, MN; ⁹Roslyn, NY; ¹⁰Detroit, MI

Généreux et al. Am Heart J 2022

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Choose the right tool...



Except Florim,
you would never use a hammer
and a chisel in a stone quarry...

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Choose the right tool...



...and a pneumatic hammer for
precision work!

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Das #heartteam des
Segeberger Herz- und Gefäßzentrums
über Silo!



Thanks

✉ holger.nef@segebergerkliniken.de
X [@holgernef](https://twitter.com/holgernef)

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