
Angiography-Based Physiology Assessment

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Disclosure Statement of Financial Interest

Within the past 12 months, I or my spouse/partner have had a financial interest /arrangement or affiliation with the organization(s) listed below

Affiliation/Financial Relationship

Grant/ Research Support:

Consulting Fees/Honoraria:

Major Stock Shareholder/Equity Interest:

Royalty Income:

Ownership/Founder:

Salary:

Intellectual Property Rights:

Company

Abbott, Medtronic, Edwards

CathWorks, HeartFlow

NIH R61 HL139929-01A1 (PI)



Why Don't We Perform Wire-Based Coronary Physiology?

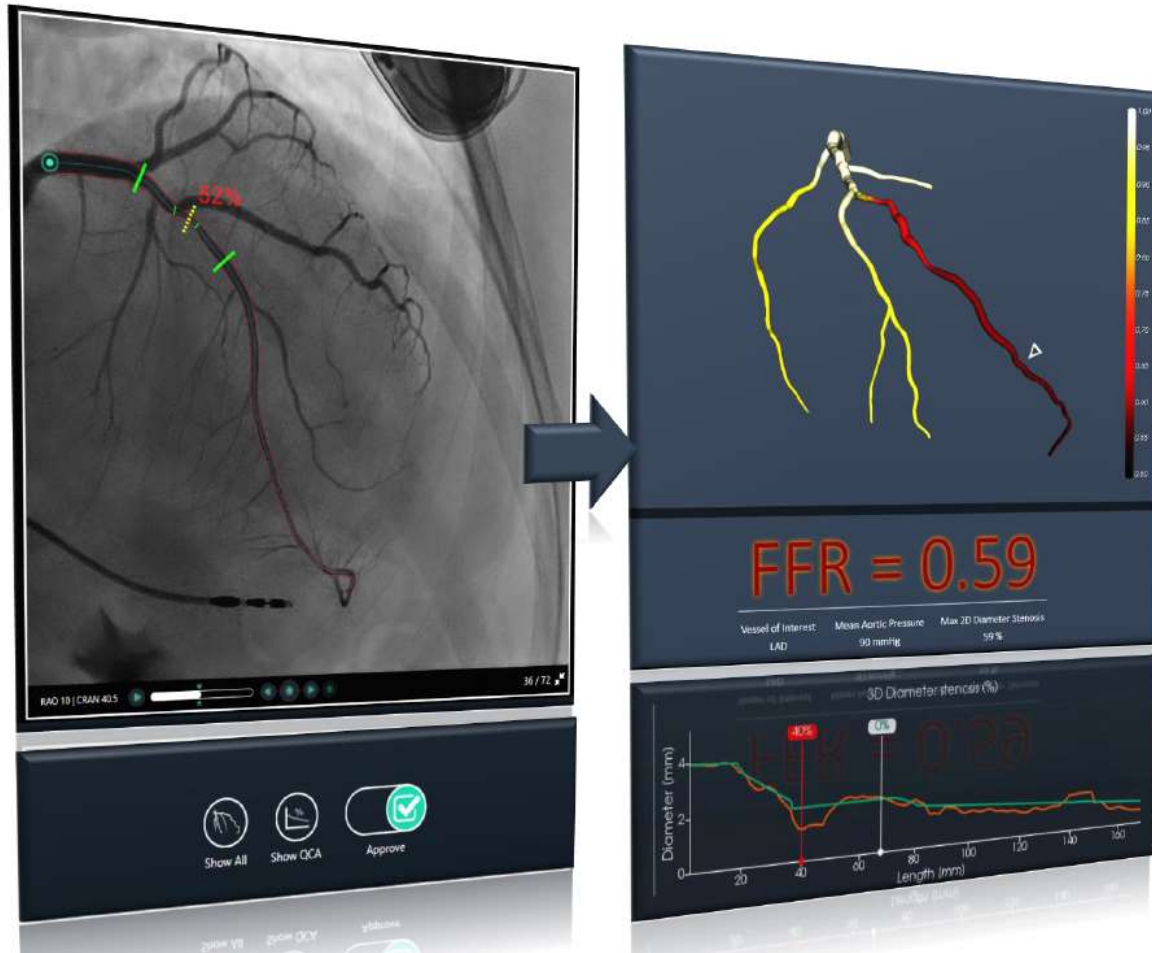
- It takes time...
- Wire handling characteristics...
- Pressure drift is frustrating...
- Side effects of adenosine...
- It is expensive...
- There is a small risk...

Coronary Pressure Wire



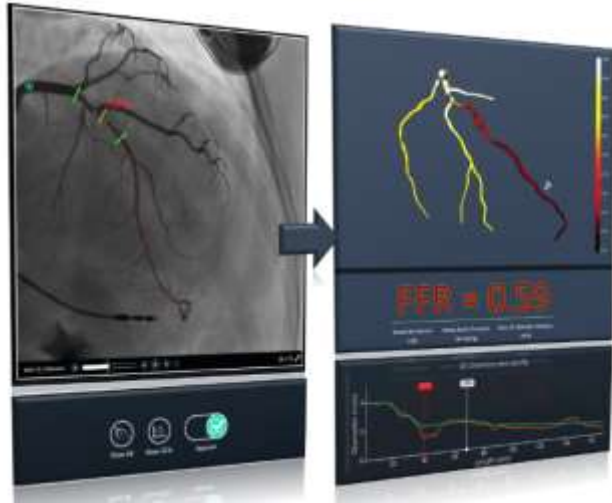
Angiography-Derived FFR

Measurement of FFR without the need of a pressure wire or adenosine

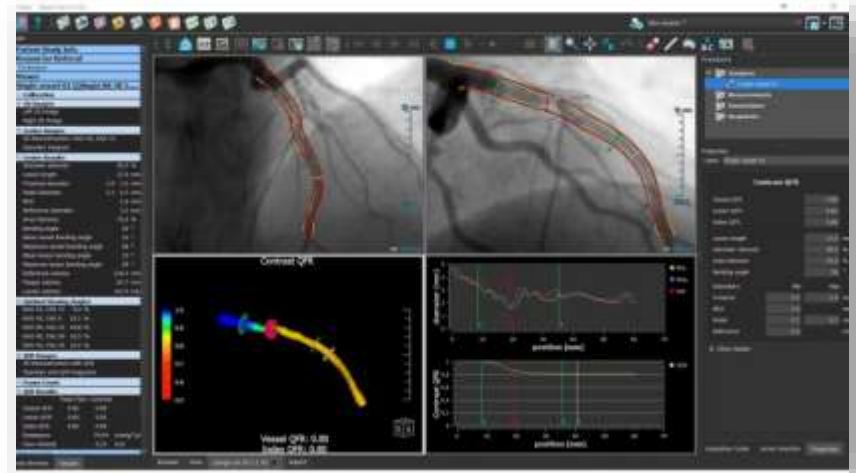


Angiography-Derived FFR

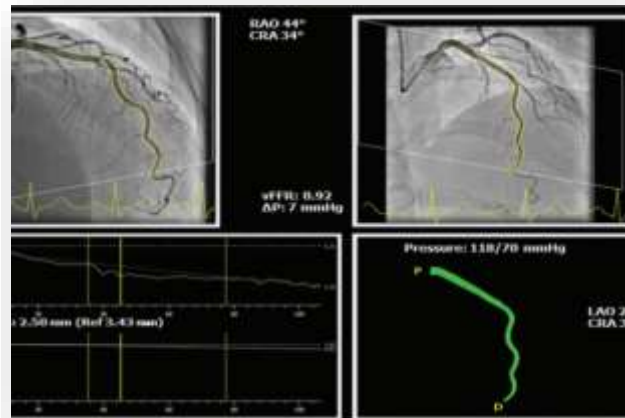
Measurement of FFR without the need of a pressure wire or adenosine



FFR_{ANGIO}
CathWorks



QFR
Medis Medical

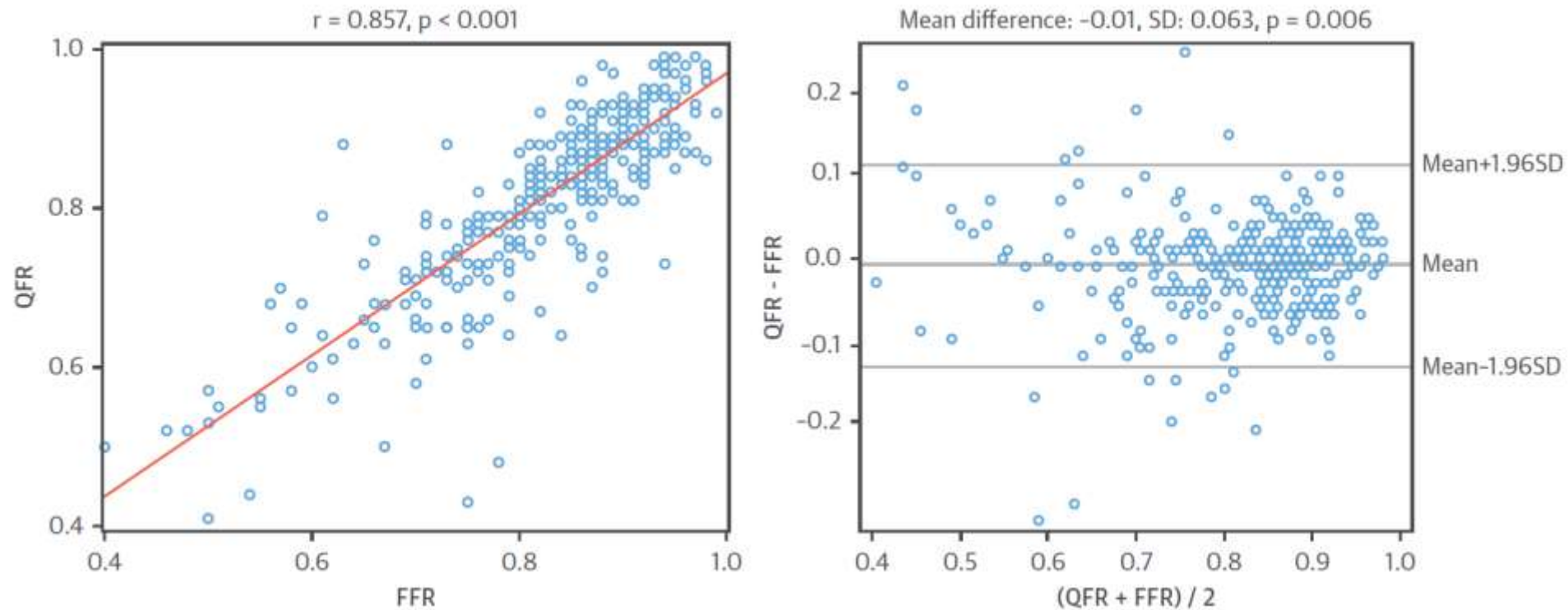


vFFR
Pie Medical



Quantitative Flow Ratio

Quantitative Flow Ratio (QFR) compared with invasive FFR in 328 lesions

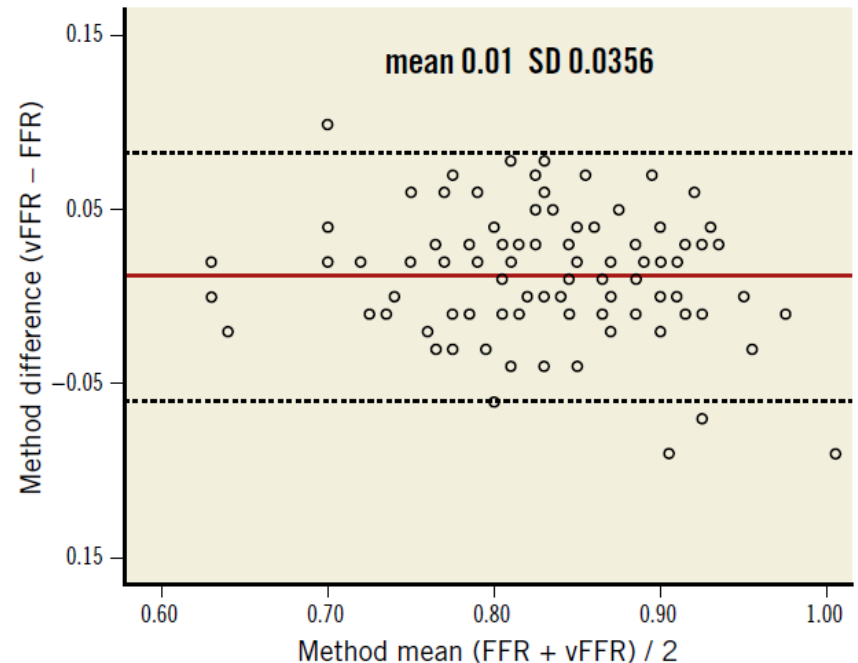
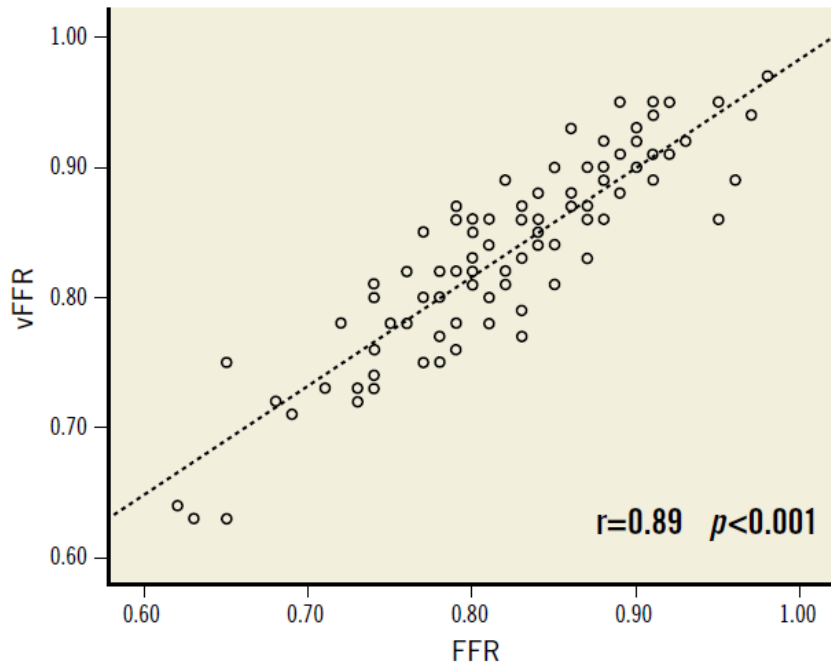


Sensitivity, specificity and accuracy of QFR was 95%, 92% and 93%



Vessel Fractional Flow Reserve

vFFR compared with invasive FFR in 100 patients

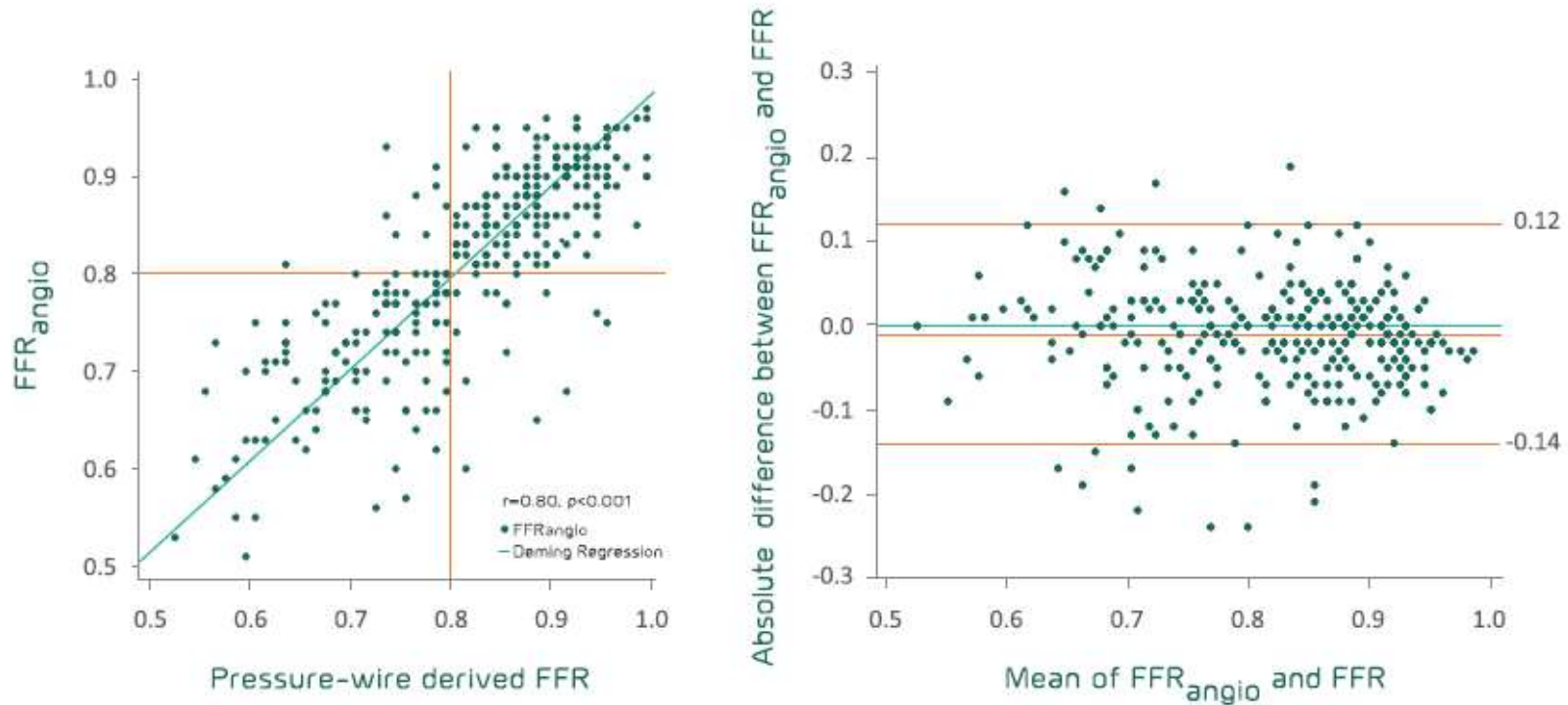


The AUC of vFFR was 0.93



FAST FFR Trial

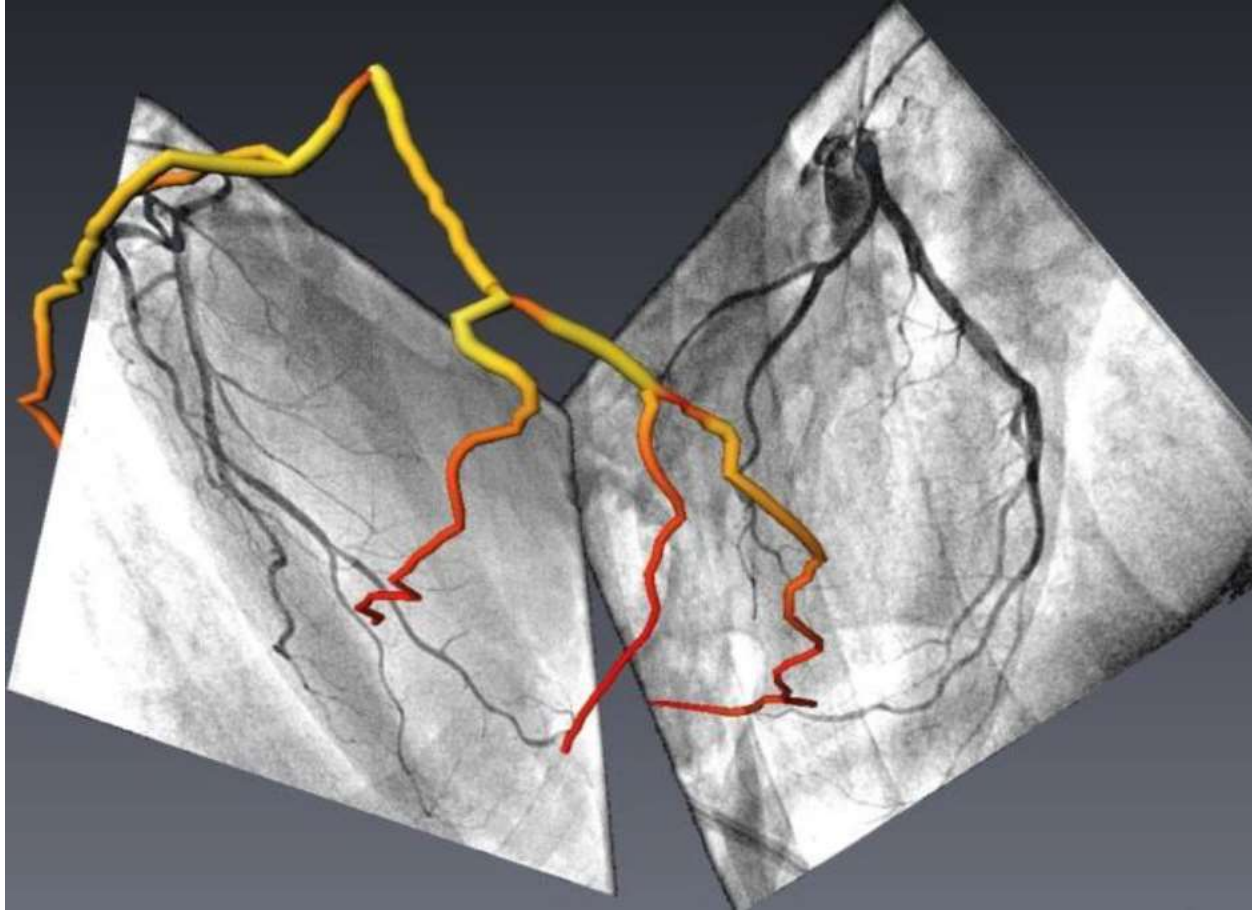
FFR_{angio} compared with invasive FFR in 319 vessels



Sensitivity, specificity and accuracy of FFR_{angio} was 94%, 91% and 92%



FFR_{angio}

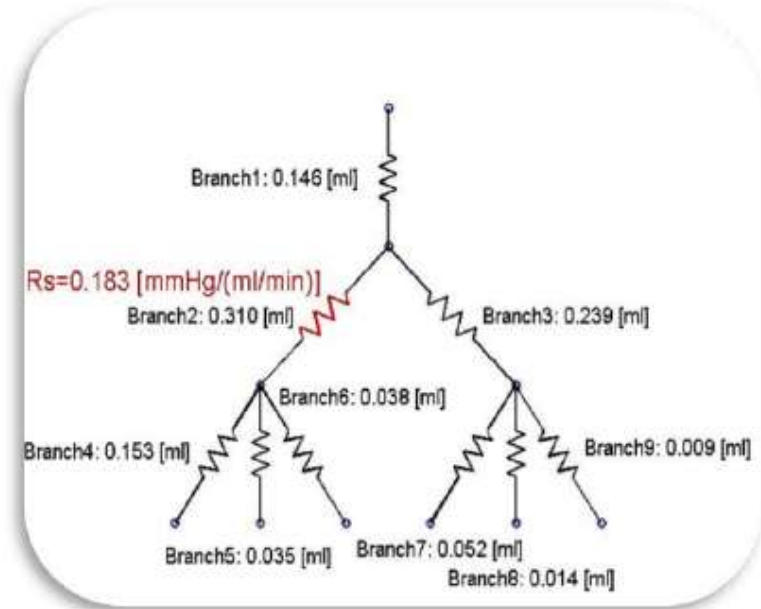
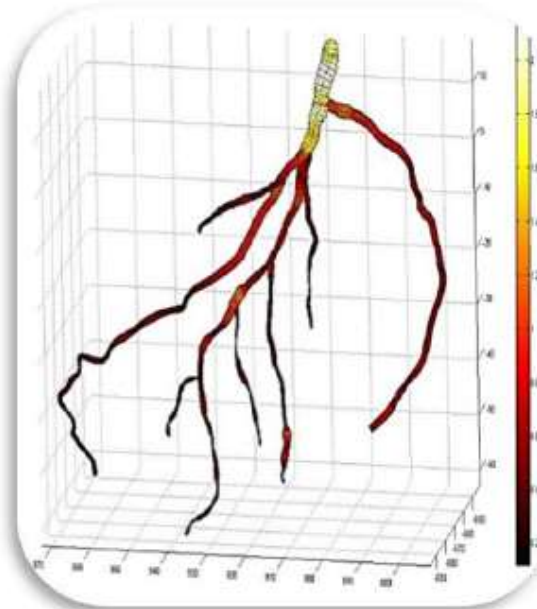
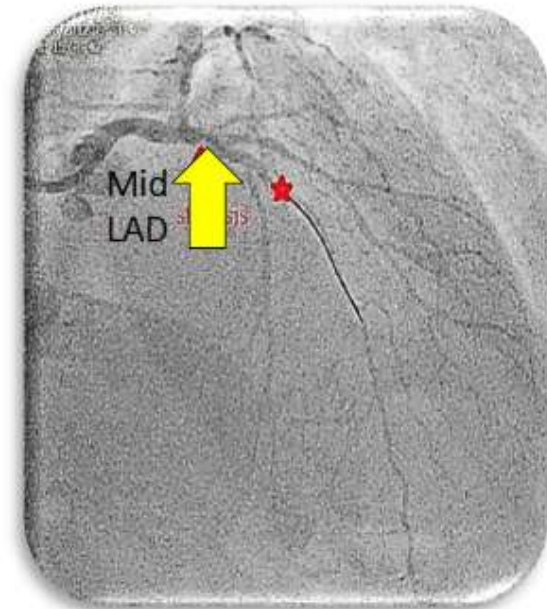


Courtesy of CathWorks



FFR_{angio}

The coronary arterial network is modeled as an electrical circuit with each segment acting as a resistor. The vessel resistance is estimated based on its length and diameter. Each vessel's contribution to flow is based on its impact on overall resistance depending on the arrangement.

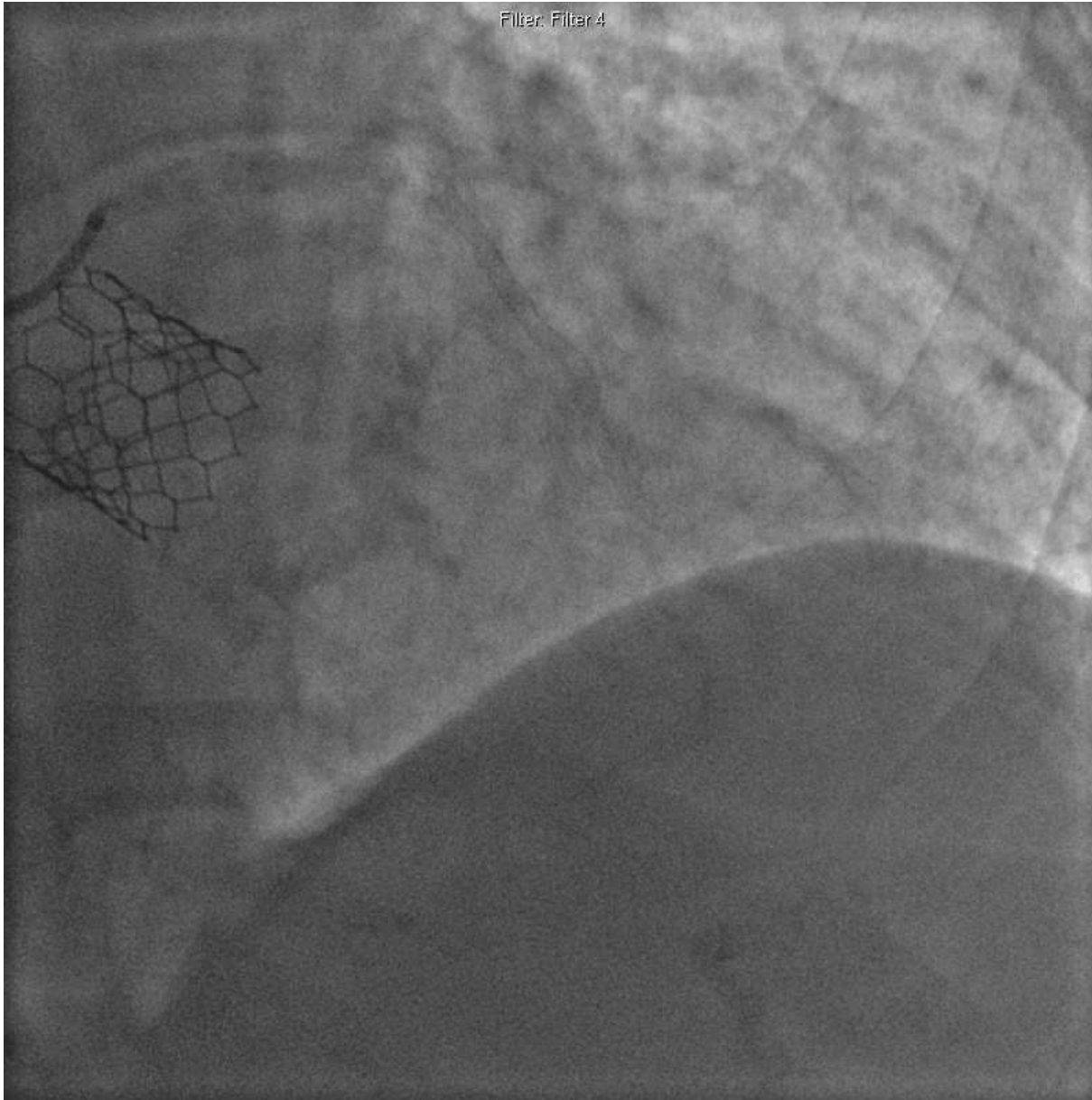


Real World Cases:

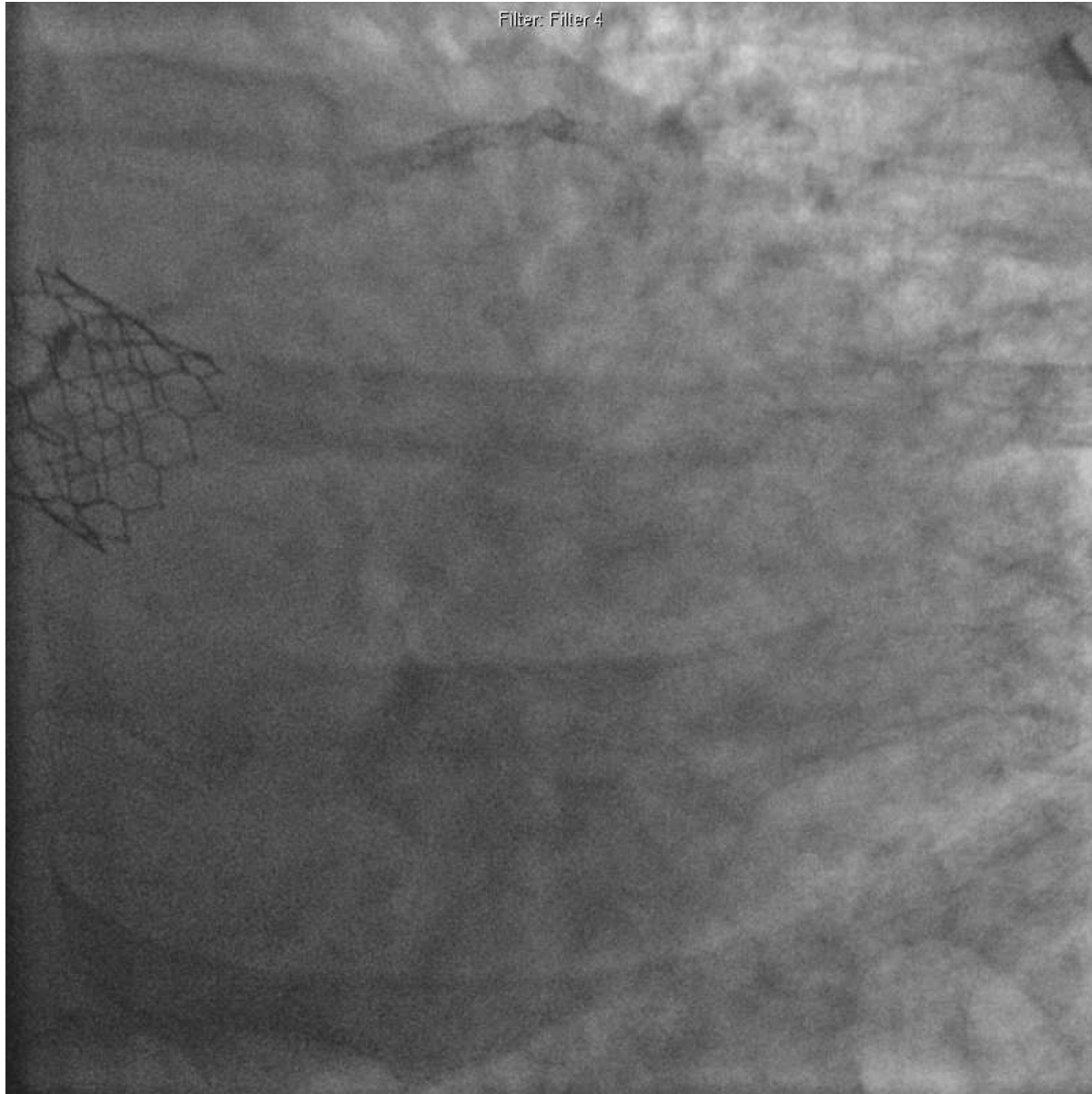
- 86 yo woman (5 feet 5 inches, 271 pounds) with history of aortic stenosis and CAD
- 18 months ago underwent TAVR and PCI of LAD. Moderate left circ/OM disease with pressure wire FFR 0.82
- Now multiple episodes of atypical chest pain
- Echo: Normal EF, mean aortic valve gradient 16, no PVL
- DSE: No stress-induced wall motion abnormalities



Filter: Filter 4



Filter: Filter 4



Filter: Filter 4



Select Images

The interface displays a grid of 8 coronary angiography image thumbnails. Each thumbnail includes a small square icon in the top-left corner, a technical label at the top, and a playback control bar at the bottom. The thumbnails are arranged in two rows of four. The top-right thumbnail is highlighted with a green border, indicating it is the selected image.

Selected

- RAO 18.8 | CAUD 22 15 FPS
- LAO 28.1 | CAUD 29.7 15 FPS
- LAO 1.8 | CAUD 27.7 15 FPS

Target Vessel:

Left

- LAD
- Diagonal
- LCX
- Marginal

Right

- Ramus
- RCA
- PDA

Mean Aortic Pressure: (mmHg) **90**



Mark Ostium and Lesion

Steps

- 1 Verify Optimal Frame
- 2 Mark Ostium
- 3 Mark Lesion

Select Lesion Tree Lumen Results

RAD 19.6 | CAUD 22 24 / 92 LAO 29.1 | CAUD 29.7 35 / 77 LAO 1.8 | CAUD 27.7 42 / 8

Drag ostium marker to ostium location

Drag lesion marker to lesion location

Drag ostium marker to ostium location

Drag lesion marker to lesion location

Drag ostium marker to ostium location

Drag lesion marker to lesion location



Draw Vessel Lines

Steps

- 1 Mark Main Vessel
- 2 Verify Lesion Assignment
- 3 Mark Side Branches & Verify Branch Points

Select > Lesion > **Tree** > Lumen > Results

RAO 19.6 | CAUD 22 24 / 92

LAO 29.1 | CAUD 29.7 35 / 77

LAO 1.8 | CAUD 27.7 42 / 83



The image displays three angiographic views of a coronary artery. The first view (RAO 19.6 | CAUD 22) shows a blue line tracing the main vessel, a red line tracing a side branch, and a cyan line tracing another side branch. The second view (LAO 29.1 | CAUD 29.7) shows the red line tracing the side branch. The third view (LAO 1.8 | CAUD 27.7) shows the red line tracing the side branch. Each view includes a playback control bar at the bottom.



Assess Vessel Contours

Steps

- 1 Edit Lumen Where Required
- 2 Approve/Disapprove Stenosis Value (%)
- 3 Review Color Matching

Select > Lesion > Tree > **Lumen** > Results

RAO 19.6 | CAUD 22 24 / 92 LAO 29.1 | CAUD 29.7 35 / 77 LAO 1.8 | CAUD 27.7 42 / 83

Approved 49%

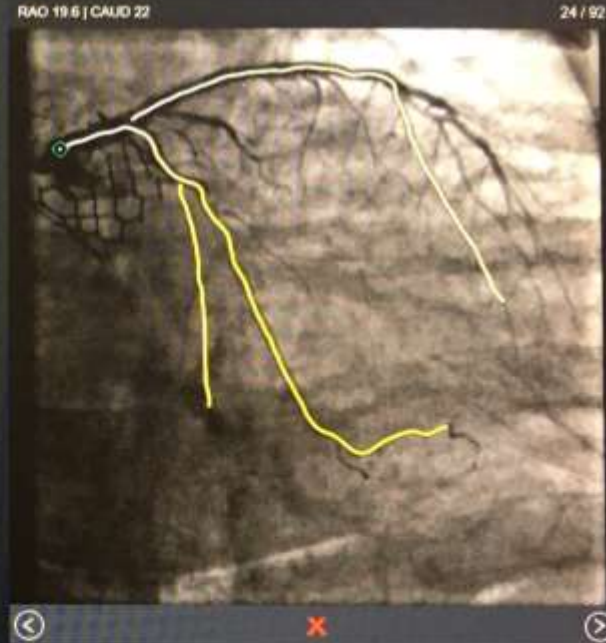
Approved 28%

Approved 54%



FFR_{angio} Left Cx/OM

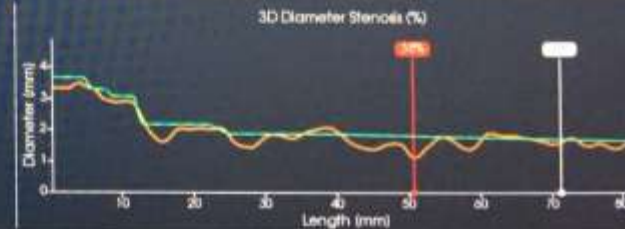
RAO: 19.6 | CAUD: 22.0



FFR = 0.88

ANGIO

Vessel of Interest	Mean Aortic Pressure	Max 3D Diameter Stenosis
LCX	90 mmHg	38 %



Pressure wire FFR = 0.83



FFR_{angio} RCA/PDA

LAO: 29.9 | CRAN: 5.9

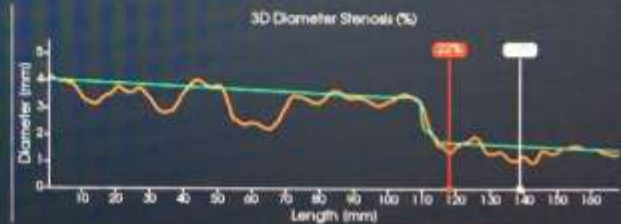
FFR = 0.86

ANGIO

Vessel of Interest	Mean Aortic Pressure	Max 3D Diameter Stenosis
PDA	97 mmHg	22 %

LAO 29.9 | CRAN 5.9

47 / 100



Pressure wire FFR = 0.81

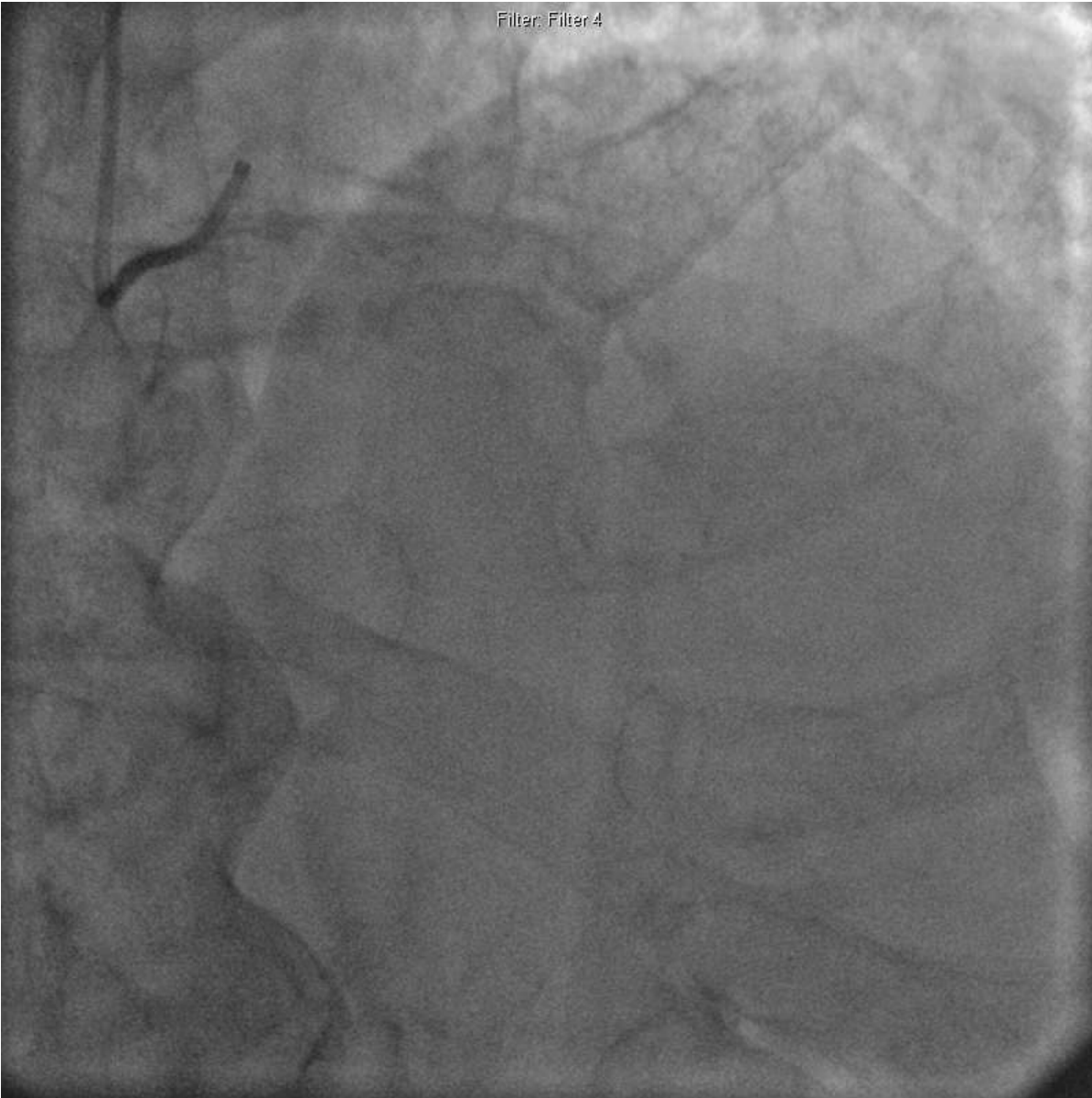


Real World Cases:

- 77 yo man with hypertension and dyslipidemia
- Presents to his local physician with progressive exertional chest discomfort
- A coronary calcium scan had been performed and showed a score of 3,398 (90th percentile)
- A myocardial perfusion scan is ordered and shows no ischemia
- Because of persistent symptoms he is referred for coronary angiography



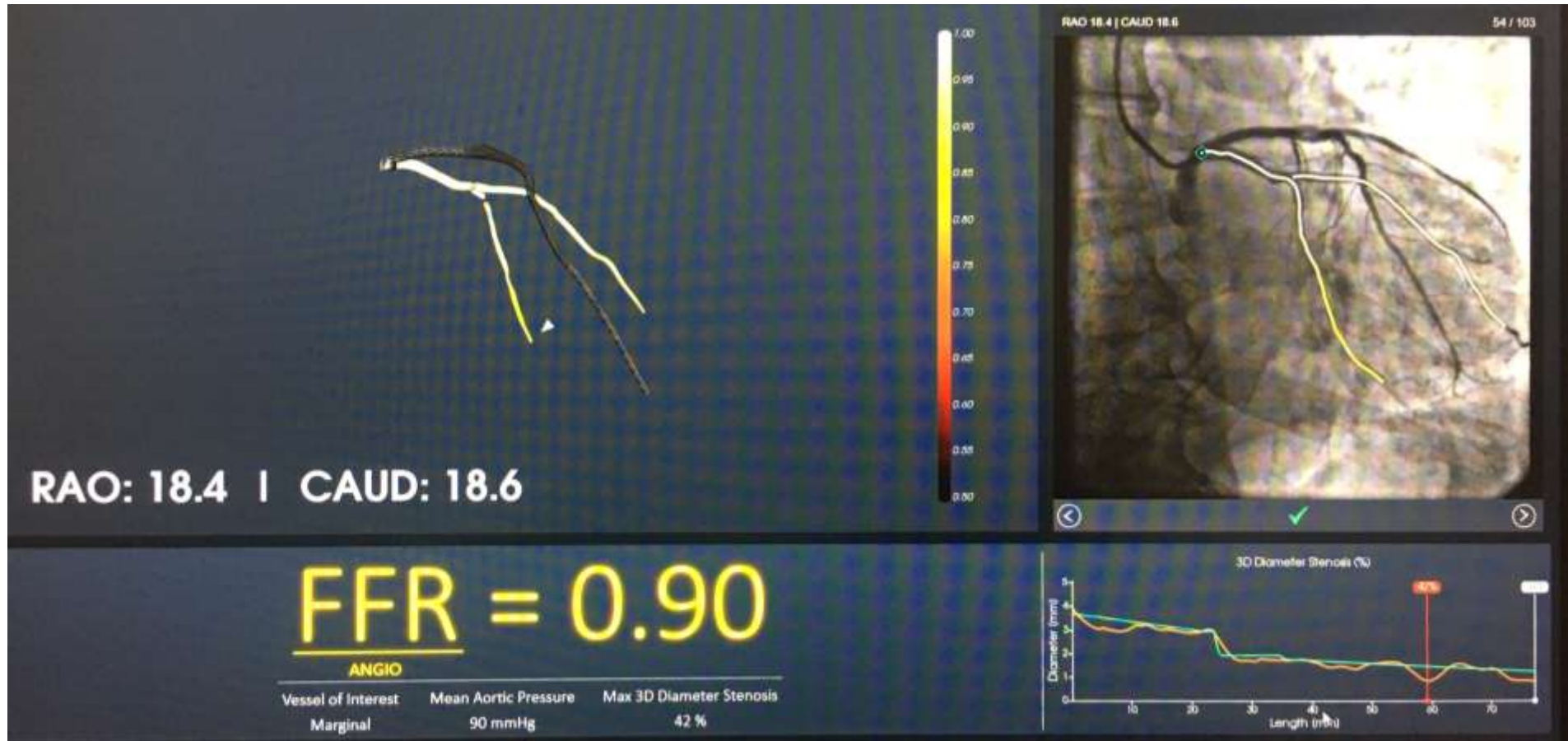
Filter: Filter 4



Filter: Filter 4



FFR_{angio} of the Left Circumflex

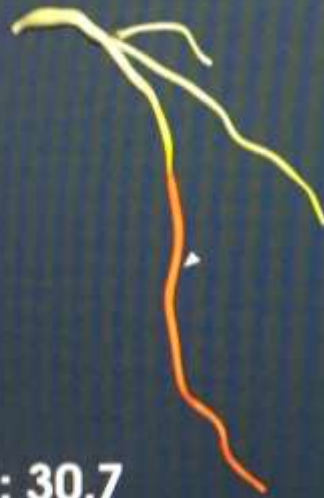


Wire-based FFR = 0.94



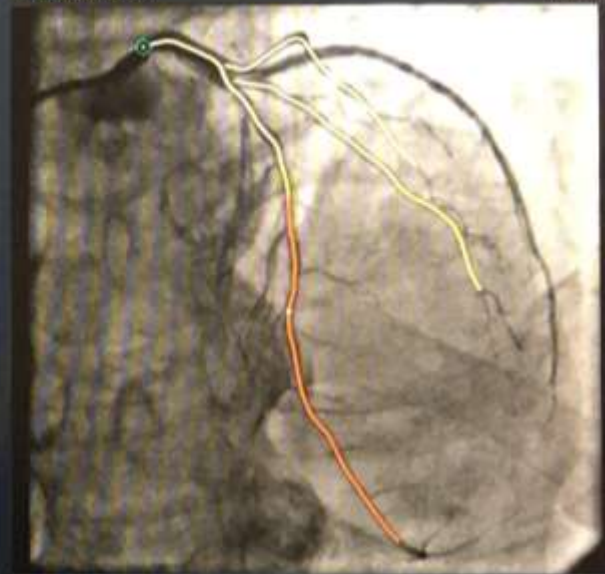
FFR_{angio} of the LAD

RAO: 5.7 | CRAN: 30.7



RAO 5.7 | CRAN 30.7

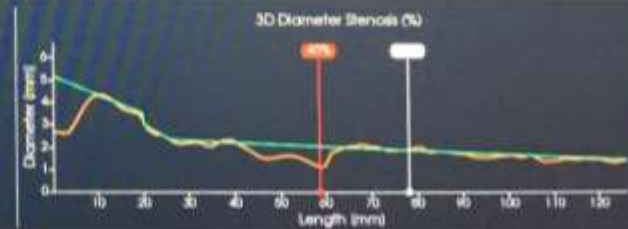
51 / 110



FFR = 0.75

ANGIO

Vessel of Interest	Mean Aortic Pressure	Max 3D Diameter Stenosis
LAD	86 mmHg	45 %



Wire-based FFR = 0.64



LAD post PCI



What's Next?

Quantitative flow ratio–guided strategy versus angiography-guided strategy for percutaneous coronary intervention: Rationale and design of the FAVOR III China trial



Lei Song, MD, ^{a,b,1} Shengxian Tu, PhD, ^{c,1} Zhongwei Sun, MSc, ^a Yang Wang, MSc, ^d Daixin Ding, BSc, ^c Changdong Guan, MSc, ^a Lihua Xie, MSc, ^a Javier Escaned, MD, ^e William F. Fearon, MD, PhD, ^f Ajay J. Kirtane, MD, SM, ^{g,h} Patrick W. Serruys, MD, PhD, ⁱ William Wijns, MD, PhD, ^j Stephan Windecker, MD, ^k Martin B. Leon, MD, ^{g,h} Gregg W. Stone, MD, ^{h,1} Shubin Qiao, MD, ^{a,b} and Bo Xu, MBBS ^{a,b}, for the FAVOR III China Investigators

Enrolment completed in January 2020 with randomization of 3,828 subjects!



What's Next?

Angiography-derived Index of Microcirculatory Resistance

