

INTERVENTIONAL CARDIOLOGY 2017

32ND ANNUAL INTERNATIONAL SYMPOSIUM



Tips and Tricks for FFR Assessment Revisited – An Update on New Techniques and Devices



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President

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Potential conflicts of interest

Speaker's name: Jacek Legutko

- Lecture fee (Philips Volcano, St. Jude, Terumo, Balton, Astra Zeneca, Medtronic, Abbott, Procardia)**

Fractional Flow Reserve (FFR)

ESC Guidelines Recommendations

2014 ESC/EACTS Guidelines on myocardial revascularization

Windecker S, et al.
*Eur Heart J*2014; doi:10.1093/eurheartj/ehu278

FFR to identify haemodynamically relevant coronary lesion(s) in stable patients when evidence of ischaemia is not available.	I	A
FFR-guided PCI in patients with multivessel disease.	IIa	B

2013 ESC guidelines on the management of stable coronary artery disease

FFR is recommended to identify hemodynamically relevant coronary lesion(s) when evidence of ischaemia is not available.	I	A	Revascularization of an angiographically intermediate stenosis without related ischaemia or without FFR <0.80 is not recommended.	III	B
Revascularization of stenoses with FFR <0.80 is recommended in patients with angina symptoms or a positive stress test.	I	B			

Montalescot G, et al. *Eur Heart J* 2013;4,2949–3003

Fractional Flow Reserve (FFR)

Main limitations

- Optimal route and dose of adenosine administration still remains a subject of debate and investigation
- Difficult deliverability and insufficient durability of the pressure wire
- Relatively high incidence of drift
- iFR concept still under investigation

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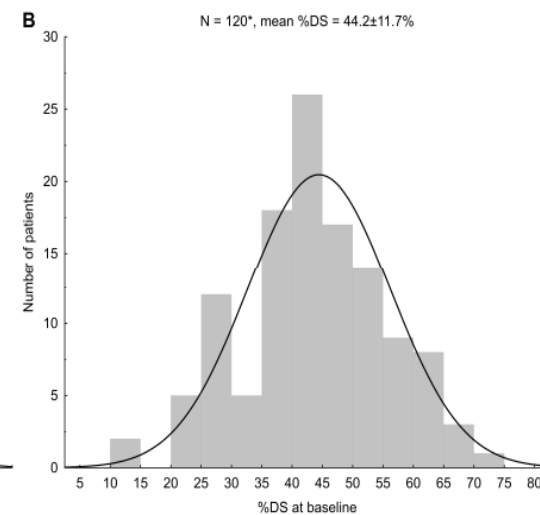
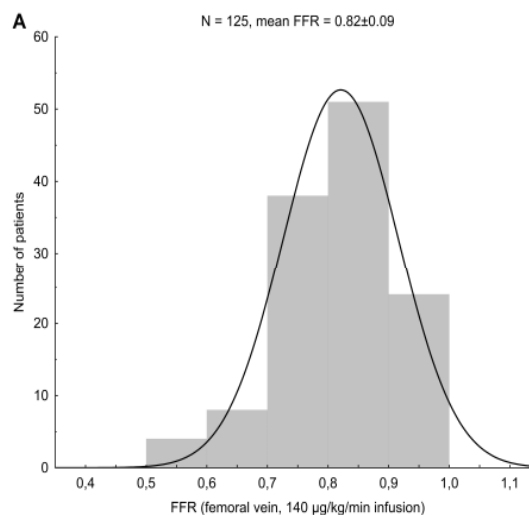
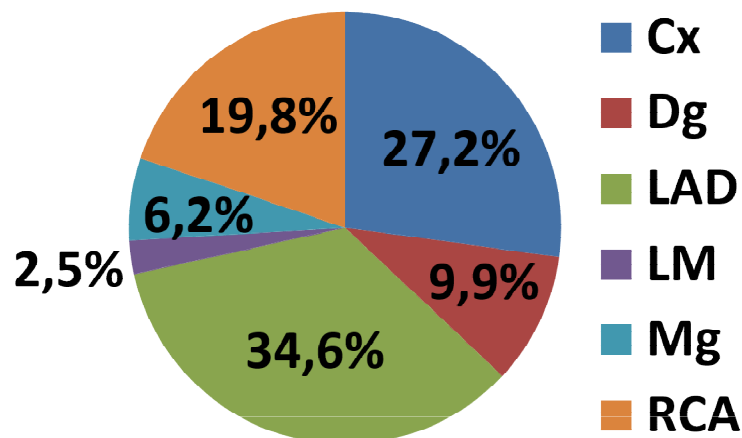
Fractional Flow Reserve (FFR)

How to provoke maximum hyperemia?

A total of 50 patients with 125 coronary artery stenoses (40-90% by visual estimation) were enrolled.

All lesions were assessed with:

- Femoral vein adenosine infusion - 140 µg/kg/min (GOLD STANDARD)
- Femoral vein adenosine infusion - 280 µg/kg/min
- Antecubital vein adenosine infusion - 140 µg/kg/min
- Intracoronary adenosine bolus injection - 100 µg, 200 µg, 400 µg, 600 µg.

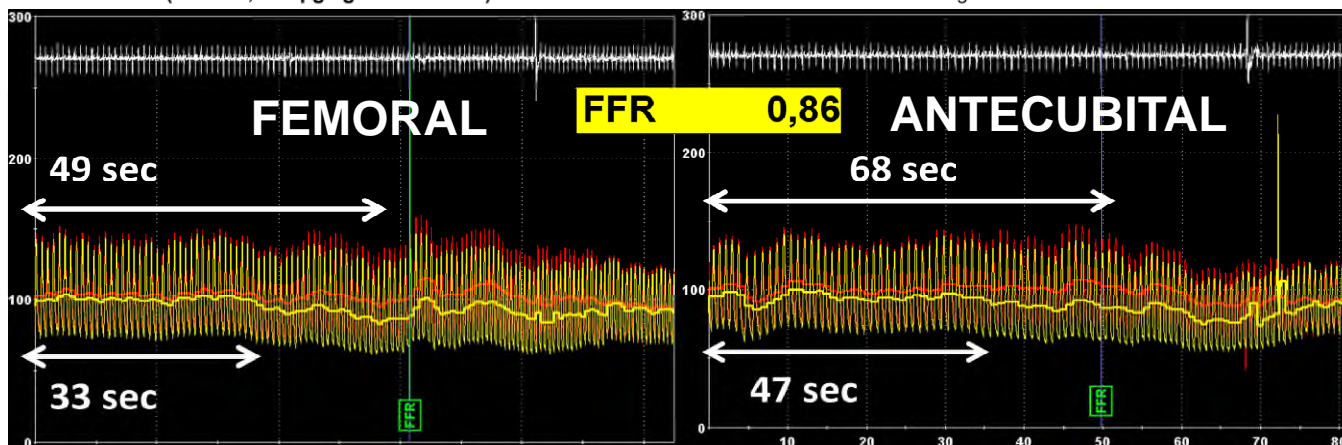
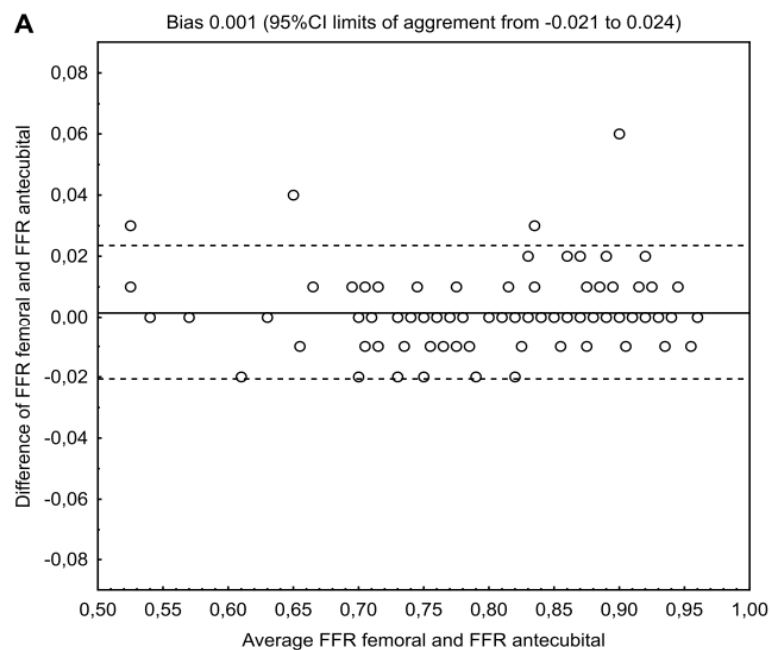
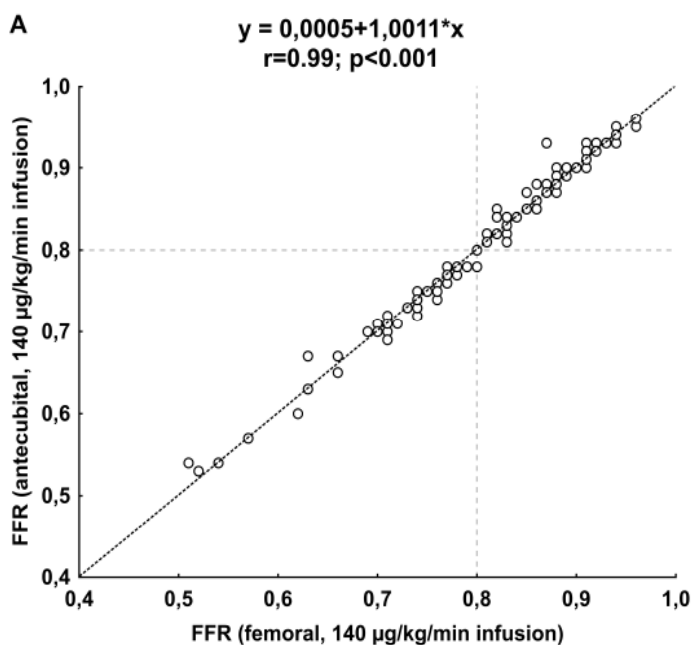


Legutko J et al. J Am Coll Cardiol. 2016;68(18S):B214.
Legutko J et al. Advances in Interventional Cardiology. 2016; 12, 4 (46).

Fractional Flow Reserve (FFR)

How to provoke maximum hyperemia?

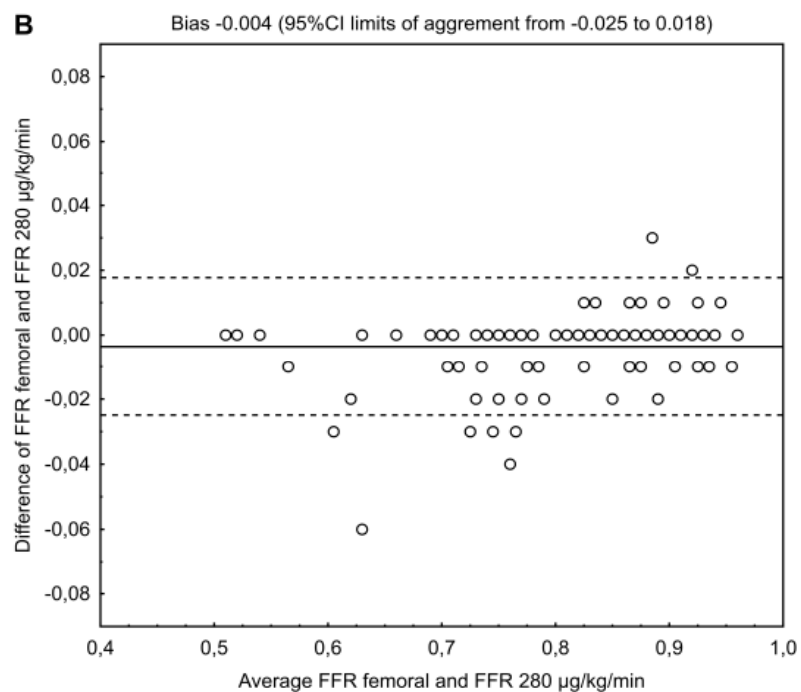
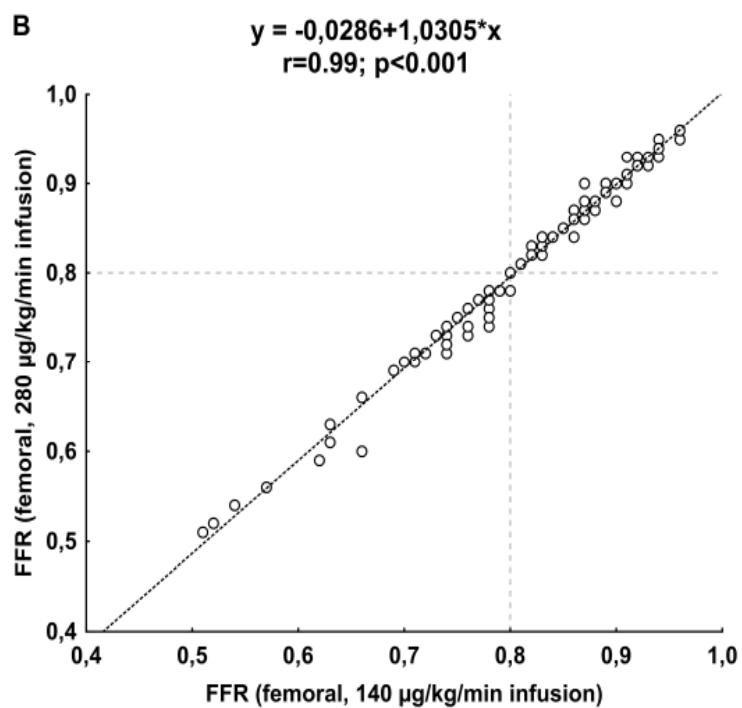
Femoral versus antecubital vein adenosine infusion (140 µg/kg/min.)



Fractional Flow Reserve (FFR)

How to provoke maximum hyperemia?

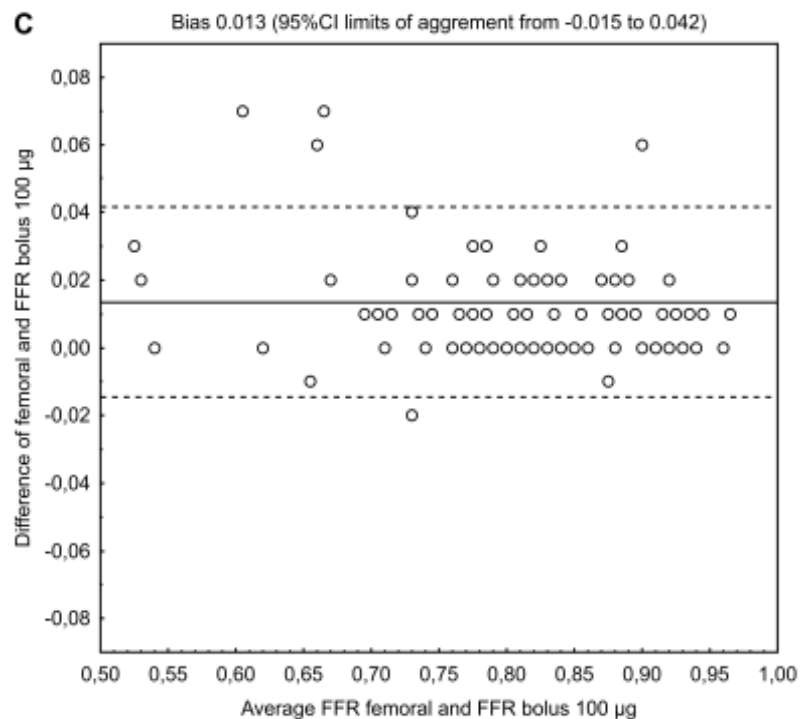
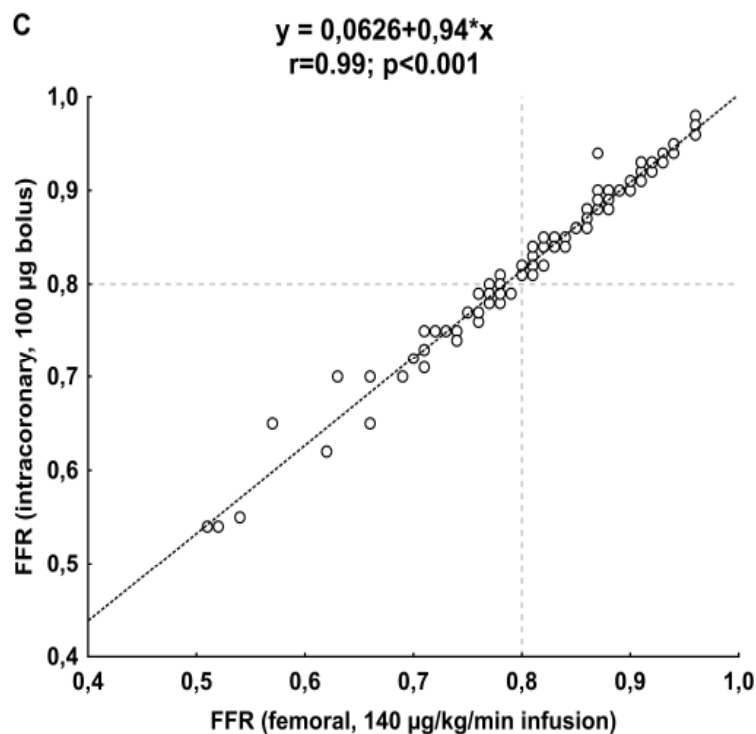
Femoral vein adenosine infusion - 140 versus 280 $\mu\text{g}/\text{kg}/\text{min}$.



Fractional Flow Reserve (FFR)

How to provoke maximum hyperemia?

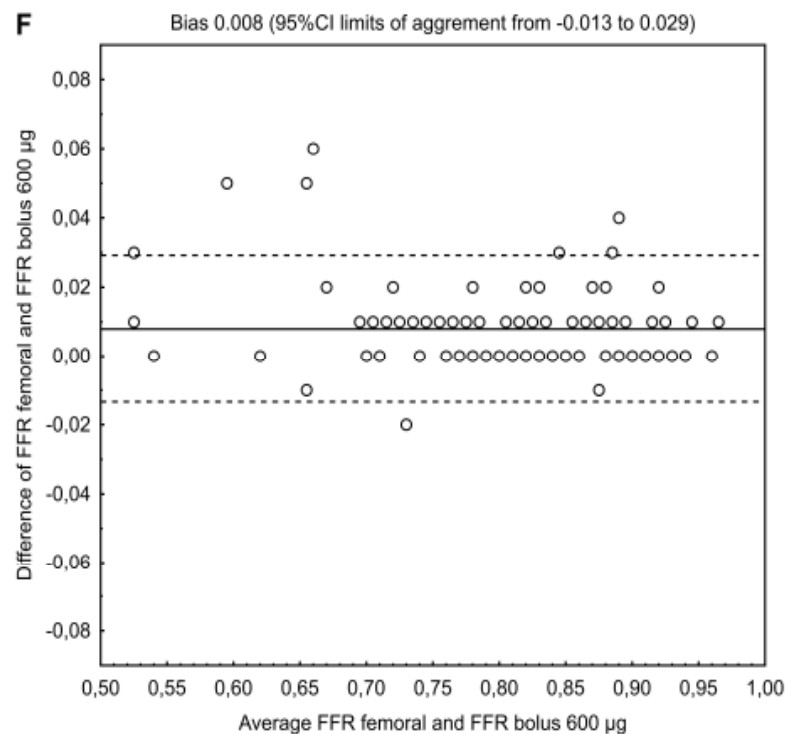
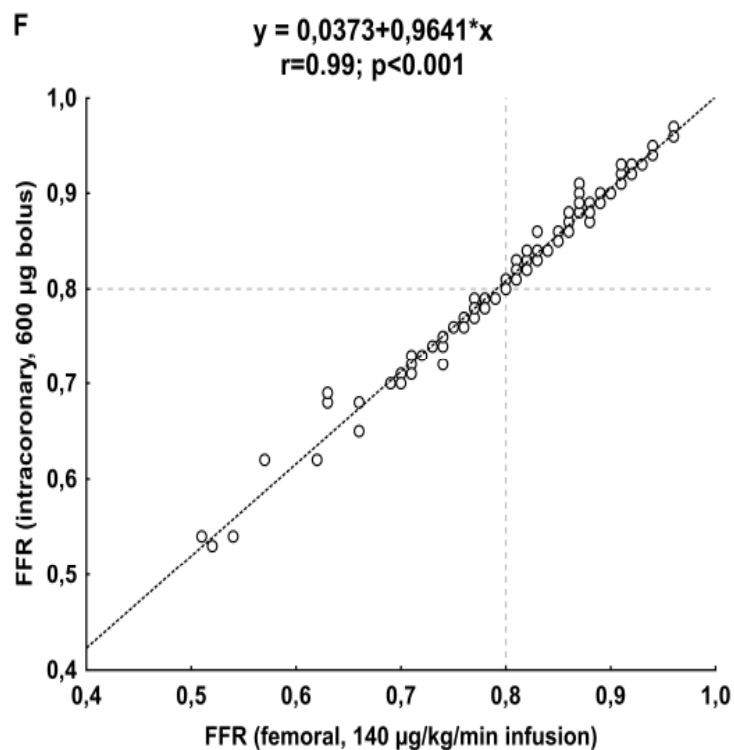
Femoral vein adenosine infusion - 140 µg/kg/min.
versus intracoronary bolus – 100 µg



Fractional Flow Reserve (FFR)

How to provoke maximum hyperemia?

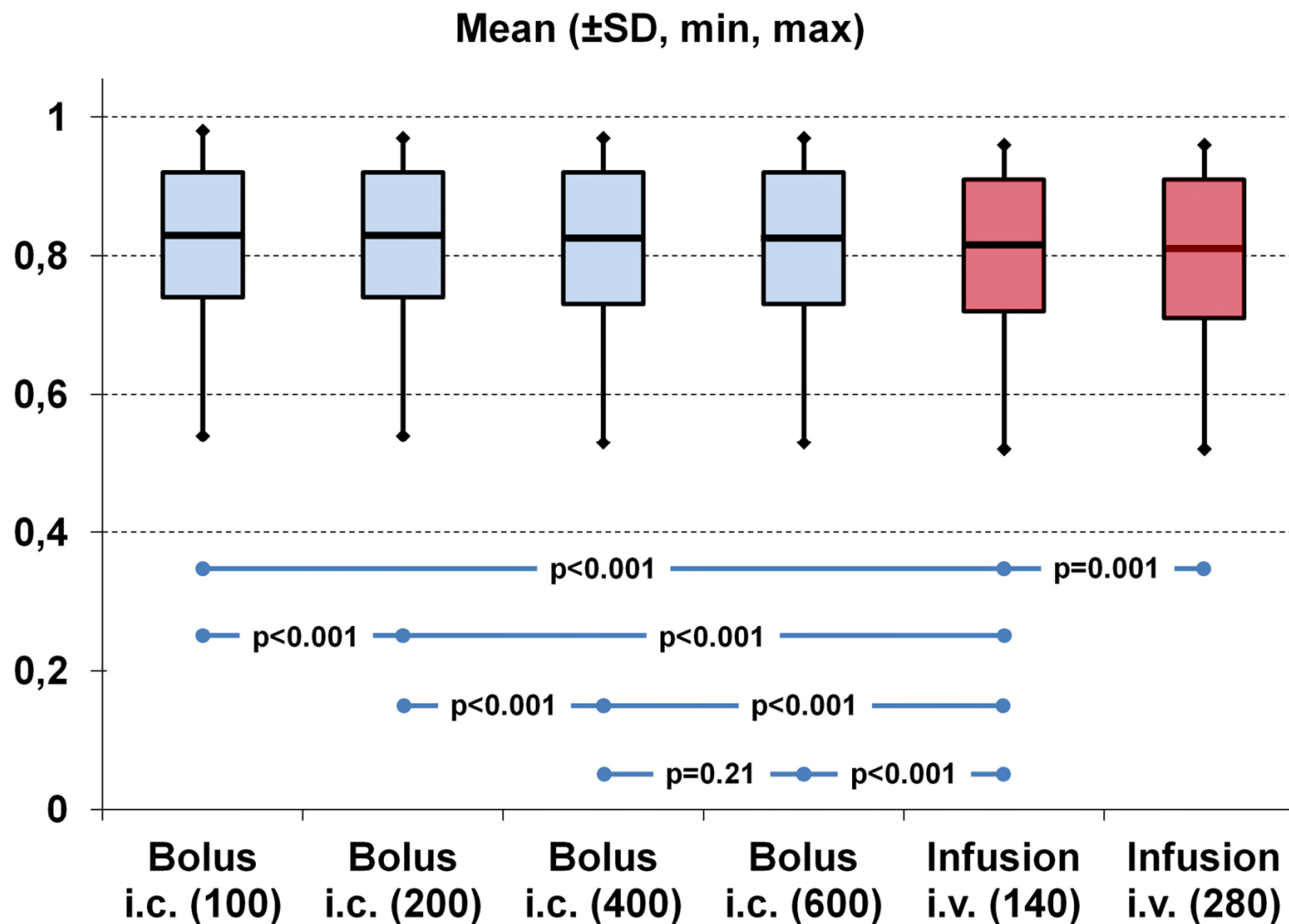
Femoral vein adenosine infusion - 140 µg/kg/min.
versus intracoronary bolus – 600 µg



Fractional Flow Reserve (FFR)

How to provoke maximum hyperemia?

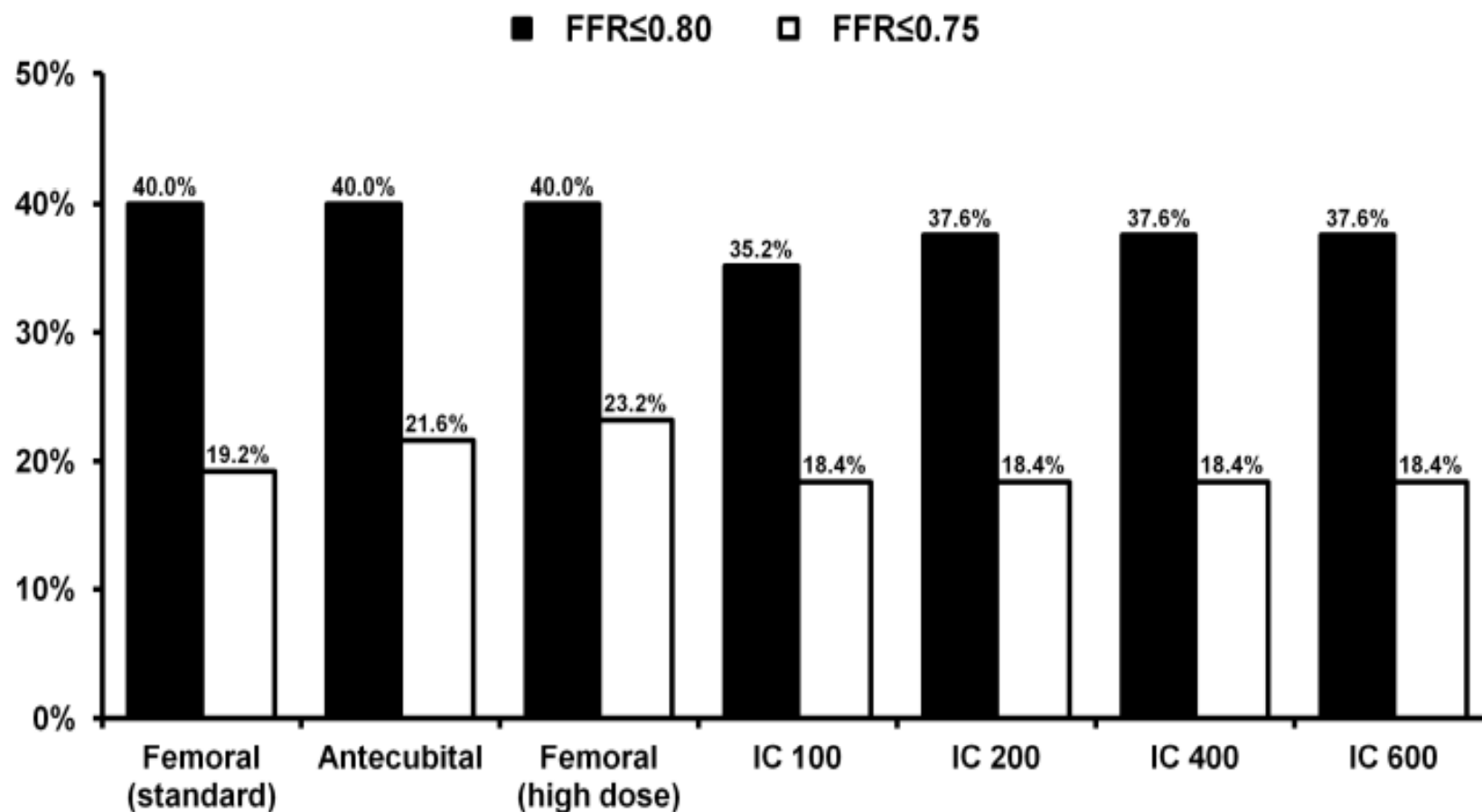
Femoral vein adenosine infusion versus intracoronary boluses



Fractional Flow Reserve (FFR)

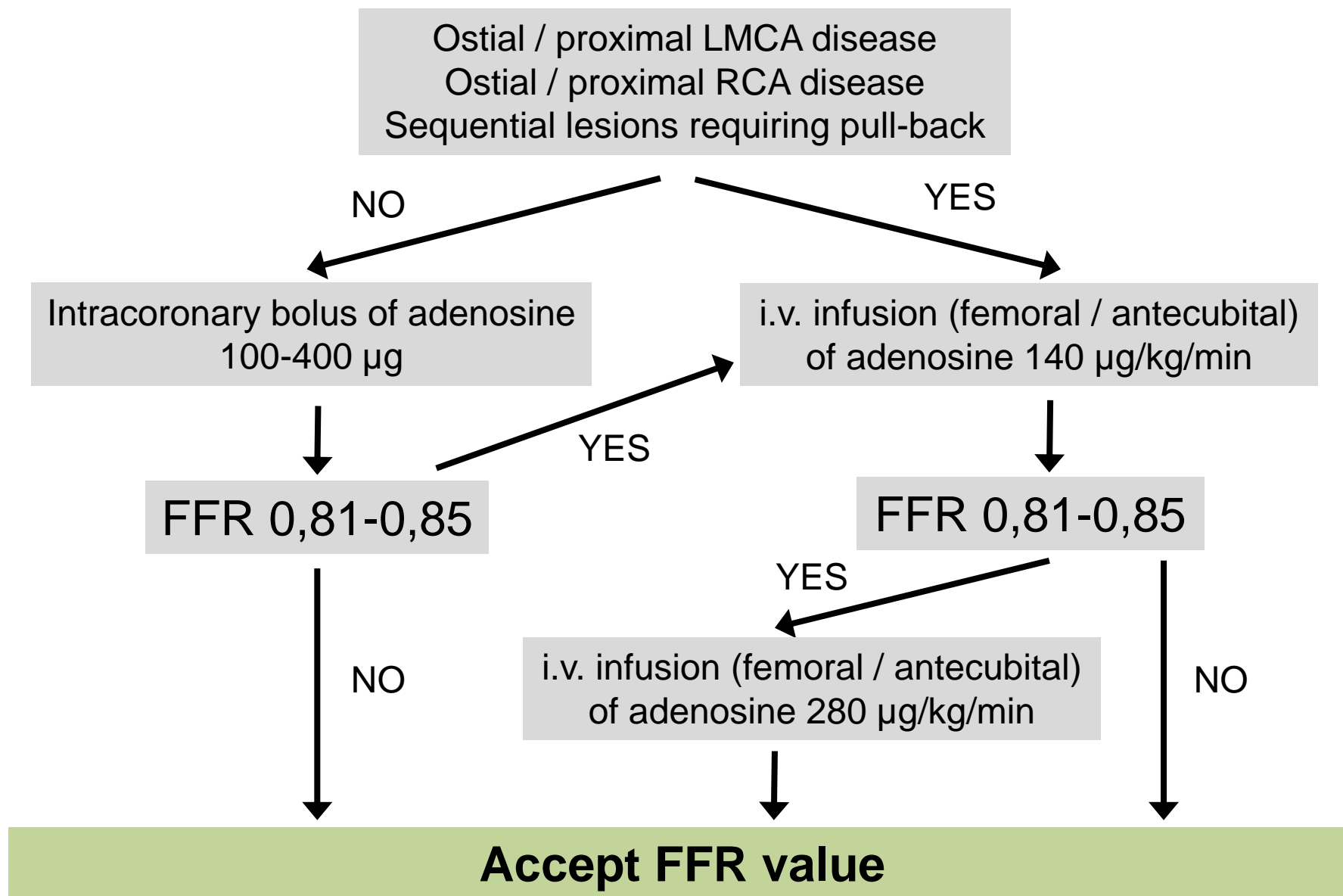
How to provoke maximum hyperemia?

Percentage of functionally significant lesions according to different methods of adenosine administration



Fractional Flow Reserve (FFR)

How to provoke maximum hyperemia?



Fractional Flow Reserve (FFR)

Main limitations

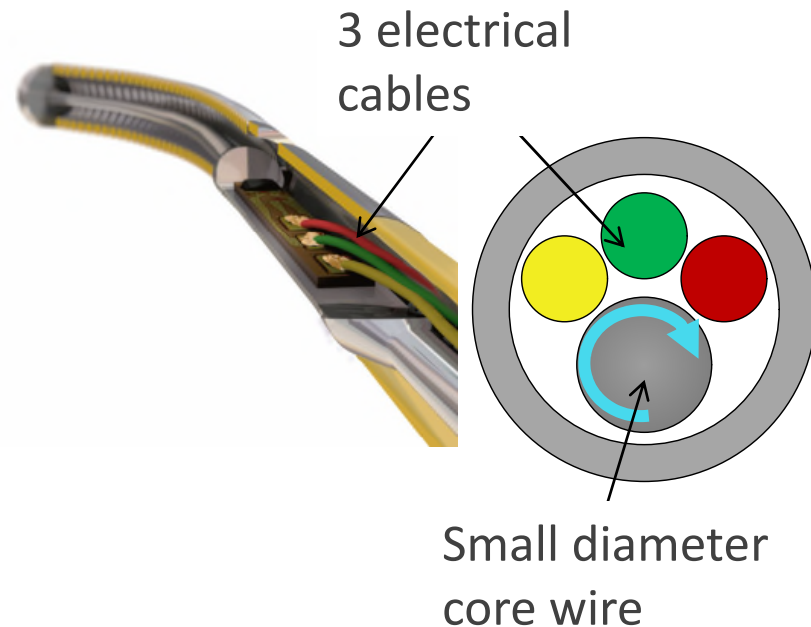
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Fractional Flow Reserve (FFR)

Limitations of the Electrical Pressure Guidewire

Electrical Pressure Guidewire

- No current FFR electrical guidewire provide workhorse wire characteristics
- Drift
- Moisture sensitive: contrast agents, blood and other liquids may result in unreliable connection, hindering multi-vessels and post-stent FFR assessment.



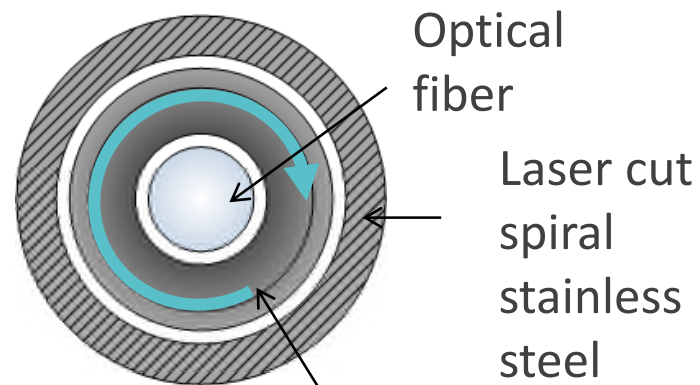
Fractional Flow Reserve (FFR)

Advantages of the Optical Pressure Guidewires

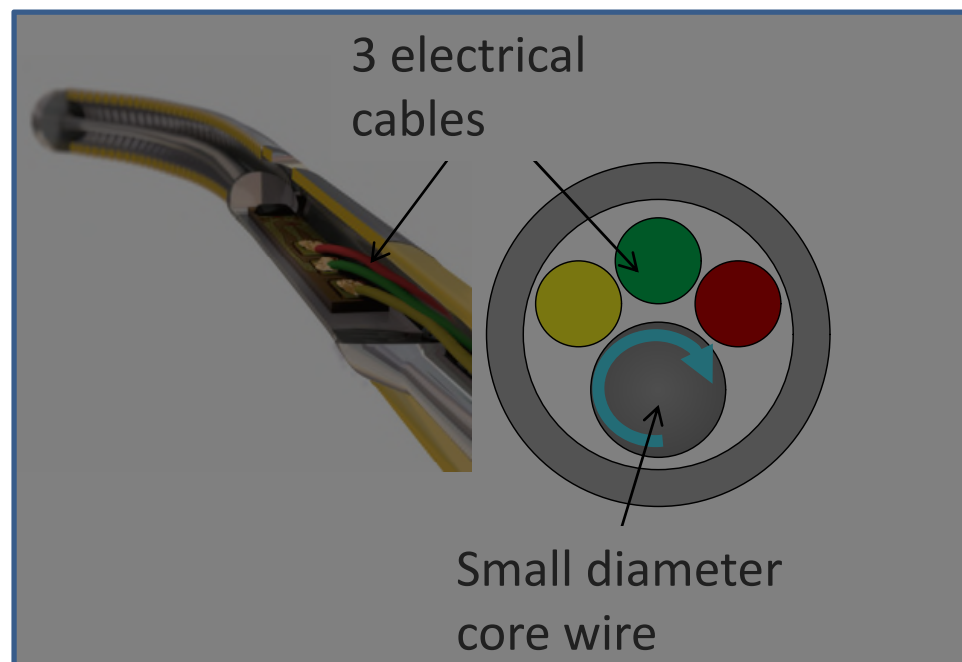
Optical Pressure Guidewire

Fiber optic technology enabling

- **Workhorse** pressure guidewire design
- **Improved** procedural freedom
 - Utilize the guidewire as a standard PCI guidewire
- **Accurate** FFR measurement - **minimal drift** *.
- **Re-connect-disconnect** – Quick, reliable, easy – true fluid resistance.



Larger diameter Nitinol core – enhanced torque characteristic



Lead with the **Light** ●●● in ACCURACY

FFR with *Confidence* – Zero drift*

- Opsens - Accurate FFR measurement showing *minimal drift**

Extract Specifications	OptoWire	St. Jude**	Volcano***
Zero drift (mmHg / h)	< 1	< 7	< 30

Opsens tested 20 devices for **8 hours**

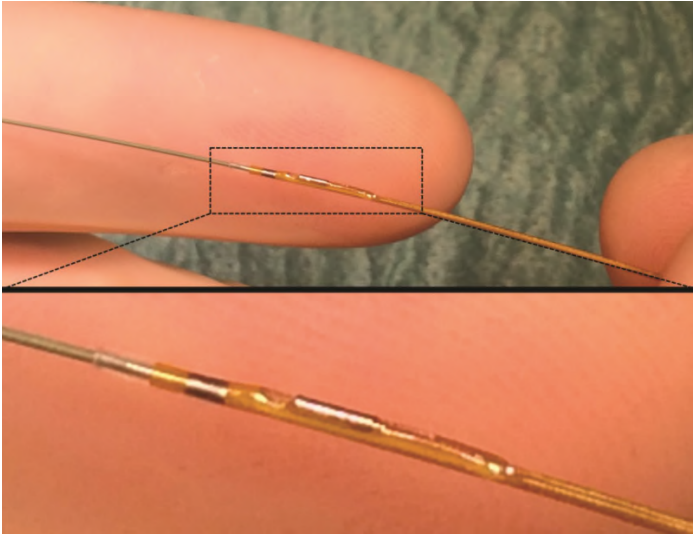
- 18 showed zero drift over 8 hours.
- 2 showed less than 1 mmHg over 8 hours.

**St-Jude documentation # 100018911.

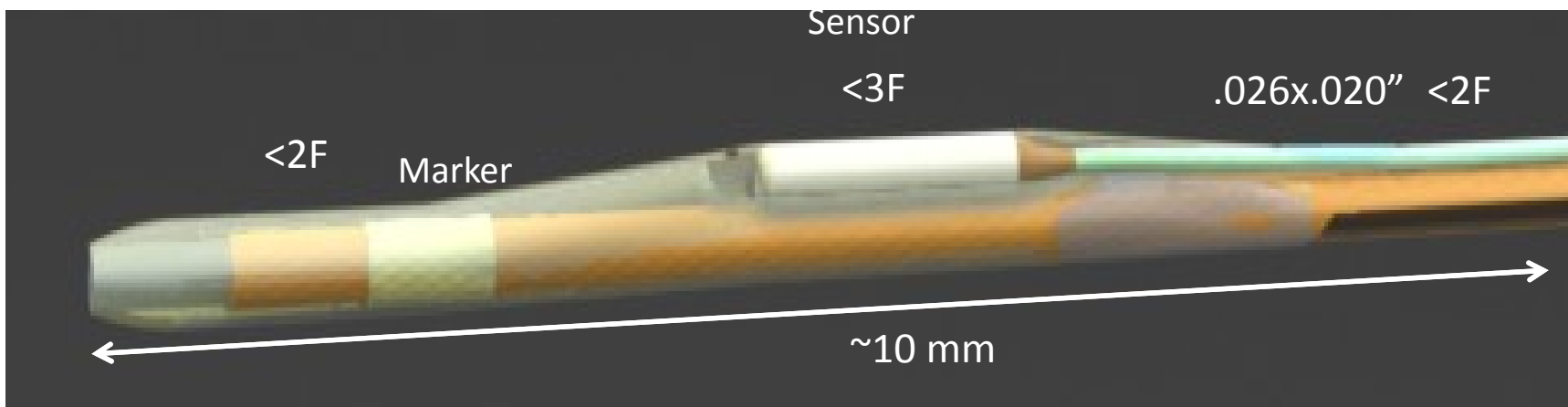
*** Extract from NHJP presentation:
Putting it all together: Why FFR works,
presented in Stanford Coronary
Physiology Conference Oct, 2015.

* Per IEC 60601-2-34 ed3

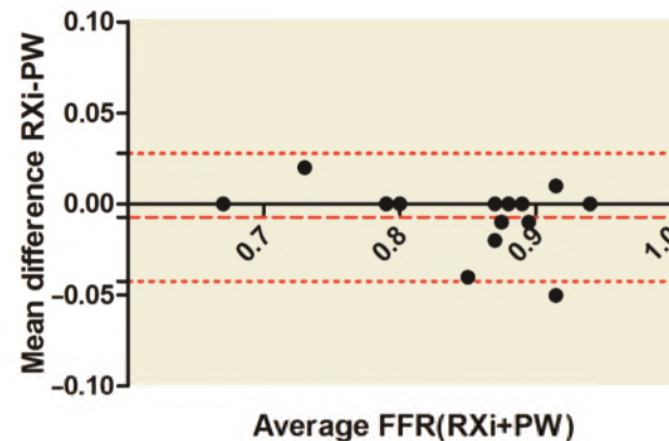
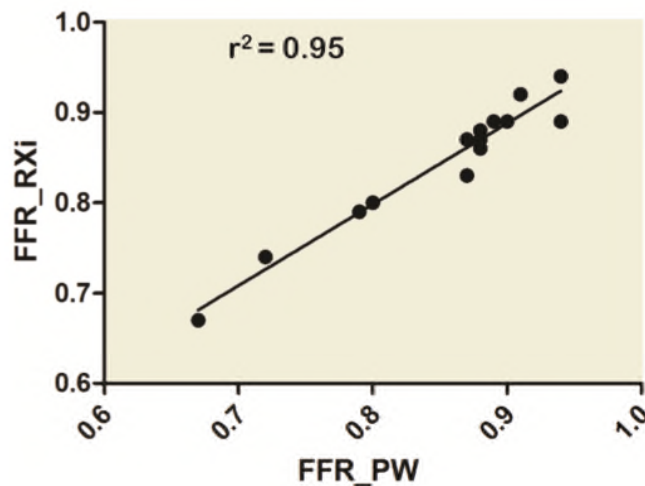
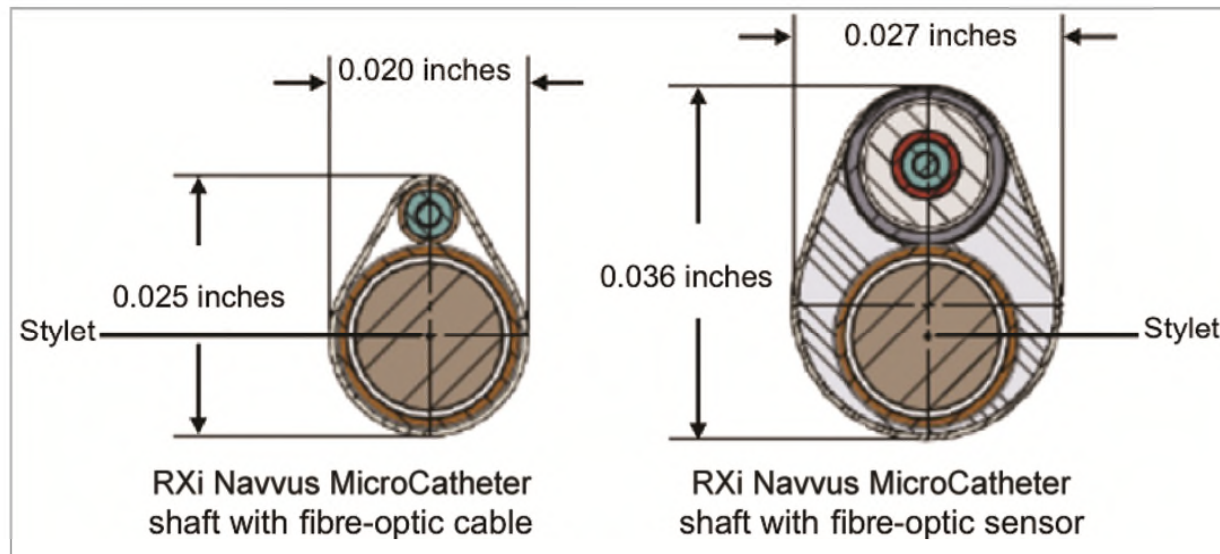
Rapid exchange ultra-thin microcatheter using fibre-optic sensing technology for measurement of intracoronary fractional flow reserve



- 0.014" guidewire compatible, rapid exchange
- Optical pressure sensing technology
- Ultra-thin distal shaft



Rapid exchange ultra-thin microcatheter using fibre-optic sensing technology for measurement of intracoronary fractional flow reserve



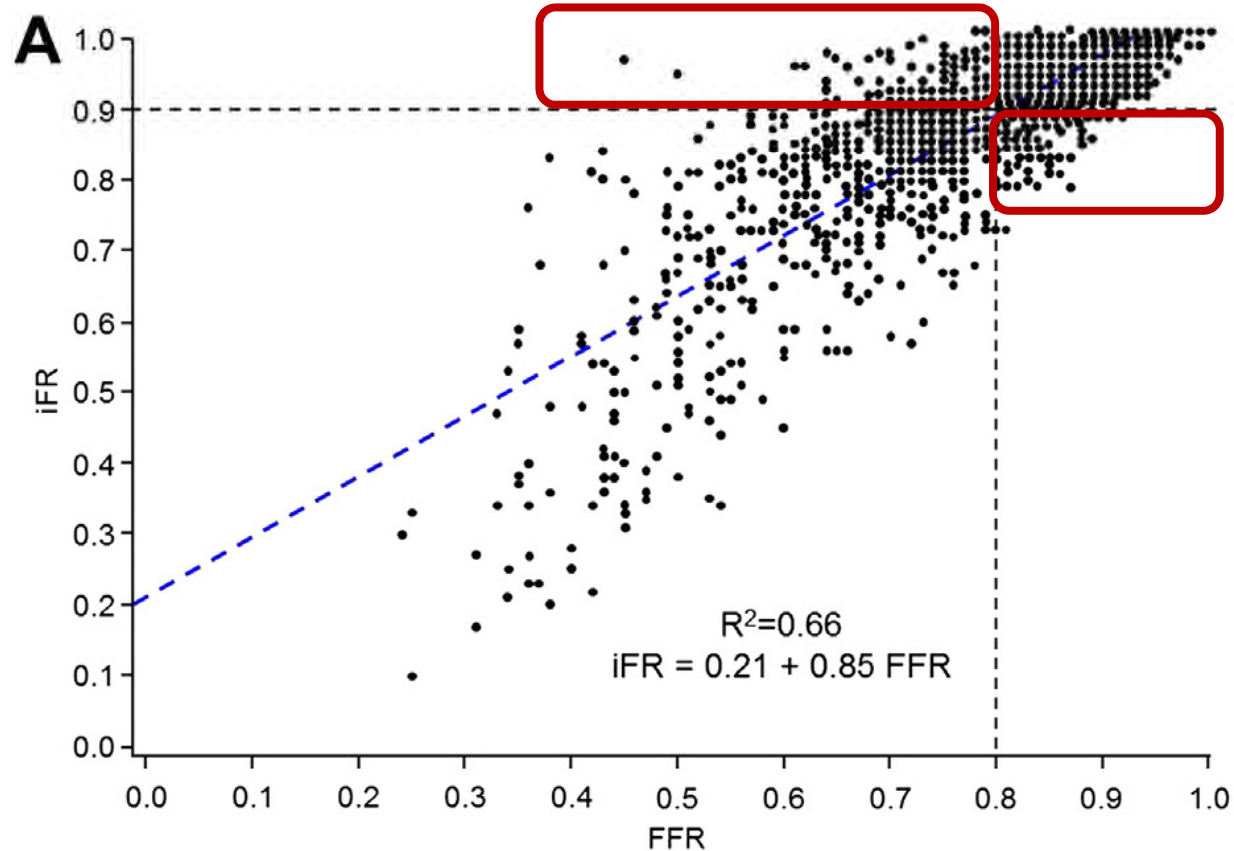
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Physiological Lesion Assessment

iFR versus FFR (RESOLVE Study)



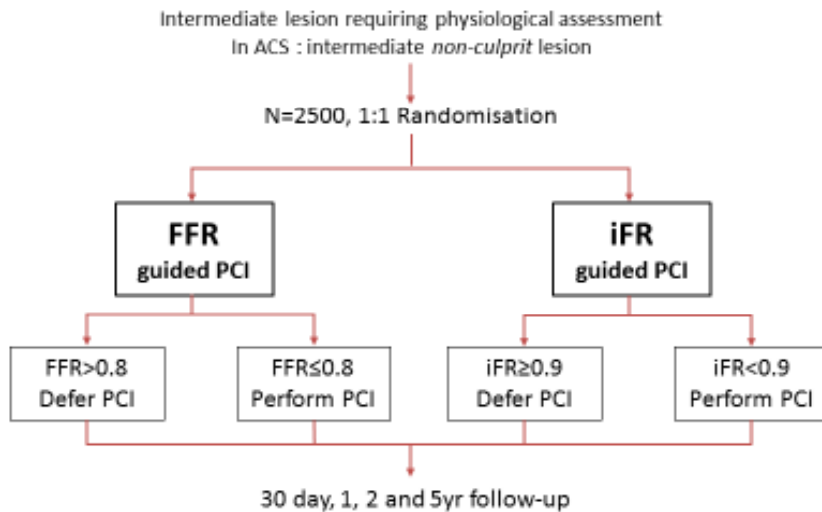
Conclusions This comprehensive core laboratory analysis comparing iFR and Pd/Pa with FFR demonstrated an overall accuracy of 80% for both nonhyperemic indices, which can be improved to 90% in a subset of lesions. **Clinical outcome studies are required to determine whether the use of iFR or Pd/Pa might obviate the need for hyperemia in selected patients.**

J Am Coll Cardiol 2014; 63:1253-1261.



DEFINE FLAIR

Functional Lesion Assessment of Intermediate stenosis to guide Revascularisation



iFR outcome data late breaking clinical trial sessions

Saturday, March 18

10:45 am – 12:00 pm

The DEFINE FLAIR study

1 year outcome data

Justin Davies, MD, PhD

Imperial College of London, UK

iFR Swedeheart study

1 year outcome data

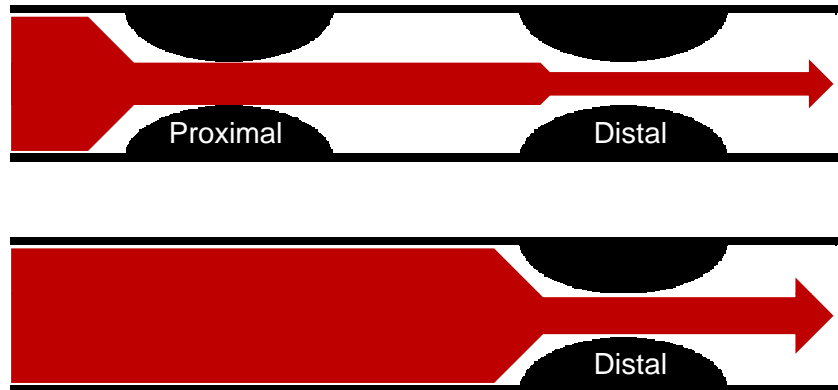
Matthias Götberg, MD, PhD

Lund University, Sweden

Fractional Flow Reserve (FFR)

How to assess sequential lesions?

- Hyperemic Flow (FFR)



- The proximal lesion limits the maximum blood flow into the distal lesion, while the distal lesion limits the maximum blood flow across the proximal lesion
- When one lesion is removed, the FFR value of the remaining lesion is changed

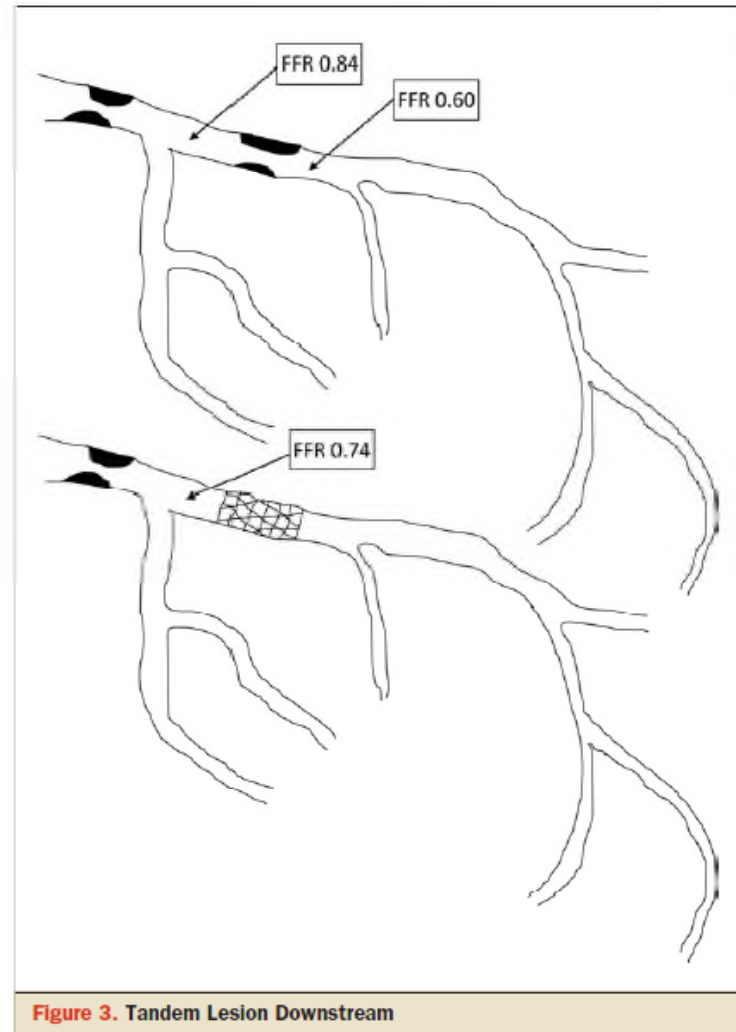


Figure 3. Tandem Lesion Downstream

Puri R, et al. J Am Coll Cardiol Interv 2012;5:697–707

Nijjer S, et al. "Pre-Angioplasty Instantaneous Wave-Free Ratio (iFR) Pullback Provides Virtual Intervention and Predicts Hemodynamic Outcome for Serial Lesions and Diffuse Coronary Artery Disease. JACC: Cardiovascular Interventions 2014; 12: 1386-1396.

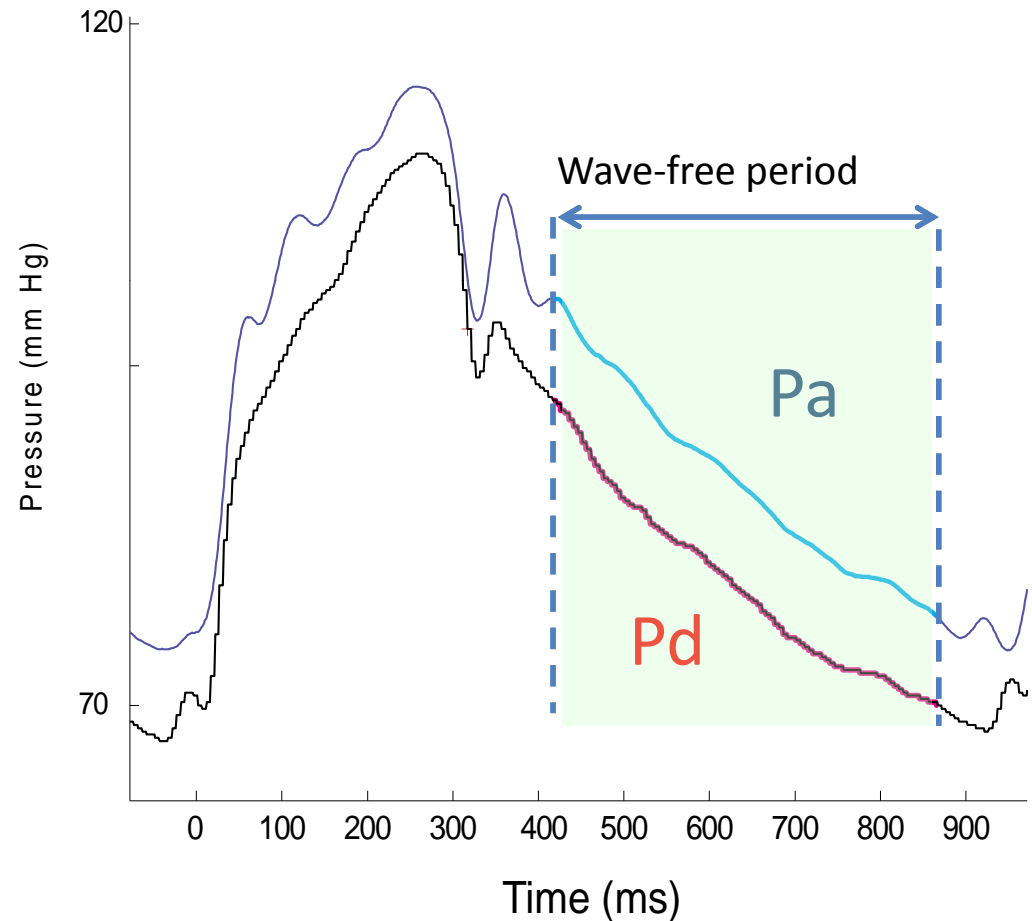
Physiological Lesion Assessment

New concept - iFR = instantaneous wave-free ratio

Definition: Instantaneous pressure ratio, across a stenosis during the wave-free period, when resistance is naturally constant and minimised in the cardiac cycle

$$iFR = \frac{Pd}{Pa}$$

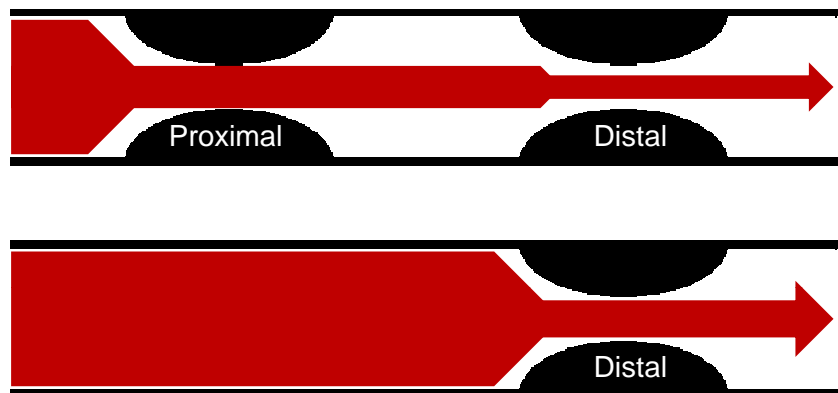
During the Wave Free period



Fractional Flow Reserve (FFR)

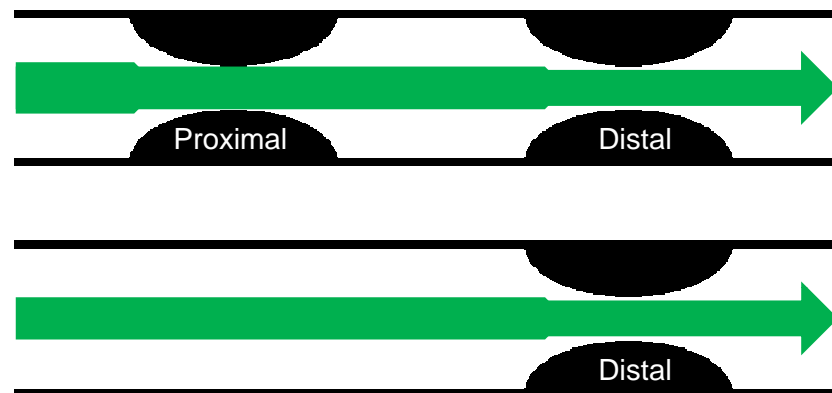
How to assess sequential lesions?

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- When one lesion is removed, the FFR value of the remaining lesion is changed

- Baseline Flow (iFR)



- The microvasculature maintains the baseline distal flow (autoregulation)
- When a lesion is removed, flow does not change substantially
- The iFR value of the remaining lesion remains constant

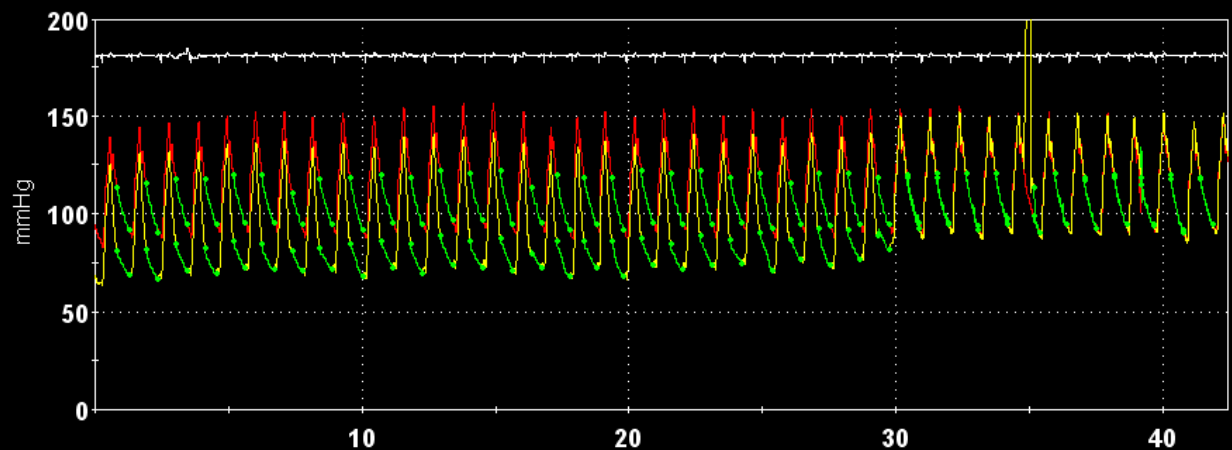
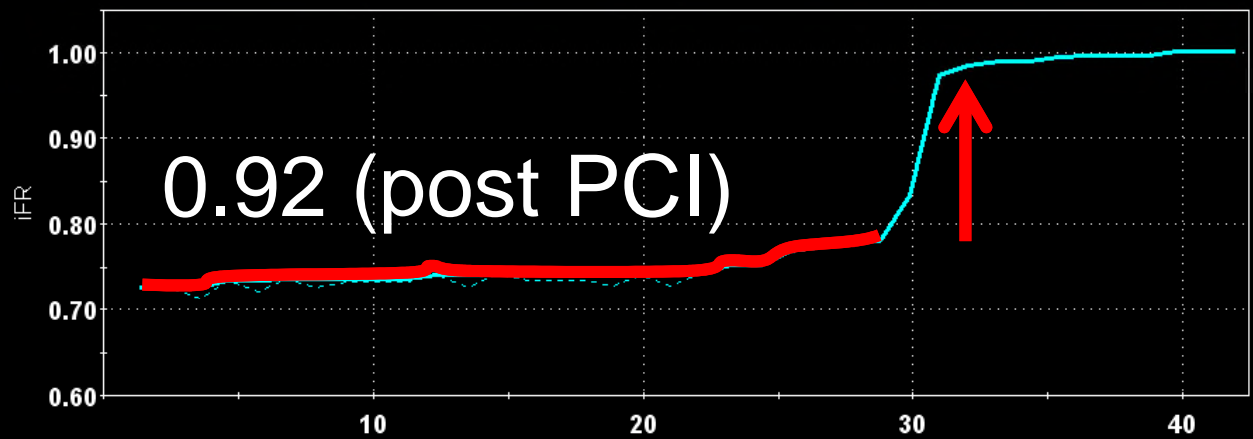


0:42

iFR[®]
Distal

0.73

List of Runs	iFR	FFR
16:28:02	0.72	
16:28:34	0.73	
Pullback		
16:30:13	0.73	
Pullback		
16:31:07	0.75	
Pullback		



Live



Options

Save Frame

Select Mode

Settings

Patient

FFR

iFR

Attach wire to connector

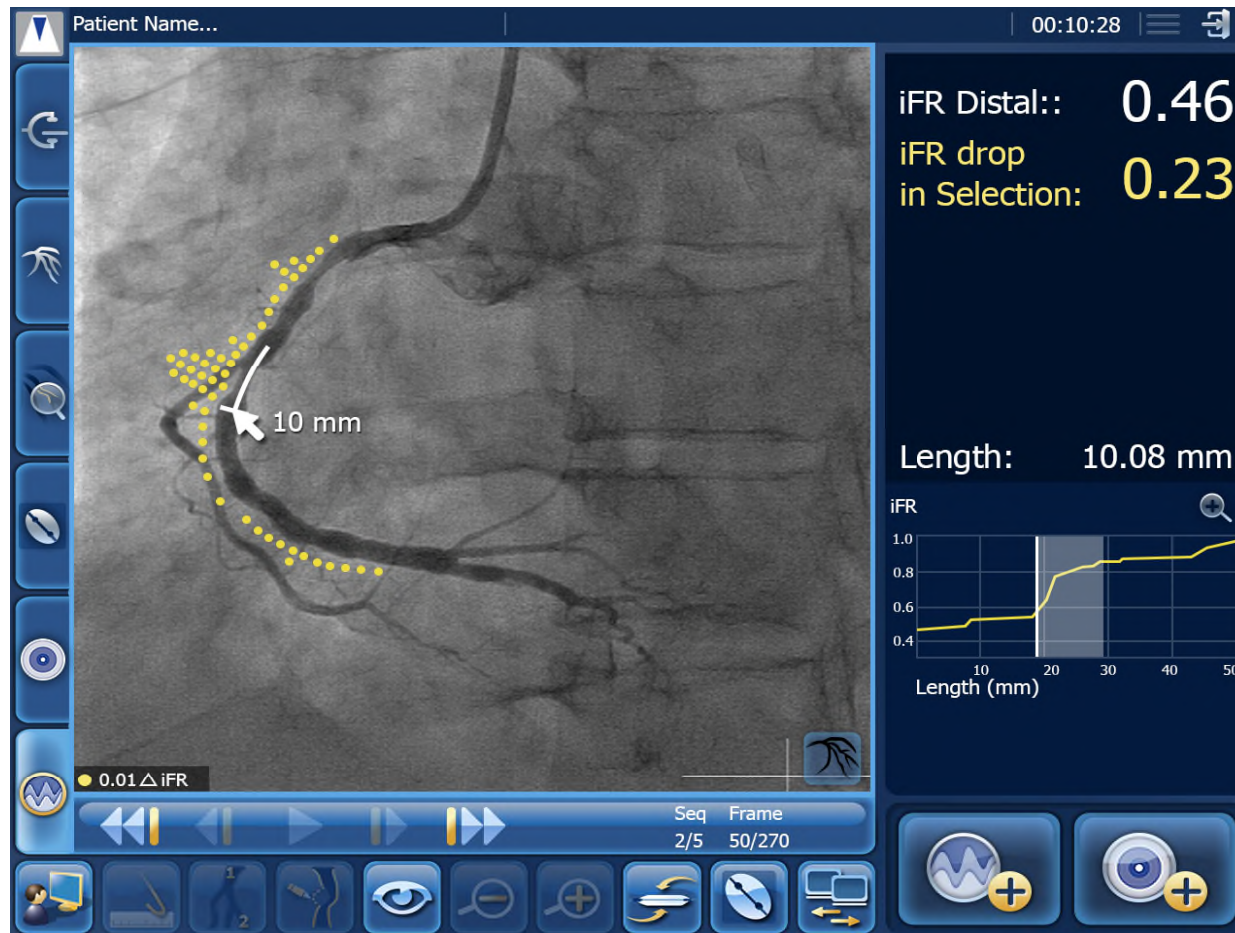
FFR PIM

Fractional Flow Reserve (FFR)

How to assess sequential lesions?

iFR Co-Registration

With iFR co-registration there is no need for hyperemic drugs, no need for time consuming pullback devices and no need for guesswork



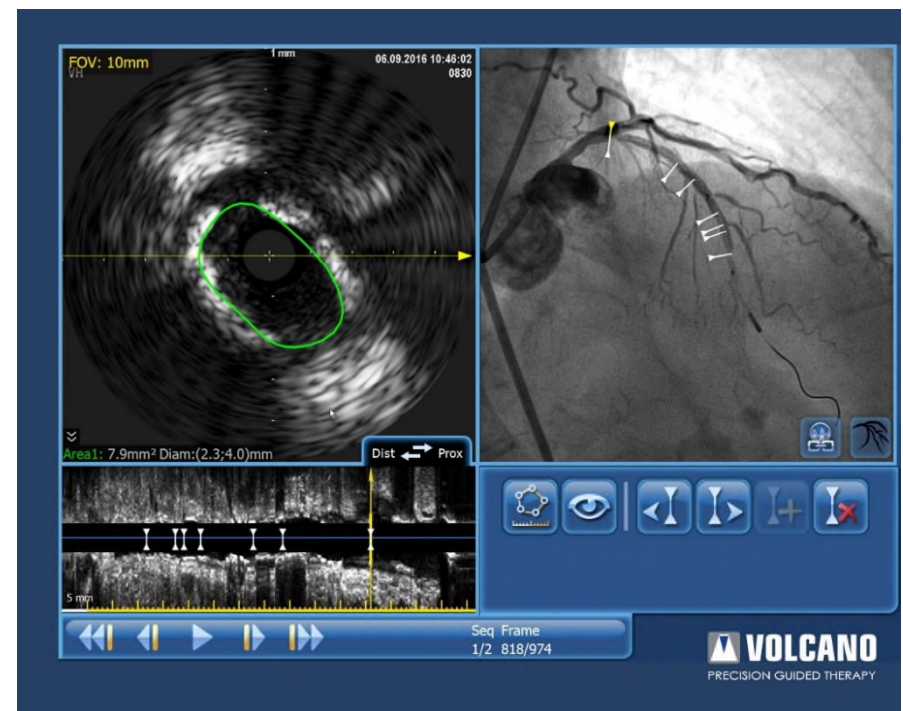
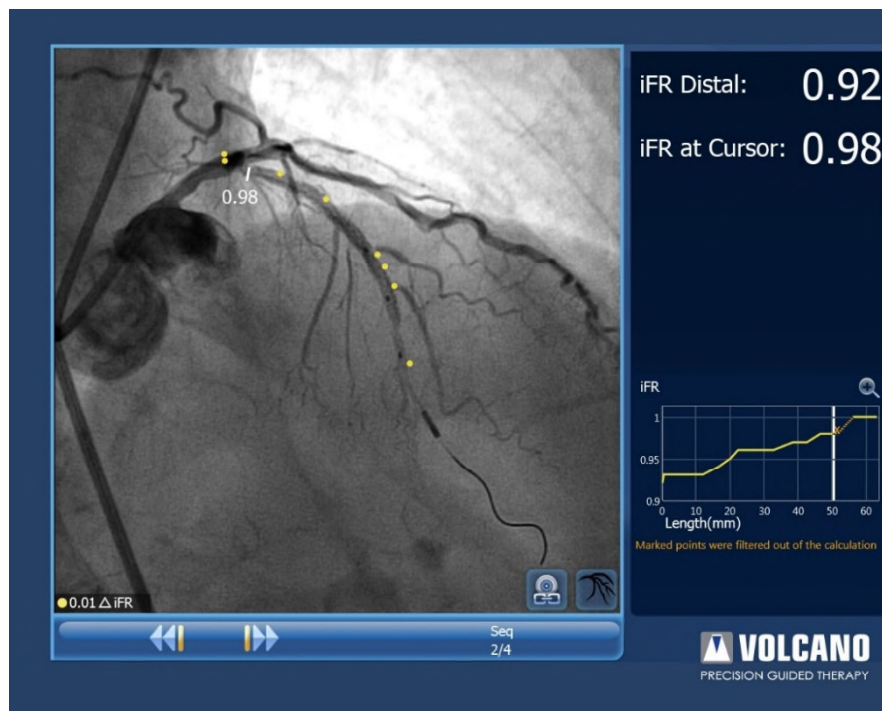
- Make length measurements without a cumbersome pullback device
- Plan your procedure with physiologic guidance

Fractional Flow Reserve (FFR)

How to assess sequential lesions?

iFR and IVUS Tri-Registration

Get the complete picture of vessel physiology and lesion morphology with iFR and IVUS Tri-registered with the angiogram



Thank you for your attention!

