



# La physiologie coronaire moderne :

## Accessible à tous ?

**Julien ADJEDJ**

**Saint Laurent du Var, France**

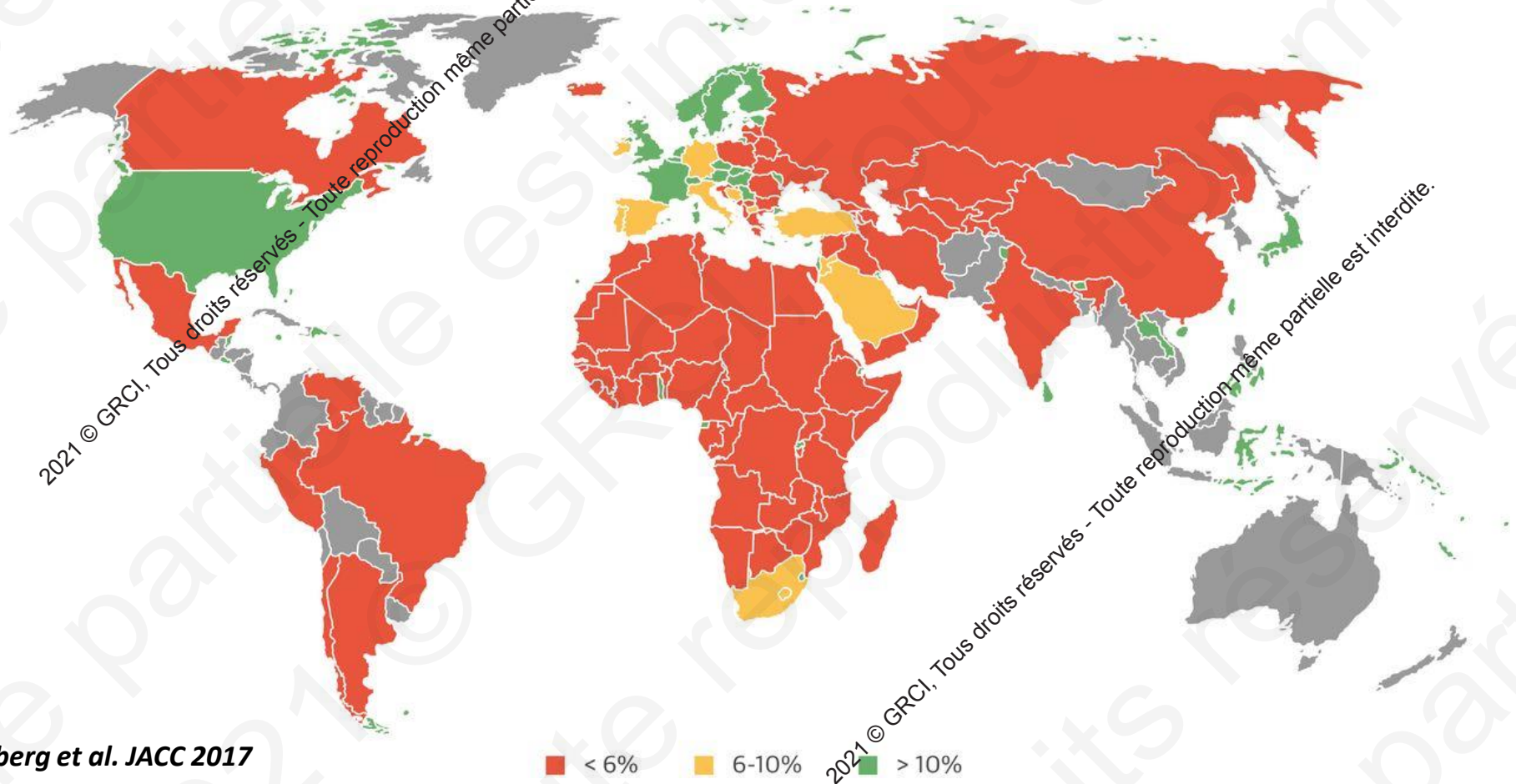
# DÉCLARATION DE LIENS D'INTÉRÊT AVEC LA PRÉSENTATION

**Nom de l'orateur : Julien ADJEDJ, Nice**

Liens d'intérêt potentiels à déclarer: Consultant pour Abbott et Biotronik

# Adoption de la FFR/iFR

Global Adoption of Coronary Physiology to Guide Revascularization Decision Making in 2016



# FFR virtuelle

FFR

FFR =

$$\frac{Q_s^{\max}}{Q_N^{\max}}$$

FFR virtuelle

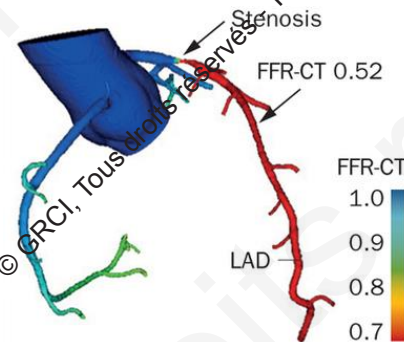
Algorithme

$$\frac{Dv}{Dt} = -\text{grad } V - \frac{1}{\rho} \text{grad } p + \frac{1}{\rho} \text{div } \tau$$

$$\tau_{ik} = \mu \left( \frac{\partial v_i}{\partial x_k} + \frac{\partial v_k}{\partial x_i} - \frac{2}{3} \delta_{ik} \frac{\partial v_s}{\partial x_s} \right) + \mu_0 \delta_{ik} \frac{\partial v_s}{\partial x_s}$$

+

Reconstruction 3D du vaisseau

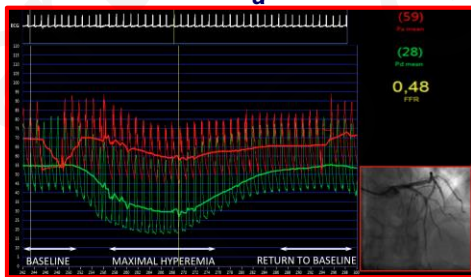


~~$$\text{FFR} = \frac{(P_d - P_v) / R_s}{(P_a - P_v) / R_N}$$~~

• Hyperemie maximale  $\rightarrow R_s = R_N$

•  $P_v \ll P_a$  et  $P_d$

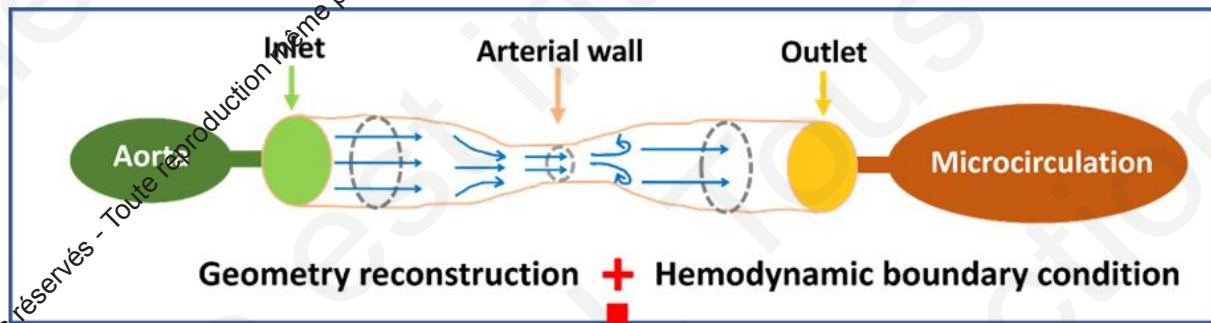
$$\text{FFR} = \frac{P_d}{P_a}$$



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# FFR virtuelles: principes

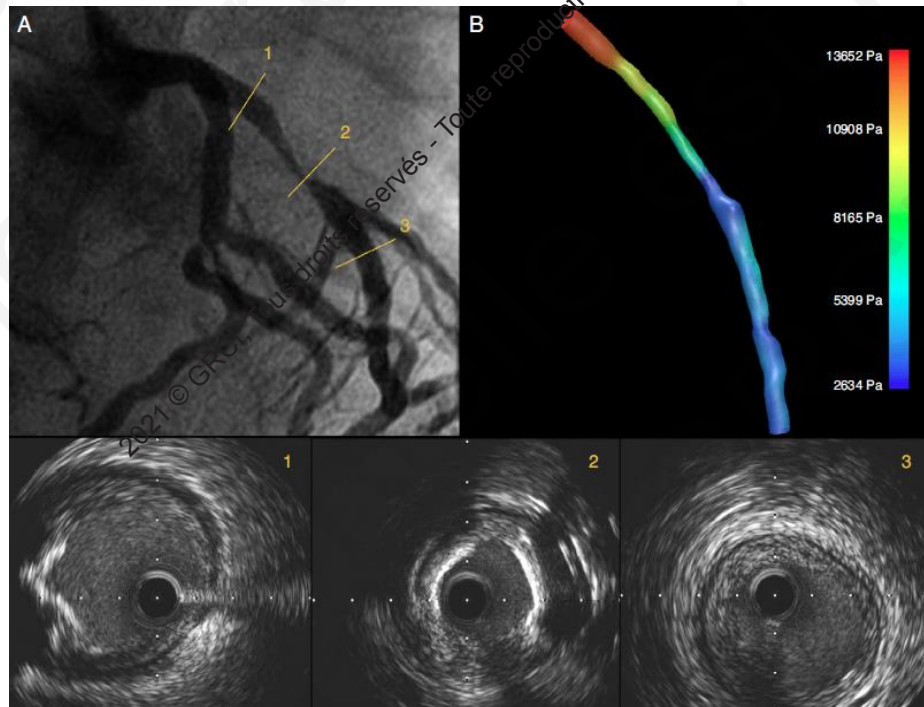


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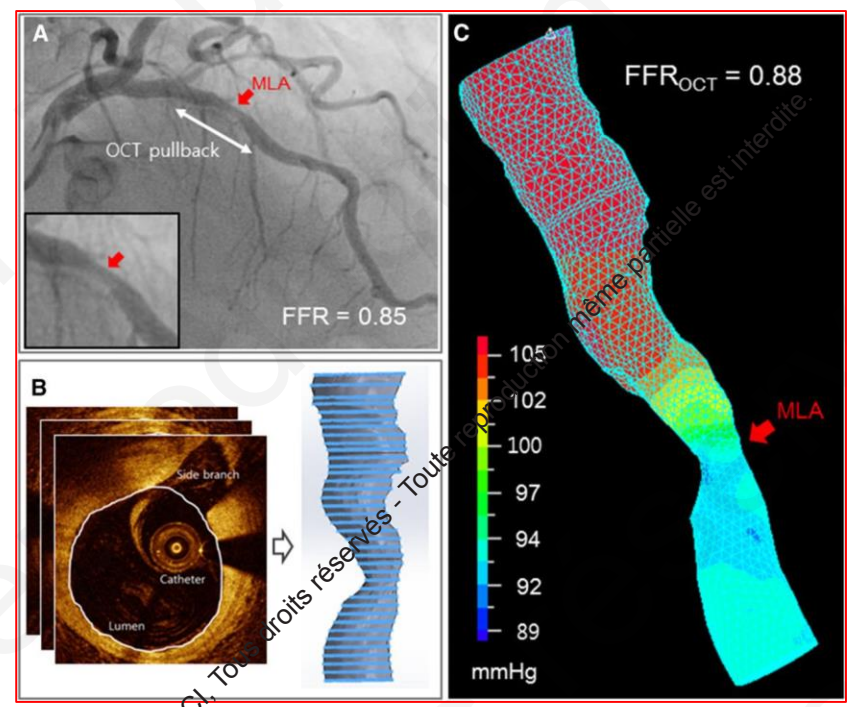
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Adedj et al. PCR-EAPCI Textbook 2019

# FFR virtuelle à partir de l'imagerie endocoronaire

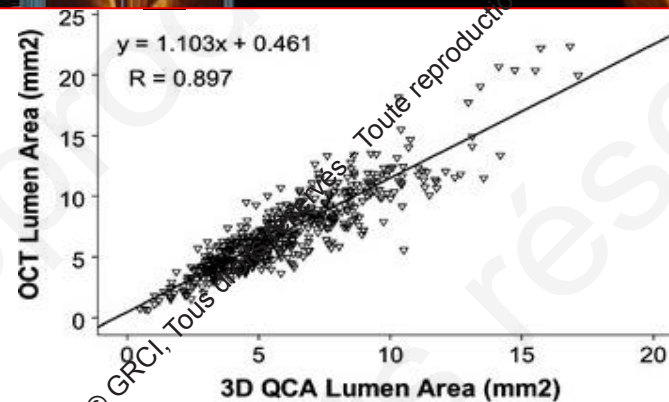
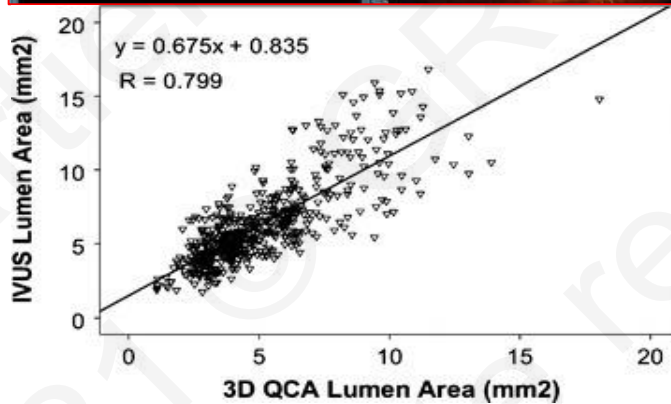
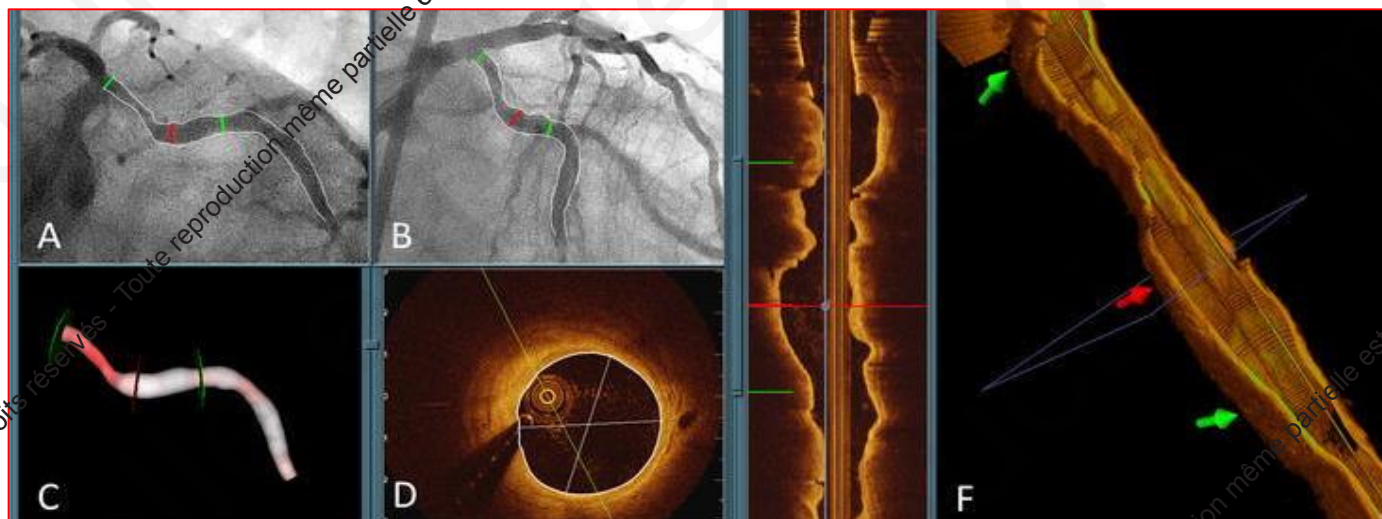


Carrizo et al. Portuguese journal of cardiology 2014.



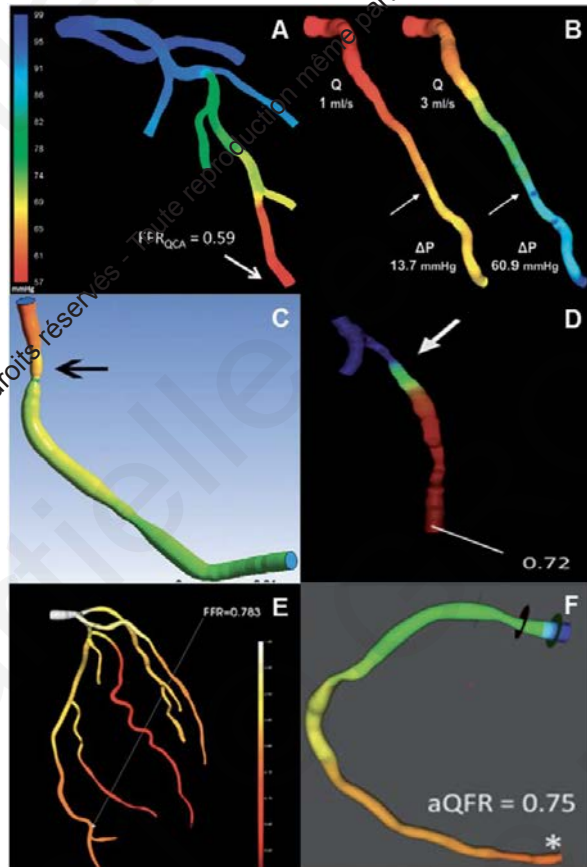
Jinyoung et al Circ Int. 2016;9:e003613

# Corrélation 3D QCA et imagerie endocoronaire

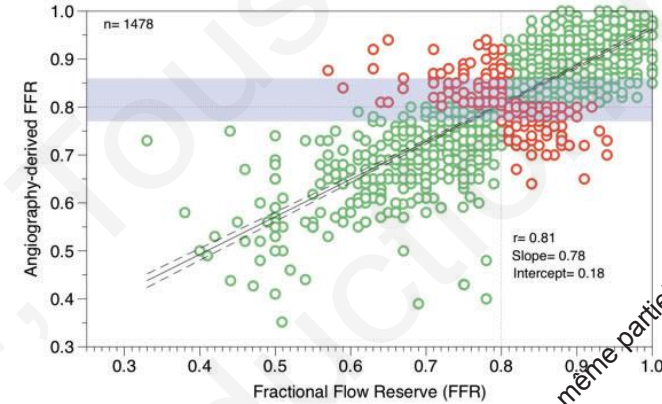


Tu et al. Int J Cardiovasc Imaging 2012.

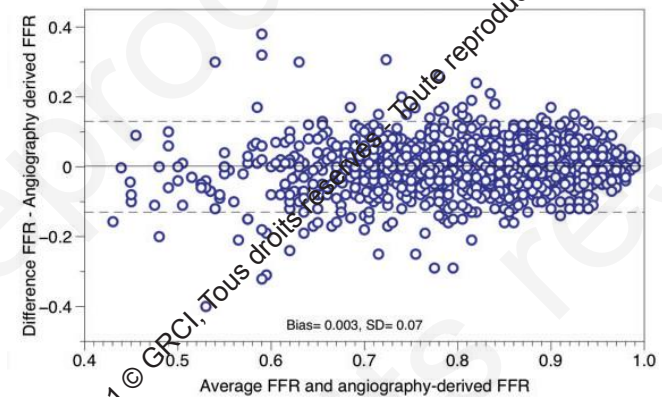
# FFR à partir des angiographies coronaire



**A** Linear regression analysis



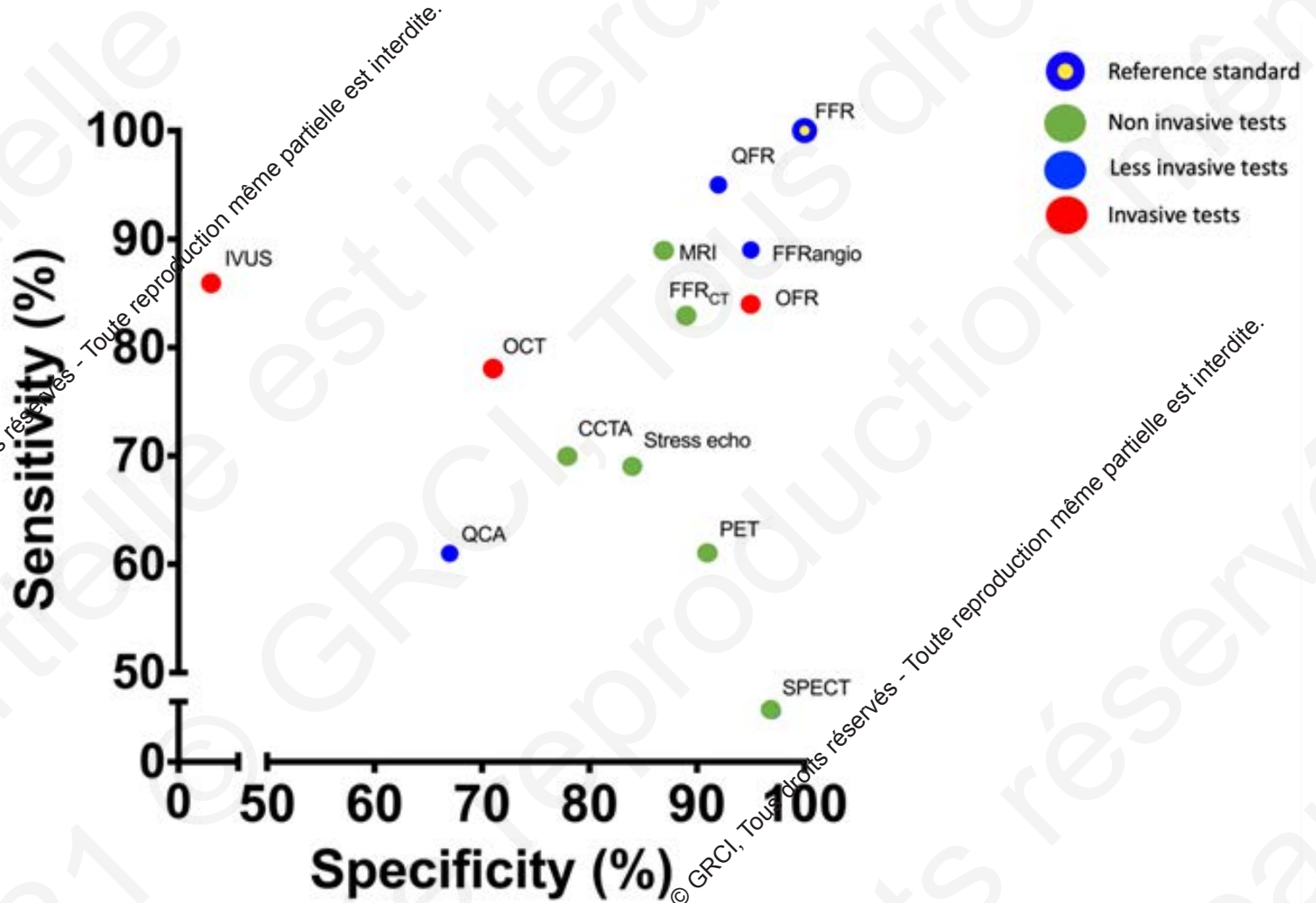
**B** Bland-Altman analysis



Collet et al. EHJ 2018.



# FFR virtuelles le bilan



Adedj et al. PCR-EAPCI Textbook 2019

Series Browser

Training\_26 Case26 XA 4 14/06/2017

Training\_26 M 14/06/2017

Training\_26 M 14/06/2017

Training\_26 M 14/06/2017

Series: 4 (1)  
Acq. speed: 15 f/s  
Cal. fac.: 0.2257 mm/pixel (Isocenter calibration)  
LAO 12, CAU 26

Series: 5 (1)  
Acq. speed: 15 f/s  
Cal. fac.: 0.2207 mm/pixel (Isocenter calibration)  
RAO 24, CAU 23

Series: 11 (1)  
Acq. speed: 15 f/s  
Cal. fac.: 0.2247 mm/pixel (Isocenter calibration)  
LAO 43, CAU 2

Series: 12 (1)  
Acq. speed: 15 f/s  
Cal. fac.: 0.2461 mm/pixel (Isocenter calibration)  
LAO 0, CAU 2

00:00:00.00

- Calibrations
- Measurements
- Annotations
- Snapshots
- Viewport layouts

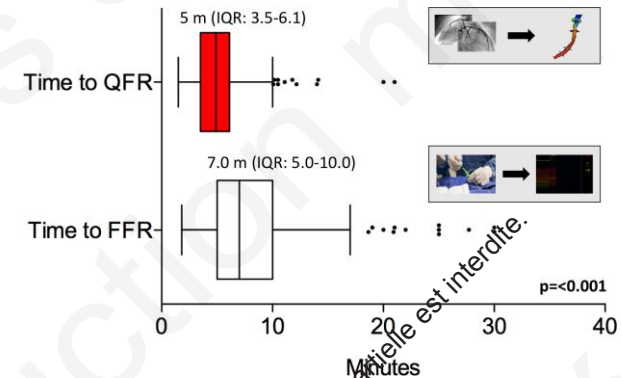
Properties

- Cine Alt+Shift
- Zooming Ctrl+Shift
- Panning Ctrl
- Window/Level
- Calibration
- Distance Measurement D
- Area Measurement A
- Text Annotation
- Snapshot S
- Viewport Layout Snapshot
- Invert image Ctrl+I
- QFR

Series Browser Results Browser View Report

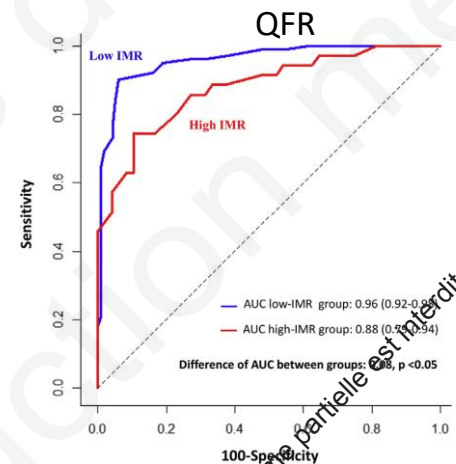
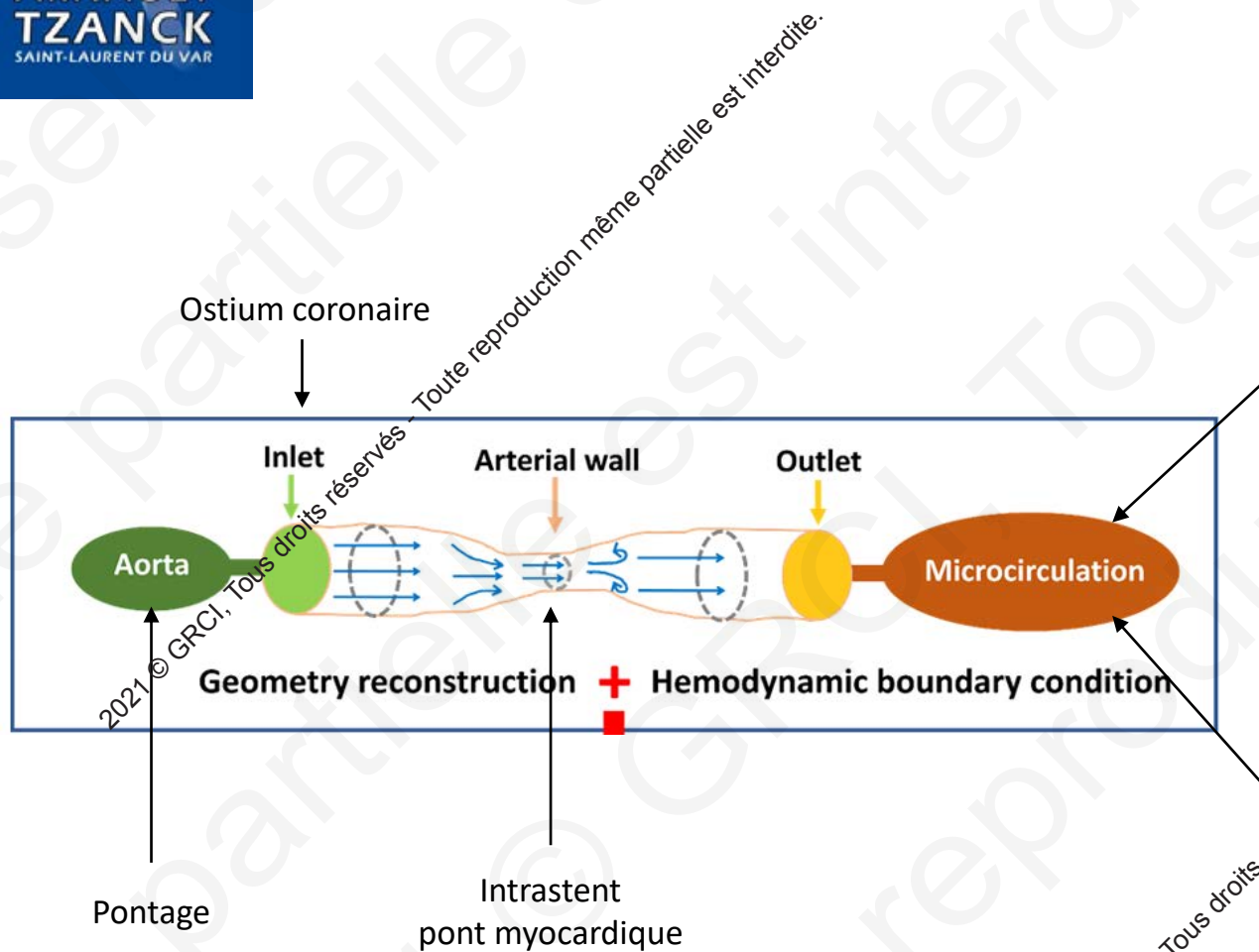
# FFR virtuelles « avantage »

- **Durée moins invasif**
- **Possibilité de faire l'analyse à posteriori**
- **Les lésions diffuses et en tandem**
- **Pluritronculaires avec CTO**
- **Recherche**



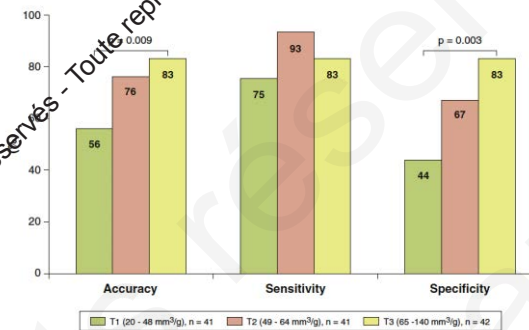
Westra et al. JAHA 2018.

# FFR virtuelles limites



Mejía-Rentería et al. JACC Int 2018.

## FFR<sub>CT</sub> et STEMI recent



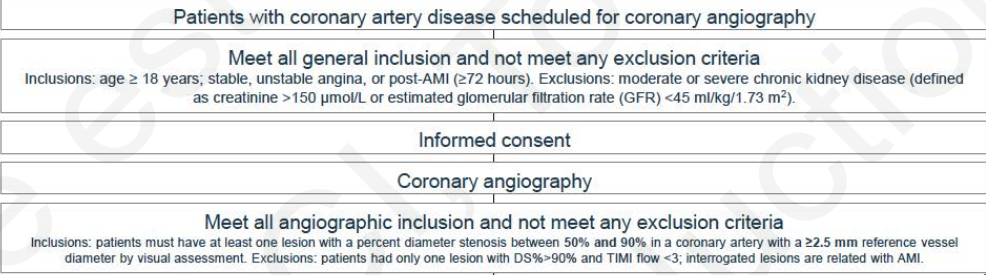
Gaur et al. JACC Imaging 2017.

# Etudes clinique: la saga FAVOR

## FAVOR III China: QFR versus angioguided PCI

### Study Design

Investigator-Initiated, Multicenter, Sham-Controlled Blinded Randomized Trial



- Randomization Stratifications
- Diabetes Mellitus
  - Multivessel Disease
  - Presence of any vessel with  $\text{DS\%} > 90\%$  and  $\text{TIMI flow} < 3$
  - Center

Identify target vessels intended to be treated with standard angiography guidance

N=3830 (1:1 randomization)

QFR-guided strategy  
N=1915

Angiography-guided strategy  
N=1915

- Independent Organizations
- Core Lab
  - CEC
  - DSMB
  - Data Management
  - Statistical Analysis

QFR was measured in all coronary arteries containing any lesion with visually-assessed  $\text{DS\%} \geq 50\%$  and  $\leq 90\%$  and  $\text{RVD} \geq 2.5 \text{ mm}$

- $\text{QFR} \leq 0.80$ : PCI
- $\text{QFR} > 0.80$ : deferral
- All measured vessel  $\text{QFR} > 0.80$ : OMT alone

PCI was performed based on visual angiographic assessment per local standard of practice

Imaging core lab analysis; clinical follow-up at 1 month, 6 months, 1 year, 2 years, and 3 years; EQ-5D questionnaires collected at 1, 6, and 12 months

CRF TCT ClinicalTrial.gov Identifier: NCT03656848 Song L, et al. Am Heart J 2020. FAVOR Series of QFR Studies

FAVOR III: Xu, B., et al. Lancet 2021.

# Etudes clinique: la saga FAVOR

## FAVOR III China: QFR versus angioguided PCI

### Key Procedural Results

	QFR-guided group (N=1913)	Angiography-guided group (N=1912)	p value
PCI performed	90.5%	99.1%	<0.0001
Number of stents placed per patient	1.45 ± 1.02	1.58 ± 0.97	<0.0001
Use of intravascular imaging	6.2%	6.3%	0.89
Contrast medium used per patient, ml	163.0 ± 75.6	169.7 ± 74.2	0.0060
Fluoroscopy time, min	14.1 ± 8.0	14.9 ± 7.4	0.0013
Procedure time, min	53.7 ± 30.4	59.4 ± 30.4	<0.0001
Adjusted procedure time, min	44.6 ± 28.8	49.5 ± 30.2	<0.0001
PCI lesion success	99.0%	99.3%	0.38
Residual anatomic SYNTAX score	2.4 ± 3.6	2.4 ± 4.0	0.49
Residual functional SYNTAX score	0.7 ± 2.3	1.0 ± 2.8	<0.0001
Residual functional SYNTAX score=0	88.1%	82.2%	<0.0001

TCT

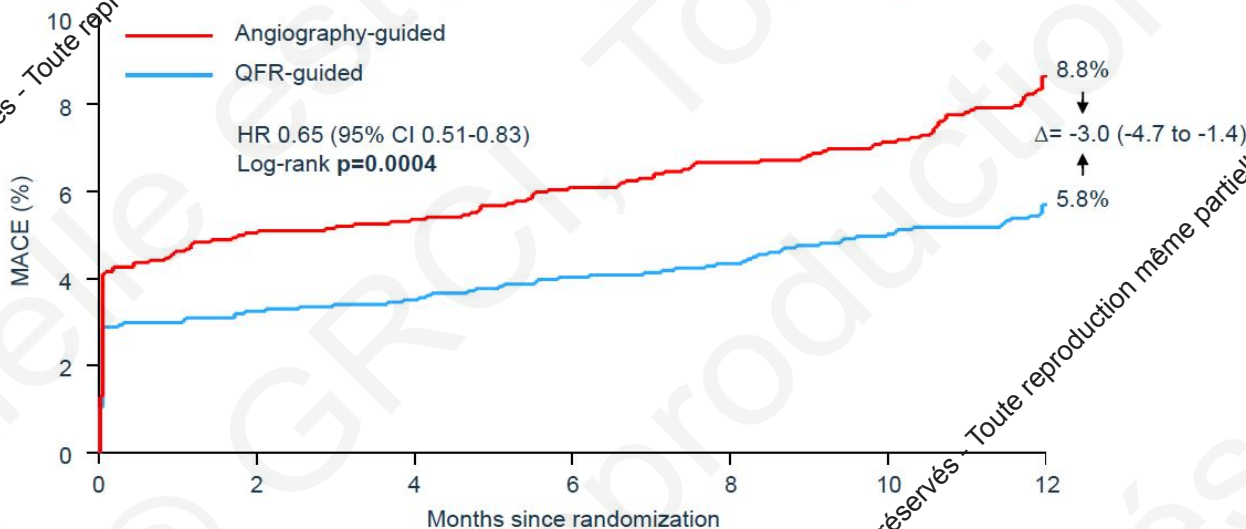
FAVOR  
Series of QFR Studies

FAVOR III: Xu, B., et al. Lancet 2021.

# Etudes clinique: la saga FAVOR

## FAVOR III China: QFR versus angioguided PCI

### Primary Endpoint (ITT)



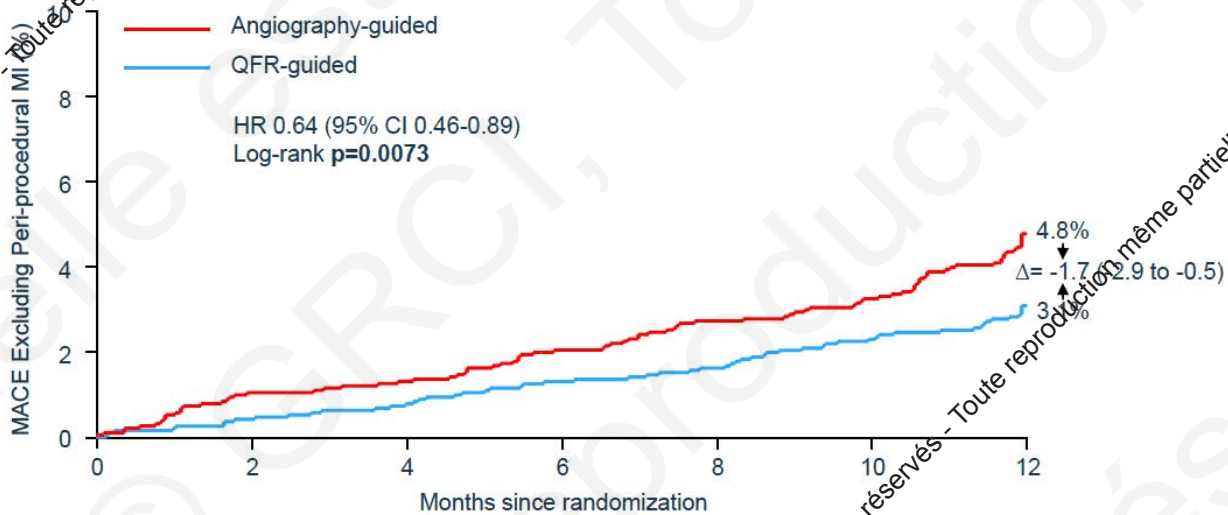
No. at risk	0	2	4	6	8	10	12
QFR-guided	1913	1845	1840	1828	1821	1809	1795
Angiography-guided	1912	1804	1798	1783	1770	1762	1732

FAVOR III: Xu, B., et al. Lancet 2021.

# Etudes clinique: la saga FAVOR

## FAVOR III China: QFR versus angioguided PCI

### Major Secondary Endpoint (ITT)



No. at risk	0	2	4	6	8	10	12
QFR-guided	1913	1900	1894	1881	1874	1862	1846
Angiography-guided	1912	1883	1877	1862	1847	1839	1808



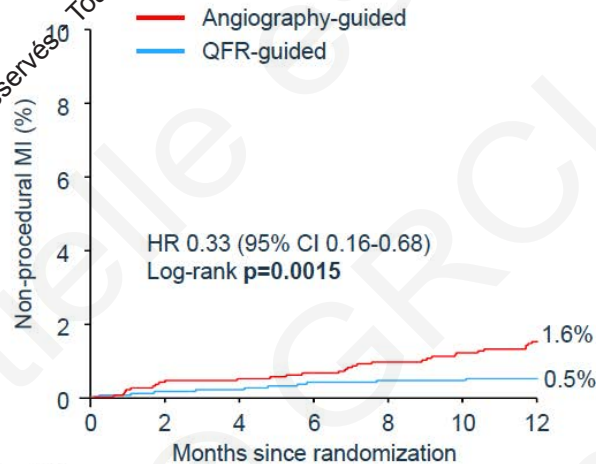
FAVOR III: Xu, B., et al. Lancet 2021.



# Etudes clinique: la saga FAVOR

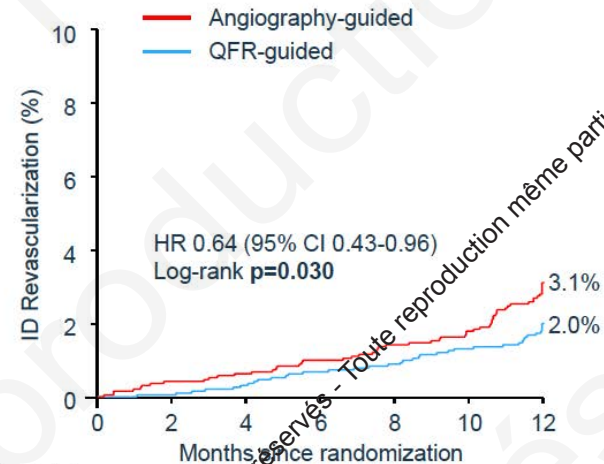
## FAVOR III China: QFR versus angioguided PCI

### Non-procedural MI and ID Revascularization



No. at risk

	0	2	4	6	8	10	12
QFR-guided	1913	1901	1899	1892	1889	1885	1882
Angiography-guided	1912	1891	1889	1881	1872	1867	1861

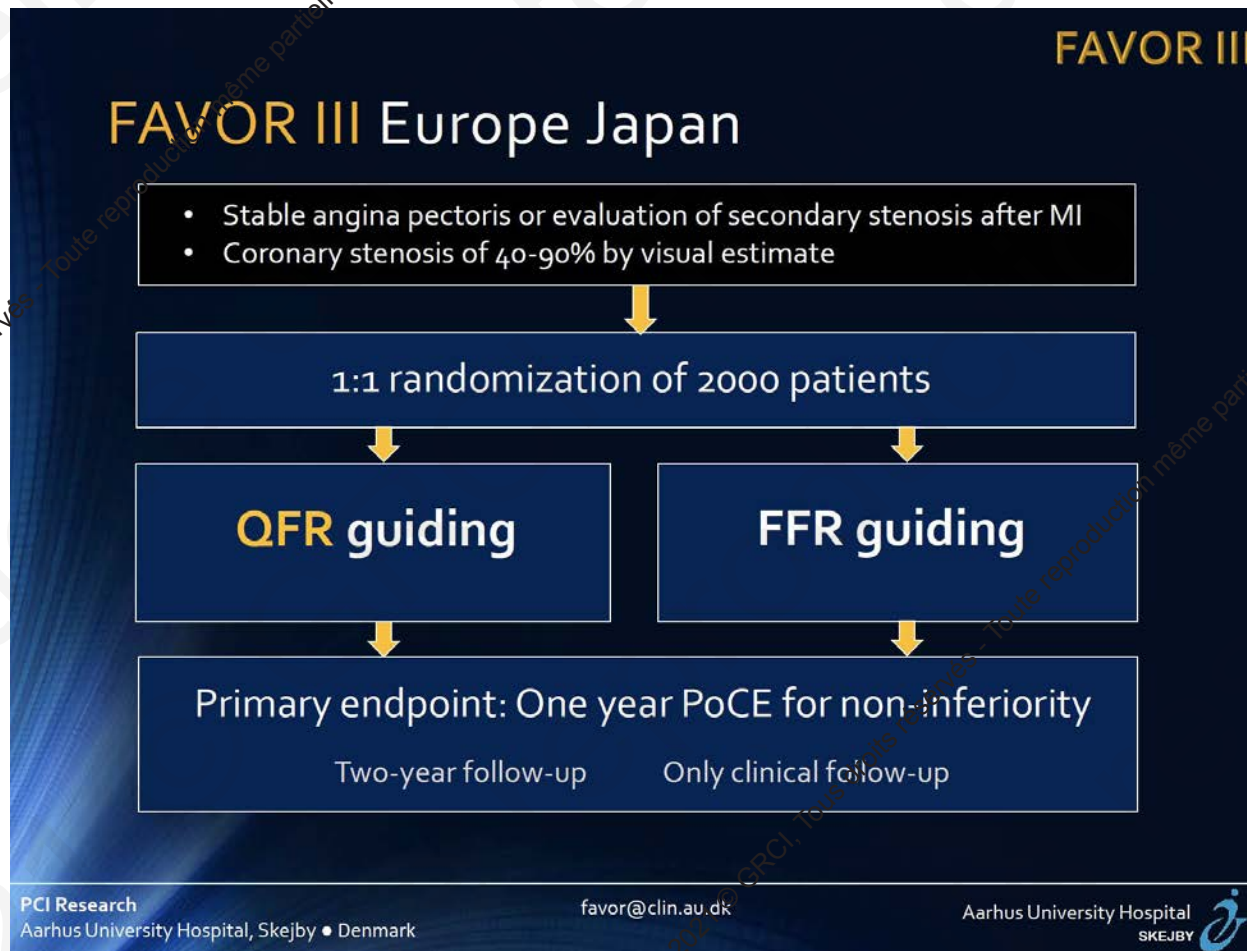


No. at risk

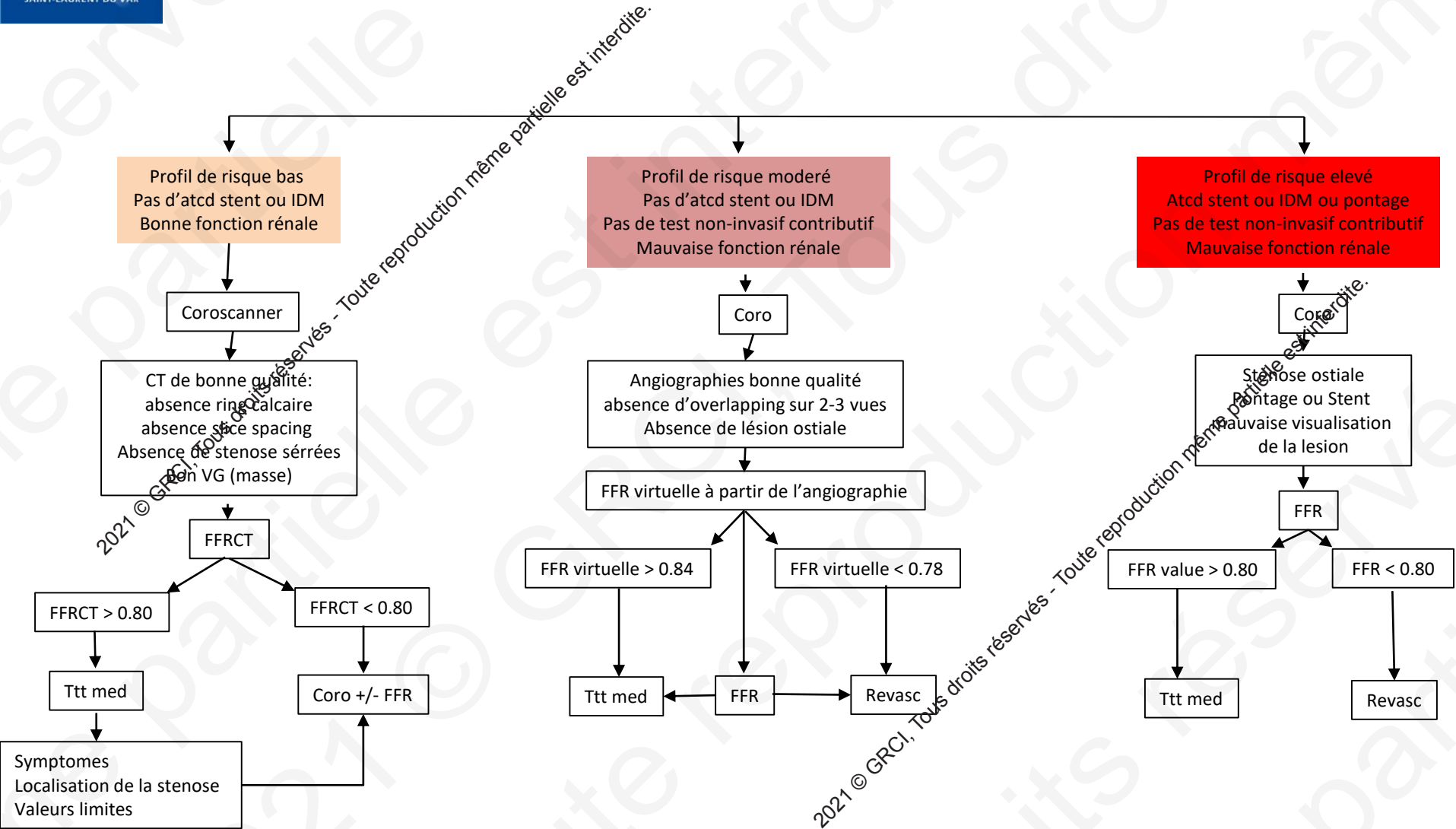
	0	2	4	6	8	10	12
QFR-guided	1913	1903	1897	1887	1881	1869	1854
Angiography-guided	1912	1897	1887	1874	1863	1859	1831

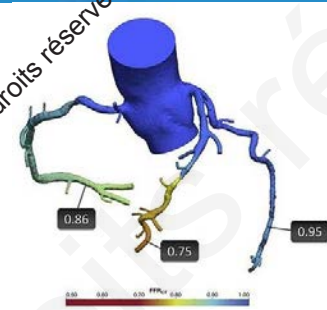
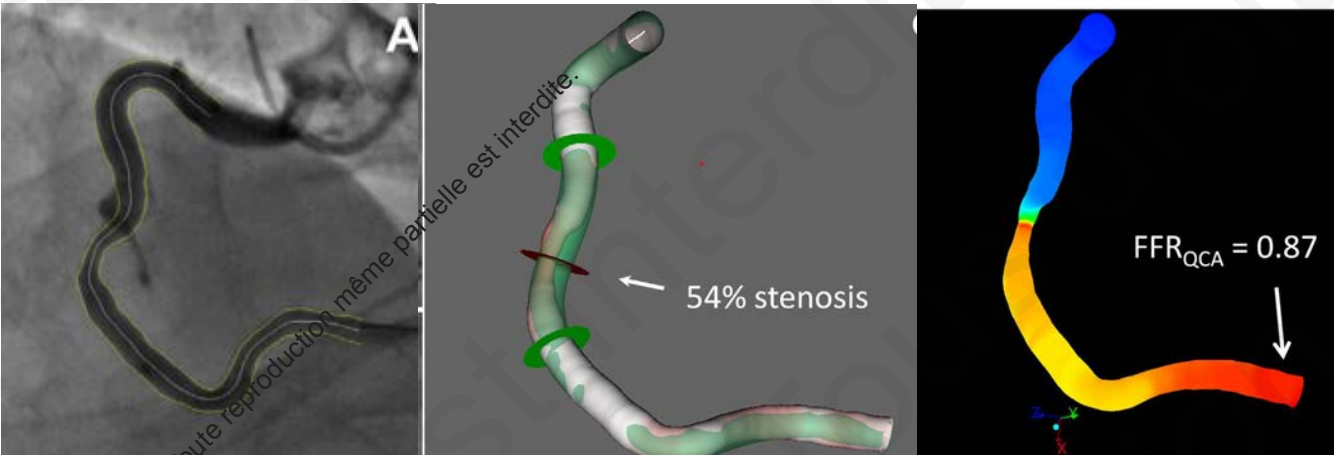
# Etudes clinique: la saga FAVOR

## FAVOR III Europe Japan:



# Ma vision de l'utilisation de la FFR & FFR virtuelle





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