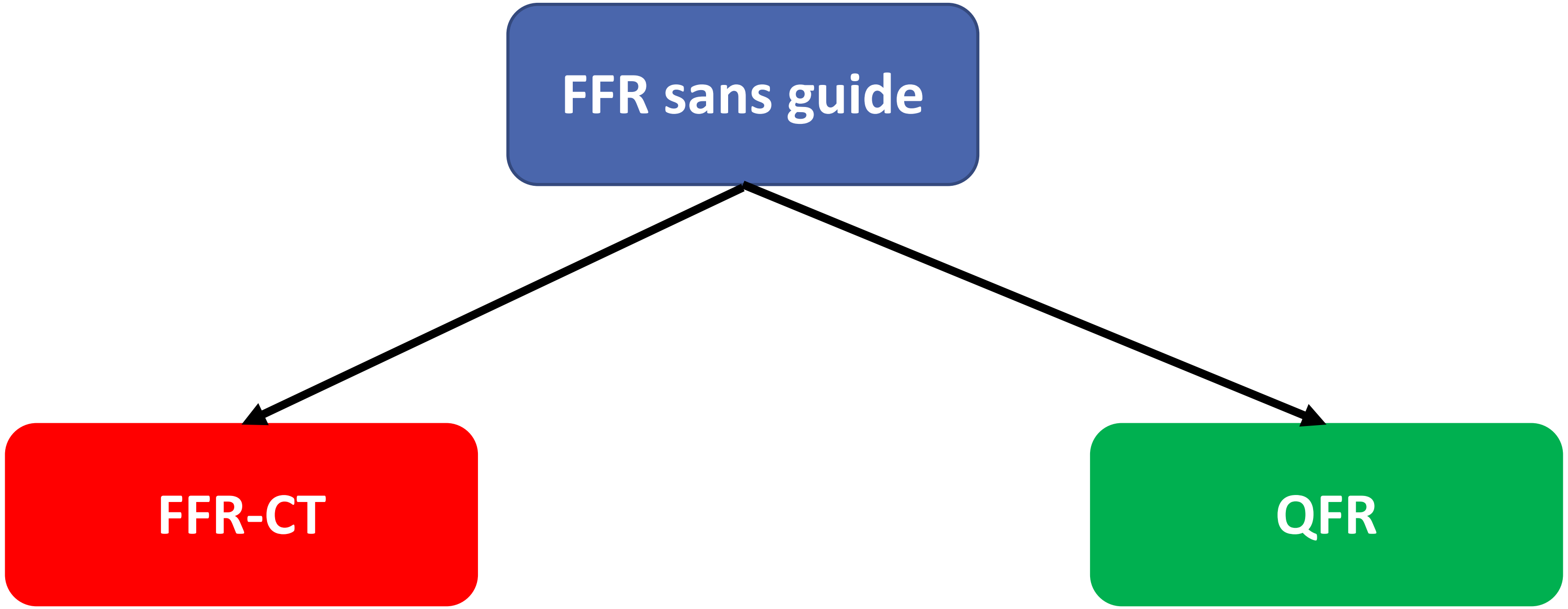
26-27-28 JANVIER 2022 HIGH TECH MARSEILLE

CHRU BREST CENTRE HOSPITALIER REGIONAL UNIVERSITAIRE

FFR sans guide
FFR-CT et QFR

DR ROMAIN DIDIER, MD, PHD

La FFR est considérée comme le **gold standard** pour déterminer la répercussion physiologique d’une sténose coronaire

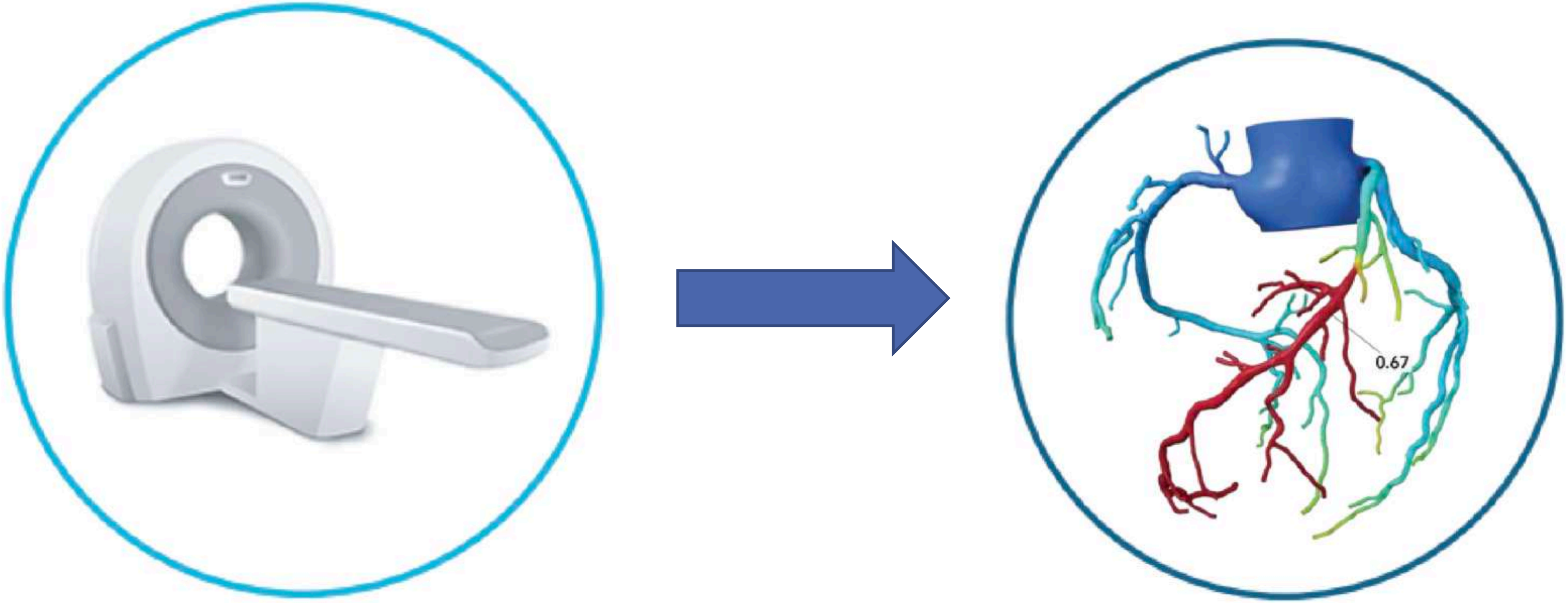


FFR sans guide

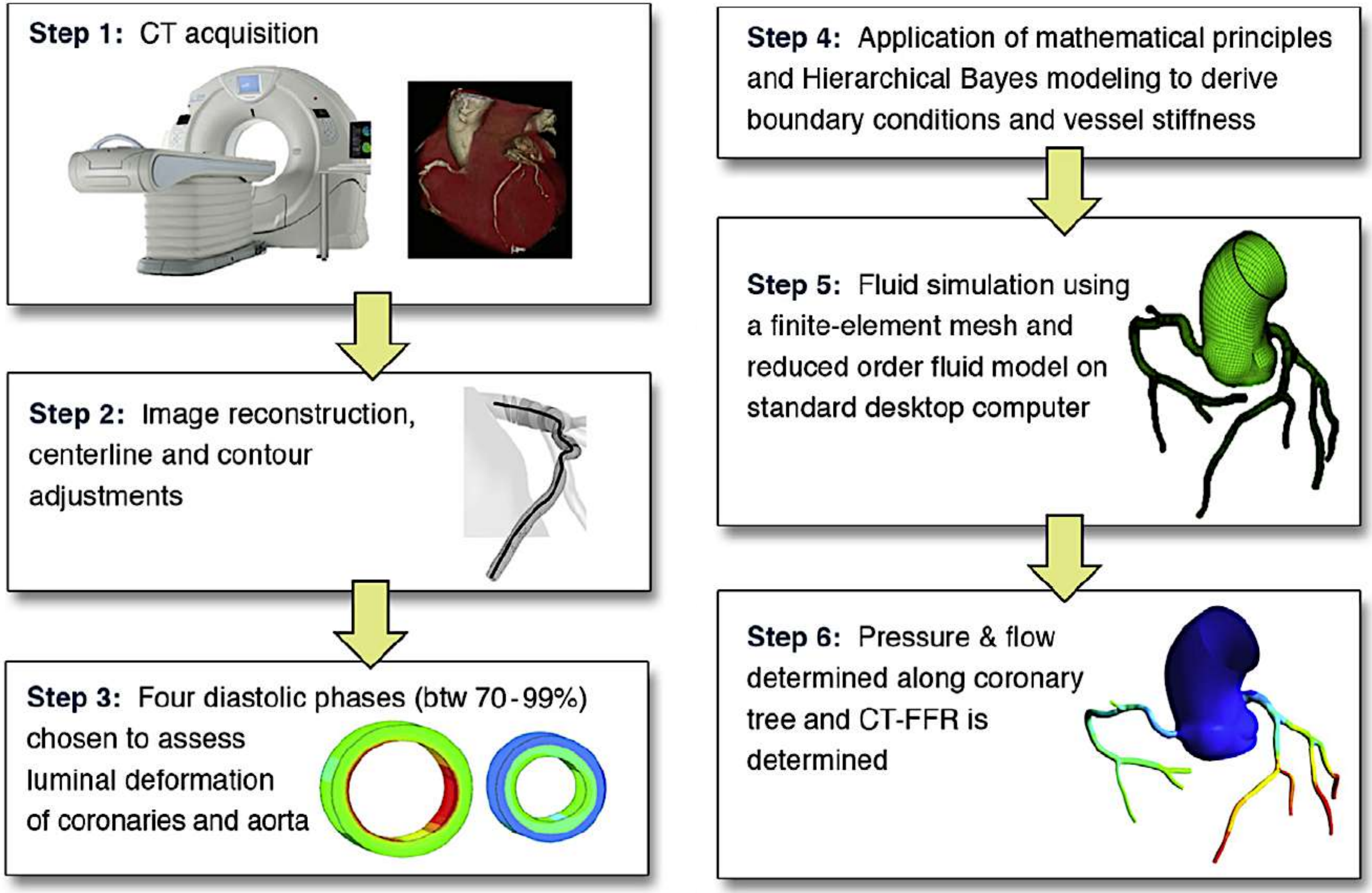
FFR-CT

QFR

FFR-CT



FFR-CT



Step 1: CT acquisition

Step 2: Image reconstruction, centerline and contour adjustments

Step 3: Four diastolic phases (btw 70-99%) chosen to assess luminal deformation of coronaries and aorta

Step 4: Application of mathematical principles and Hierarchical Bayes modeling to derive boundary conditions and vessel stiffness

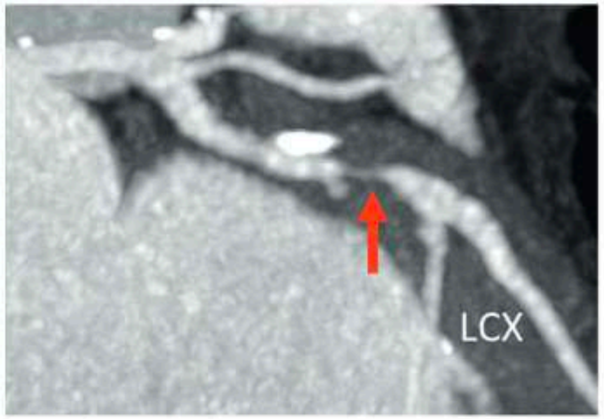
Step 5: Fluid simulation using a finite-element mesh and reduced order fluid model on standard desktop computer

Step 6: Pressure & flow determined along coronary tree and CT-FFR is determined

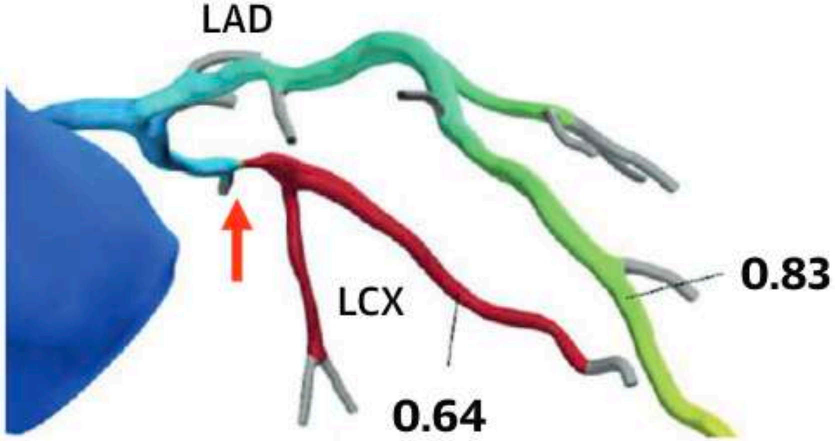
Ko B et al JACC imaging 2017;10:663-673

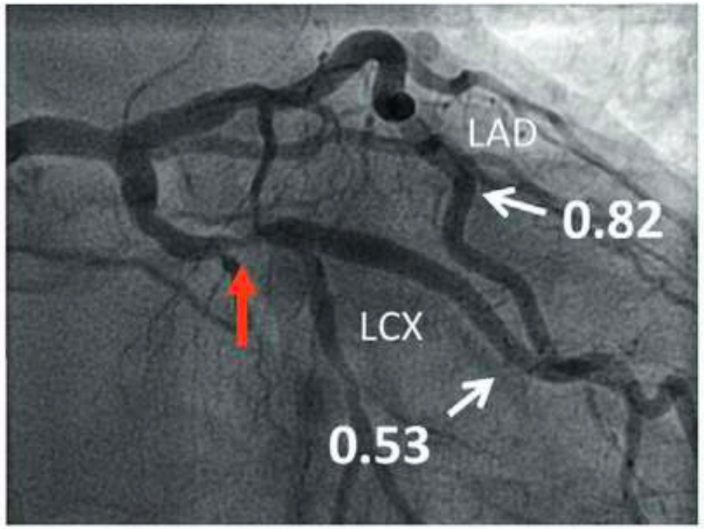
FFR-CT

CTA



FFR_{CT}


LAD
LCX
0.83
0.64


LAD
0.82
LCX
0.53

J Am Coll Cardiol. 2019 Jan 22;73(2):161-173.

FFR-CT

Etude PROMISE, 10 000 patients symptomatiques ne retrouve pas de différence à 2 ans sur les événements majeurs par rapport aux tests ischémiques standard (Décès, infarctus, complications procédurales)

Réduit Le nombre d’indication de coronarographie 28%

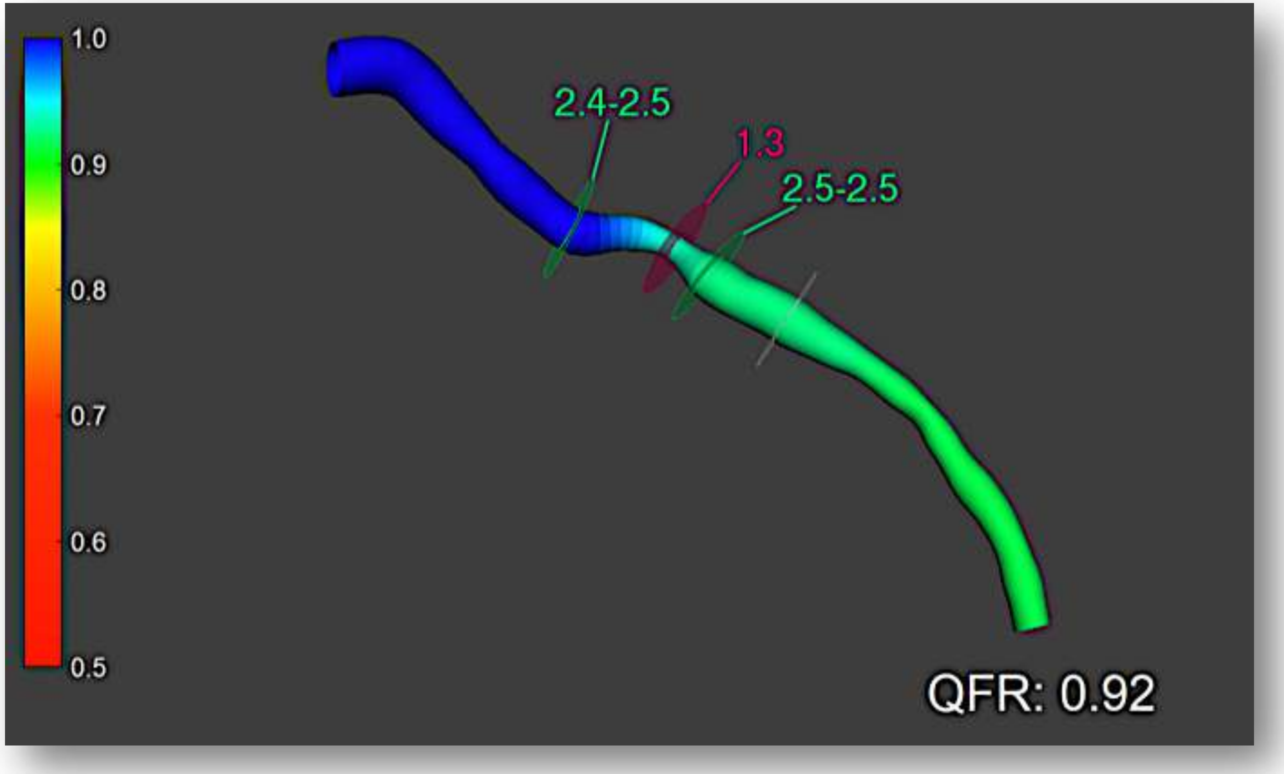
Réduit Le nombre d’indication de coronarographie blanches 44%

Non disponible actuellement en France

Douglas et al NEJM 2015;372:1291-1300

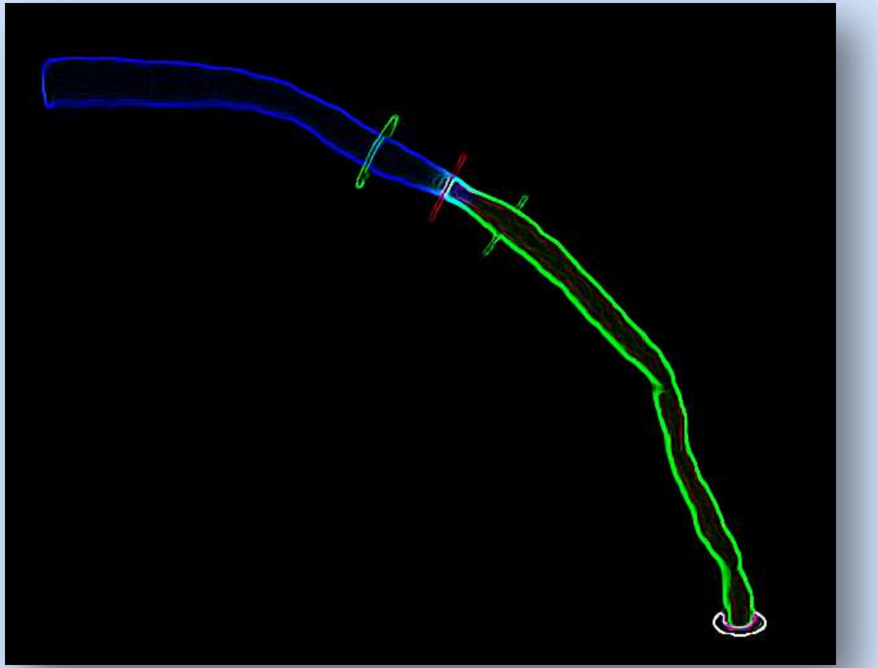
Lu M et al JACC Cardiovascular imaging 2017;10:1350-1358

Quantitative Flow Ratio


1.0
0.9
0.8
0.7
0.6
0.5
2.4-2.5
1.3
2.5-2.5
QFR: 0.92

Quantitative Flow Ratio ?

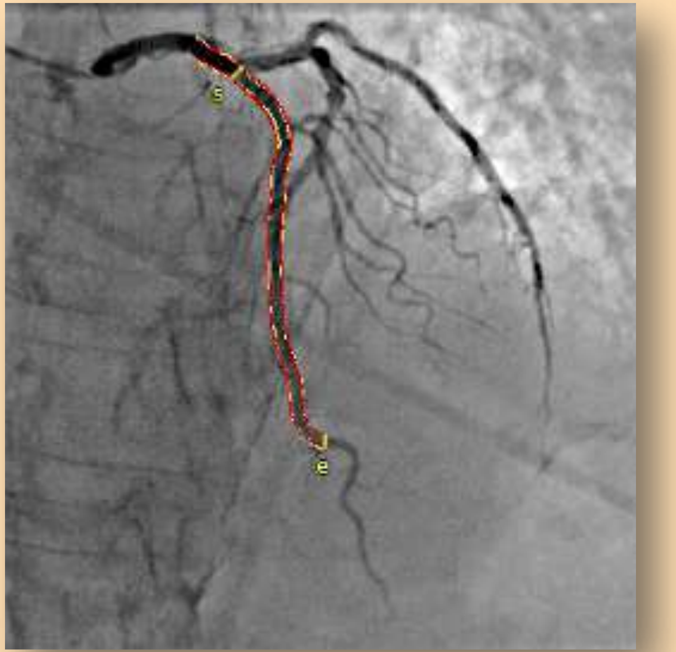
Reconstruction 3D des images angiographiques



+

Flux TIMI

Comptage de flux



Pourquoi utiliser la QFR en pratique quotidienne?

QFR

Rapide

Pas d'adénosine

Pas de guide

Live

Prix

Cas rétrospectif

ATC guidées

Etudes de la QFR

14,000+
Patients[1]

17,000+
Lesions[1]

Etude QFR Timeline

2016
FAVOR I study[2]

2017
FAVOR II China study[4]

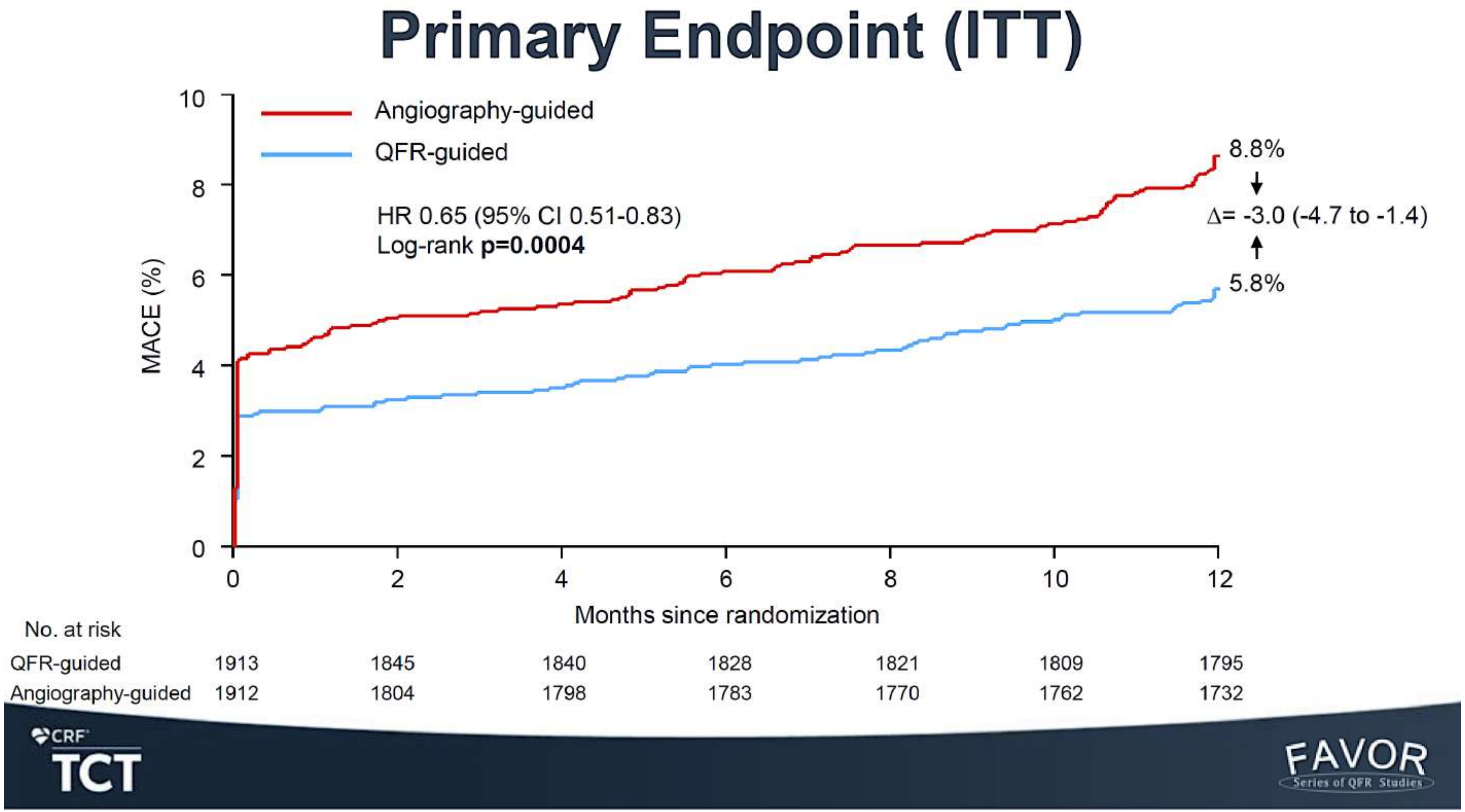
2018
FAVOR II Europe-Japan study[3]

2020
FAVOR III study

1, Medis Internal Summary: QFR publications 2021111 (Internal Document), Medis B.V, Dated: 19 December 2020.
2, Tu, Shengxian, et al. "Diagnostic accuracy of fast computational approaches to derive fractional flow reserve from diagnostic coronary angiography: the international multicenter FAVOR pilot study." JACC: cardiovascular interventions 9.19 (2016): 2024-2035.
3, Westra, Jelmer, et al. "Diagnostic performance of in-procedure angiography-derived quantitative flow reserve compared to pressure-derived fractional flow reserve: the FAVOR II Europe-Japan study." Journal of the American Heart Association 7.14 (2018): e009603.
4, Xu, Bo, et al. "Angiography-based quantitative flow ratio for online assessment of coronary stenosis: FAVOR II China study." Journal of the American College of Cardiology (2017): 24376.

Etudes de la QFR

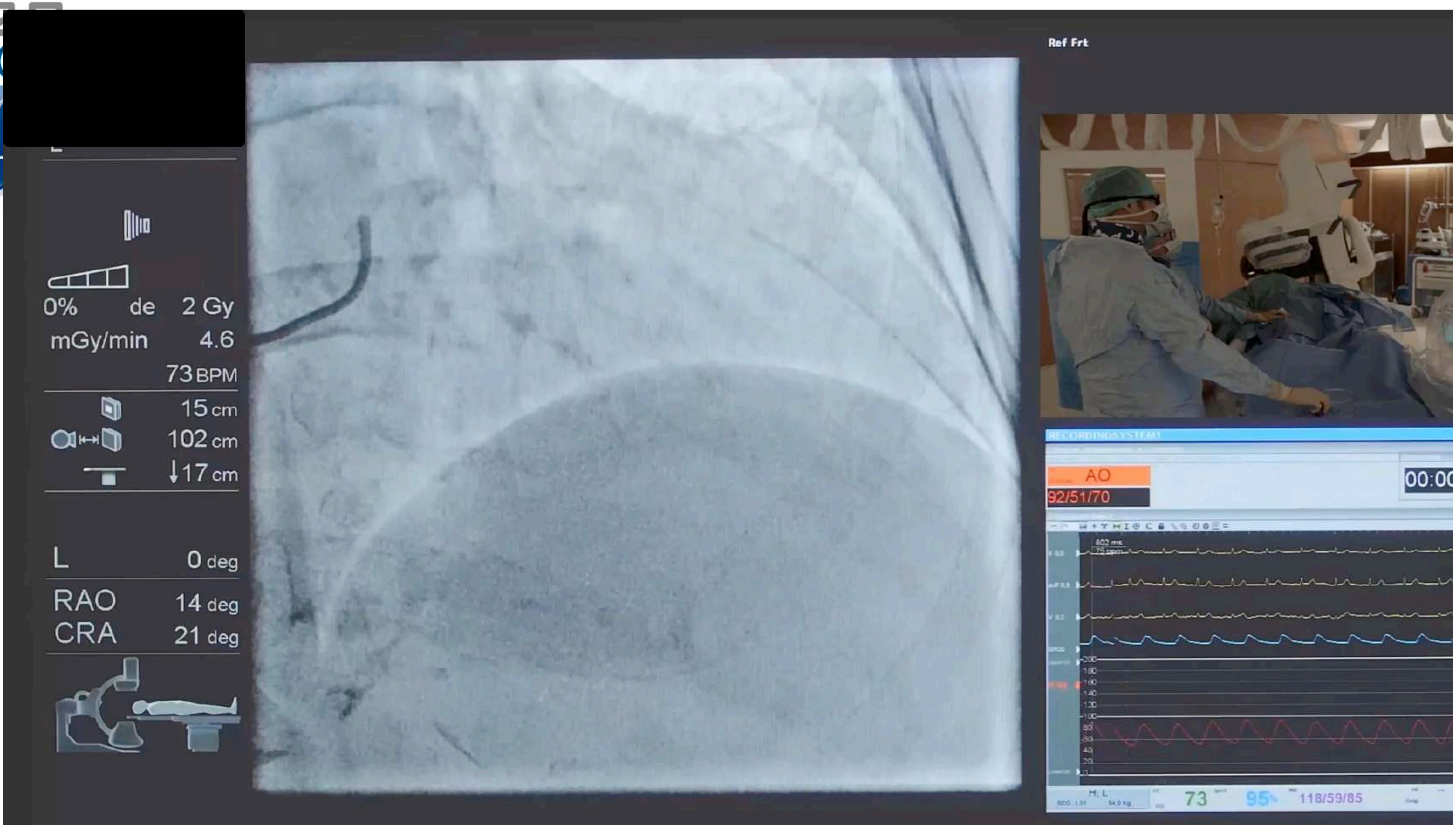
FAVOR III



Primary Endpoint (ITT)

No. at risk							
QFR-guided	1913	1845	1840	1828	1821	1809	1795
Angiography-guided	1912	1804	1798	1783	1770	1762	1732

[redacted]



Ref Frt

0% de 2 Gy
mGy/min 4.6
73 BPM
15 cm
102 cm
↓17 cm
L 0 deg
RAO 14 deg
CRA 21 deg

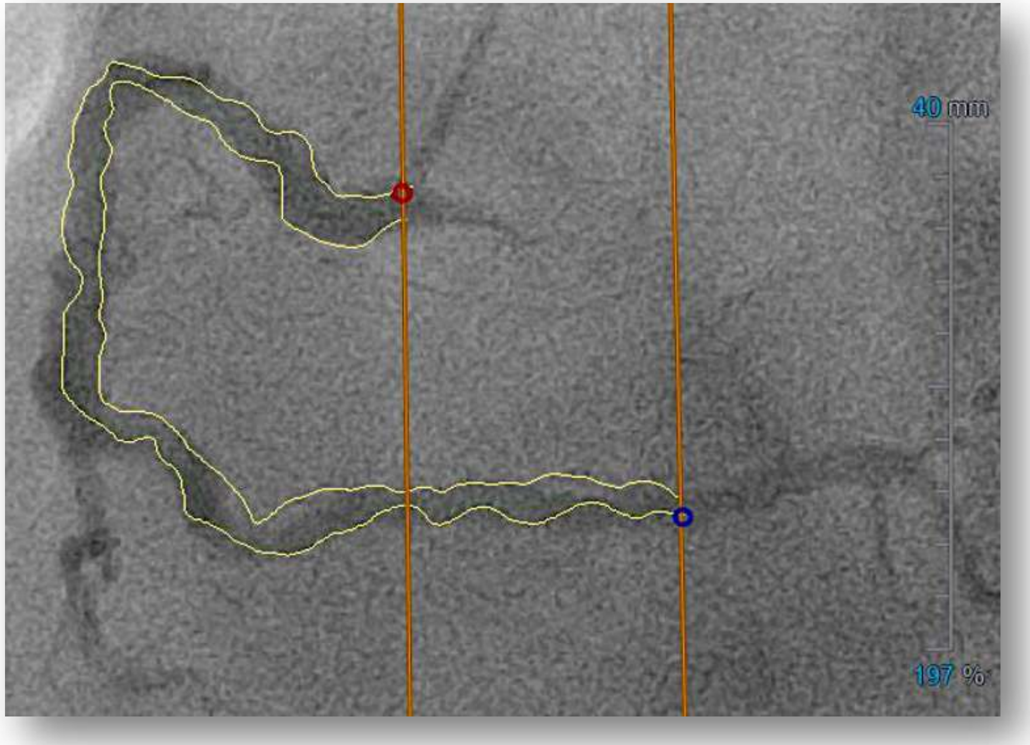
RECORDINGSYSTEM1
AO
92/51/70
00:00
73
95
118/59/85

Limites de la QFR

Limitations → Bonnes pratiques

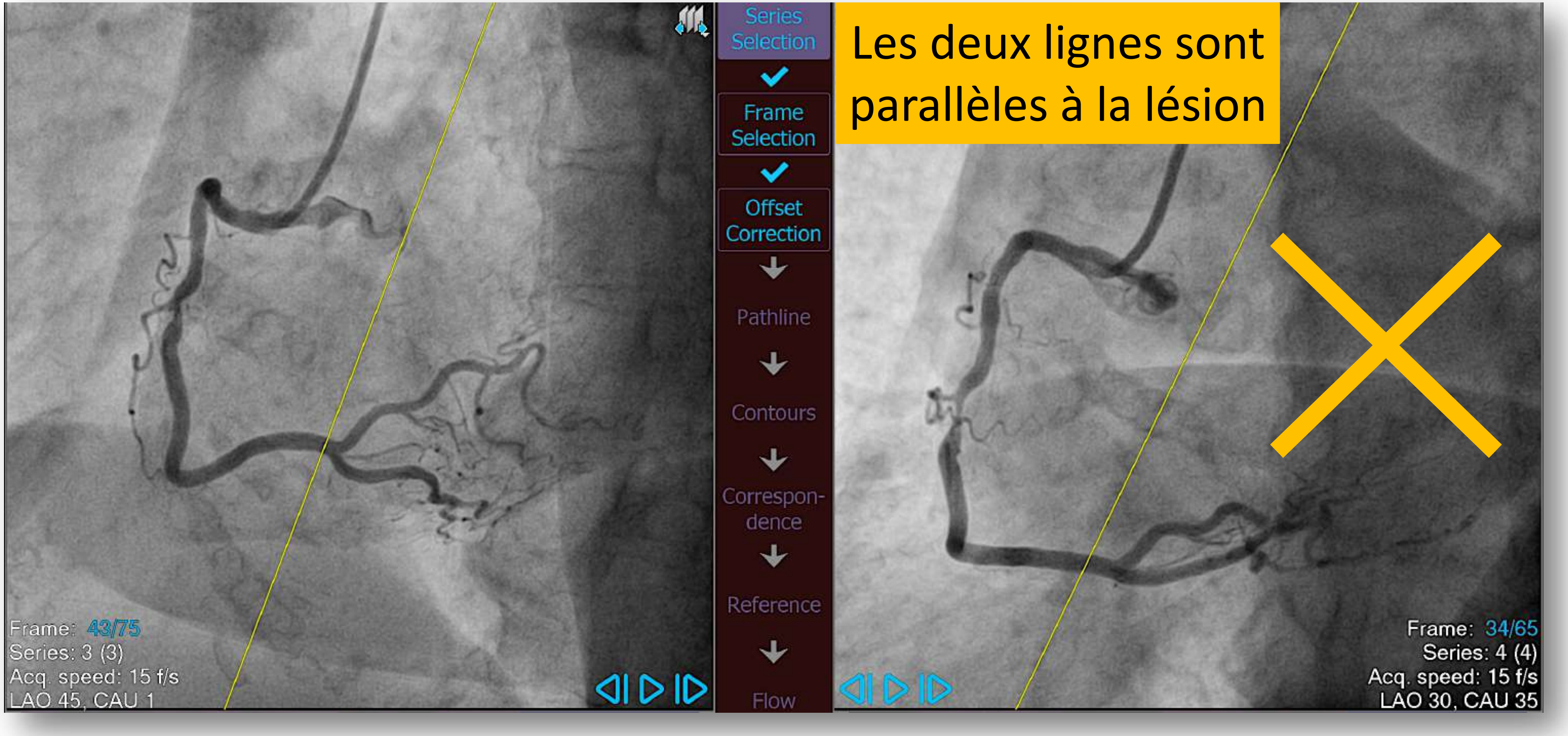
Bonnes pratiques

Plus la qualité de l’image est meilleure, Plus la mesure de la QFR est fiable



Bonnes pratiques

Importance du choix de la seconde incidence



Les deux lignes sont parallèles à la lésion

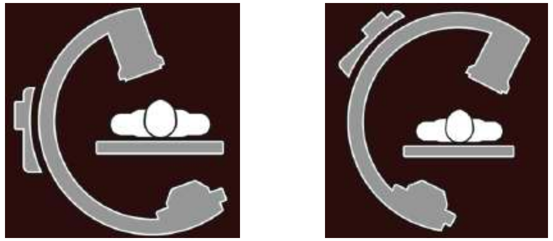
Frame: 43/75
Series: 3 (3)
Acq. speed: 15 f/s
LAO 45, CAU 1

Frame: 34/65
Series: 4 (4)
Acq. speed: 15 f/s
LAO 30, CAU 35

Series Selection
✓
Frame Selection
✓
Offset Correction
Pathline
Contours
Correspon-dence
Reference
Flow

Bonnes pratiques

Importance du choix de la seconde incidence

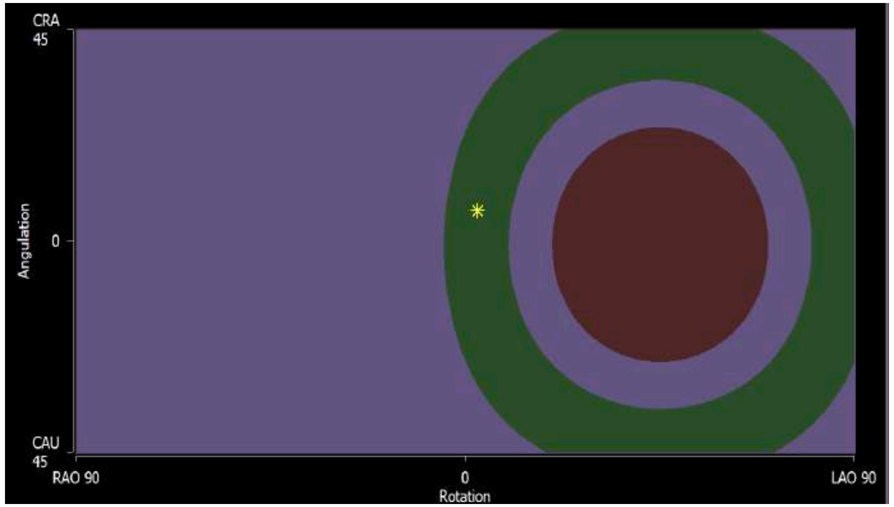


Suivre les recommandations d'incidences

ou

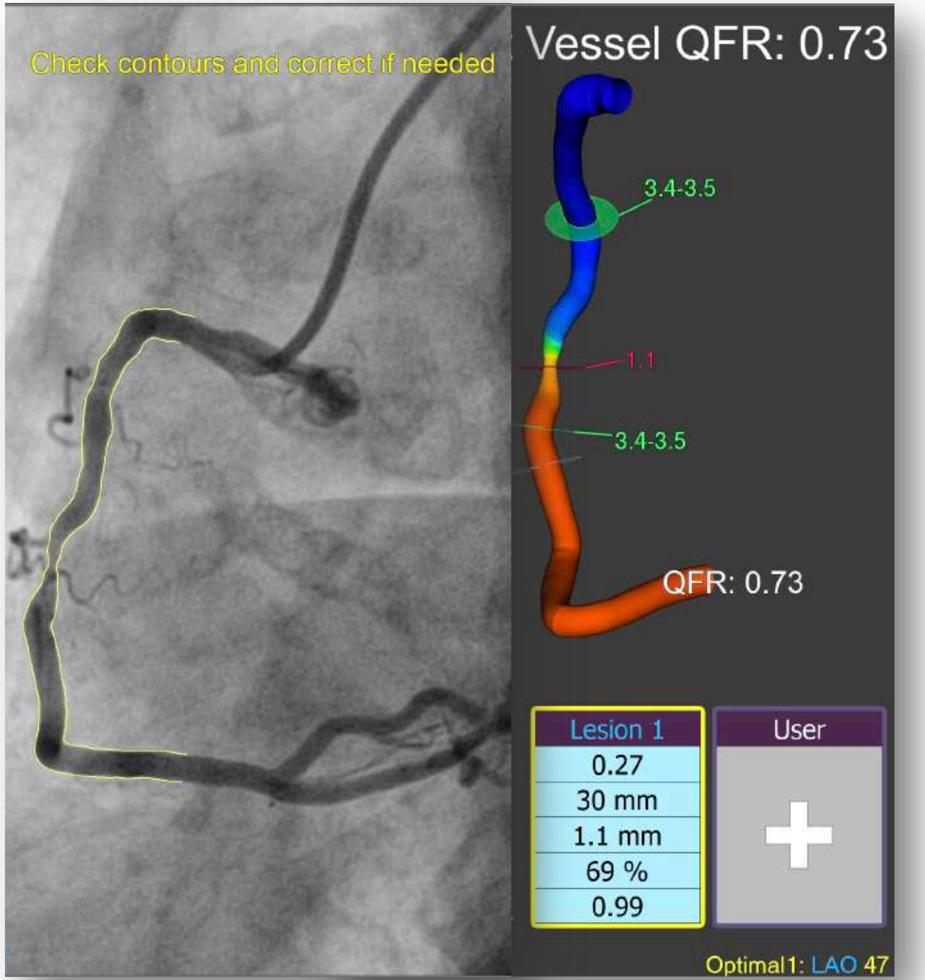
Utiliser l'assistant online

Vessel	1st View	2nd View
LAD/Diag	AP, CRA 45	RAO 30, CRA 20
LCX/OM	LAO 10, CAU 25	RAO 25, CAU 25
RCA	LAO 45, CAU 10	LAO 20, CRA 20
LM	RAO 20, CAU 45	AP, CAU 10



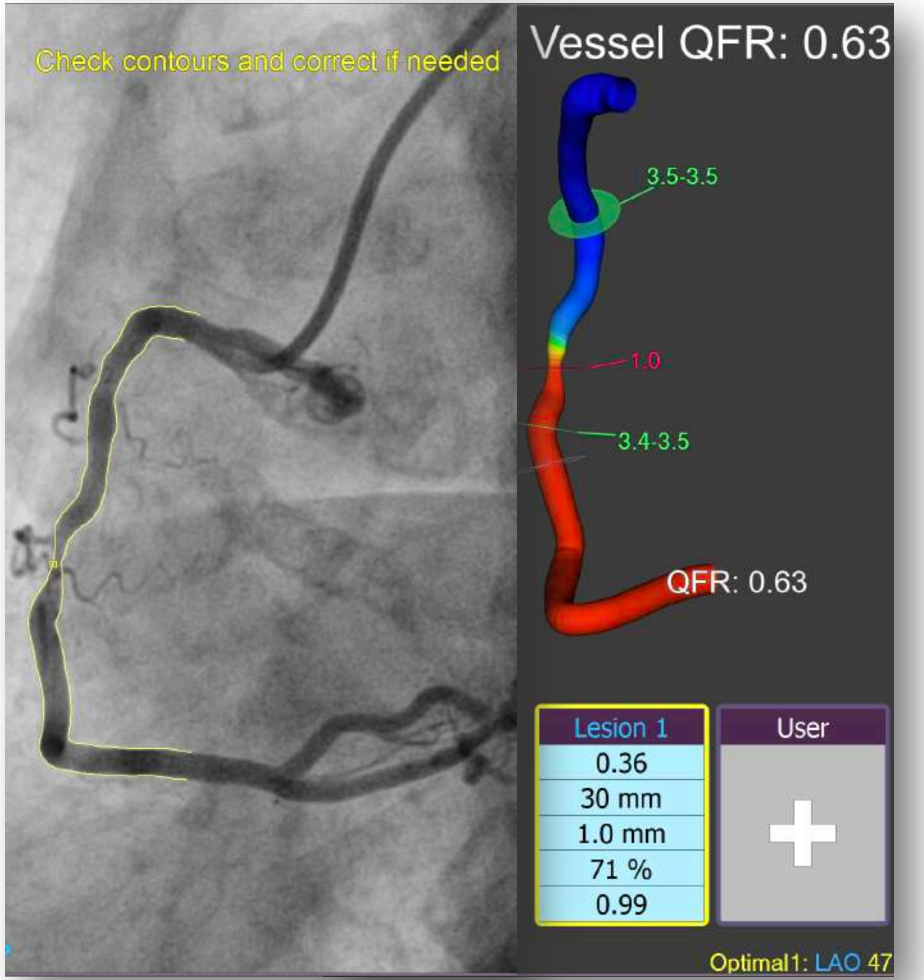
Bonnes pratiques

Modifier les contours uniquement si nécessaire


Check contours and correct if needed
3.4-3.5
1.1
3.4-3.5
QFR: 0.73
User
+
Optimal1: LAO 47

Vessel QFR: 0.73

Lesion 1
0.27
30 mm
1.1 mm
69 %
0.99


Check contours and correct if needed
3.5-3.5
1.0
3.4-3.5
QFR: 0.63
User
+
Optimal1: LAO 47

Vessel QFR: 0.63

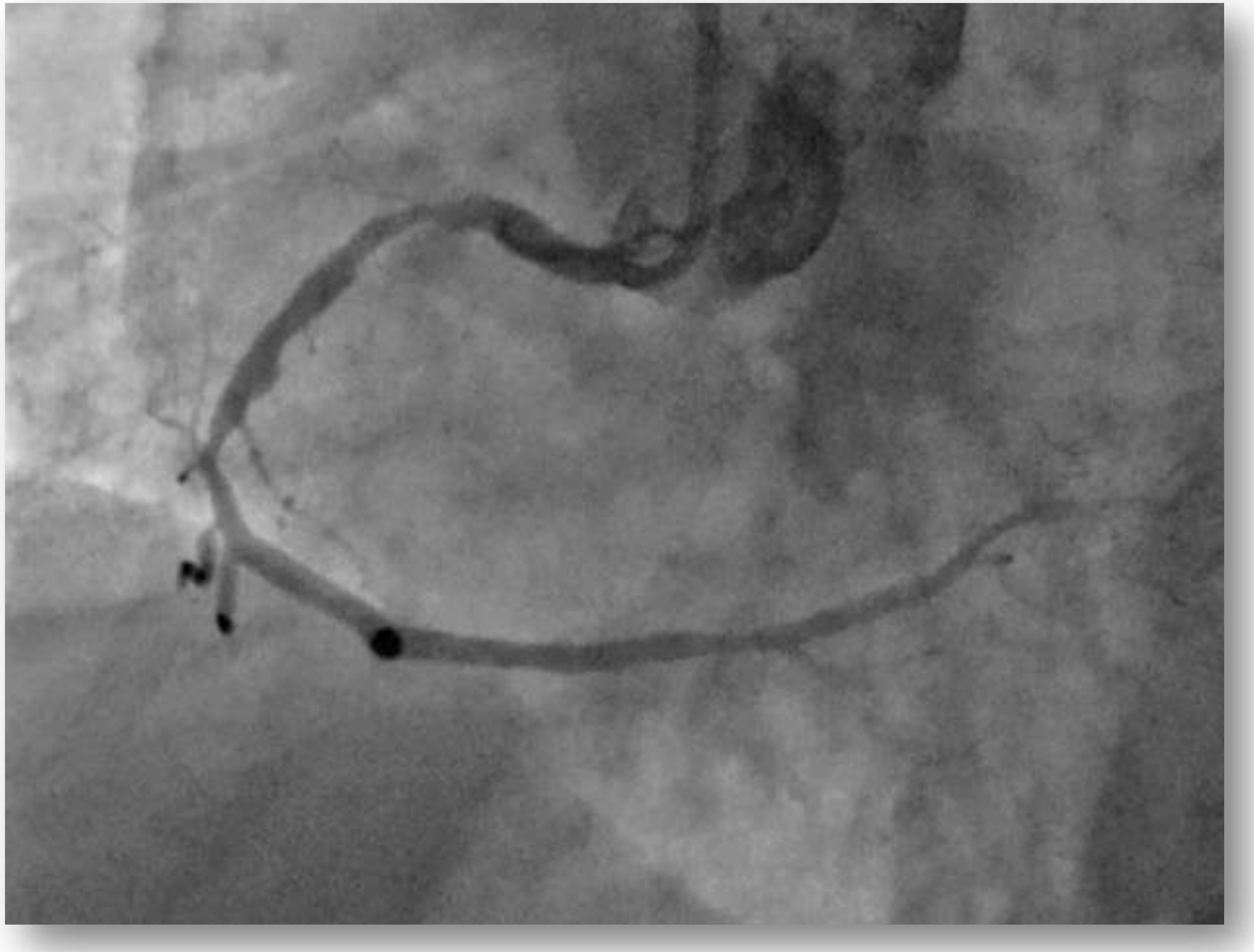
Lesion 1
0.36
30 mm
1.0 mm
71 %
0.99

Cas Clinique: QFR et lésions multiples

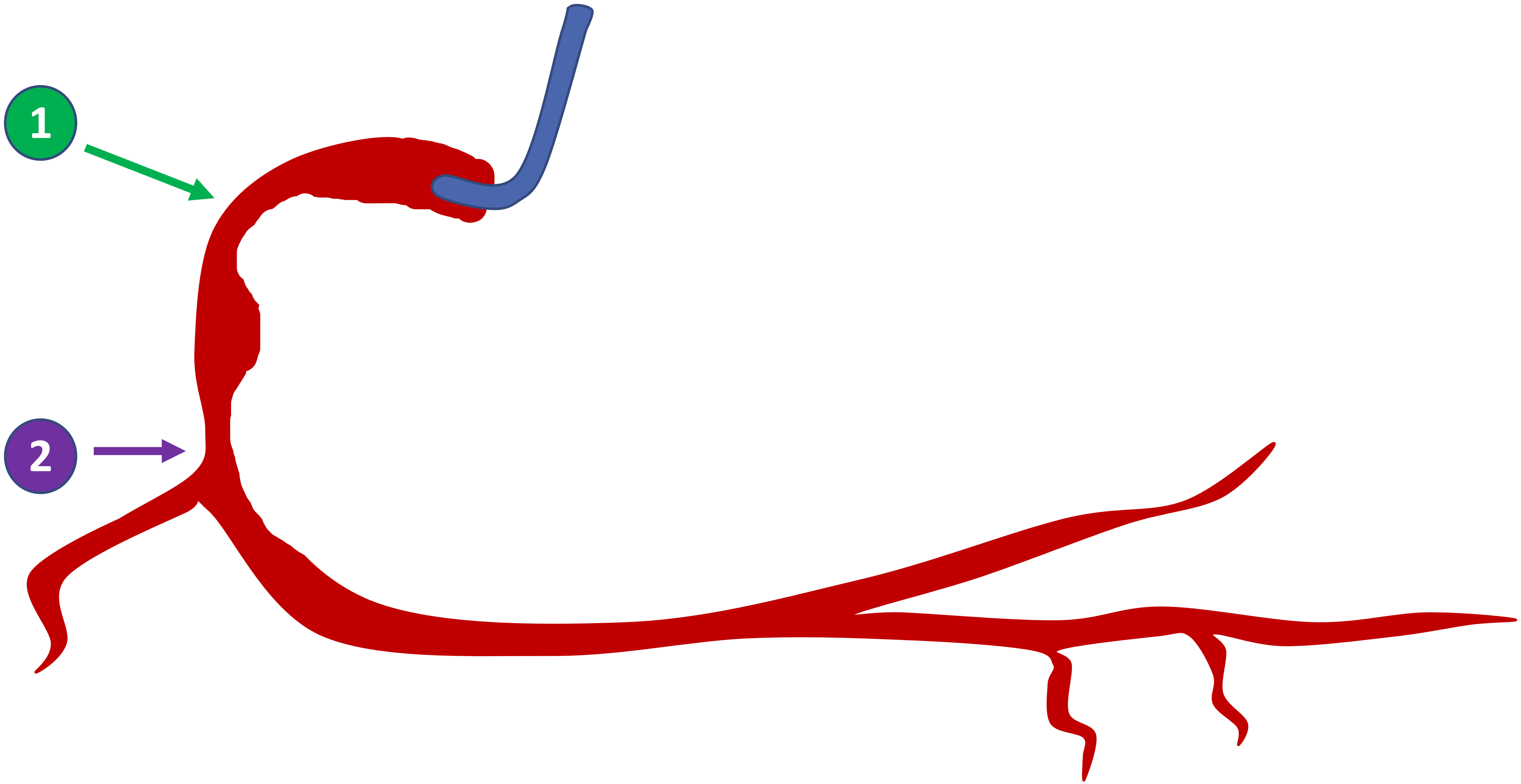
Mr M 70 ans

Angor d’effort

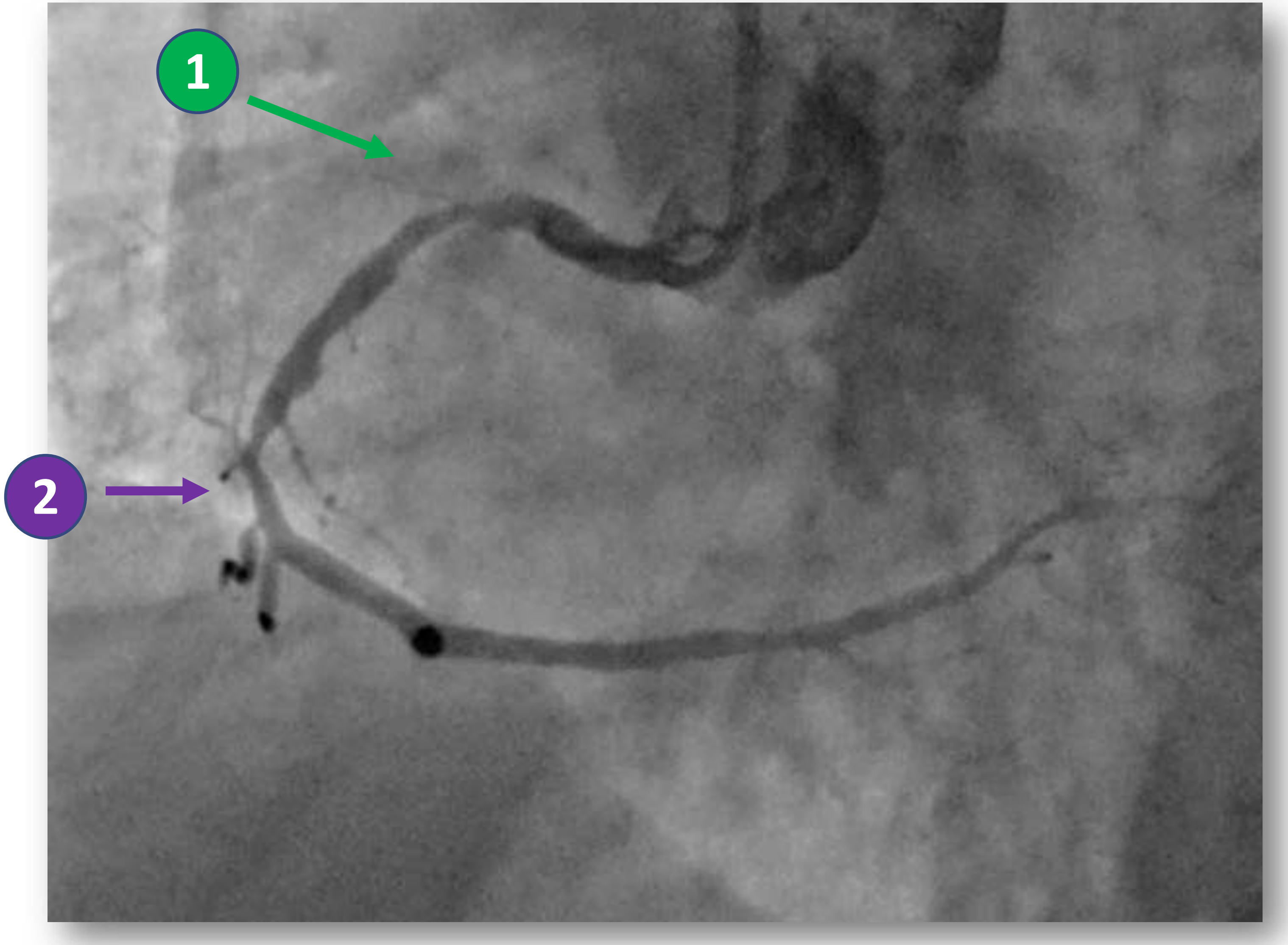
Pas de lésion significative du réseau gauche



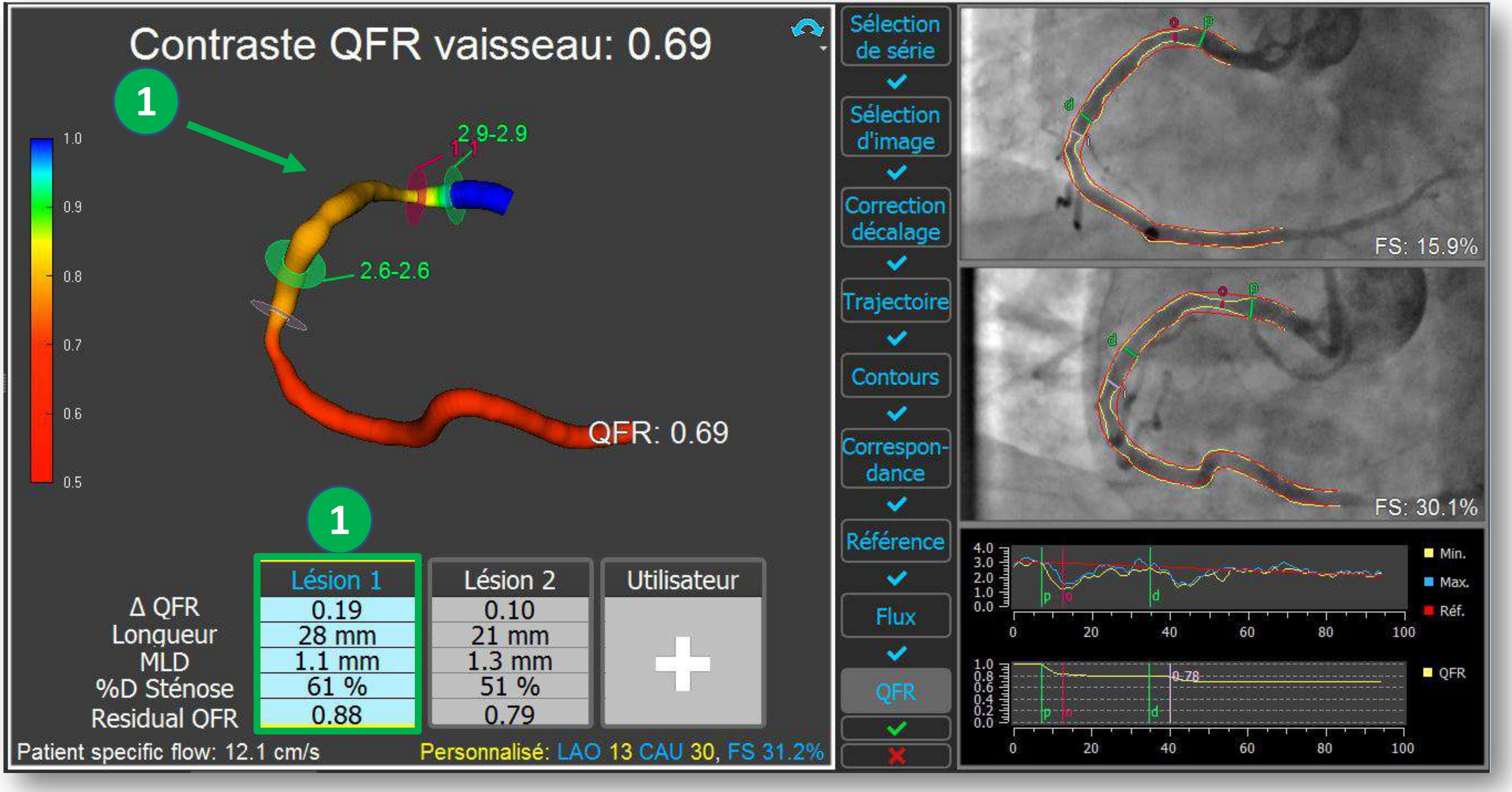
Cas Clinique: QFR et lésions multiples



Cas Clinique: QFR et lésions multiples



Cas Clinique: QFR et lésions multiples


1
2.9-2.9
1
1
2.6-2.6
1.0
0.9
0.8
0.7
0.6
0.5
QFR: 0.69
1
Sélection de série
Sélection d'image
Correction décalage
Trajectoire
Contours
Correspon-dance
Référence
Flux
QFR
FS: 15.9%
FS: 30.1%
4.0
3.0
2.0
1.0
0.0
p
o
d
0
20
40
60
80
100
Min.
Max.
Réf.
1.0
0.8
0.6
0.4
0.2
0.0
0.78
QFR
+

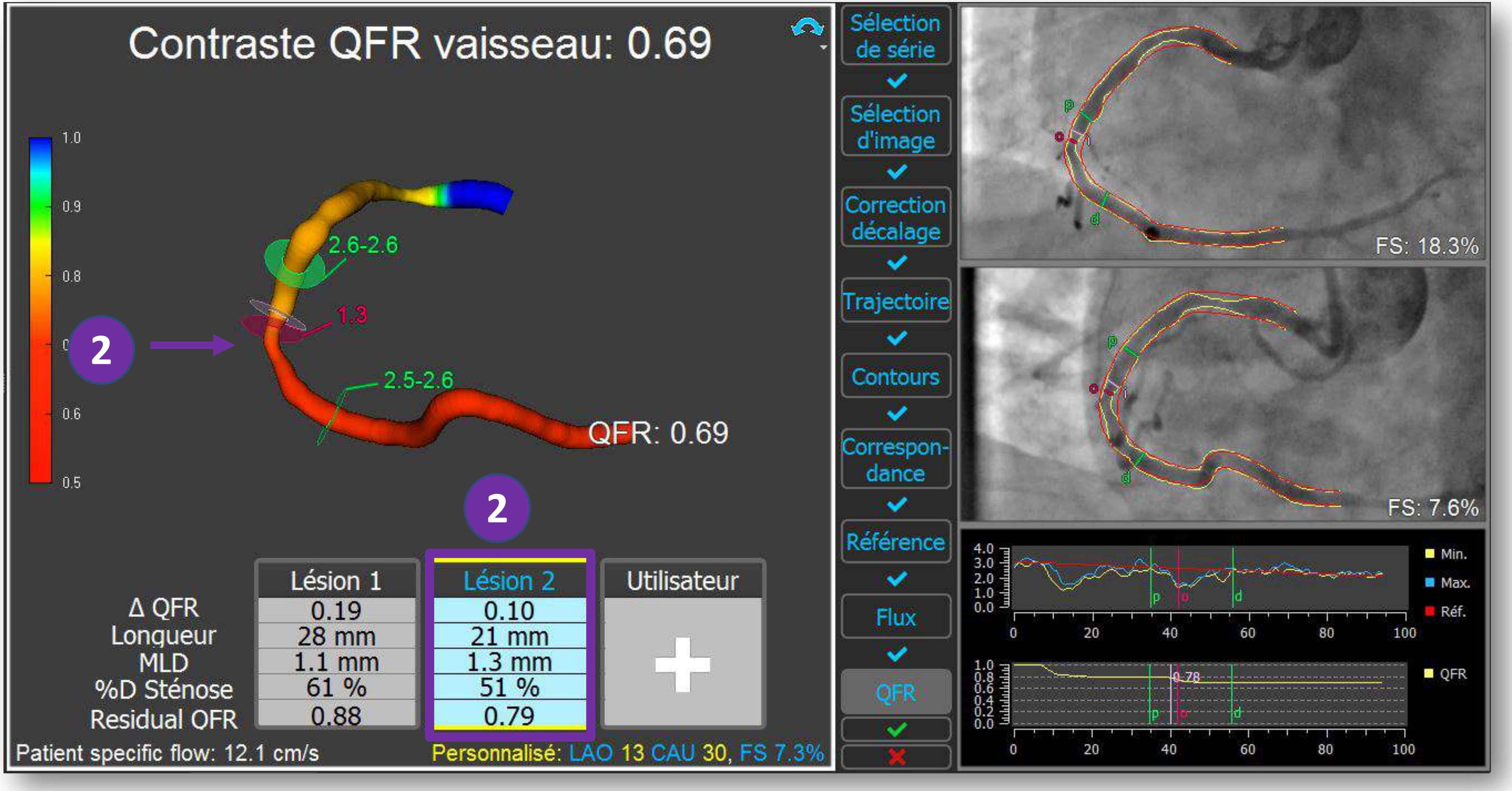
Contraste QFR vaisseau: 0.69

	Lésion 1	Lésion 2	Utilisateur
Δ QFR	0.19	0.10	
Longueur	28 mm	21 mm	
MLD	1.1 mm	1.3 mm	
%D Sténose	61 %	51 %	
Residual QFR	0.88	0.79	

Patient specific flow: 12.1 cm/s

Personnalisé: LAO 13 CAU 30, FS 31.2%

Cas Clinique: QFR et lésions multiples

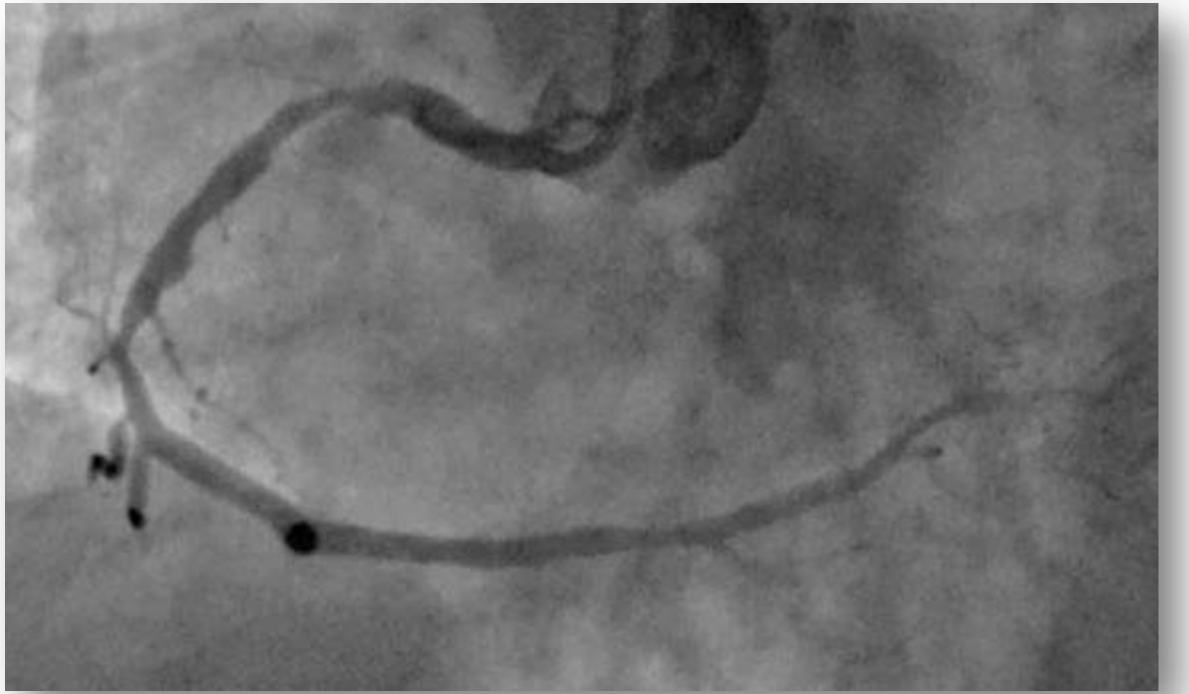

Contraste QFR vaisseau: 0.69
1.0
0.9
0.8
0.6
0.5
2.6-2.6
1.3
2.5-2.6
QFR: 0.69
2
2
Sélection de série
✓
Sélection d'image
✓
Correction décalage
✓
Trajectoire
✓
Contours
✓
Correspon-dance
✓
Référence
✓
Flux
✓
QFR
✓
✗
p
o
d
FS: 18.3%
FS: 7.6%
4.0
3.0
2.0
1.0
0.0
0
20
40
60
80
100
Min.
Max.
Réf.
1.0
0.8
0.6
0.4
0.2
0.0
0.78
QFR

	Lésion 1	Lésion 2	Utilisateur
Δ QFR	0.19	0.10	+
Longueur	28 mm	21 mm	
MLD	1.1 mm	1.3 mm	
%D Sténose	61 %	51 %	
Residual QFR	0.88	0.79	

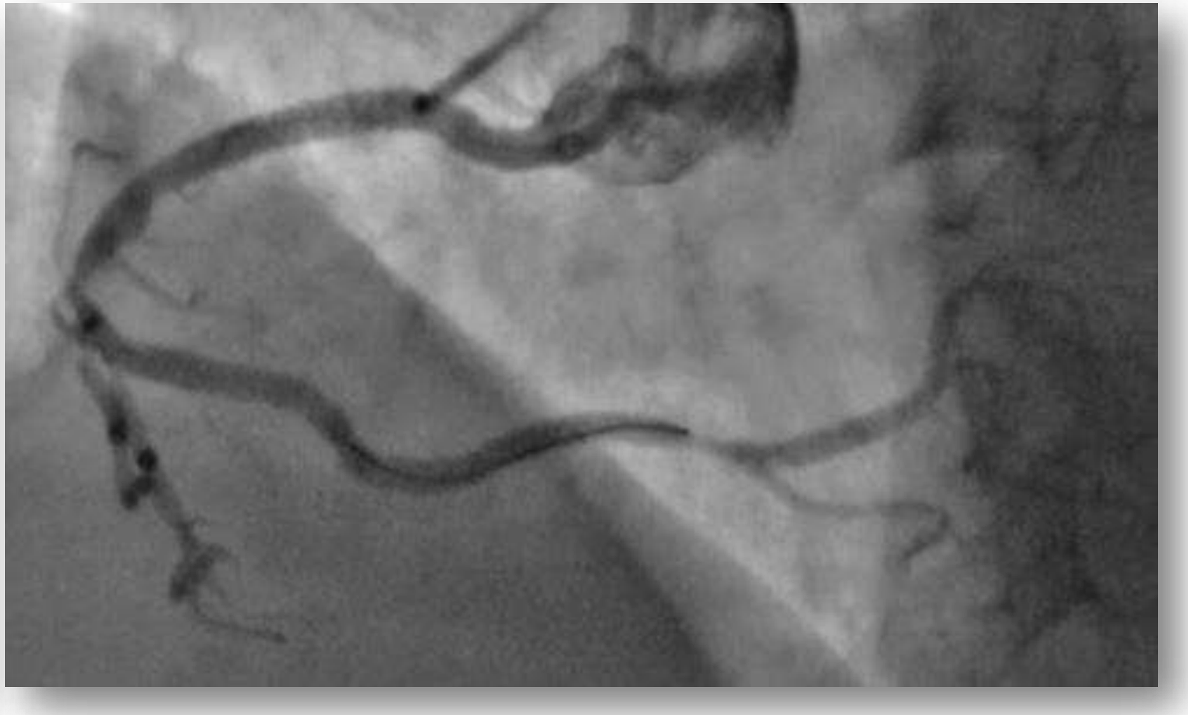
Patient specific flow: 12.1 cm/s

Personnalisé: LAO 13 CAU 30, FS 7.3%

Cas Clinique: QFR et lésions multiples

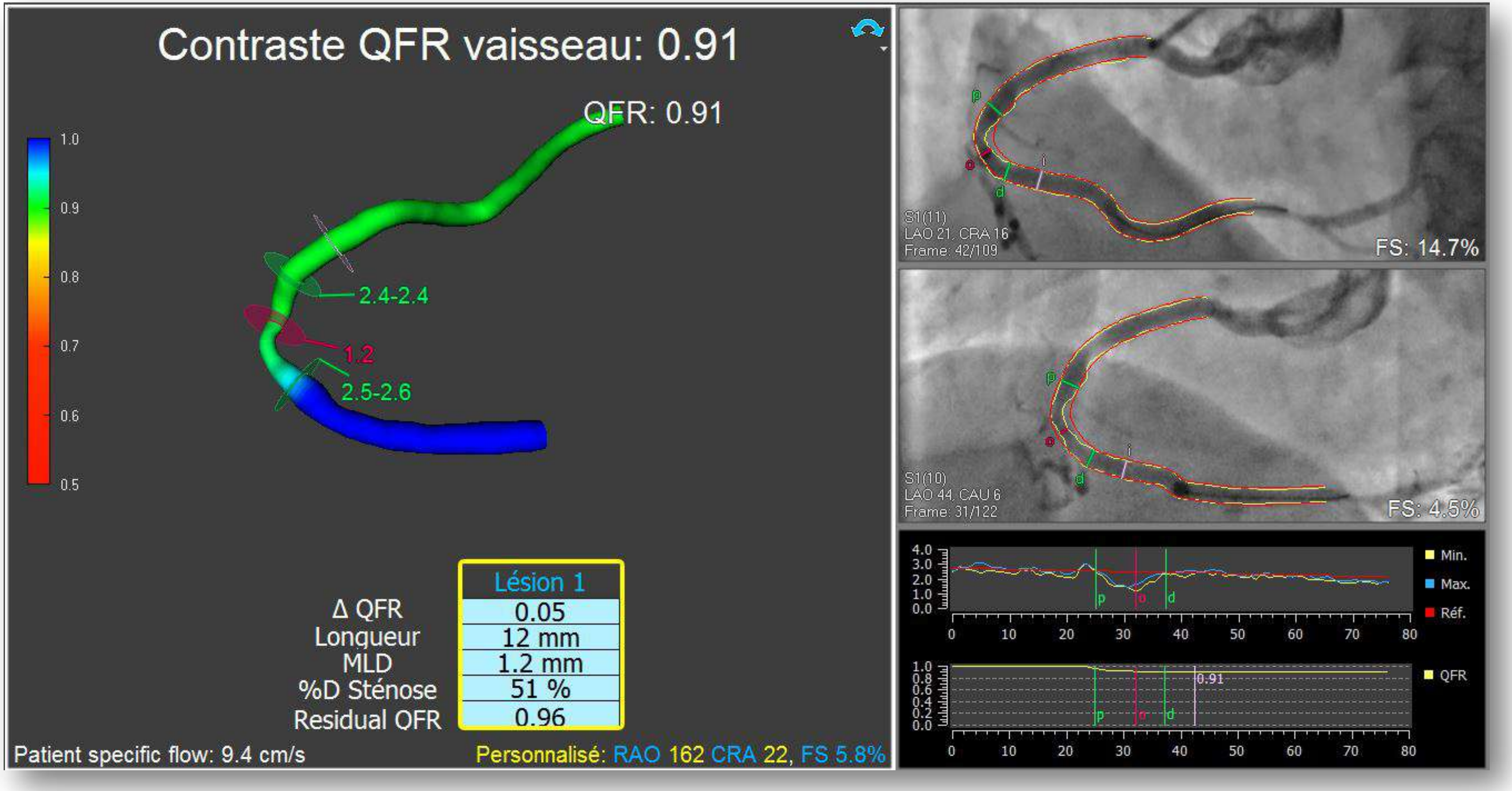


Pré



Post 18 mm x 3.5 mm DES

Cas Clinique: QFR et lésions multiples



Contraste QFR vaisseau: 0.91

	Lésion 1
Δ QFR	0.05
Longueur	12 mm
MLD	1.2 mm
%D Sténose	51 %
Residual QFR	0.96

Patient specific flow: 9.4 cm/s

Personnalisé: RAO 162 CRA 22, FS 5.8%

QFR: 0.91
1.0
0.9
0.8
0.7
0.6
0.5
2.4-2.4
1.2
2.5-2.6
S1(11)
LAO 21, CRA 16
Frame: 42/109
FS: 14.7%
S1(10)
LAO 44, CAU 6
Frame: 31/122
FS: 4.5%
4.0
3.0
2.0
1.0
0.0
p
o
d
0
10
20
30
40
50
60
70
80
Min.
Max.
Réf.
1.0
0.8
0.6
0.4
0.2
0.0
0.91
QFR

Messages

FFR-CT

A partir du coroscanner

Permet de mieux sélectionner les patients stables devant avoir une coronarographie

Non disponible actuellement en France

QFR

A partir de l'angiographie

Excellente prédiction de FFR ≤ 0.80

Avantages: rapidité, rétrospective, pas de guide, prix, angioplastie guidée par la physiologie

Limitations: précautions d'usages