Potential conflicts of interest

Speaker's name: Bon-Kwon Koo

☐ **I have the following** potential conflicts of interest to report:

- ☐ Research contracts
- ☐ Consulting
- ☐ Employment in industry
- ☐ Stockholder of a healthcare company
- ☐ Owner of a healthcare company
- ☐ Other(s)

I do not have any potential conflict of interest

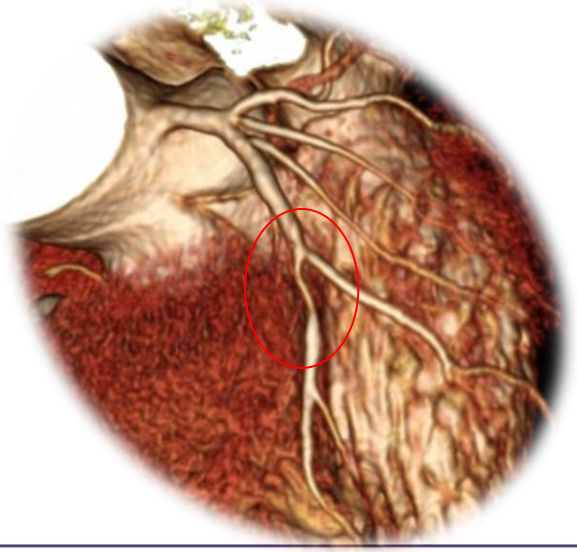
A novel non-invasive technology for treatment planning using virtual coronary intervention and CT-derived computed fractional flow reserve (FFR_{CT})

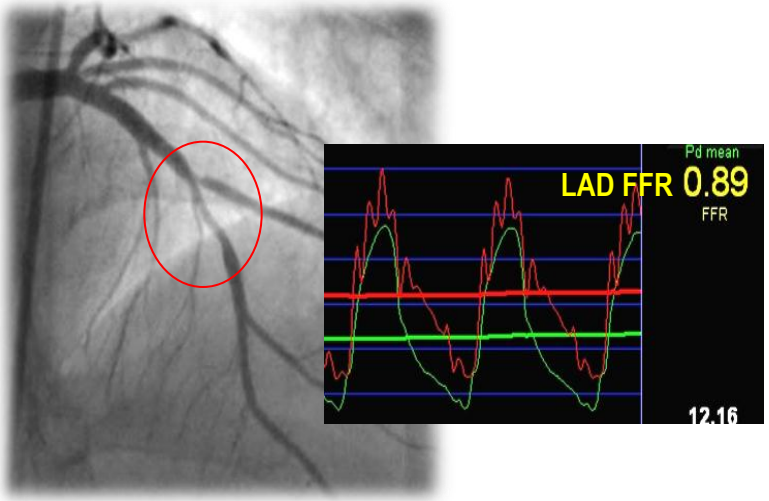
Bon-Kwon Koo, Kyung-Hee Kim, Andrejs Erglis, James K. Min, Kyung-Woo Park, Joon-Hyung Doh, Hyo-Soo Kim,

Seoul National University Hospital, Korea, Pauls Stradins Clinical University Hospital, Latvia, Cedars-Sinai Medical Center, USA, Inje University Ilsan Paik Hospital, Korea

Background

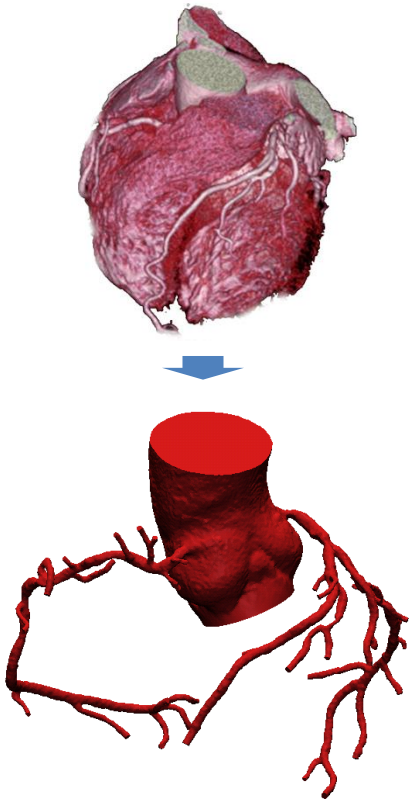
- Coronary CT angiography (CCTA) provides accurate anatomical information. However, CCTA cannot provide the functional information.
- Fractional flow reserve (FFR) is the gold standard for the diagnosis of myocardial ischemia. However, FFR requires invasive procedures and cannot provide anatomical information.





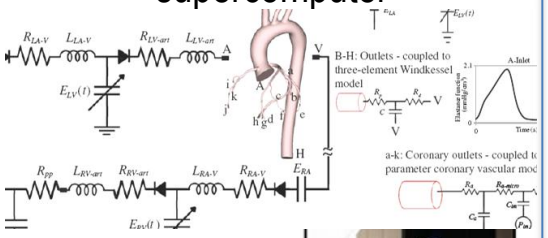
Non-invasive CT + FFR: FFR_{CT}

Computational Model based on CCTA

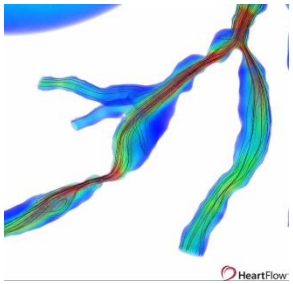


Blood Flow Solution

Blood flow equations solved on supercomputer



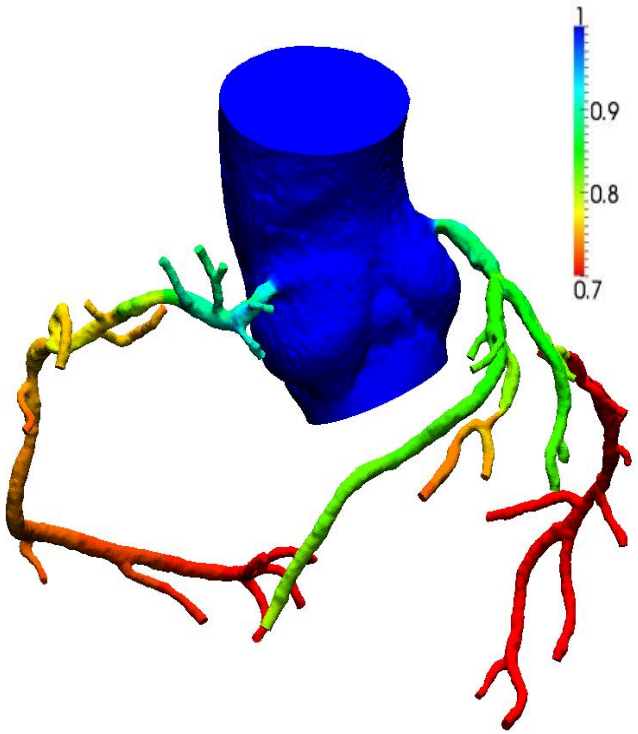
$$\rho \bar{v}_{,t} + \rho \bar{v} \cdot \nabla \bar{v} = -\nabla p + \nabla \cdot \tilde{\tau}$$
$$\nabla \cdot \bar{v} = 0$$



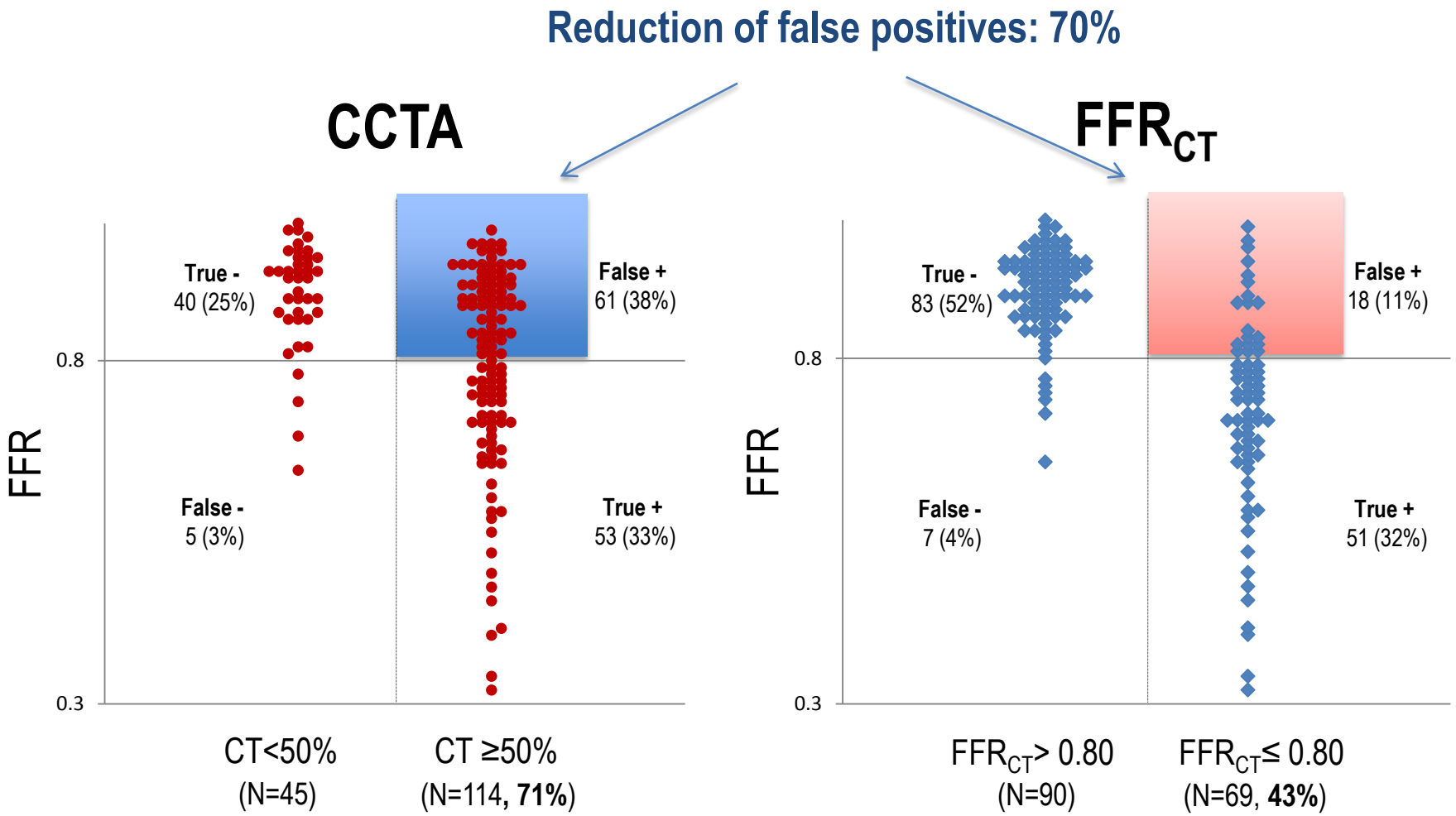
Physiologic models

-Myocardial demand
-Morphometry-based boundary condition
-Effect of adenosine on microcirculation

CT-derived computed FFR (FFR_{CT})



DISCOVER FLOW study



Koo BK, et al, J Am Coll Cardiol, 2011

Objectives

- To investigate the feasibility of treatment planning using virtual stenting and CT-derived computed FFR (FFR_{CT})

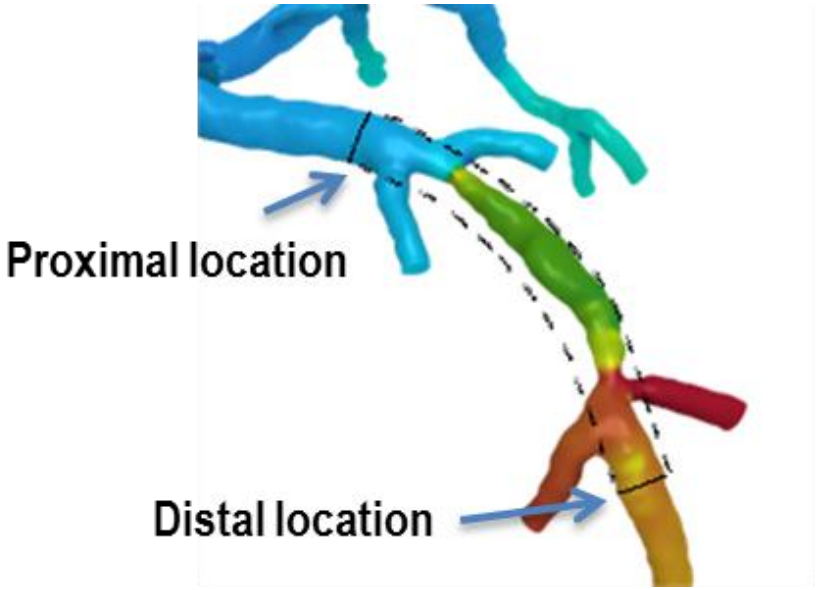
- To assess the diagnostic performance of post-PCI FFR_{CT} to predict the success of PCI in relieving myocardial ischemia

Methods

- **Study Design:** Prospective, blinded, multicenter study
- **Study sites:**
  - Seoul National University Hospital, Seoul, Korea
  - Paul Stradins Clinical University Hospital, Riga, Latvia
  - Inje University Paik Hospital, Koyang, Korea
- **Study population:** Stable patients with successful stent implantation who underwent pre-PCI CCTA (≥64-detector row) and post-PCI FFR measurement
- **Inclusion criteria:** Stenosis in a major coronary artery ≥2mm diameter
- **Exclusion criteria:** RWMA in a target segment; LVEF<40%; Prior revascularization, Collateral feeding vessel

Virtual Stenting

- Modification of computational model to restore the area of treated coronary segment to the proximal and distal reference areas

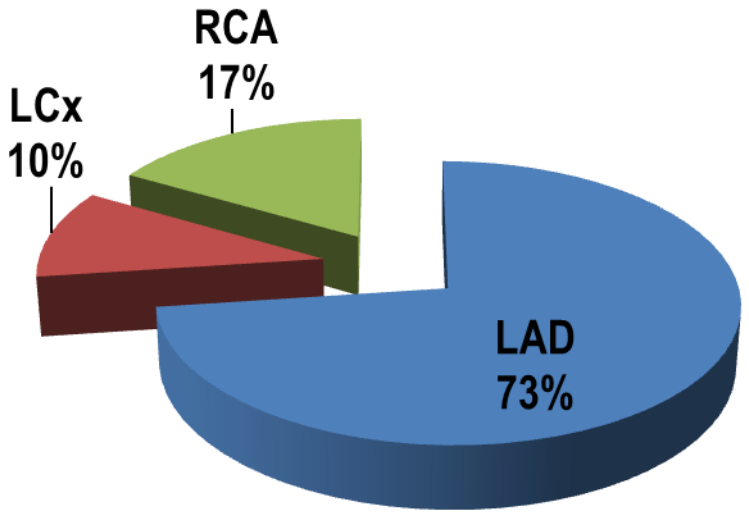


Patients and lesions

- 48 vessels in 44 patients

Variable	
Age	65.0±9.1
Male	80 %
Hypertension	82%
Diabetes	29 %
Current smoker	36 %
BMI	24.4 ± 2.6
Prior MI	11 %
LV ejection fraction	63.1 ± 7.4 %

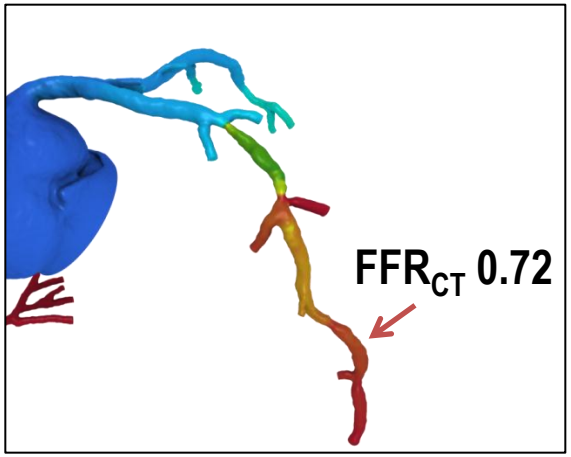
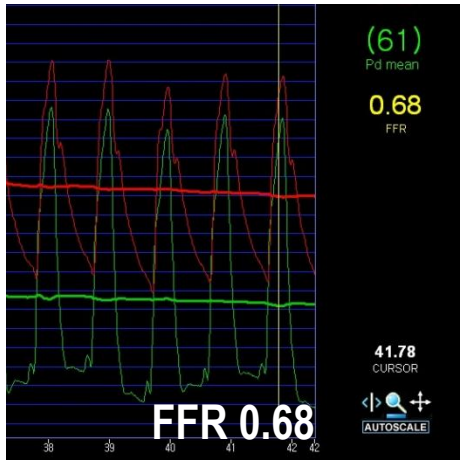
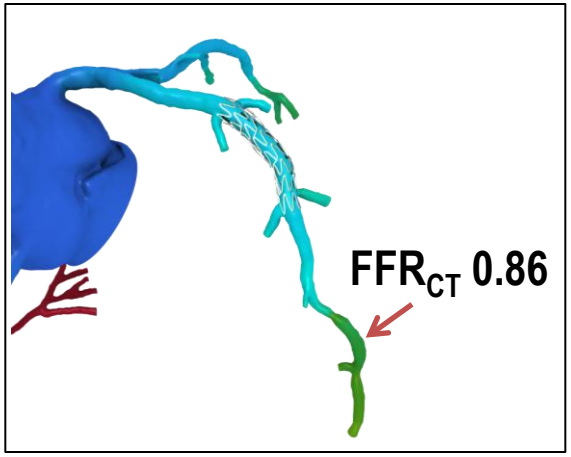
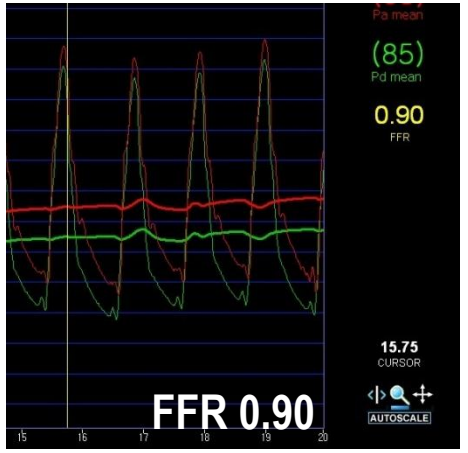
Lesion location



Angiographic and procedural data

Before stenting	
Reference diameter, mm	3.0 ± 0.7
Minimal lumen diameter, mm	1.1 ± 0.5
% Diameter stenosis	64.5 ± 14.0
Lesion length, mm	21.5 ± 13.5
After stenting	
Reference diameter, mm	3.0 ± 0.5
Minimal lumen diameter, mm	2.6 ± 0.5
% Diameter stenosis	10.1 ± 8.5
Stent diameter, mm	3.1 ± 0.4
Stent length, mm	26.0 ± 10.1

Case

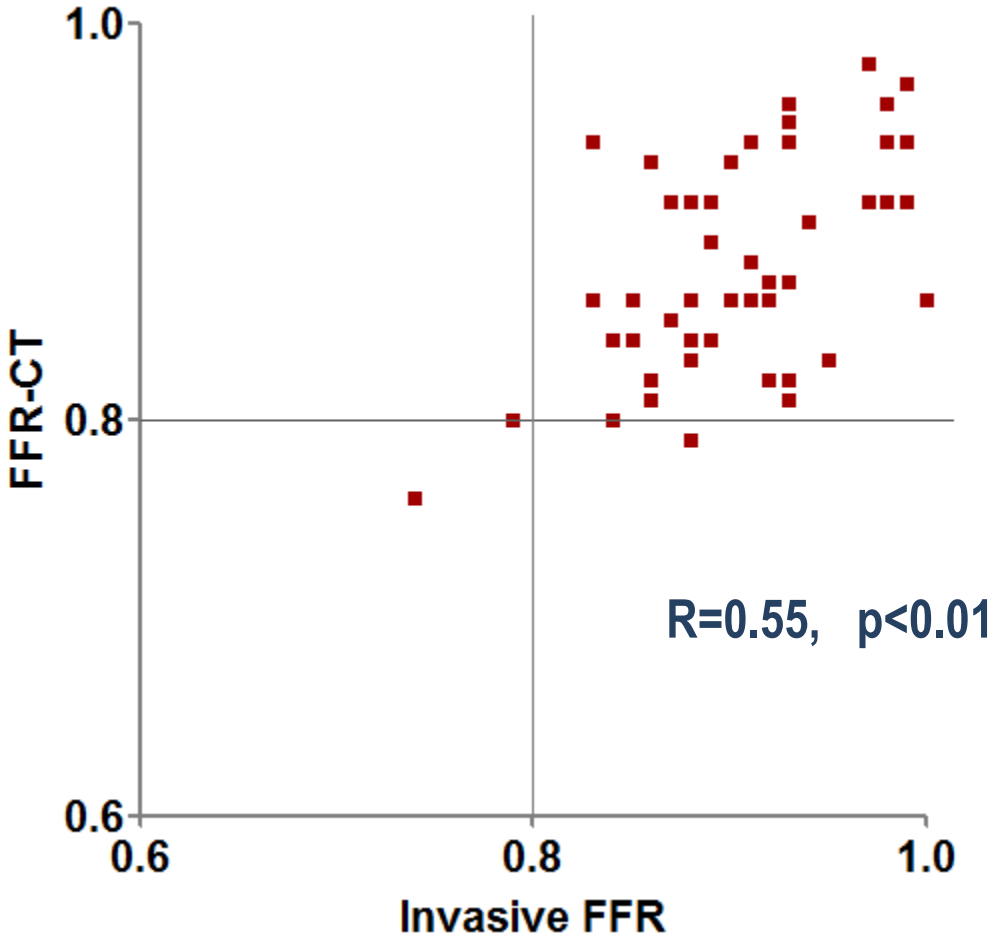
	CT-derived computed FFR (FFR_{CT})	Angiography	Invasive FFR
Before Stenting			
After Stenting			

Invasive FFR vs FFR_{CT}: Post - PCI

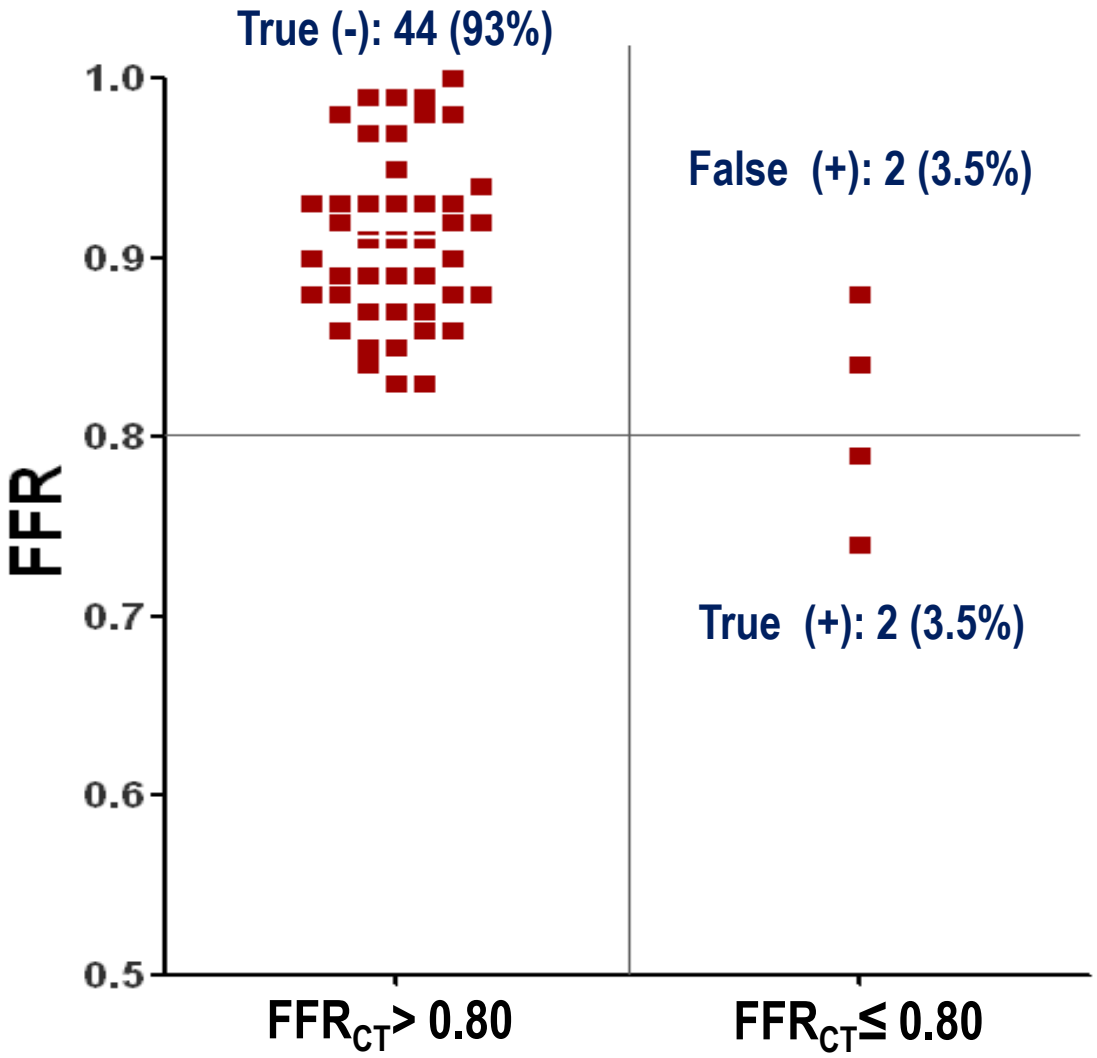
FFR 0.90 ± 0.05

FFR_{CT} 0.88 ± 0.05

△ **0.02± 0.05**

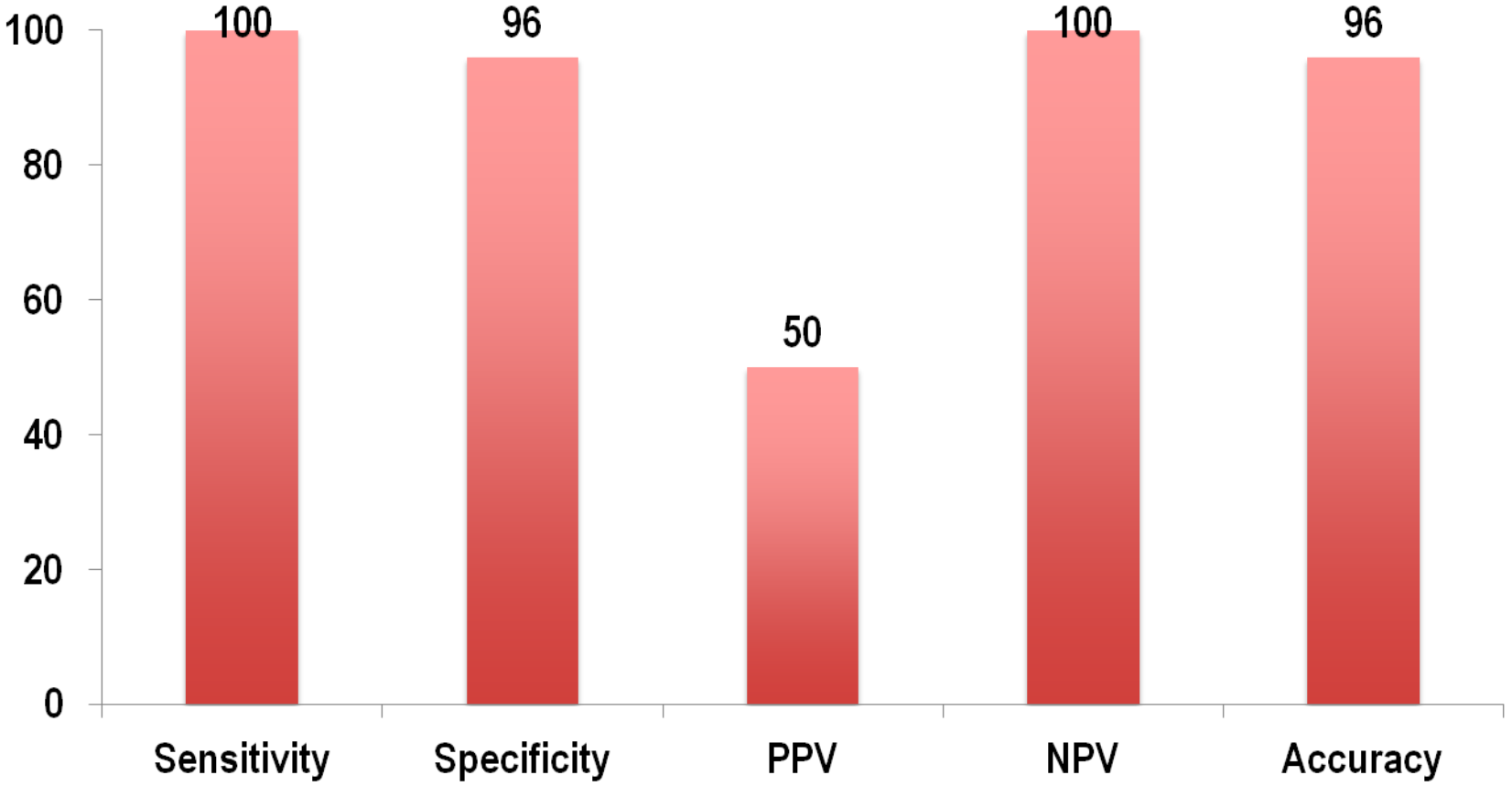


FFR after stenting vs. FFR_{CT} after virtual stenting



Diagnostic performance of FFR_{CT} after stenting

FFR_{CT} to predict the presence of residual ischemia (FFR≤ 0.8) after stenting



PPV: positive predictive value, NPV: negative predictive value

Conclusion

- Treatment planning using virtual stenting and FFR_{CT} is feasible.
- FFR_{CT} after virtual stenting can accurately predict the success of PCI in relieving myocardial ischemia.
- This novel technology may enable optimal patient- and lesion-specific treatment choice before invasive procedures.