PARALLEL SESSION SUMMARY

Computational stenting simulations: From computers to real-time decision making

Gabriele Dubini

XIV European Bifurcation Club meeting - Brussels, Belgium - 12th & 13th October 2018

Yves Louvard: Introduction

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Cath

Equipment and Technolog

Designing a Compu Interventional

Steven L. Dawson,[1]* MD, Steph
David W. Shaffer,[1] Ph

Interventional cardiology training trac
a master-apprentice model, much a
realistic computer-based training sys
and guide wire choices, three-dimens
learning system is desirable, in order
patients at risk. Here we present the
rates synthetic fluoroscopy, real-tim
and selective right- and left-sided cor
catheters. Significant learning compo
Cardiovasc. Intervent. 51:522–527, 20

Key words: simulation; training; inter

www.icps.com.fr

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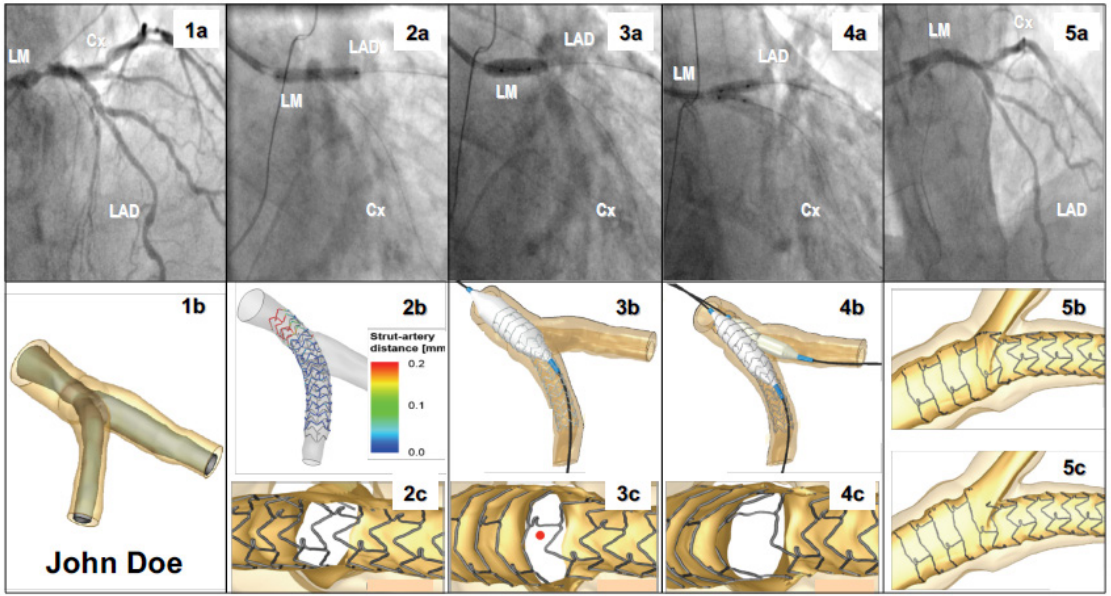
Learning / teaching: provisional stenting strategy (John Doe project 2011)

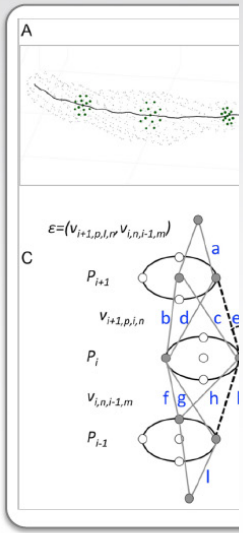


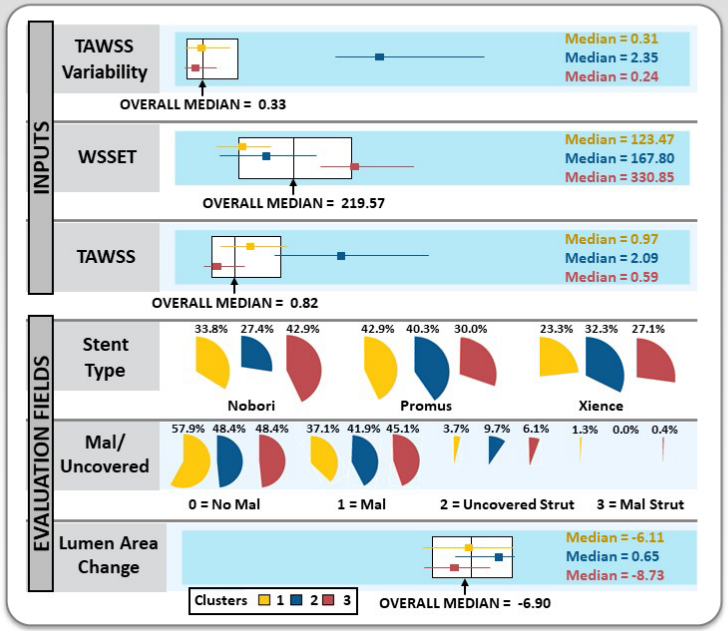
www.icps.com.fr Peter Mortier, Jolanda Wentzel, Gabriele Dubini, Yves Louvard, Thierry Lefevre

John La Disa: Role of biomechanical stresses (fluid and solid) in bifurcation stent restenosis

Patie

Results from cluster analysis





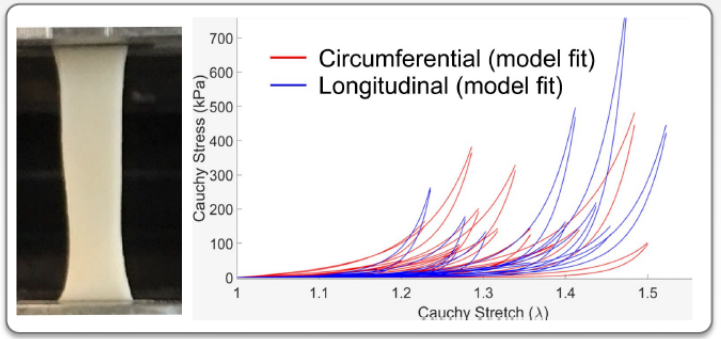
Uncover relationships between local stent-induced WSS changes and markers of restenosis or late stent thrombosis in OCT images that are missed when analyzing results on a per artery basis.

A. Aleiou - MS Thesis

John La Disa: Role of biomechanical stresses (fluid and solid) in bifurcation stent restenosis

Requests for atherosclerotic data

- McKittrick and colleagues - incorporating disease characteristics into computational models has been hindered by the “limited availability of required parameters, with the majority of literature values from healthy vessels”. Most models fail to capture the effects of disease, specifically the presence of atherosclerotic plaque, on drug release and distribution.
- Akyildiz et al - data are missing on tensile & compressive properties of coronary arteries… due to limited availability before autopsy
- Chen and Kassab - there are few studies accounting for plaque substructure in constitutive models for coronary arteries

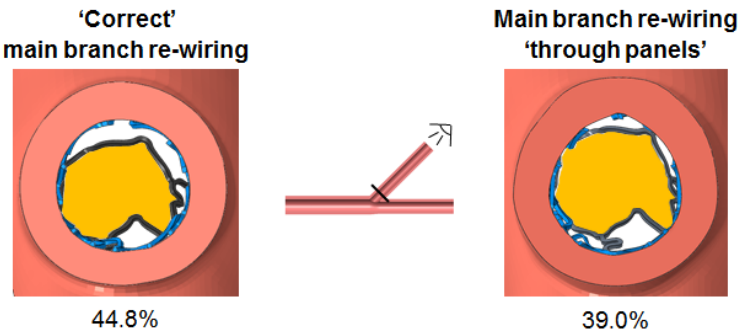


McKittrick et al. ABME. 2016;44:477-87
Akyildiz et al. J Biomech. 2014;47:773-83
Chen & Kassab. J Biomech. 2016;49:2548-59

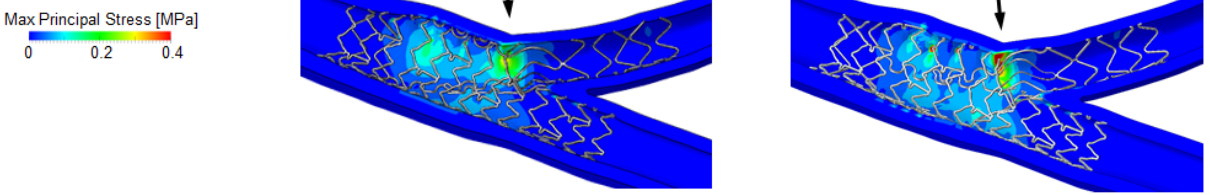
Claudio Chiastra: Computational parameters and techniques for realistic bifurcation stenting simulations

Tryton study: results

- **SB ostial area stenosis**



- **Arterial wall stress**



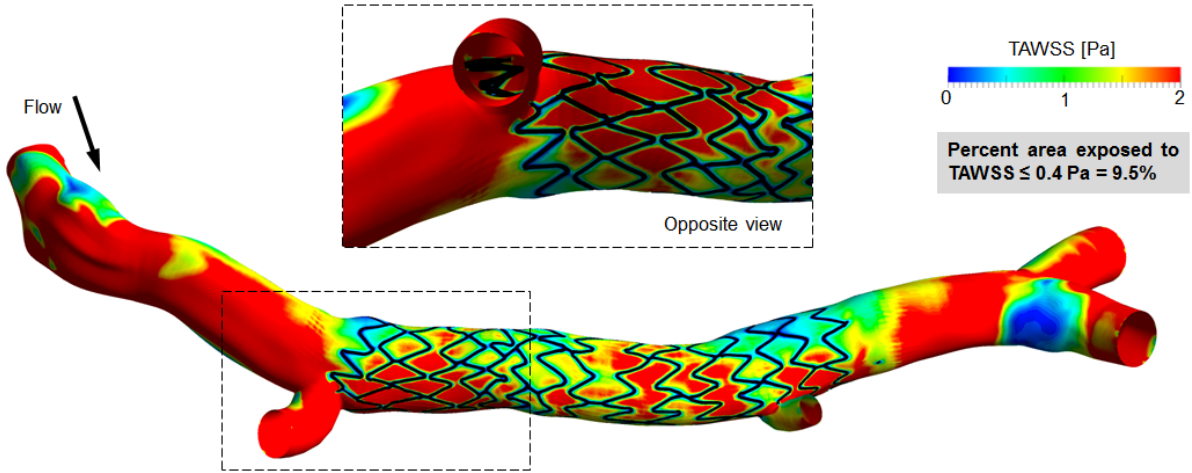
Grundeken, Chiastra et al. *Catheter Cardiovasc Interv.* 2018

Claudio Chiastra: Computational parameters and techniques for realistic bifurcation stenting simulations

Patient-specific simulations: examples

- **Distal right coronary artery**
- 3.5x24 mm **Nobori** (Terumo) + post-dilation

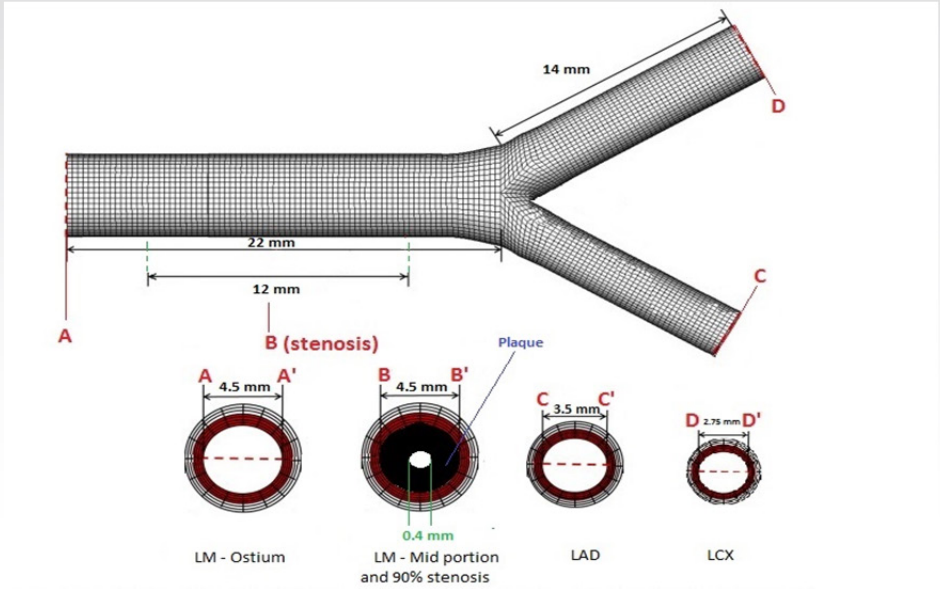
Gemelli
Fondazione Policlinico Universitario A. Gemelli
Università Cattolica del Sacro Cuore



Gianluca Rigatelli: Computational fluid dynamic comparison of different optimization techniques in left main provisional or culotte stenting

Computed flow dynamic in Left Main: model building up

Coronary Left Main Model



Gianluca Rigatelli: Computational fluid dynamic comparison of different optimization techniques in left main provisional or culotte stenting

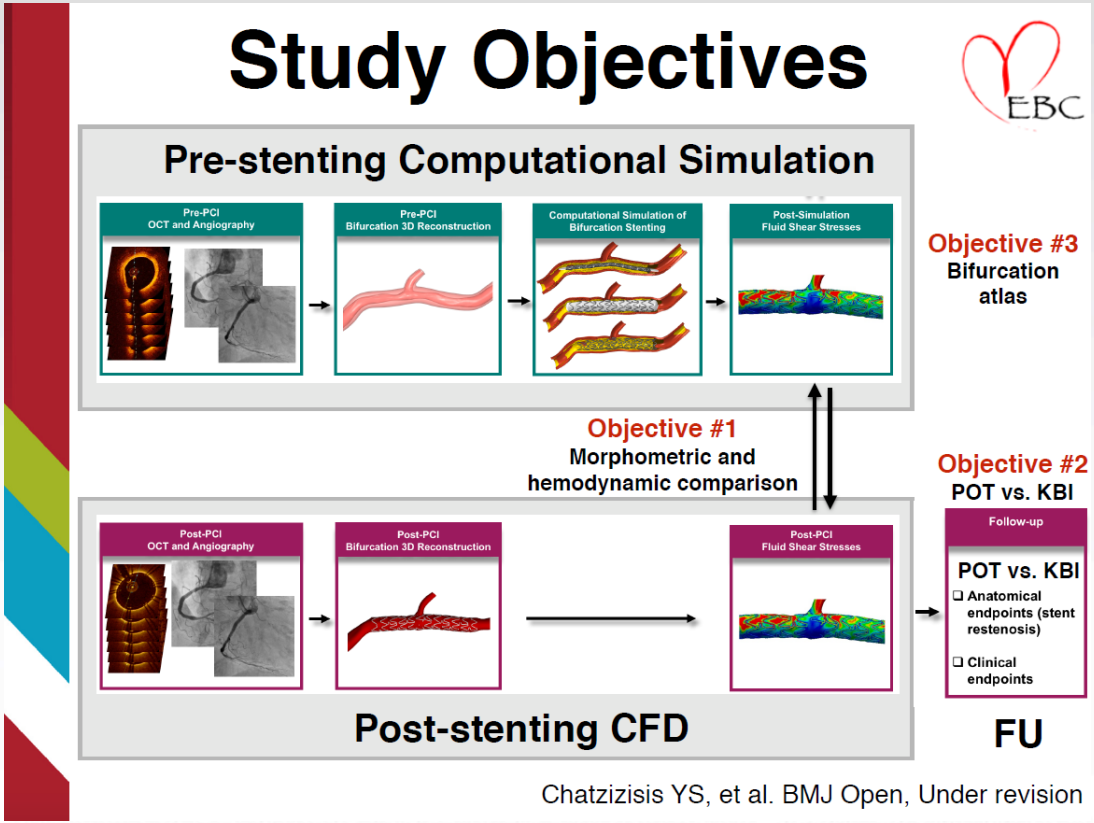
Computed flow dynamic Results summary

Answers

-in LM provisional stenting:
POT, Kissing Balloon and 2-SK showed a similar beneficial impact on the bifurcation rheology at both carena and SB wall opposite to the carena

-in LM Culotte stenting:
POT-Kissing balloon-POT and Snuggle Kissing performed slightly better than the other techniques, probably reflecting a better strut apposition.

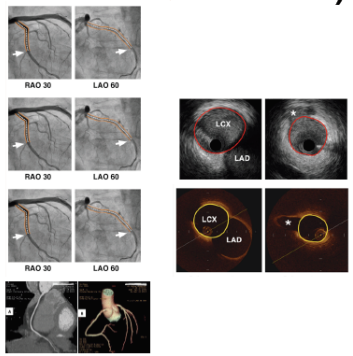
Yiannis S. Chatzizisis & Yusuke Watanabe: Updates on Flow ISR/ProPOT study and cases presentation



Yiannis S. Chatzizisis & Yusuke Watanabe: Updates on Flow ISR/ProPOT study and cases presentation

What we Need to Perform Realistic Bifurcation Stenting Simulations?

- ☑ **Imaging data (ROUTINE ACQUISITIONS)**
  - Angio (3D QCA)
  - Angio + IVUS
  - Angio + OCT
  - Coronary CTA



- ☑ **Detailed description of PCI procedure**
  - Balloons types, sizes etc
  - Stent types, sizes etc

→ **Computational simulation** (3D recon, CFD etc)

UNMC

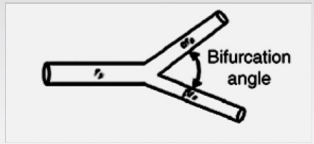
Ghassan S. Kassab: Real-time patient-specific computational simulations

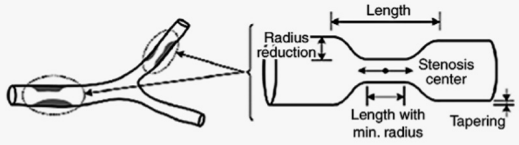
Approach

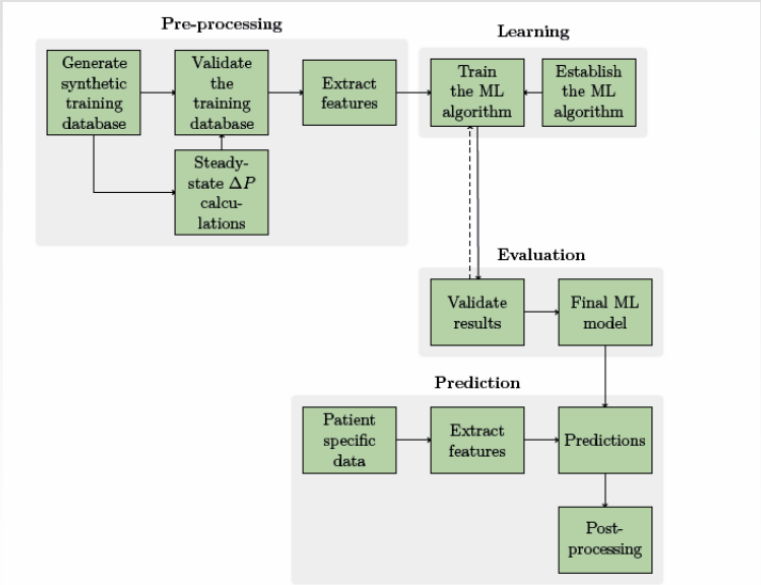
- To develop a **searchable virtual patient atlas (SVPA)** of patient-specific coronary bifurcations. SVPA will be based on 120 patient models (Flow ISR study).
- Use **shape dictionary learning (SDL)** models to automatically generate additional (several hundred) models for our SVPA.
- **Machine learning (ML)** models will be trained with the simulation data in order to create ML-FE (finite element) surrogates that can predict model outputs directly from patient geometry.

Ghassan S. Kassab: Real-time patient-specific computational simulations

Implementation of ML Algorithm for Coronary Flow Analysis







The four main steps of the process are pre-processing, learning, evaluation and prediction.