INSIGNEO

Institute for *in silico* Medicine

The role of haemodynamics and peripheral vasculature in vessel constrictions after FDS aneurysm treatment

Alberto Marzo

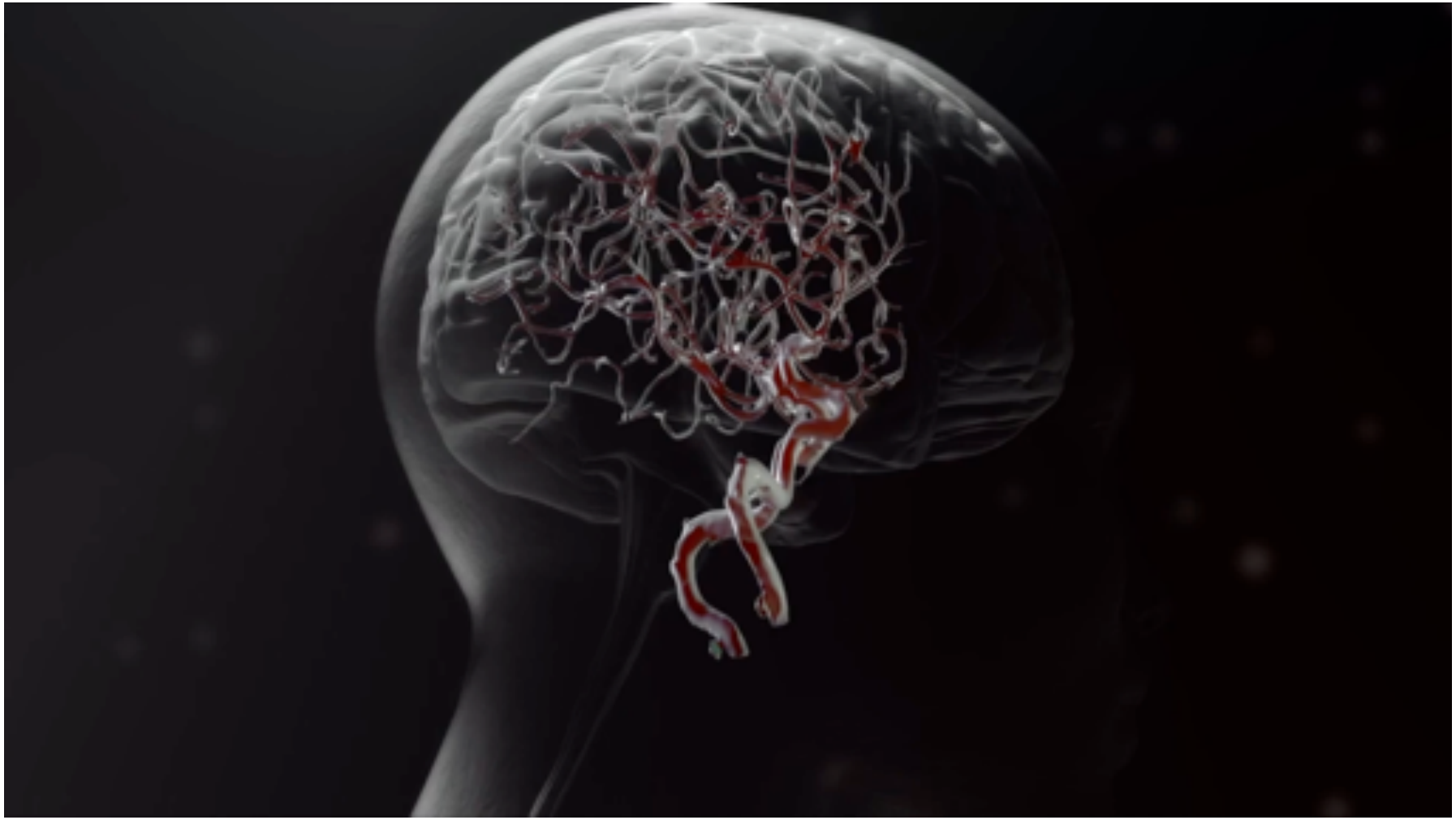
Moura F, Larrabide I, Narata AP

The University Of Sheffield.

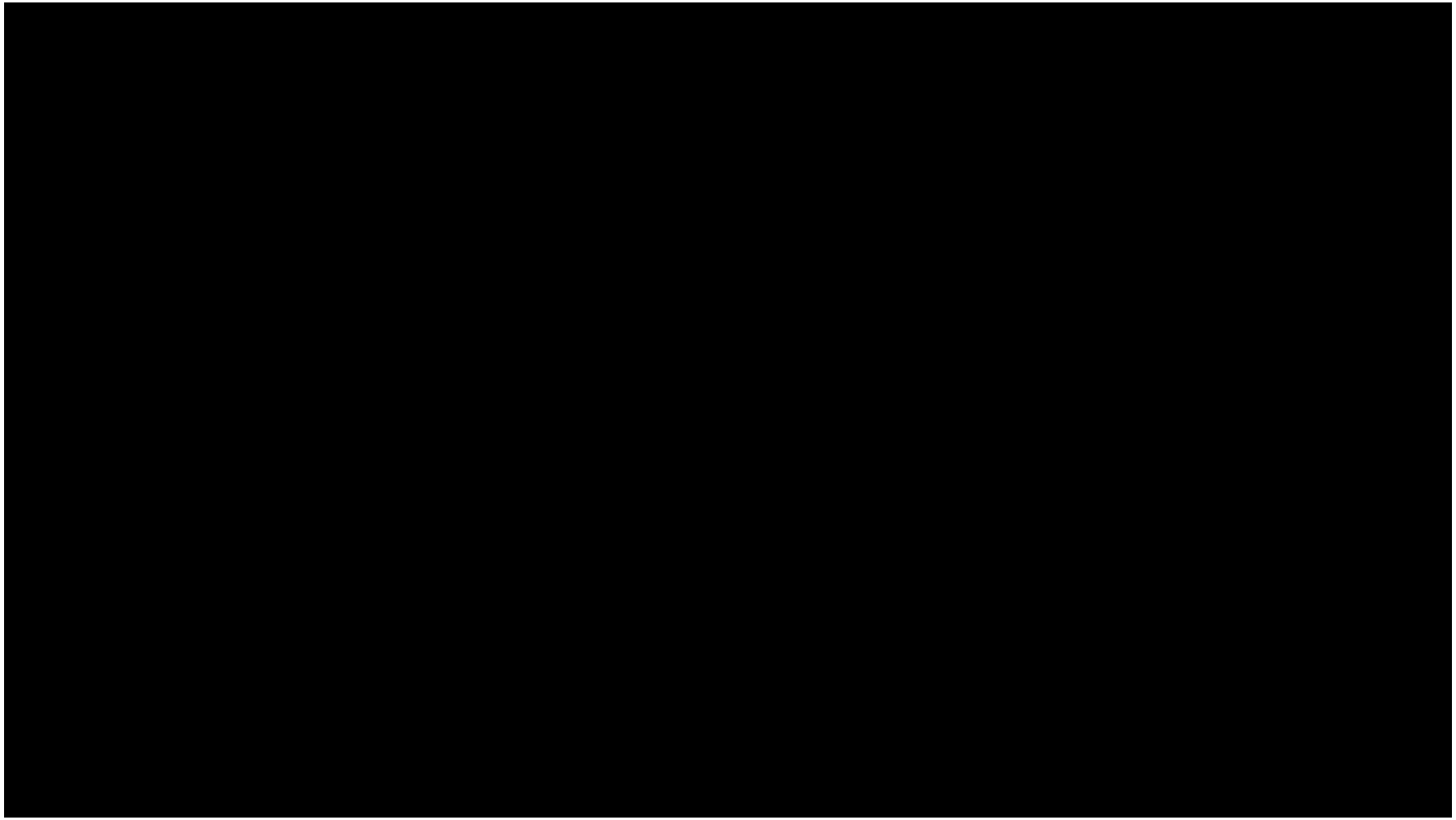
Sheffield Teaching Hospitals NHS
NHS Foundation Trust

CompBioMed

Intracranial aneurysm

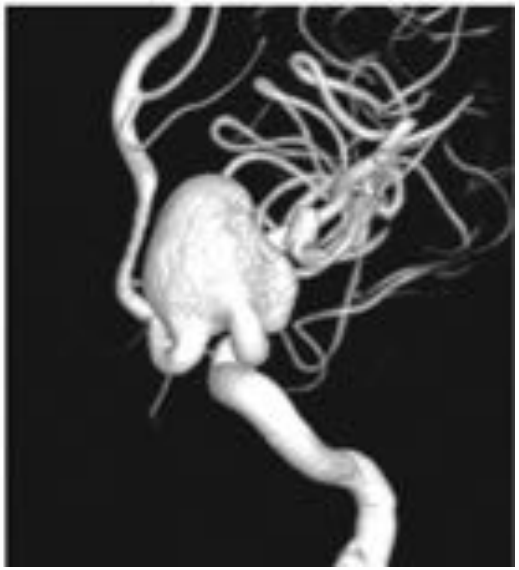


Treatment with FDS

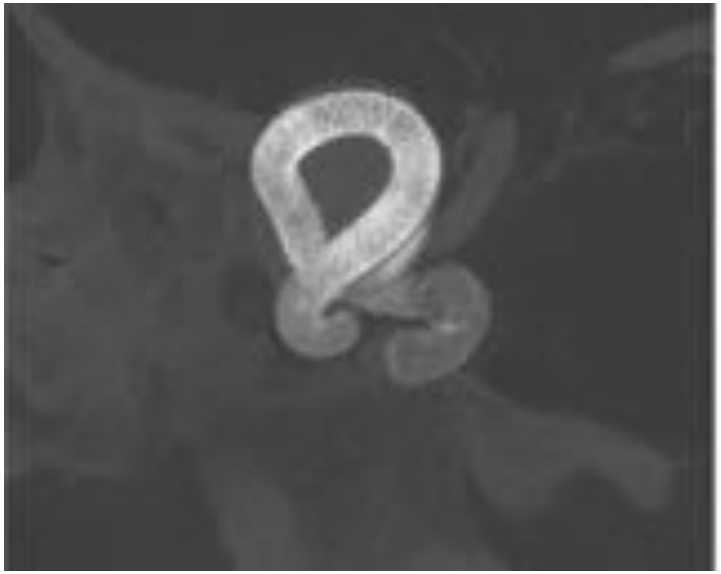


Vessel narrowing or occlusion

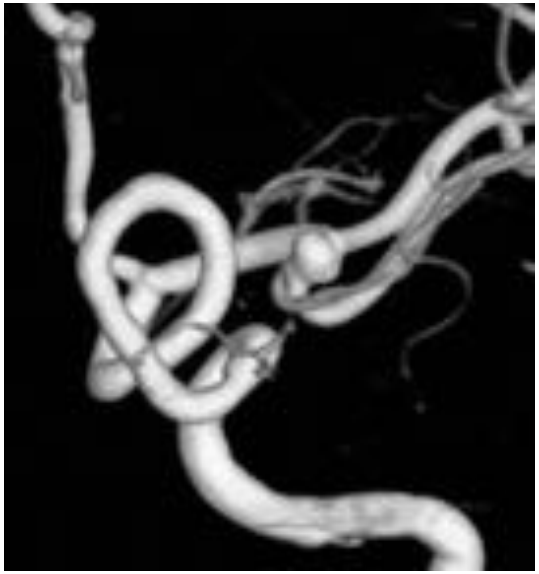
before treatment



after treatment

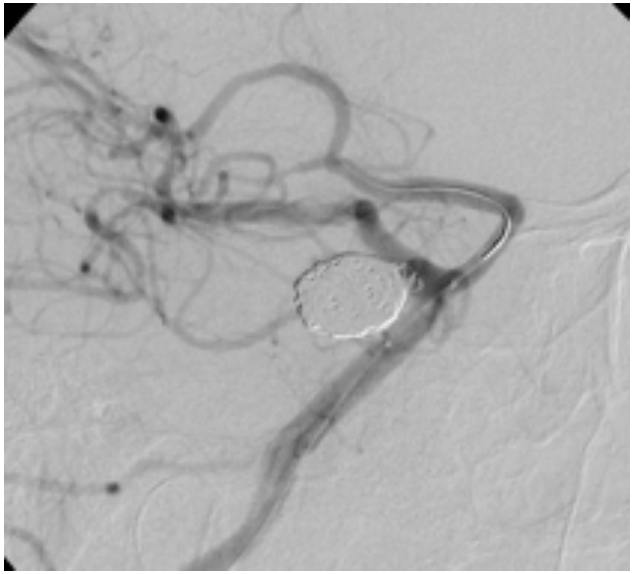


after treatment

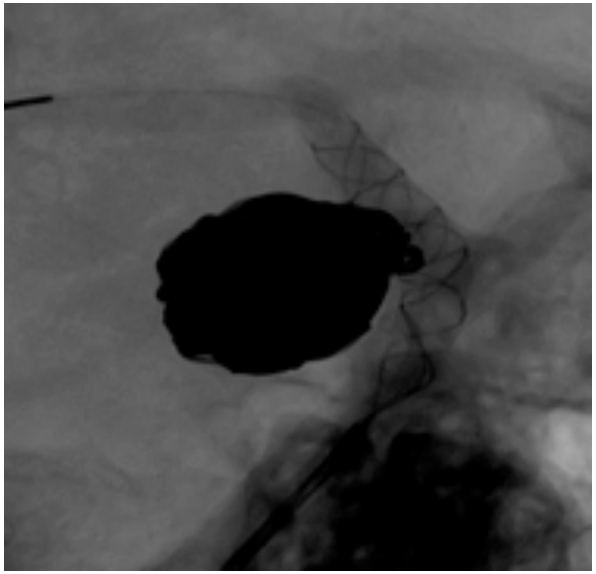


Vessel narrowing or occlusion

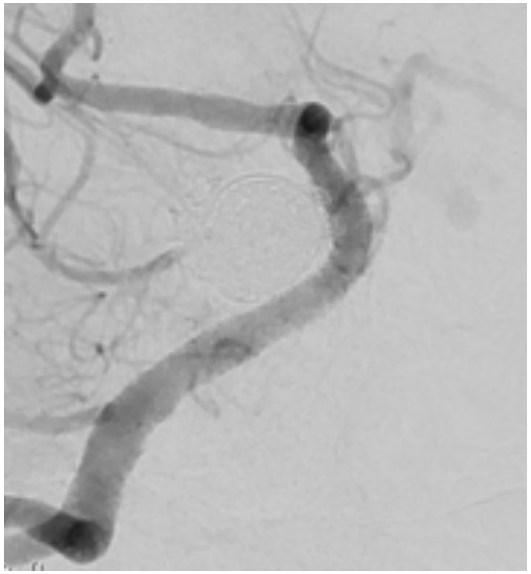
before treatment



after treatment



after treatment



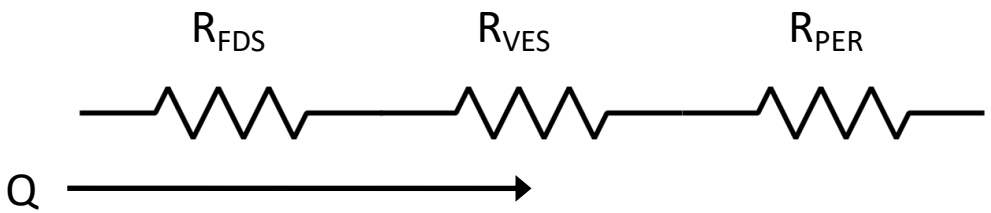
Challenge: reason some branches remain unchanged and others are affected by narrowing remains unknown

Hypothesis: clinical outcome depends on the relative impact of flow resistance induced by stent with respect to overall artery resistance in the jailed artery on haemodynamics

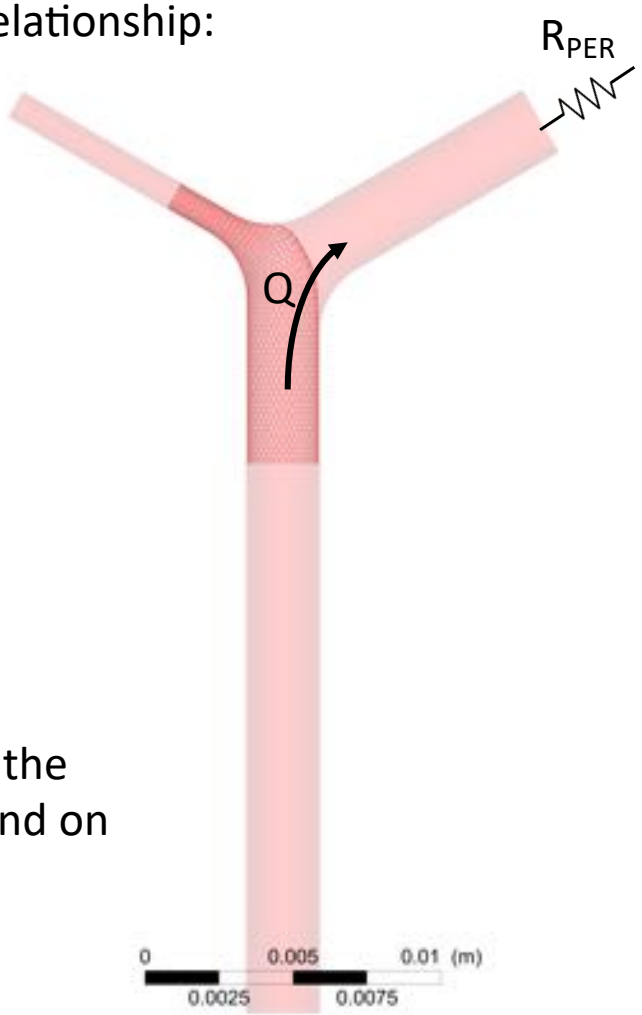
Resistance to flow

Blood flow in vessels can be described by Hagen-Poiseuille relationship:

$$\frac{\Delta P}{Q} = R \qquad R = \frac{8\mu L}{\pi r^4}$$



Hypothesis: the smaller the relative significance of R_{FDS} over the total resistance the smaller the impact on haemodynamics and on flow-mediated vessel narrowing.



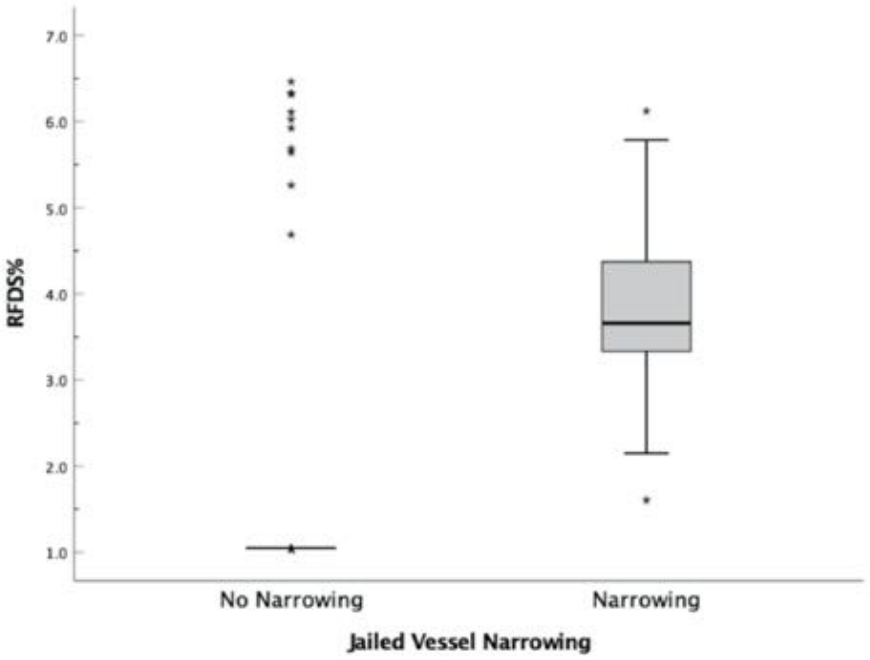
Data collection and analysis

Hôpital Bretonneau, Tours (France)

Alfried Krupp Krakenhaus, Essen (Germany)

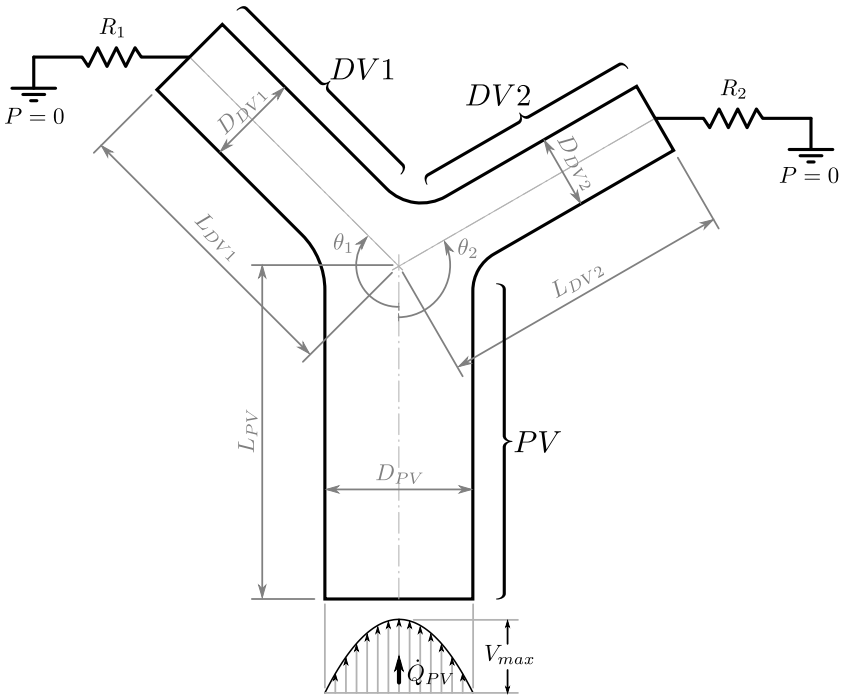
- Radiological images and demographic data from 142 aneurysms treated with FDS;
- Vascular resistance values estimated from patient-specific anatomical data (3DRA);
- Pearson correlation analysis used to identify correspondence between anatomical data and clinical outcome ($p<0.01$);

Data collection and analysis



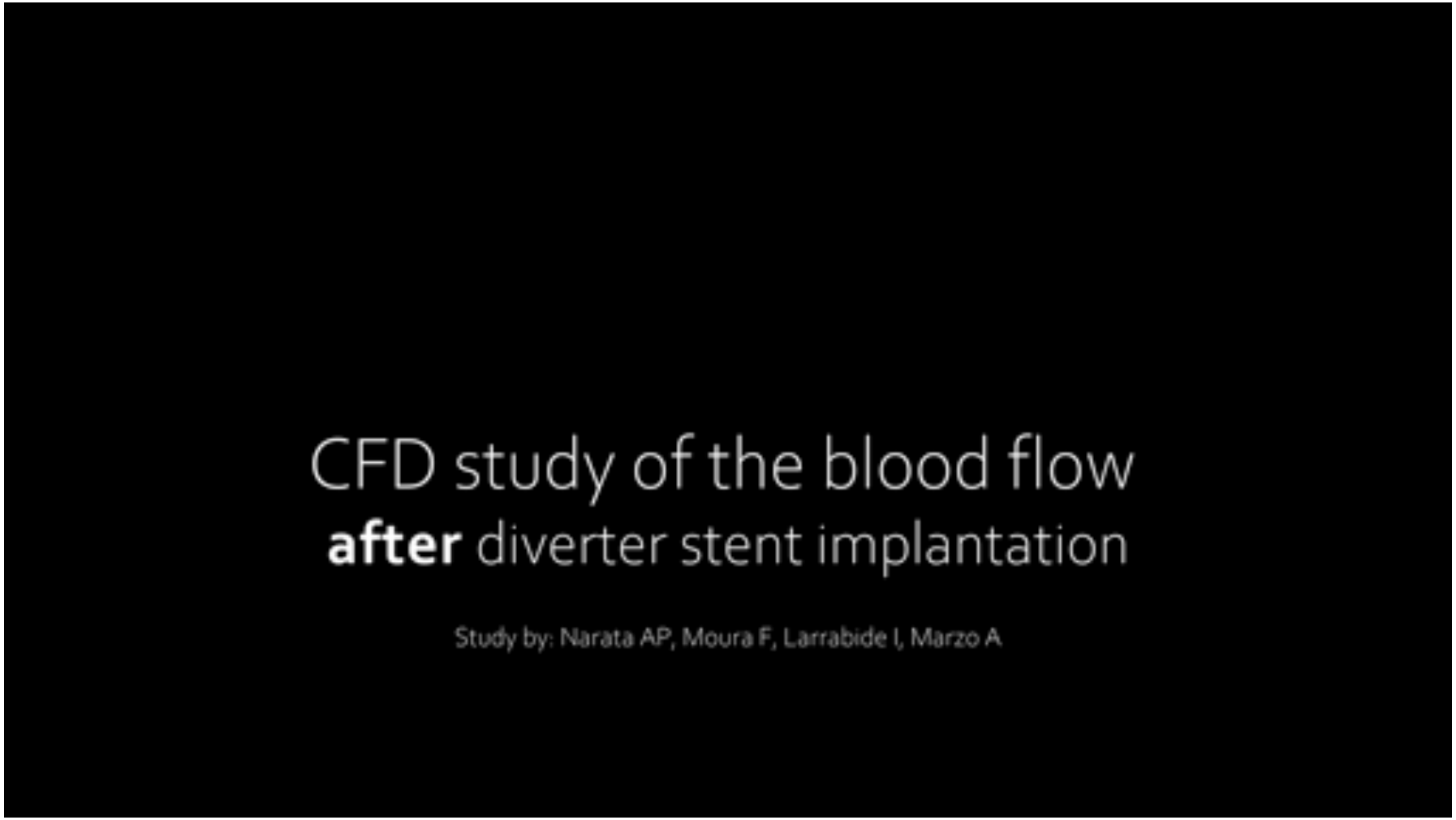
- Radiological images and demographic data from 142 aneurysms treated with FDS;
- Vascular resistance values estimated from patient-specific anatomical data (3DRA);
- Pearson correlation analysis used to identify correspondence between anatomical data and clinical outcome ($p<0.01$);

Data collection and analysis

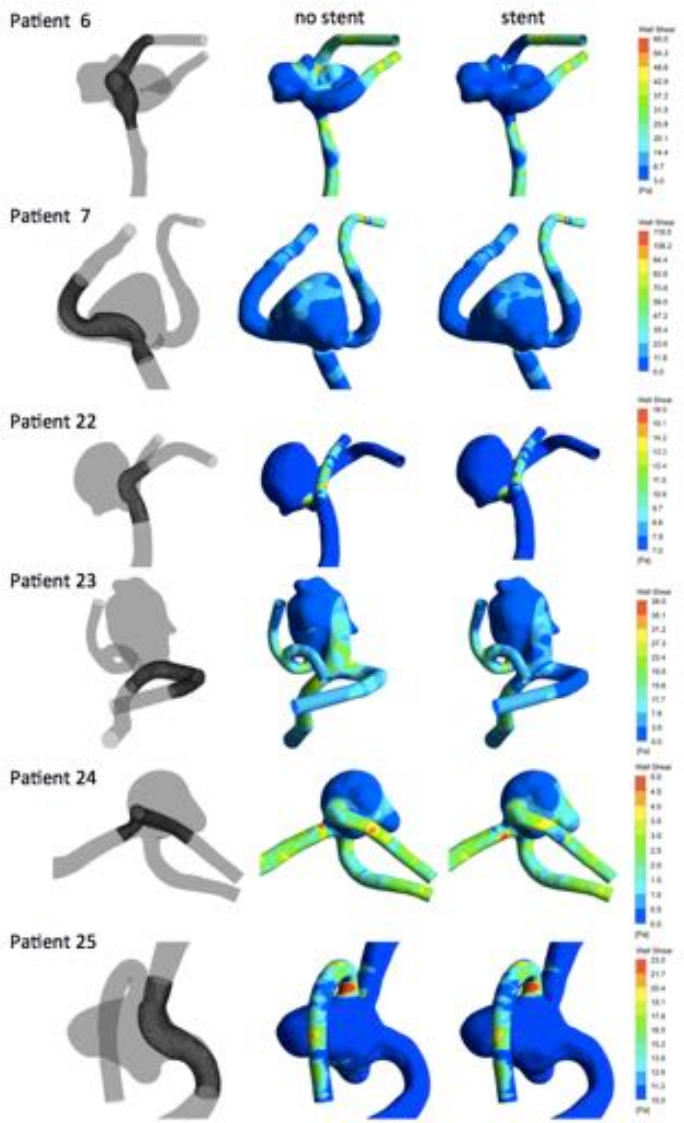


- Radiological images and demographic data from 142 aneurysms treated with FDS;
- Vascular resistance values estimated from patient-specific anatomical data (3DRA);
- Pearson correlation analysis used to identify correspondence between anatomical data and clinical outcome ($p<0.01$);
- Patient-specific CFD (ANSYS-CFX) analysis to investigate cause effect mechanisms;

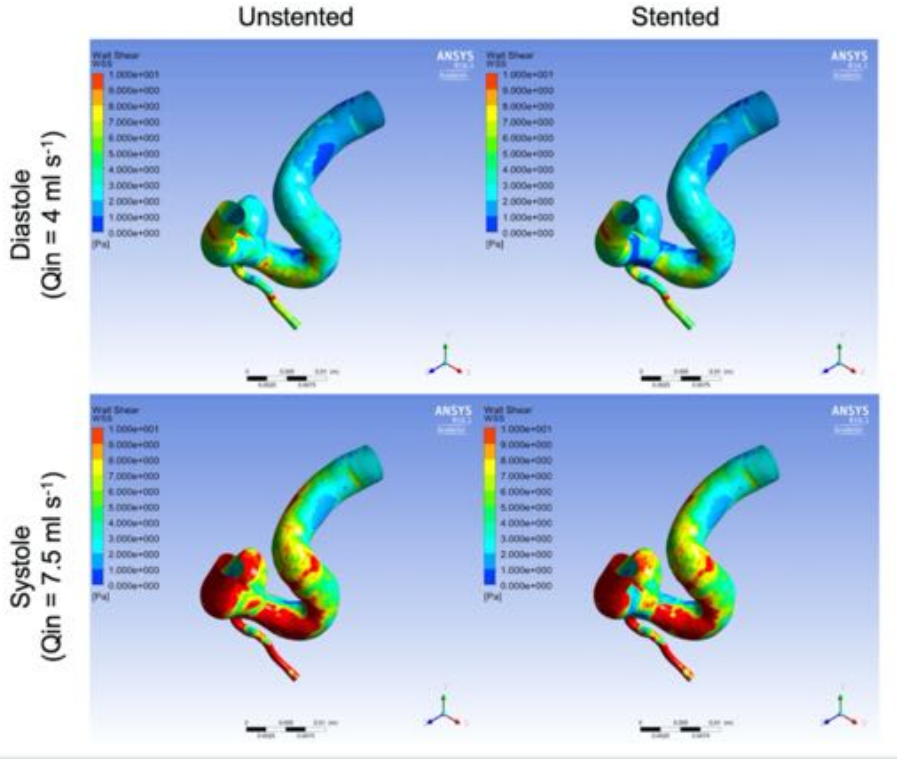
CFD simulation



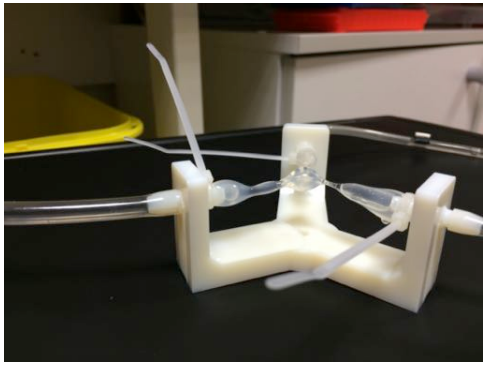
Data collection and analysis

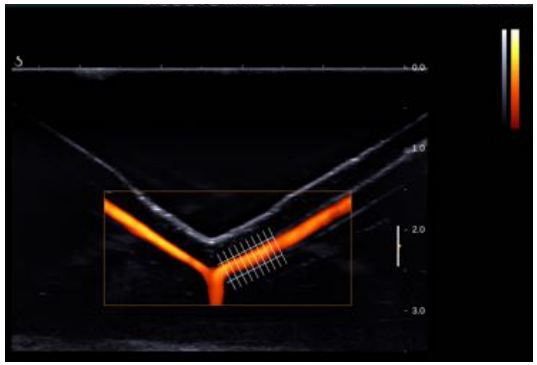


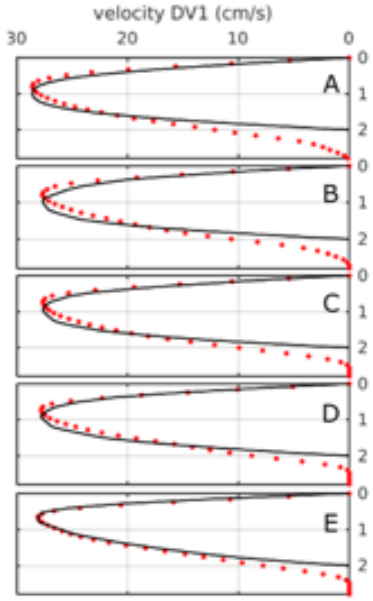
- Relevant haemodynamic values (e.g. WSS) only marginally affected by FDS when clinical outcome is positive and when FDS-induced resistance is negligible.

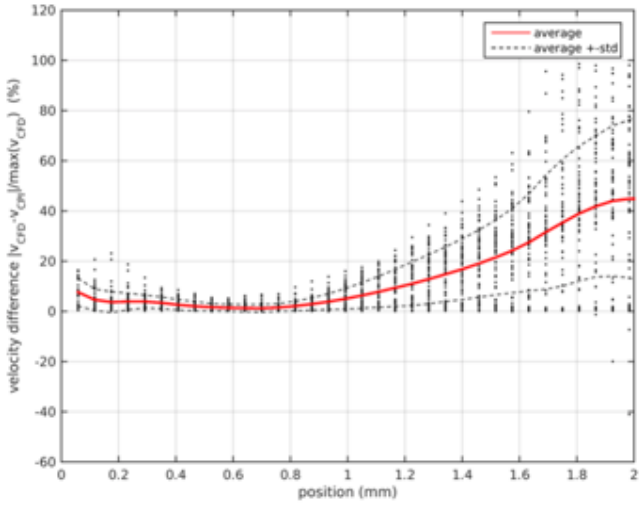


Validation









- Collaboration with University Hospital Tours (Inserm)
- Power-Doppler ultrasound to measure velocity profiles across a vessel;
- Good levels of accuracy near the US probe;
- This may lead to development of non-invasive techniques for *in vivo* measurements.

Acknowledgements

Fernando Moura, Brazil

Alberto Marzo, UK

Ignacio Larrabide, Argentina

Ana Paula Narata, France

Medtronic

ROYAL ACADEMY OF ENGINEERING

CompBioMed

INSIGNEO

Institute for *in silico* Medicine

Thank You!

The University Of Sheffield.

Sheffield Teaching Hospitals NHS
NHS Foundation Trust

CompBioMed