AORTIC LIVE | 2016

October 17–18, 2016
Philharmonie Essen, Germany

3D Printing in Aortic Surgery: The link from diagnosis to Surgical planning and Treatment

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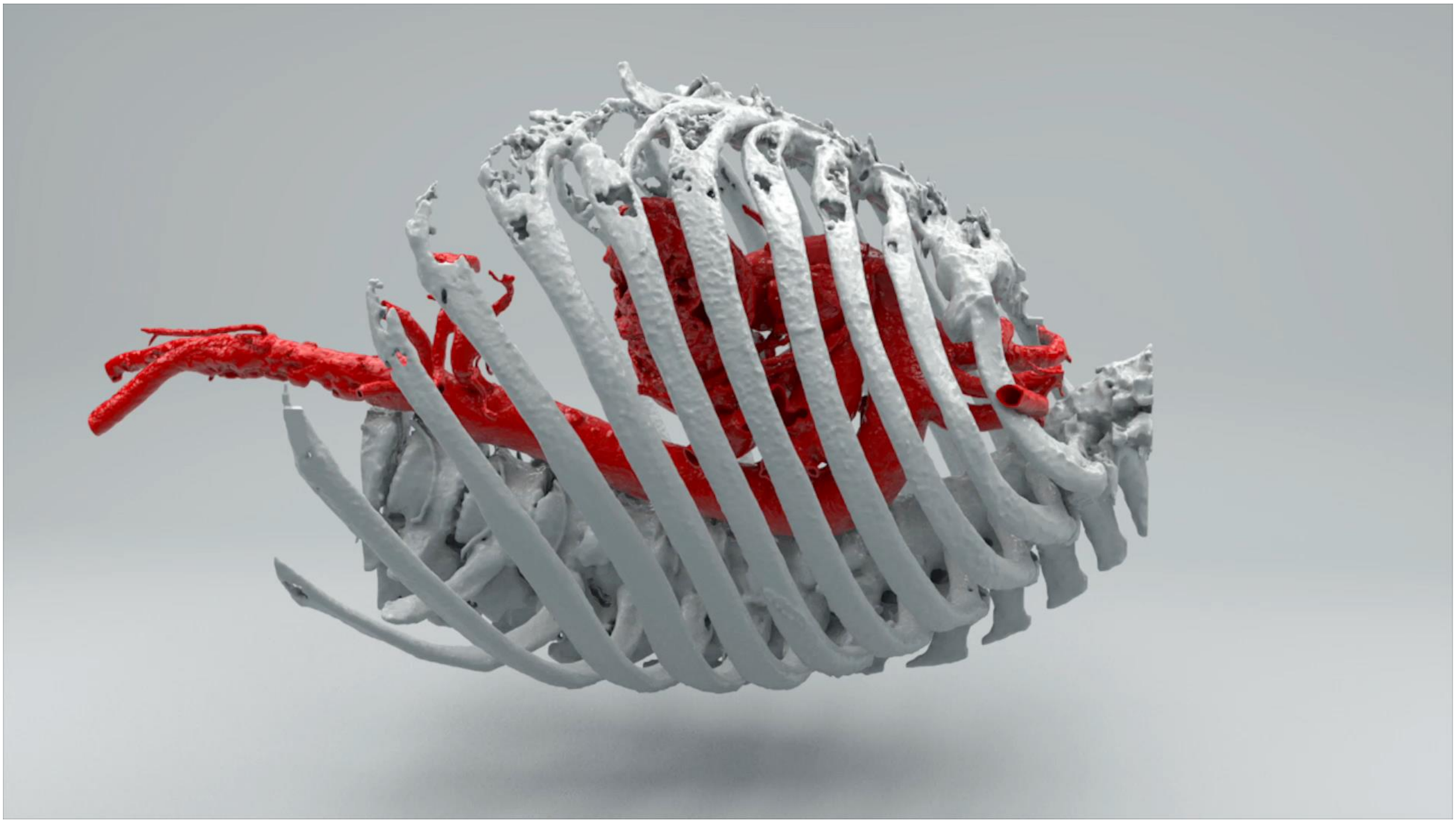
MILANO

Rendering or Printing ?



SIMULATION

Strategy to teach:

Technical Skills
Procedures
Operations
New Devices

Recreate similarity to reality

SIMULATION MODELS

- Animals and Cadavers reproduce a real anatomical scenario (not always available and difficult to reach)
- Virtual Reality is in an ongoing R&D phase
- **3D Printing opens a new scenario**

IMAGING

- **Integral part of surgical and transcatheter intervention**

- **Plays an increasingly important role for preoperative surgical planning and for peri-procedural evaluation imaging guidance**

- **In minimally invasive and transcatheter procedures, preoperative findings cannot be confirmed by direct visualization of the structures**

European Heart Journal (2010) **31**, 2727–2741
doi:10.1093/eurheartj/ehq302

REVIEW

Imaging

Three-dimensional imaging in the context of minimally invasive and transcatheter cardiovascular interventions using multi-detector computed tomography: from pre-operative planning to intra-operative guidance

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Received 18 June 2010; accepted 3 August 2010; online publish-ahead-of-print 25 August 2010

IMAGING ANALYSIS

Open source softwares (ie Osyrix,VTK, 3D slicer, MITK

- **Multi Planar reconstruction (MPR):**

Data obtained from axial CT scan are reconstructed in any desired plan

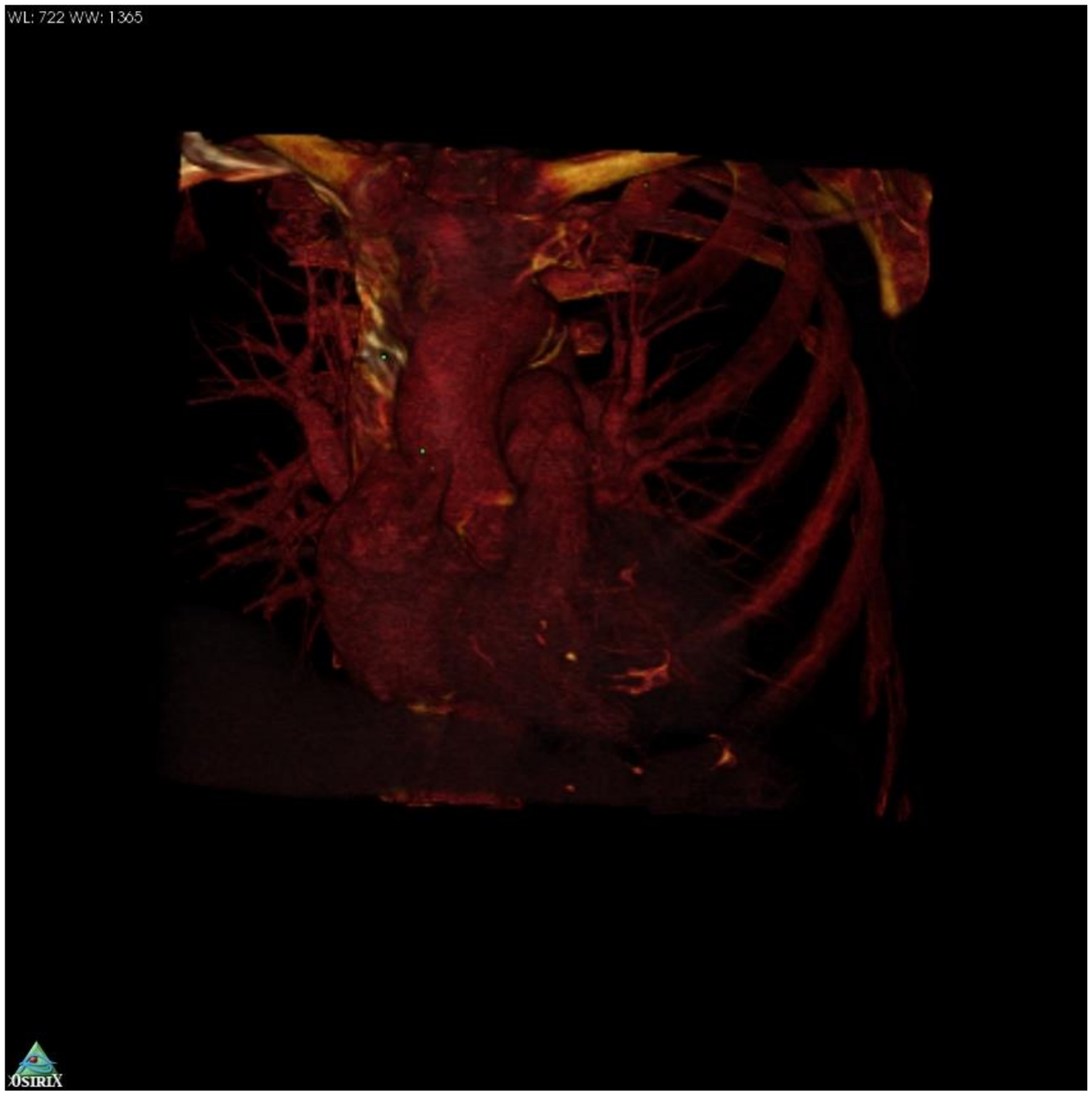
- **Maximum-intensity projection (MIP)**

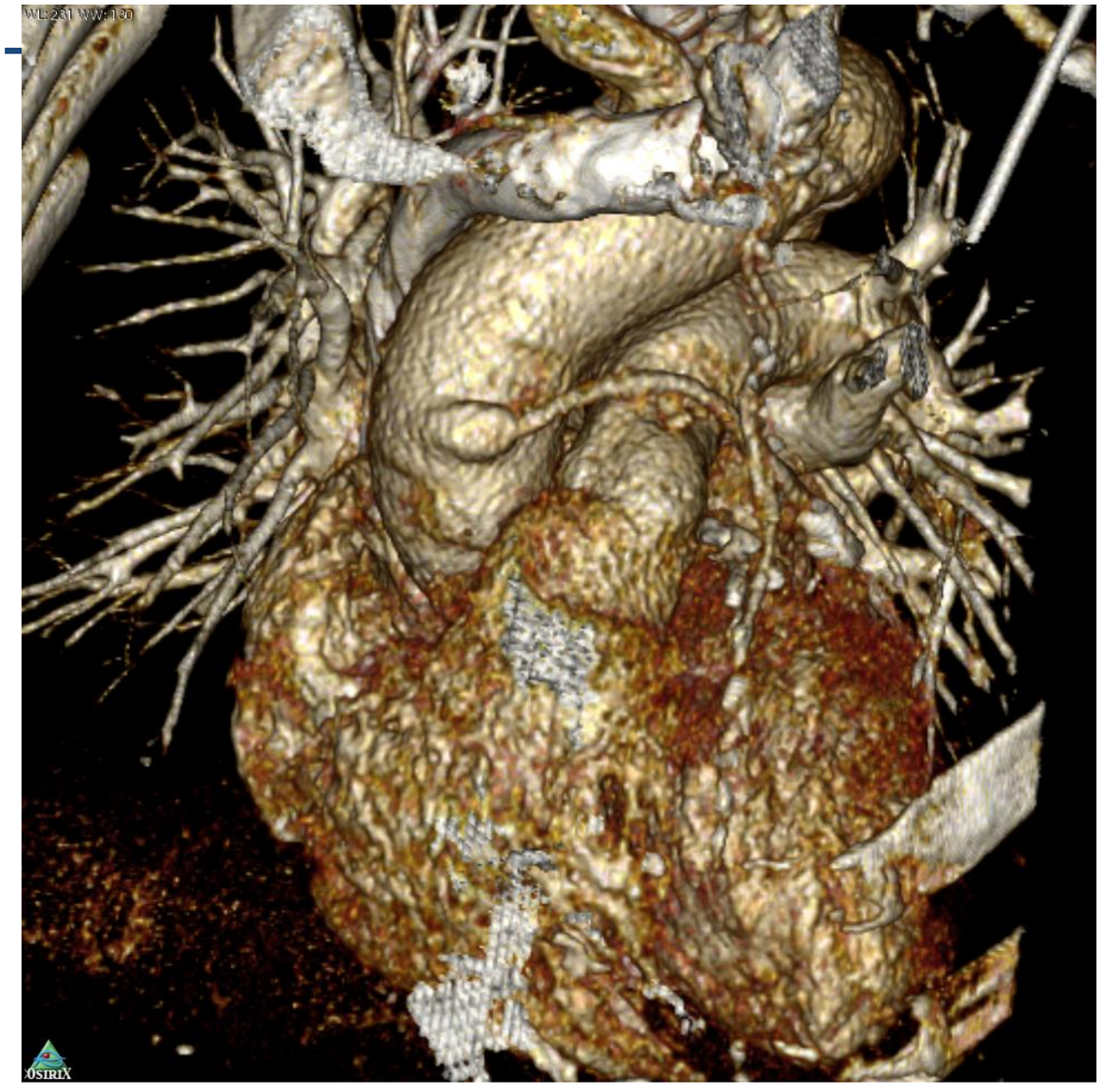
Create an image similar to conventional angiography
Calcification will dominate the image appearance

- **Volume rendered technique**

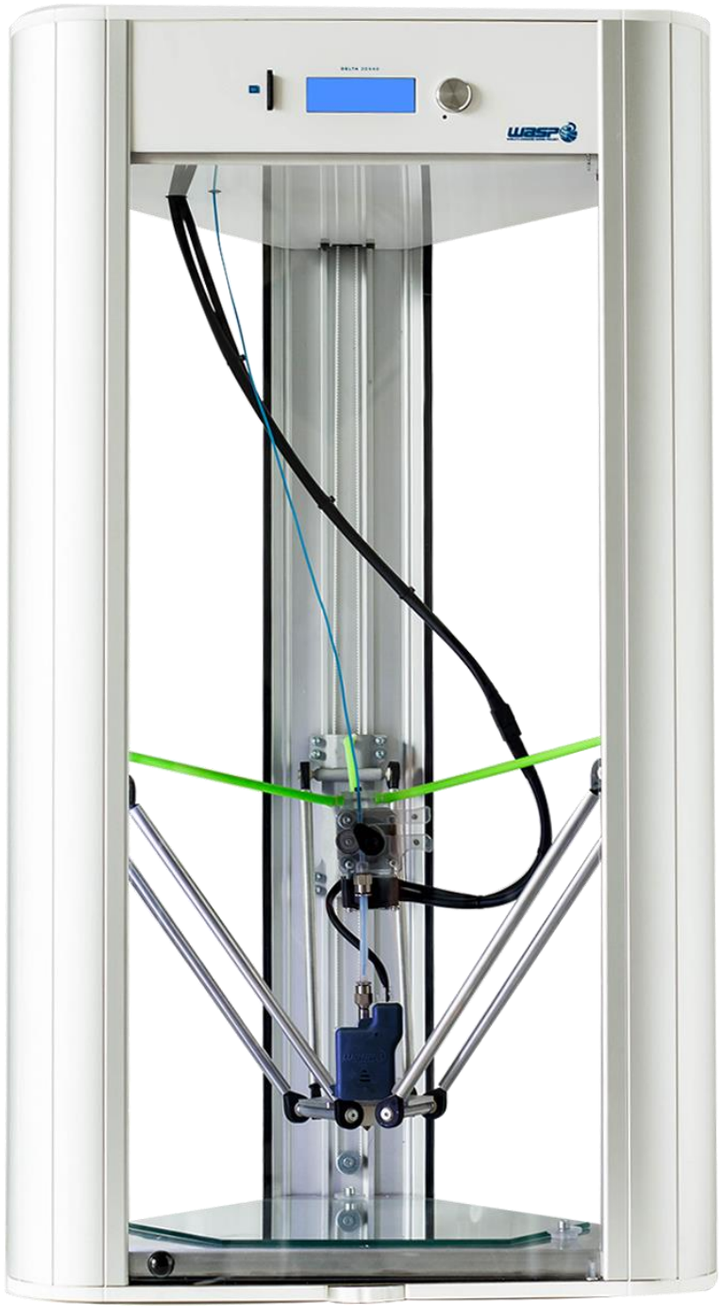
Reconstruction of 3D images (better with contrast!)

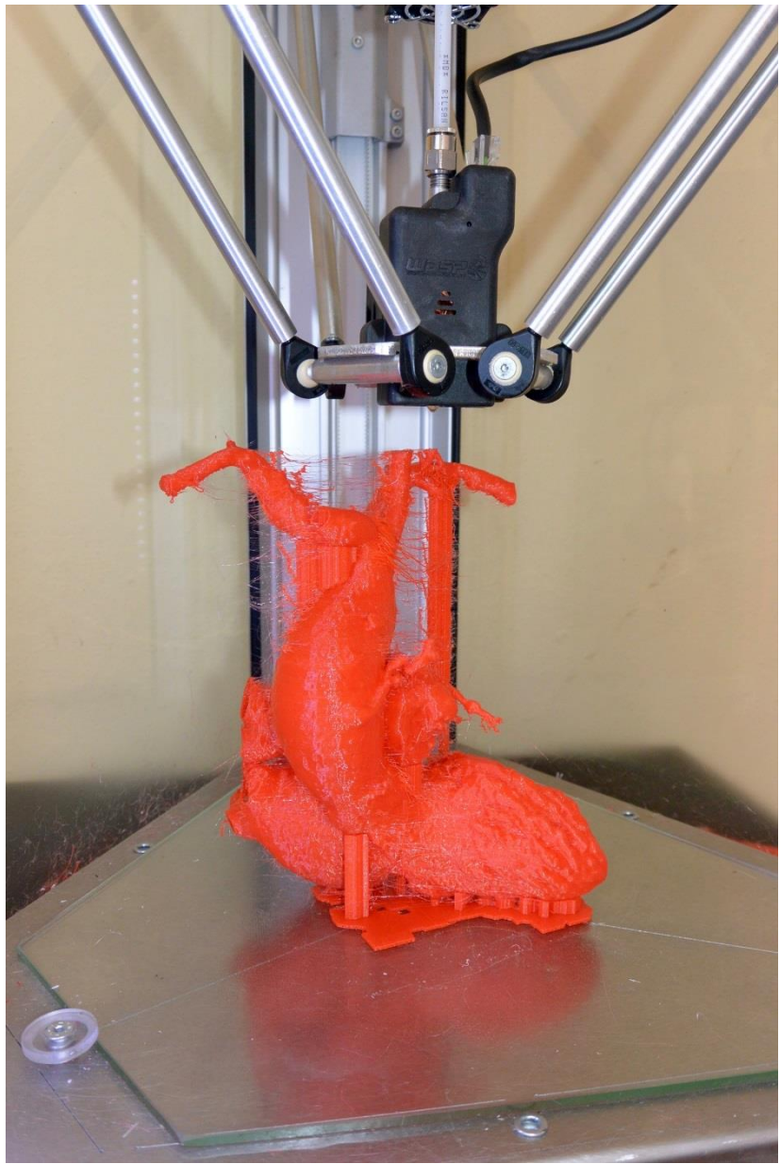
3D Volume Rendering

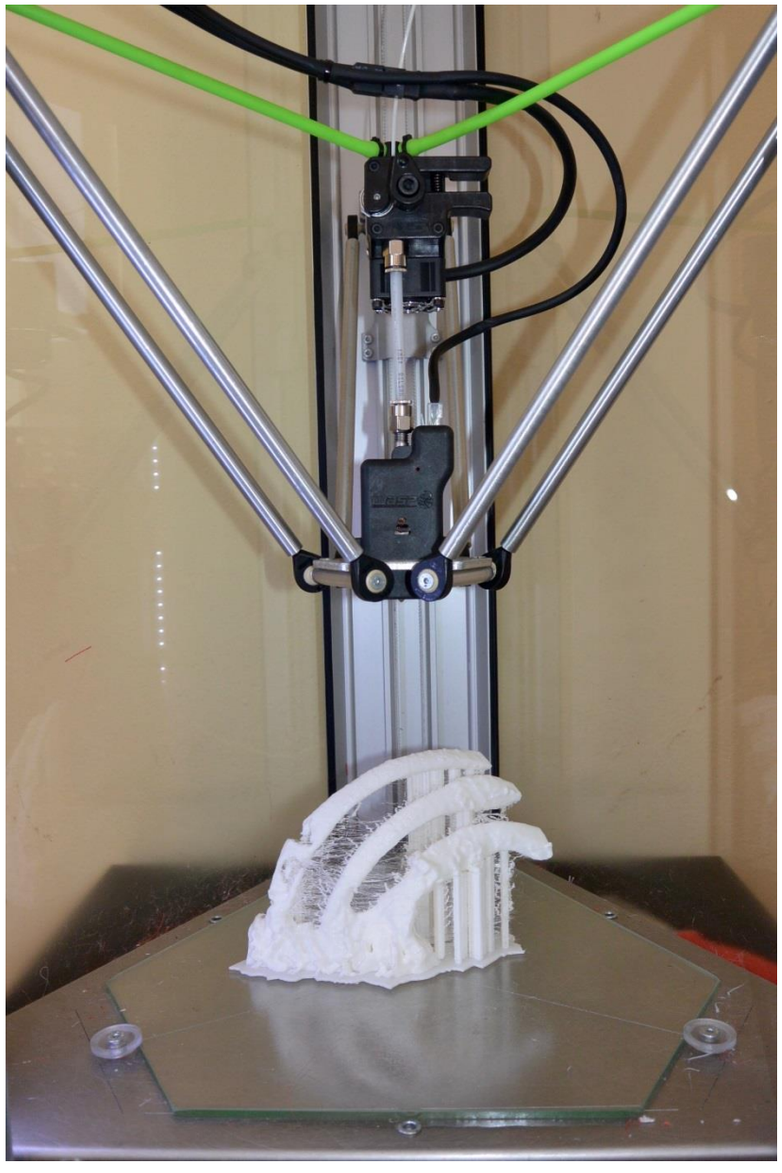




OUR EXPERIENCE







OUR EXPERIENCE

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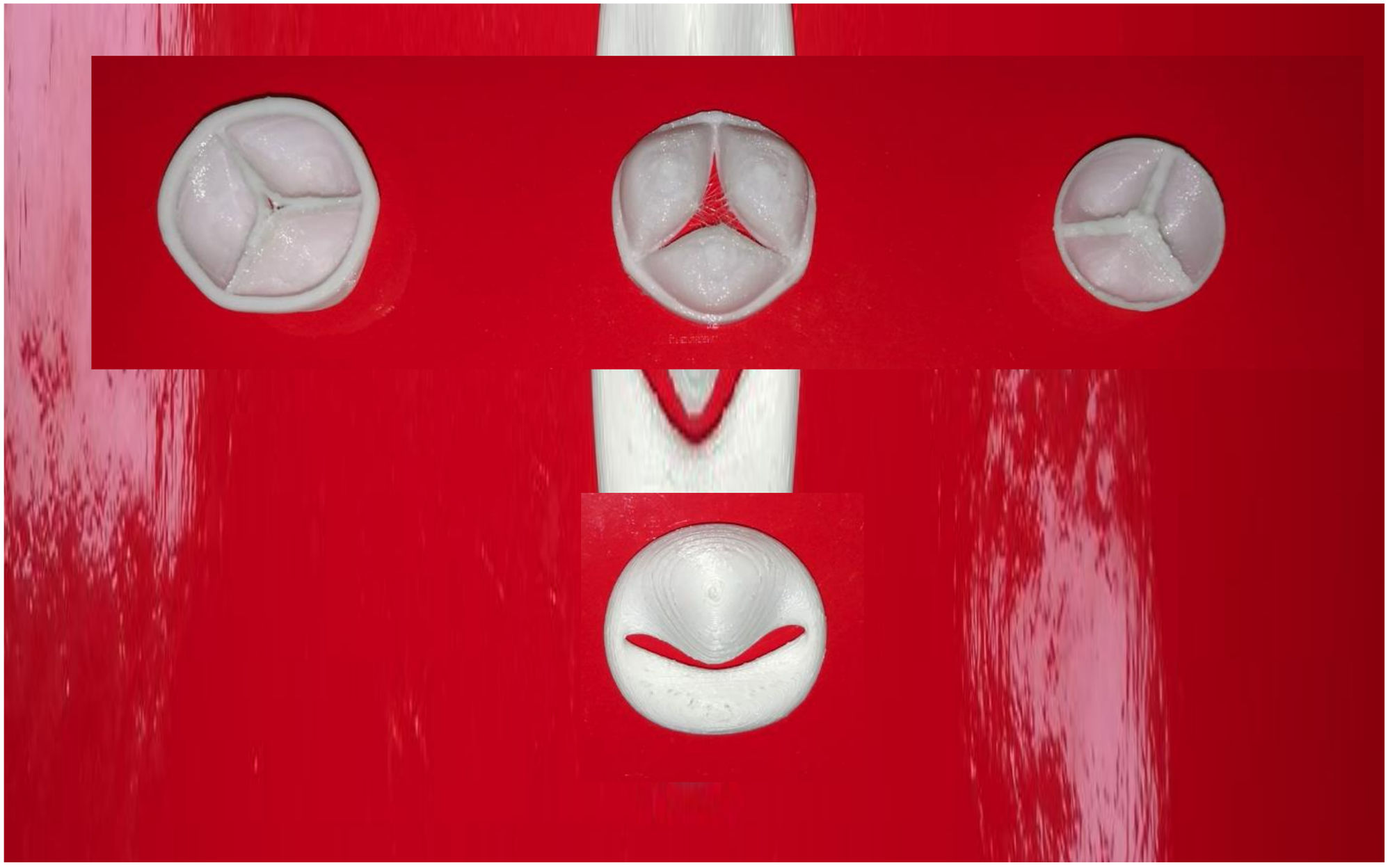


OUR EXPERIENCE

OUR EXPERIENCE

CASE 1

75 yrs Severe symptomatic AS

PREVIOUS CABG:

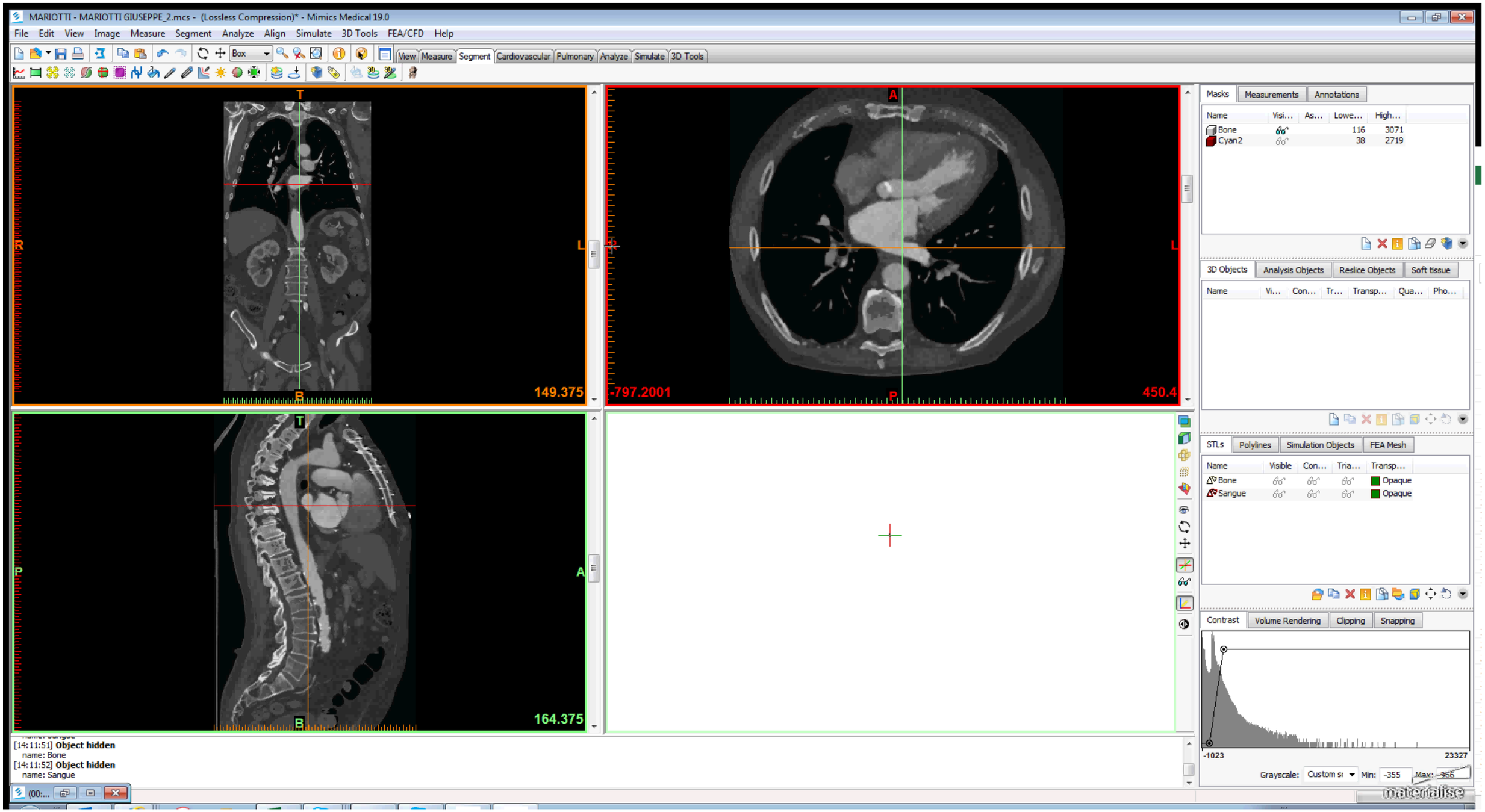
LIMA LAD; RIMA-Ygraft-OM, safen vein-RInt

Uncontrolled Diabetes – COPD – Euroscore: 14.5

High risk for resternotomy

Operation: **AVR via RT**

MIMICS 19 di Materialise



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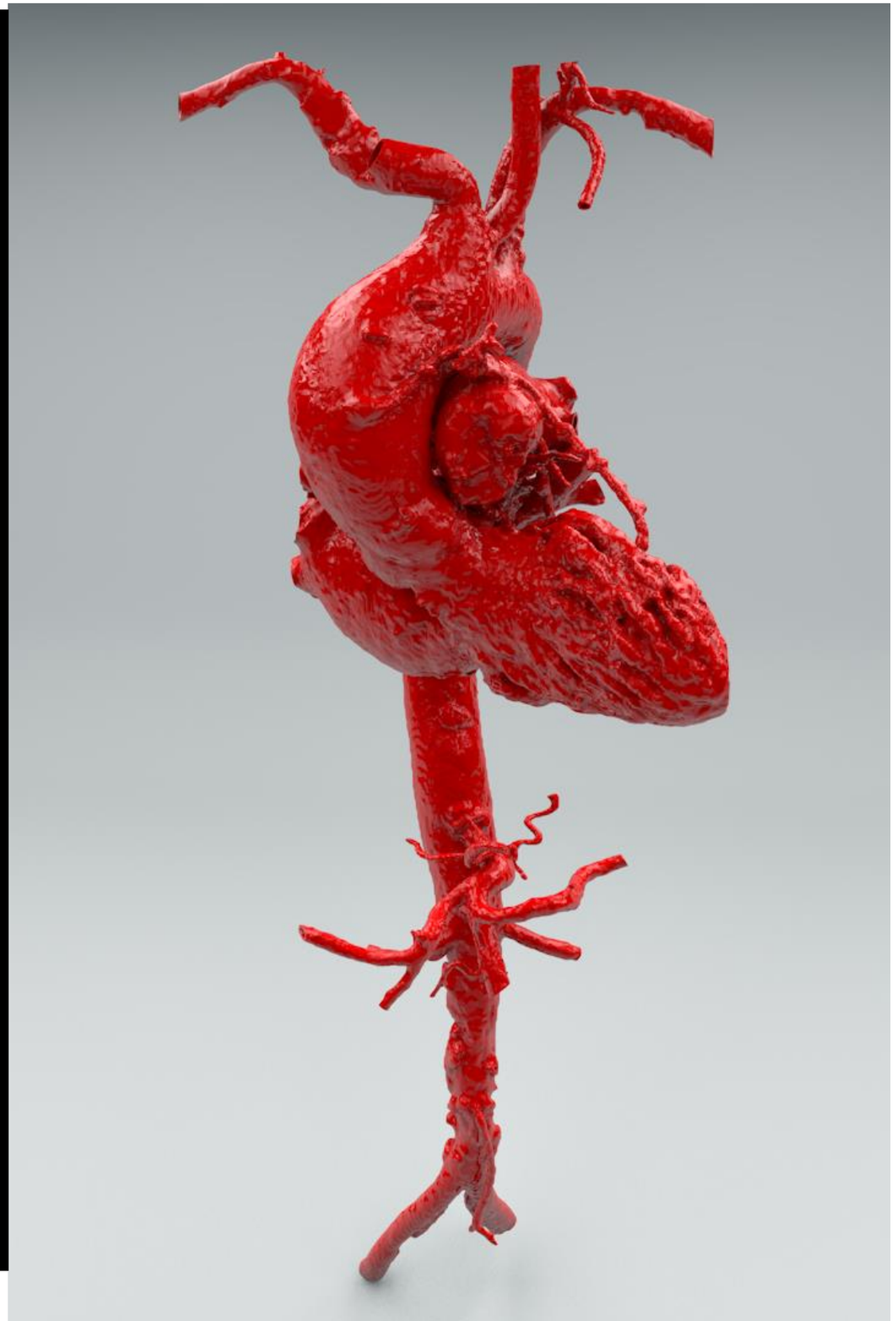

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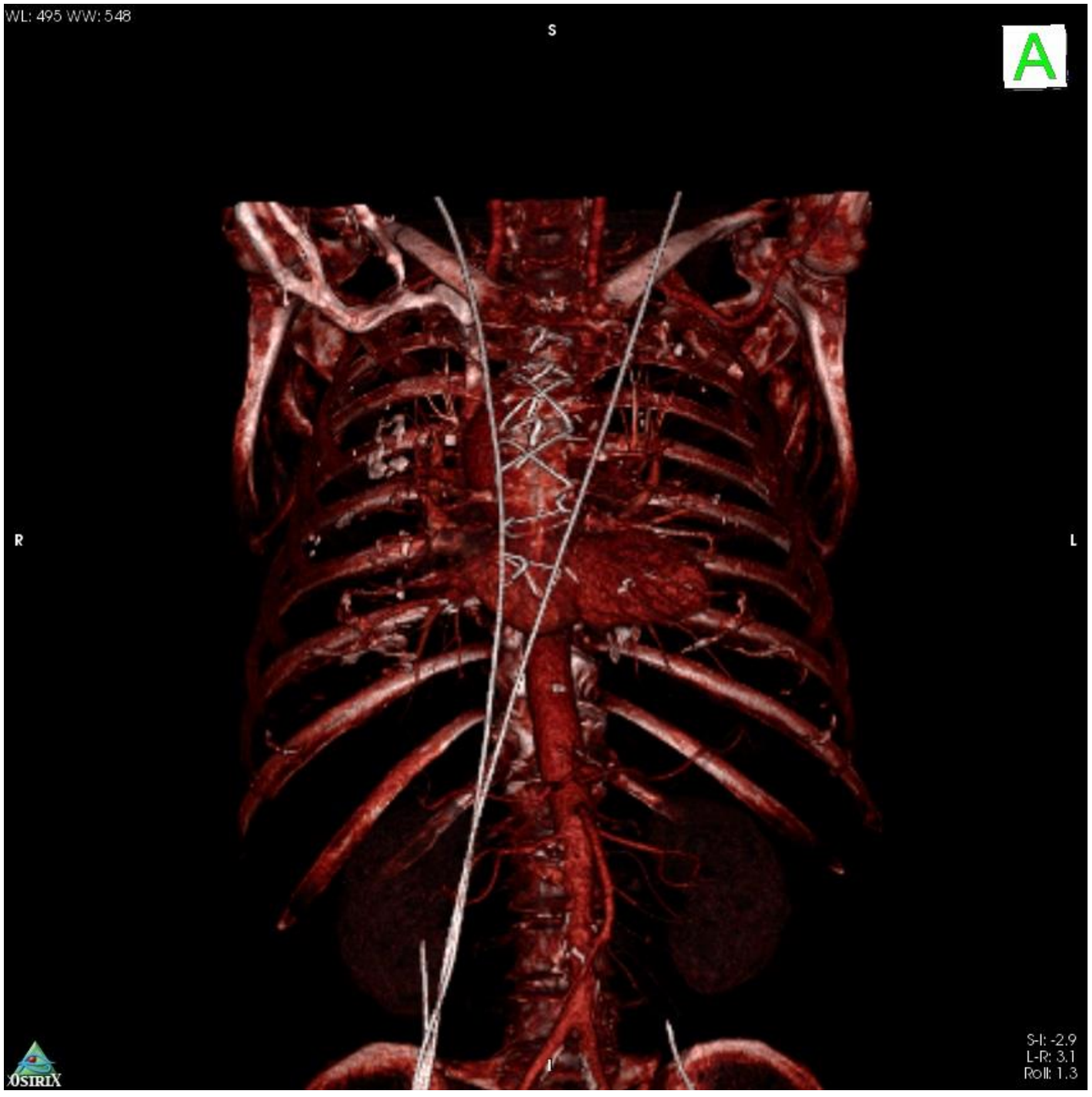

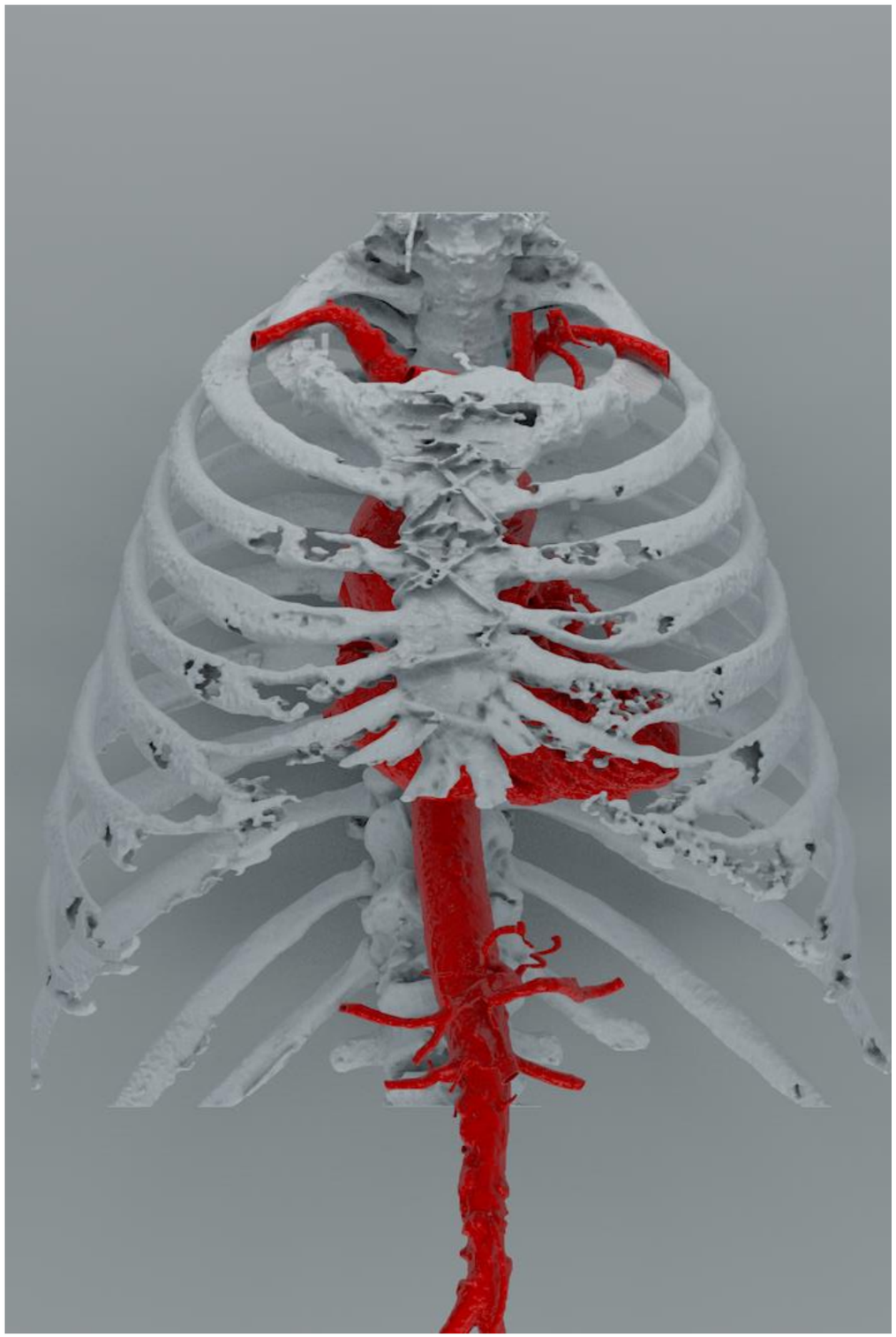

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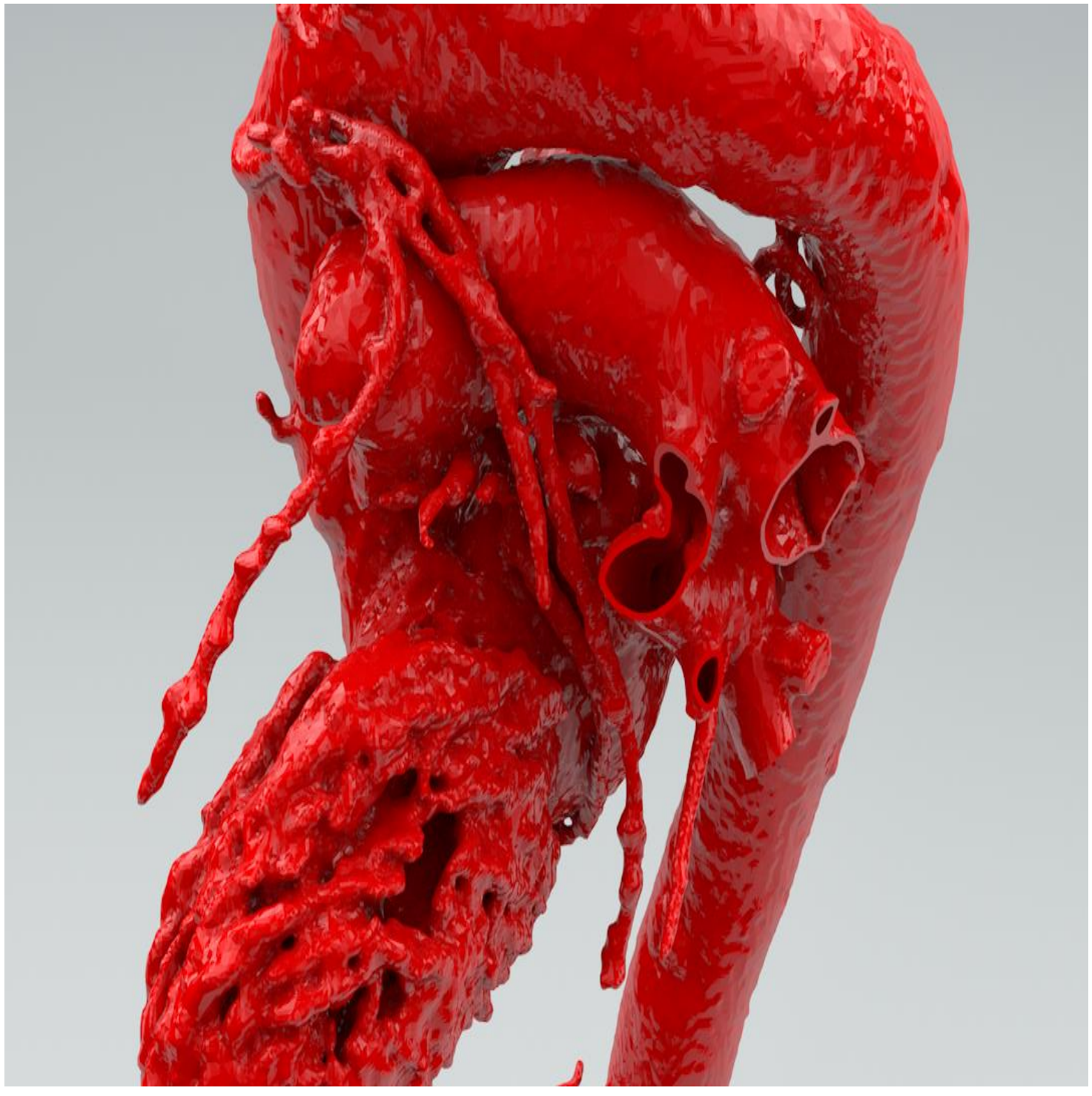


CASE 2

45 yrs

Normal Bicuspid Aortic valve

Ascending Aortic aneurism (50 mm)

Familiar hystory of dissection

Ascending aortic replacement via MS

Pre operative Images

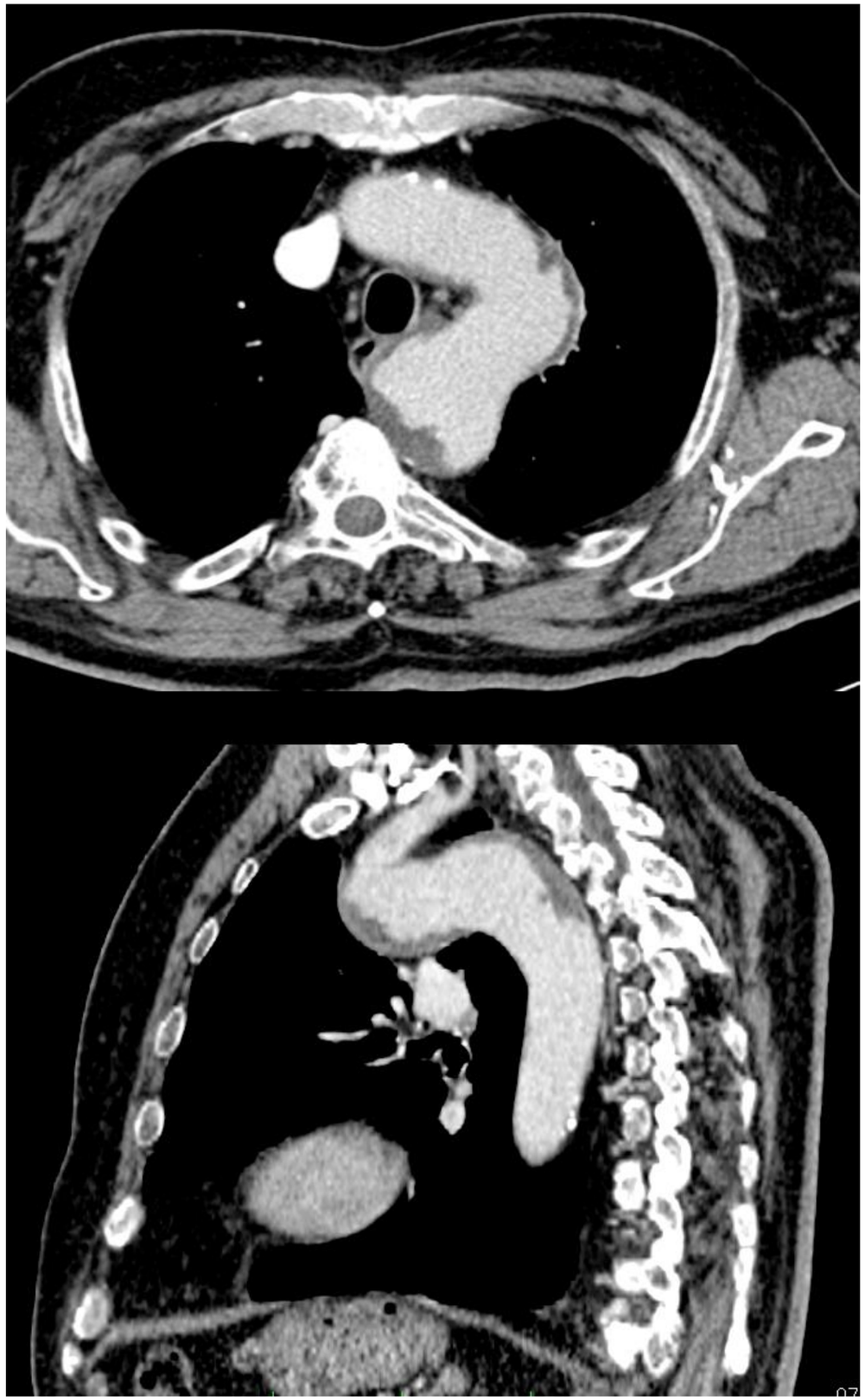
Pre operative Images (simulation)

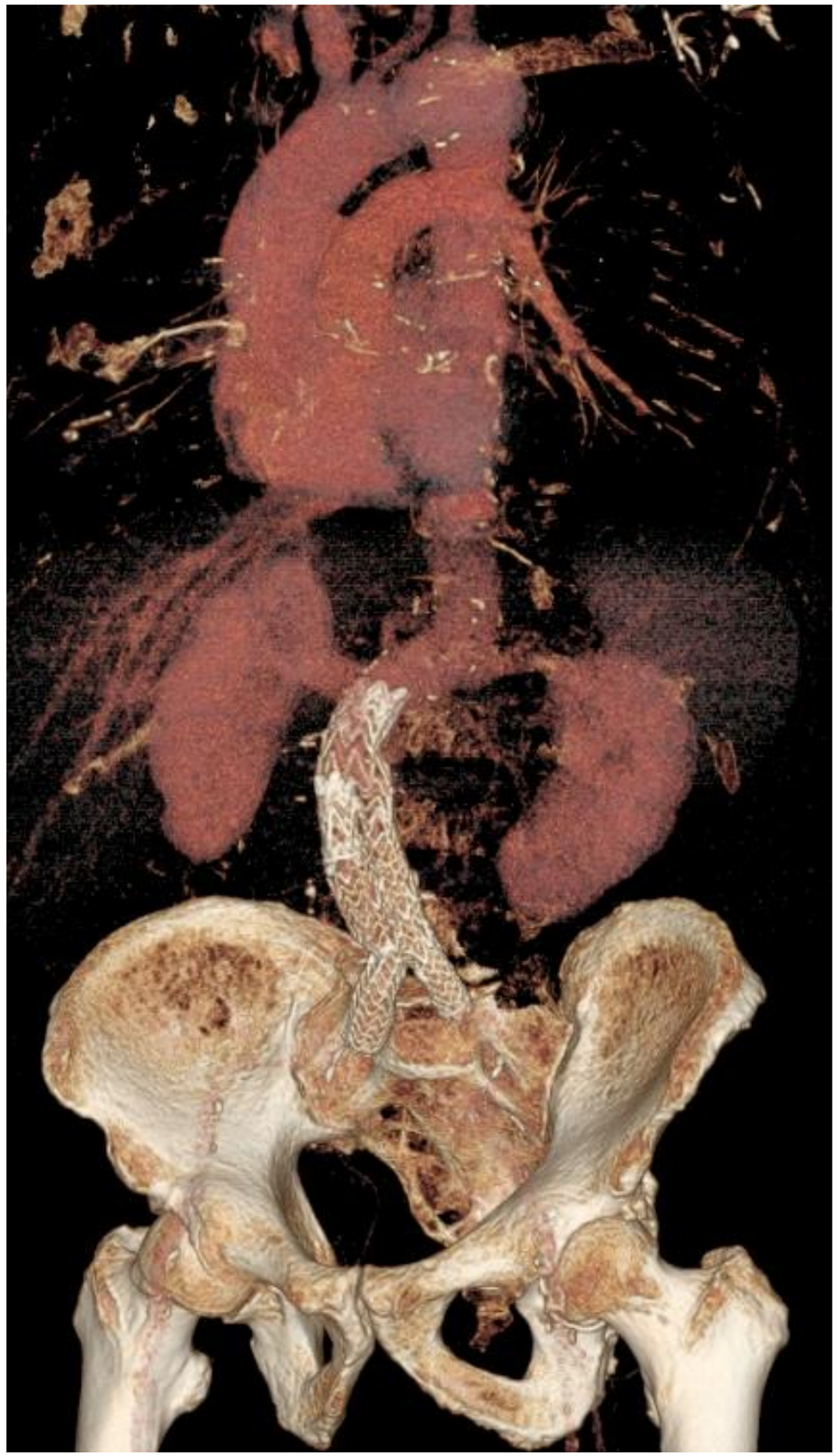
CASE 3
70 yrs

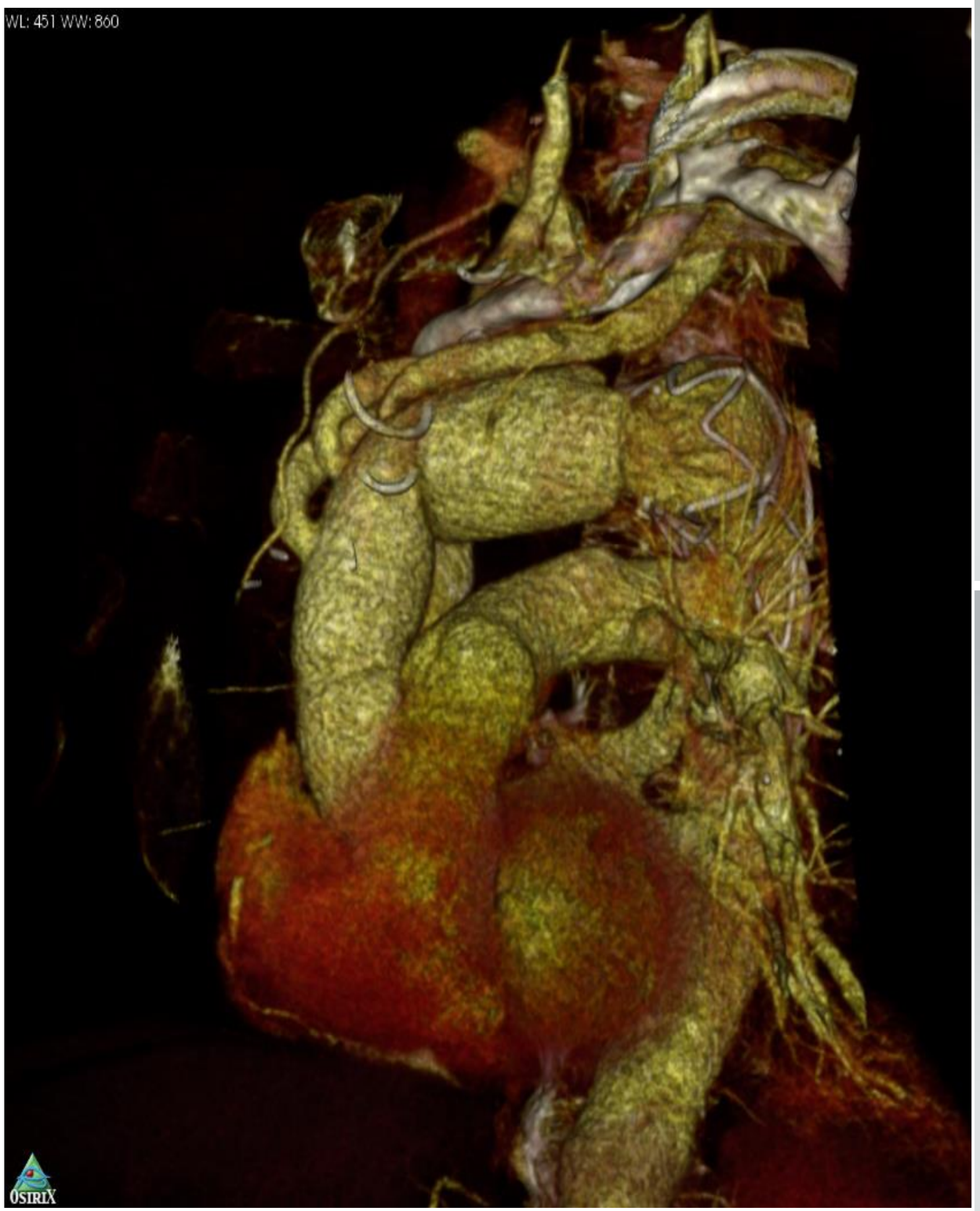
Previous AAA Endovascular graft for aorto-iliac aneurysm

Chest pain: Penetrating atherosclerotic ulcers and aneurysm in Aortic Arch and Proximal Thoracic Descending Aorta

Operation:
FET and total arch replacement via MS



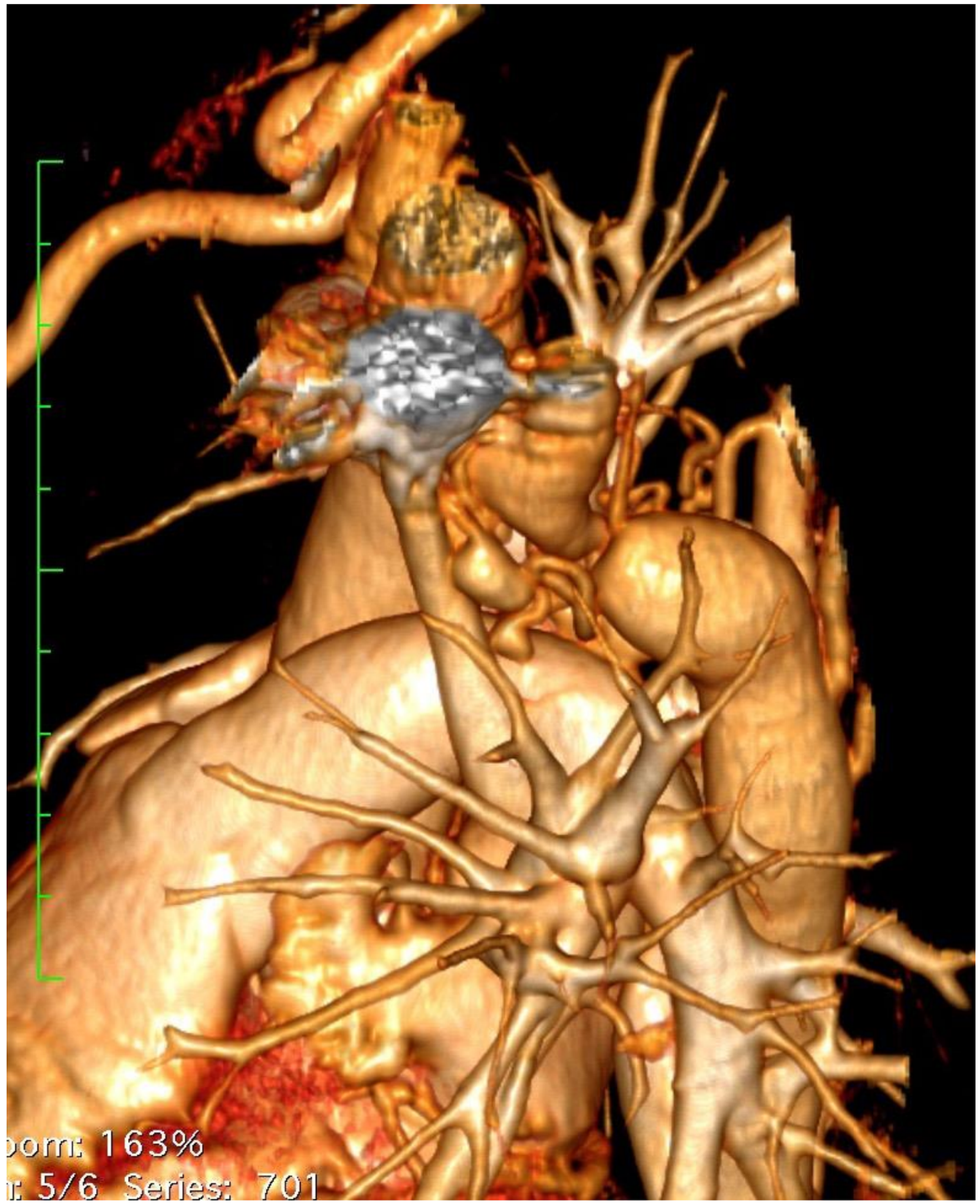



WL: 451 WW: 860
OSIRIX

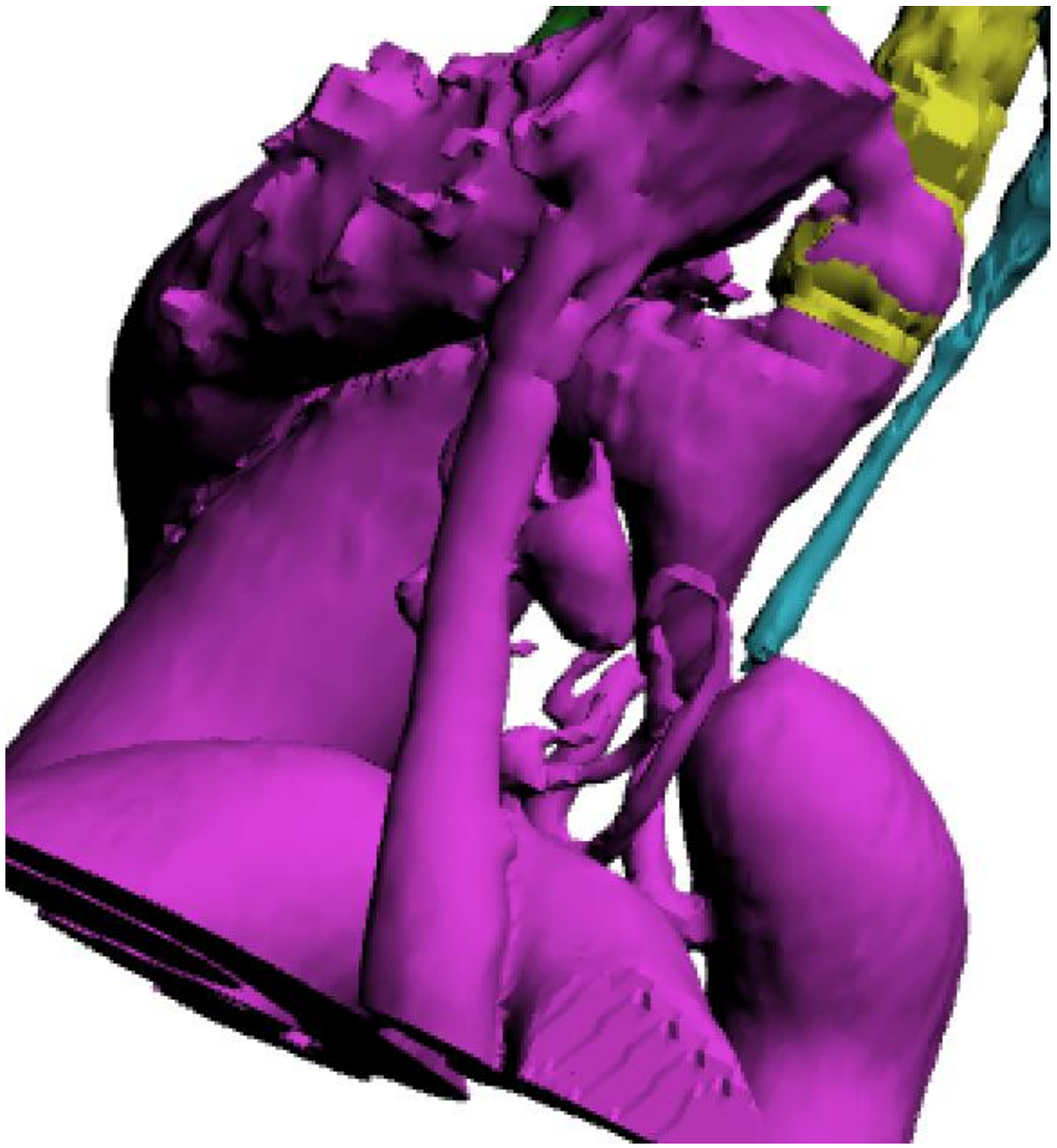
C.D., female, 23 y.
Coarctation

- Reduced exercise tolerance during the last 2 years
- Recent diagnosis of Aortic Coarctation
- Admitted to another Institution for surgery
- Surgery declined due to “high risk”, taking into account the unusual anatomy (CT scan)

CT scan: tight coarctation
just distal to left carotid (left subclavian hypoplasia)



STL reconstruction (Mimics)



3D model (Materialise)
(Heartflex material)

Planning Catheter Intervention

* Use covered stent to reduce the risk of dissection/rupture in a tight stenosis

* Avoid occlusion of the carotid

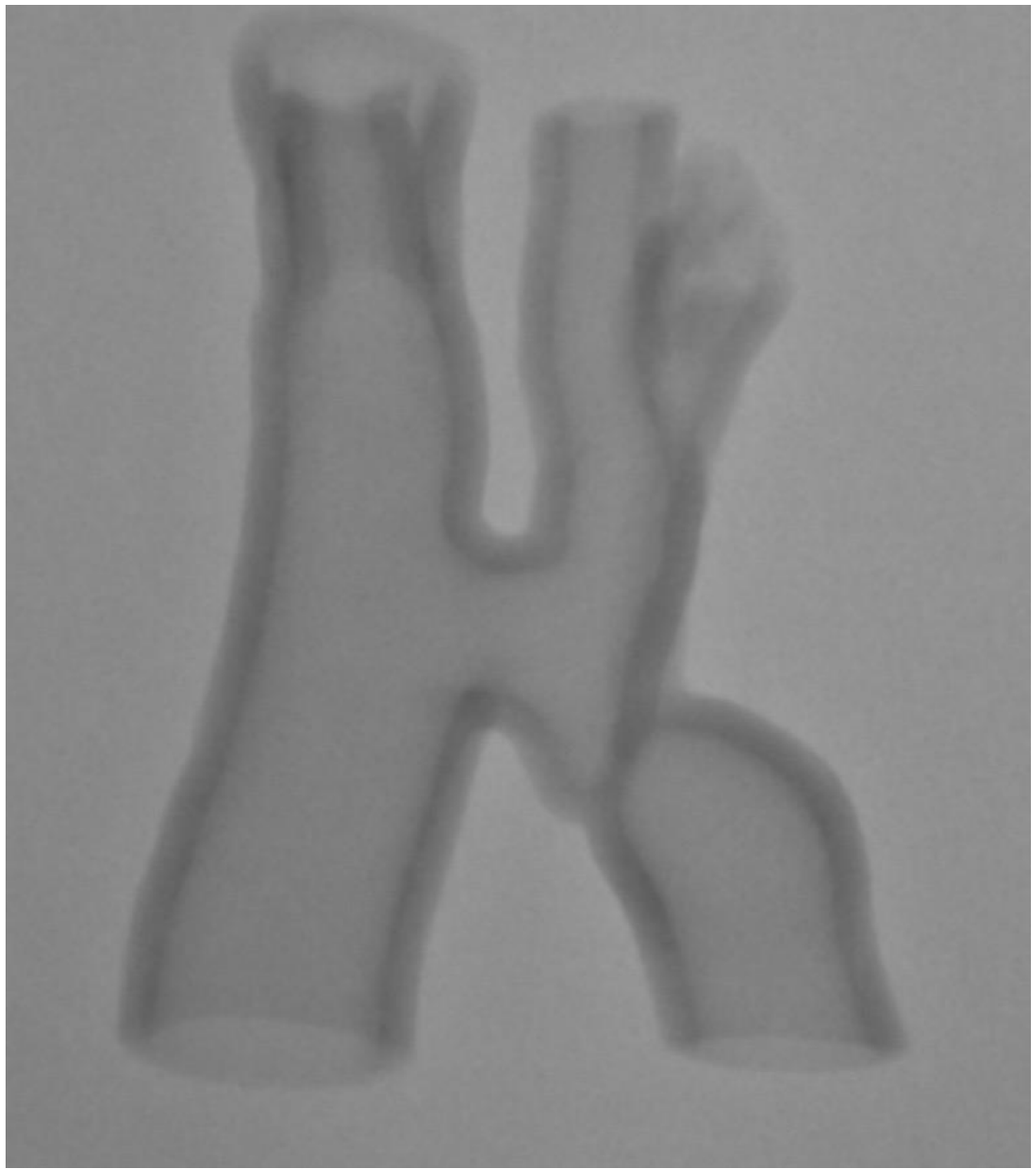
Planning the strategy of the procedure

Single covered stent
(39 mm CP)
mounted on 2 balloons
(BALT 10x40 mm)

2 wires into right subclavian and left carotid

3D model

3D model fluoro

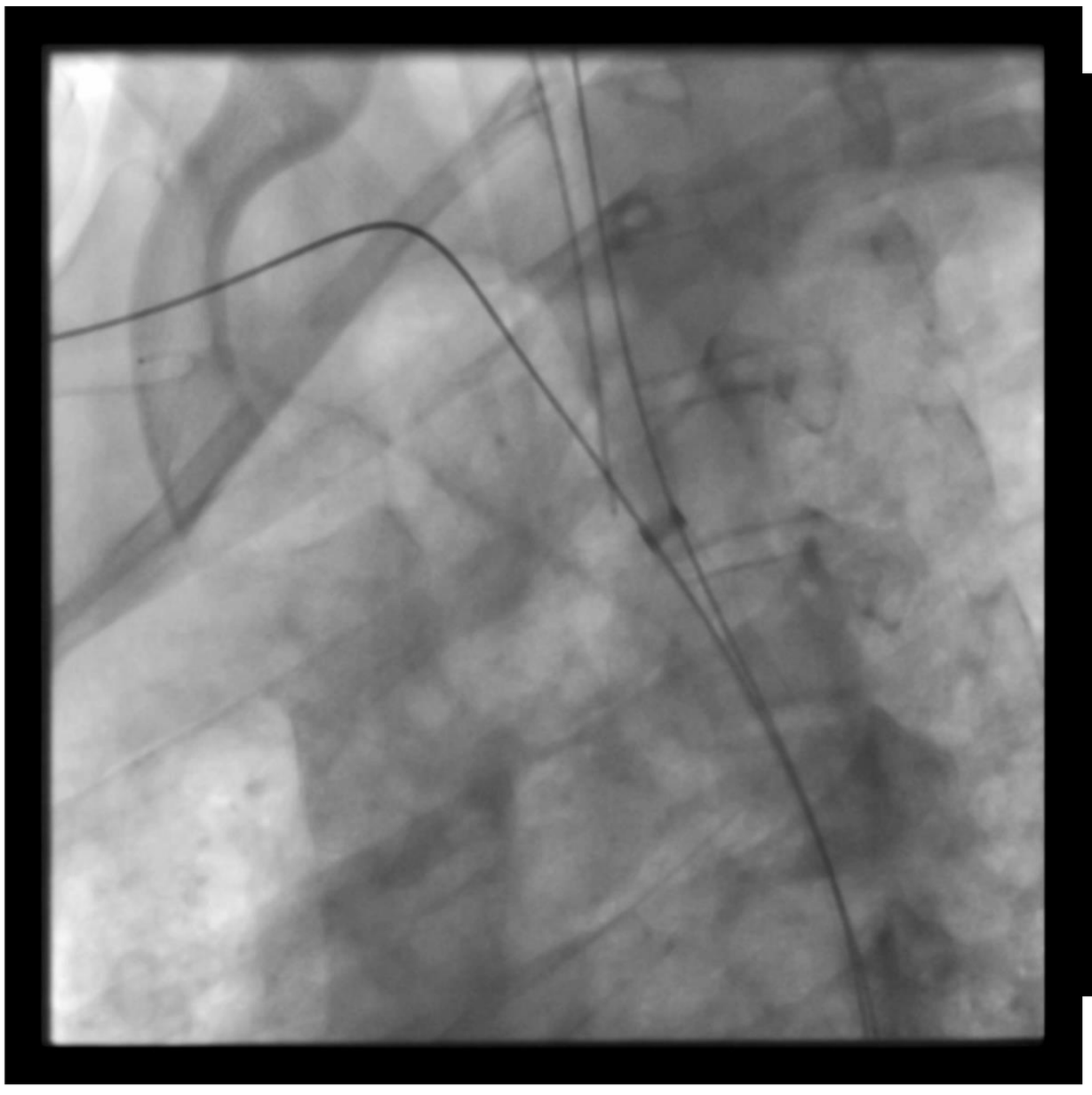


Distal part of stent deployment

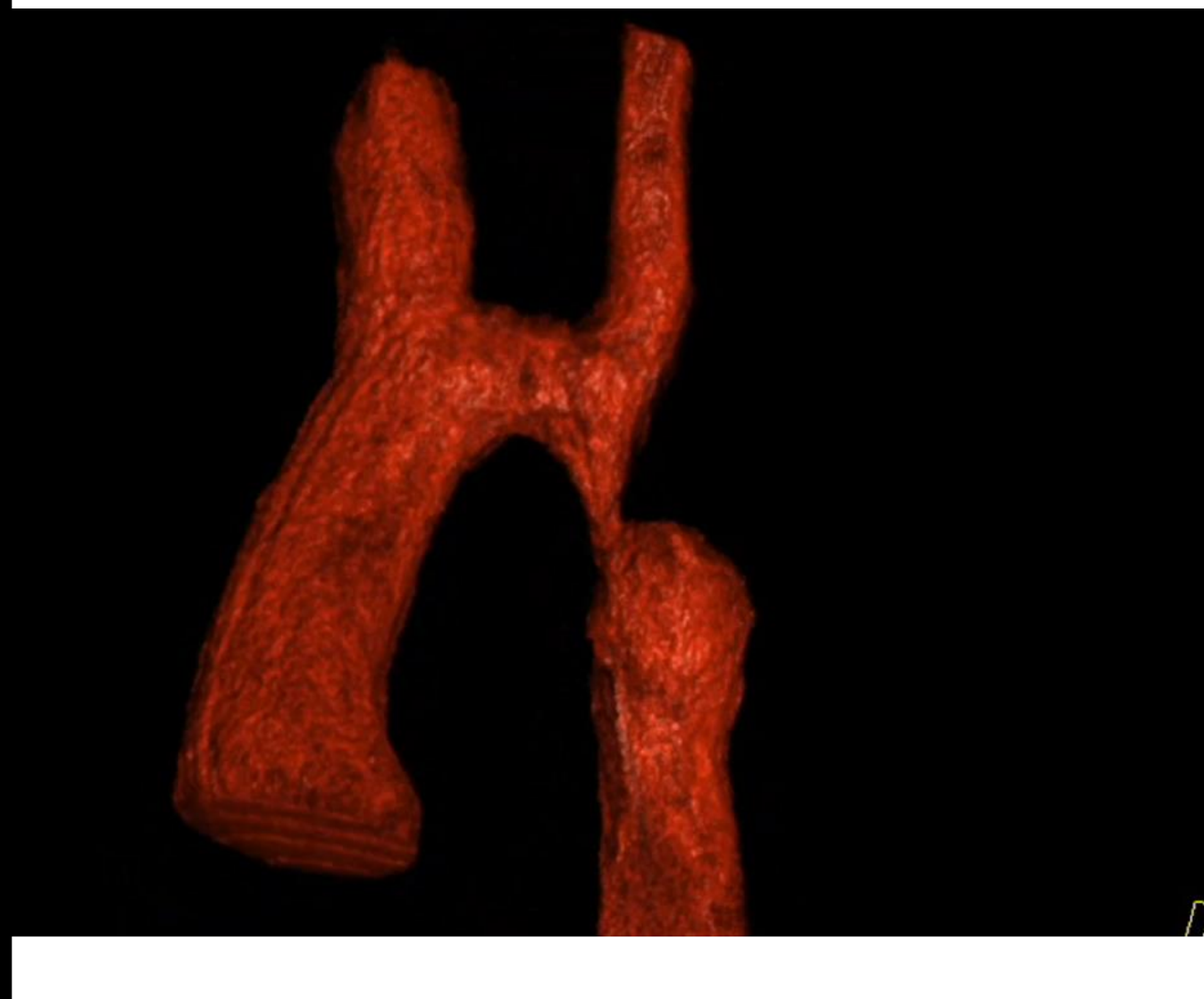
Full stent deployment

Hemodynamics: 60 mmHg gradient

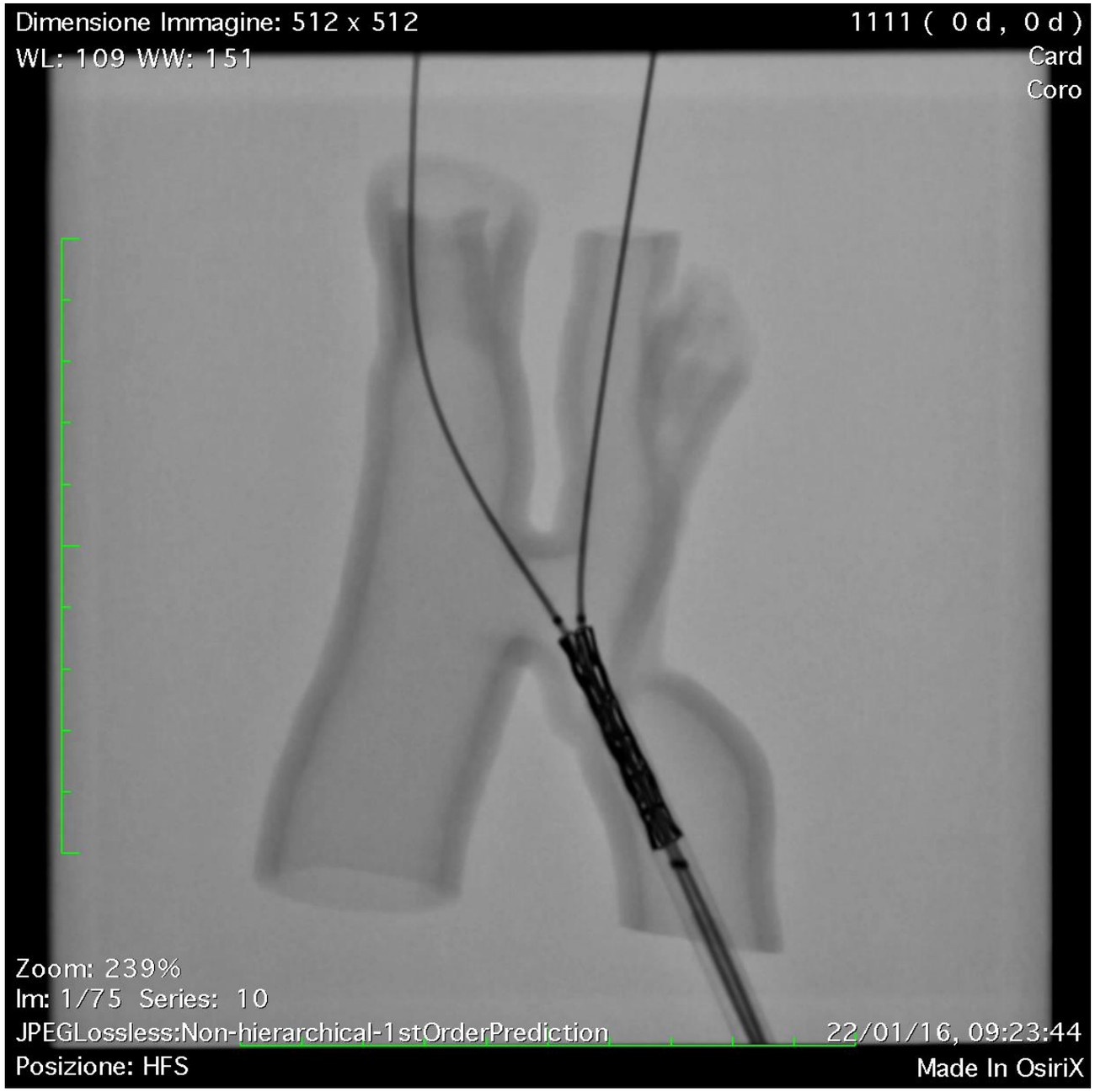
Conventional angio



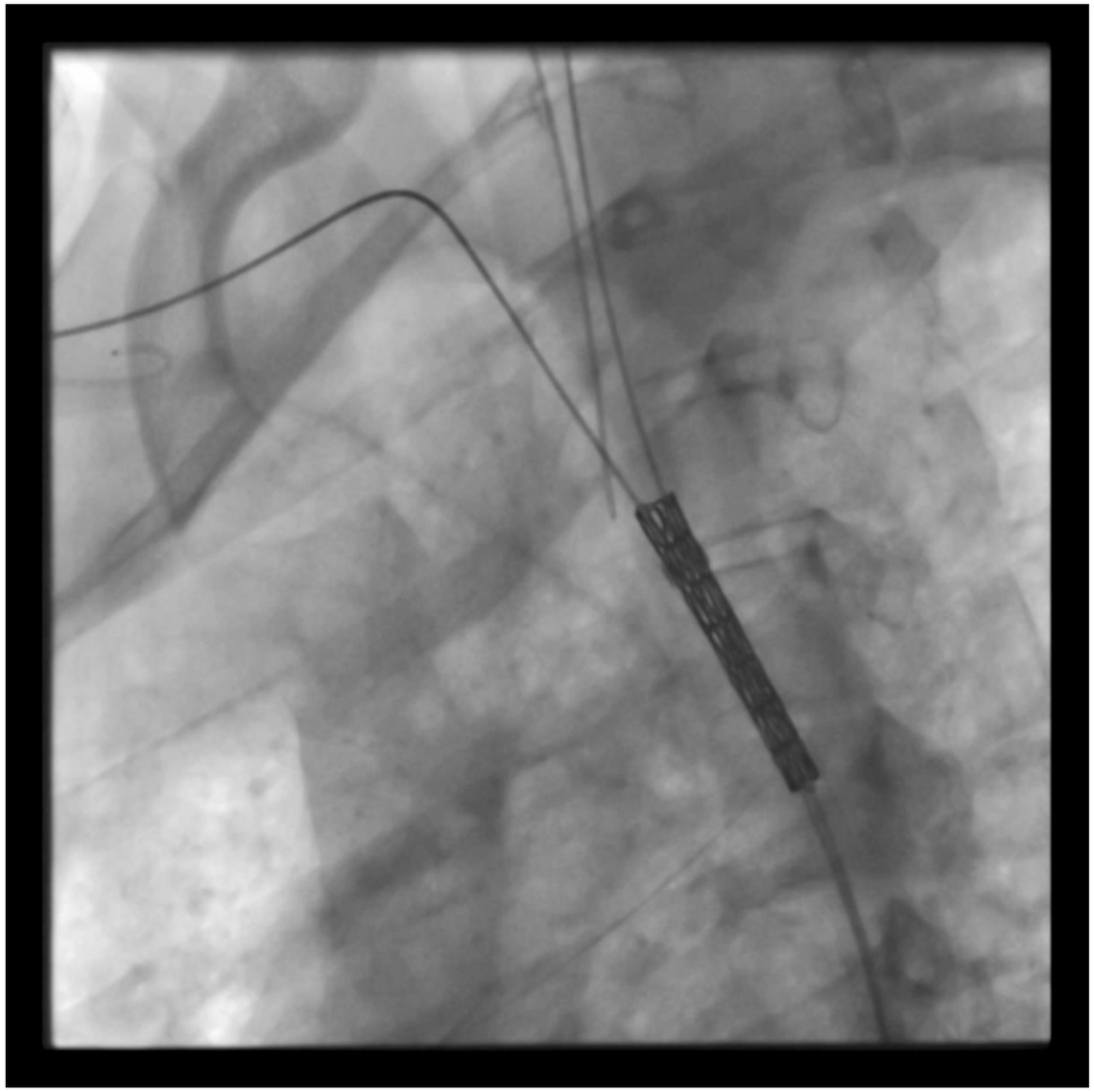
3DR angio



3D model simulation

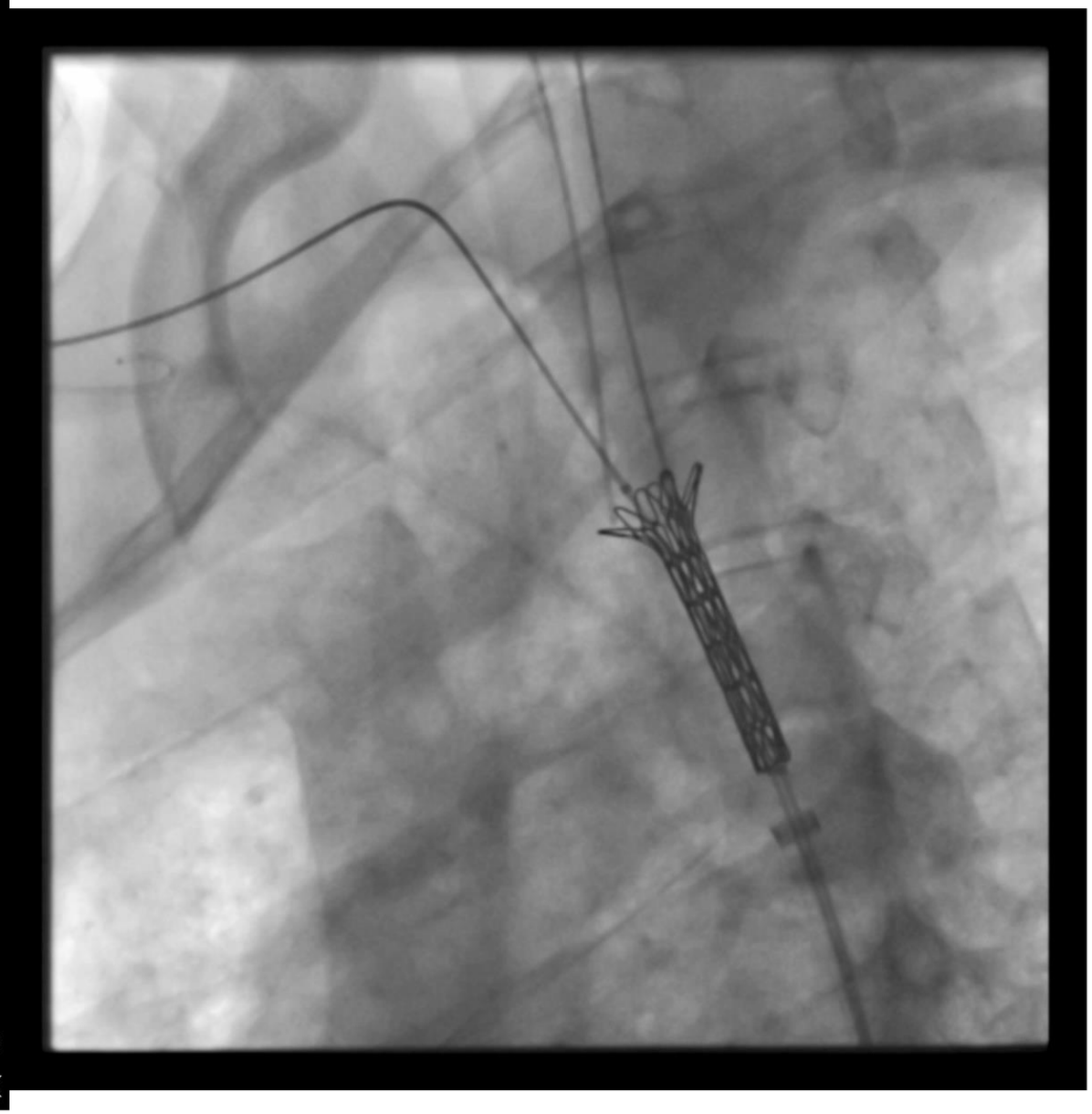


Patient procedure

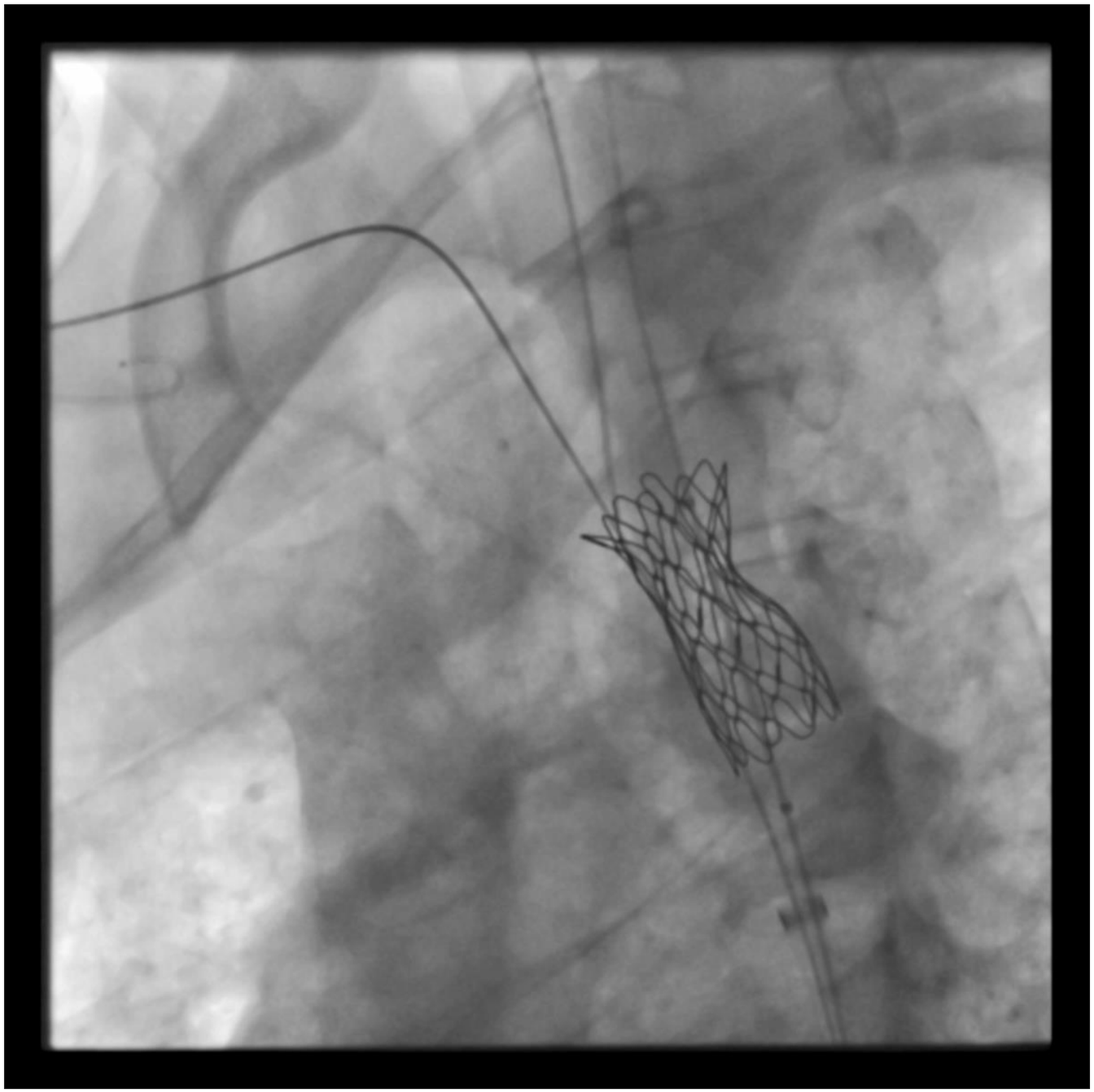


3D model simulation

Patient procedure

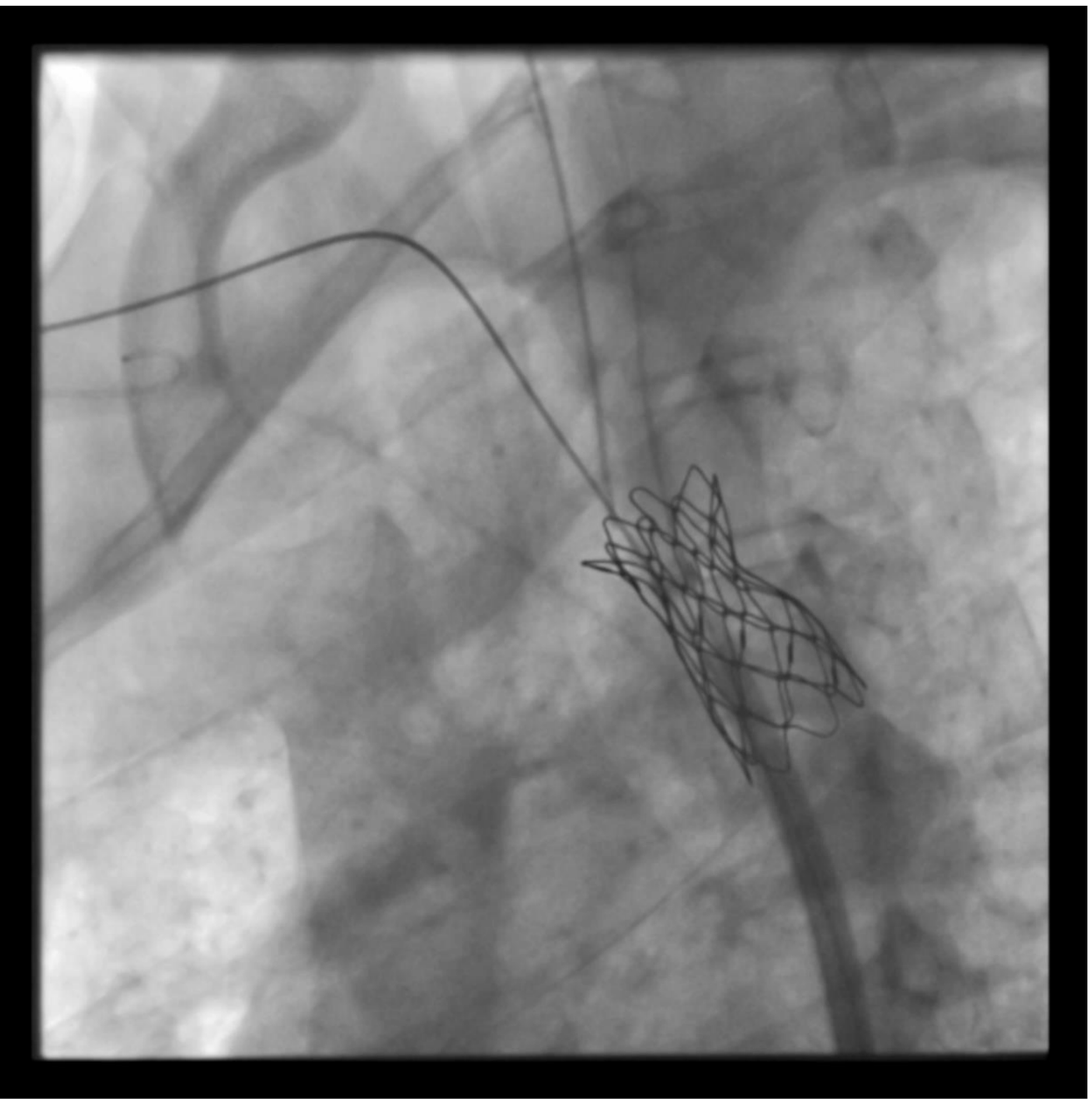


Distal part of stent over dilation (BALT 18x40 mm)

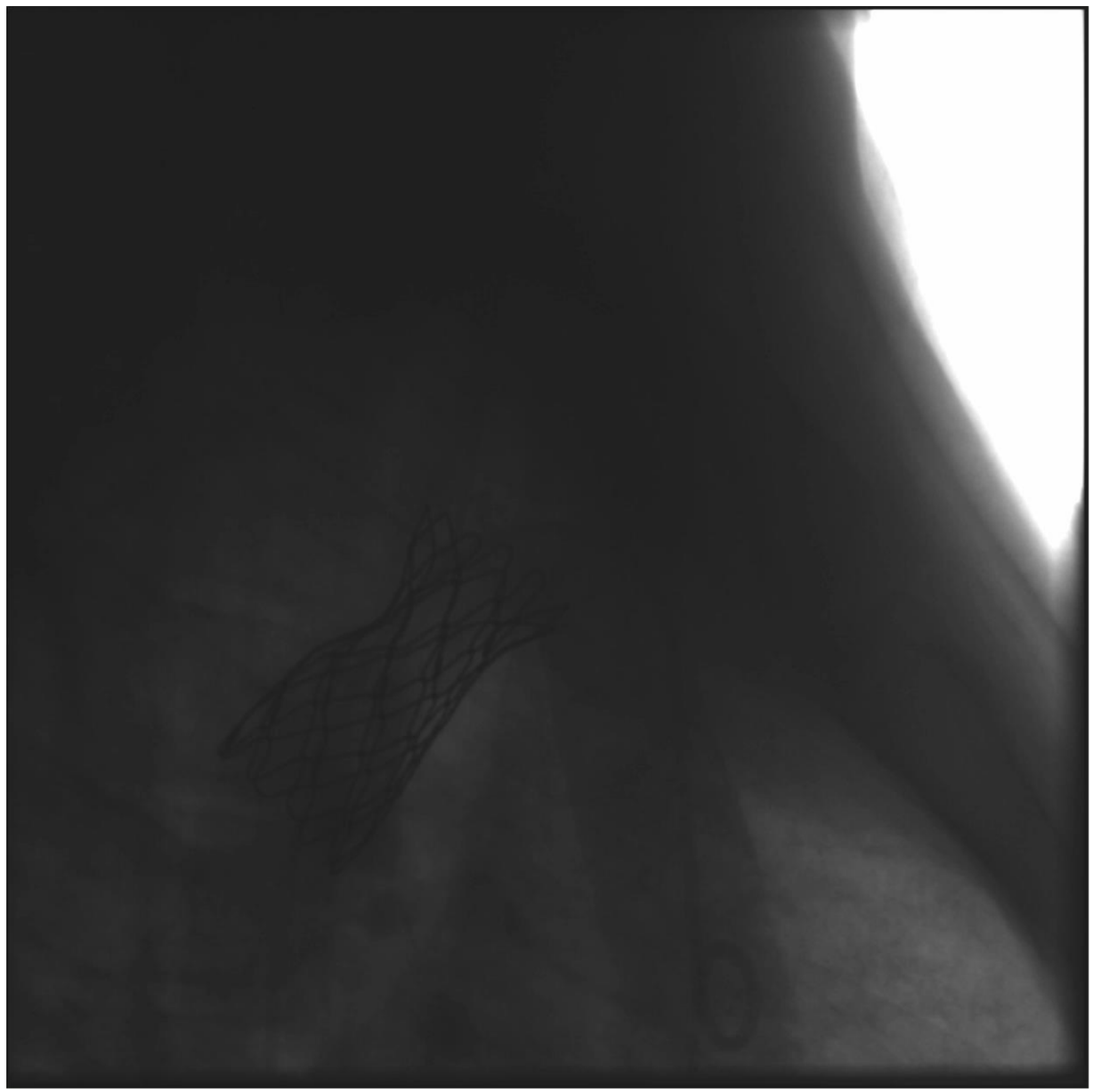


Final result: no residual gradient

Conventional angio



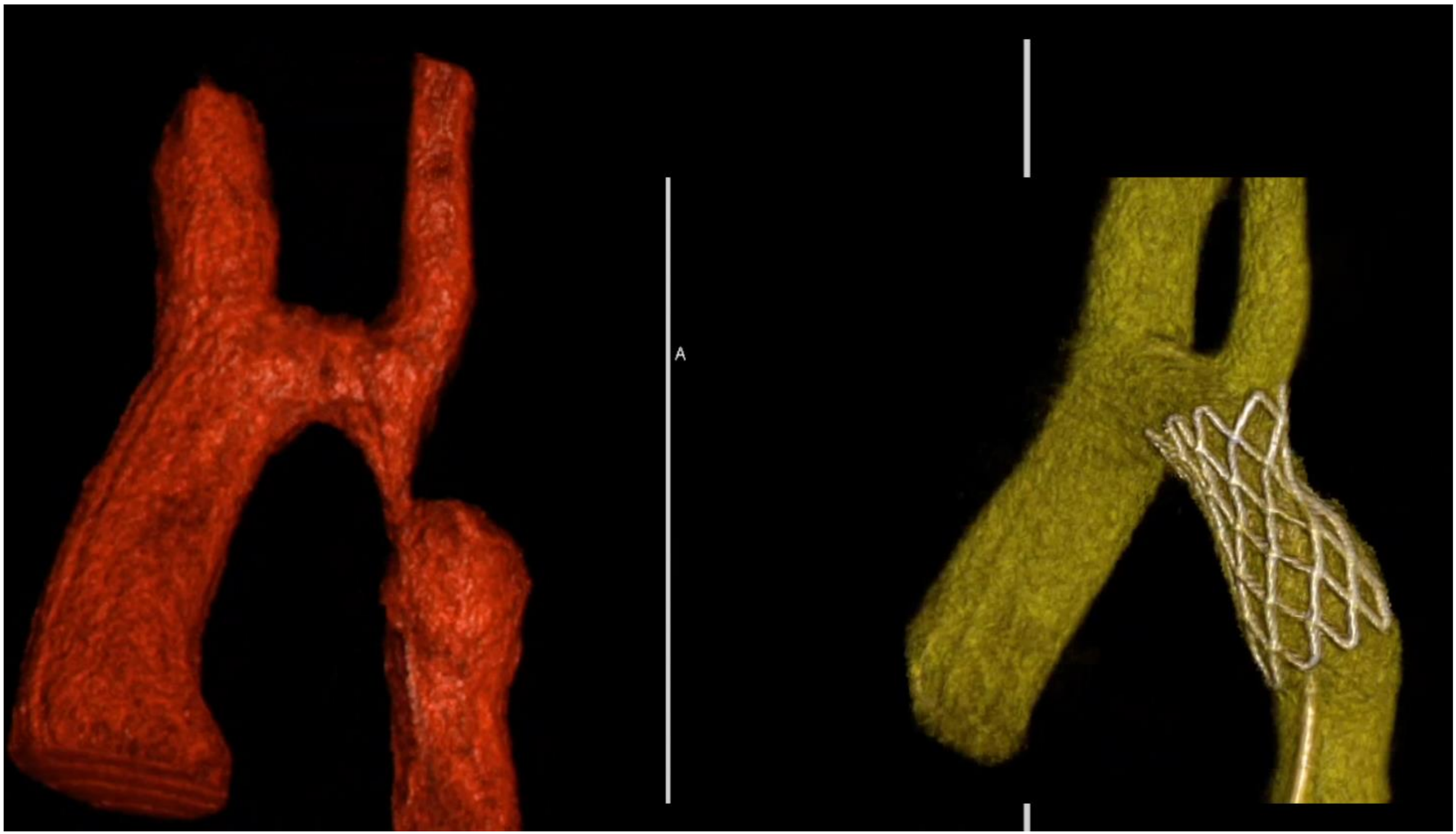
3DR angio



PRE-

POST-

Final result



Conclusions

- Simulation on 3D model proved to be extremely helpful for planning surgical and transcatheter intervention in complex aortic surgery

Thank you!