How close are we to routine X-ray free aortic procedures?

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Disclosures

Cook:

Proctoring, Speaker’s fees, Grant support, Consulting

Cydar Medical:

Advisory board

Philips:

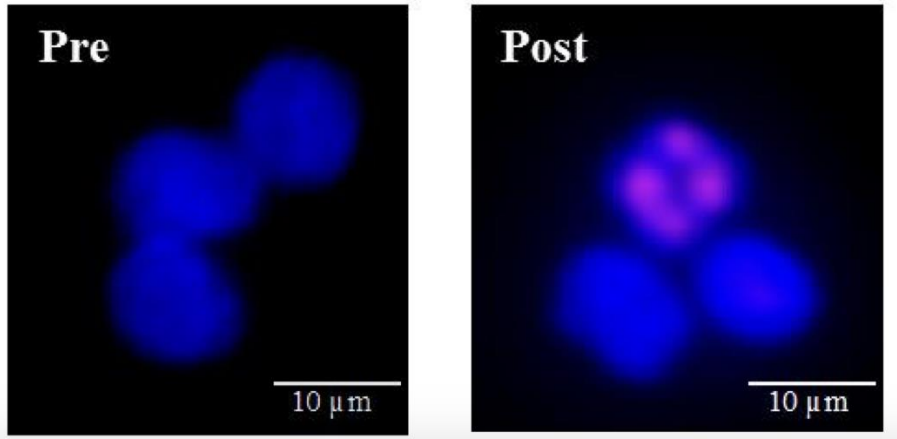
Consulting

Why we need X-ray free aortic procedures: Operators

ORIGINAL RESEARCH ARTICLE

Radiation-Induced DNA Damage in Operators Performing Endovascular Aortic Repair

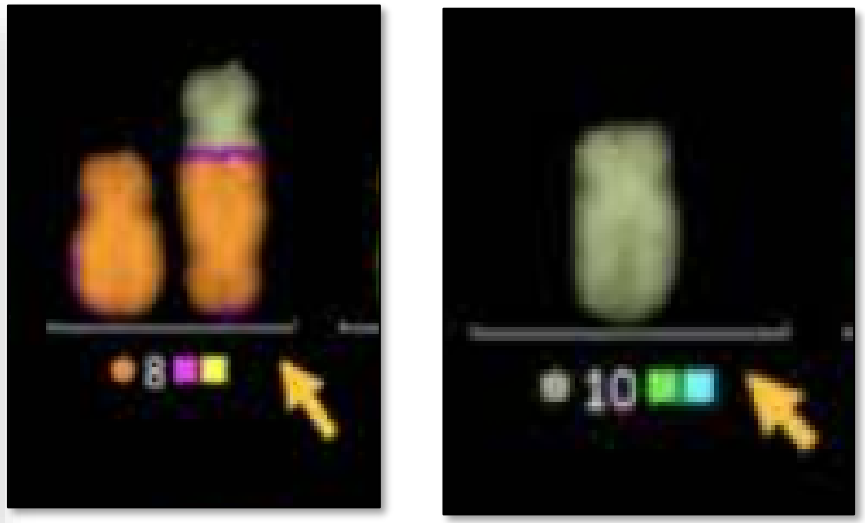
El-Sayed T (Modarai B) et al. Circulation 2017



RESEARCH LETTER

Higher Incidence of Chromosomal Aberrations in Operators Performing a Large Volume of Endovascular Procedures

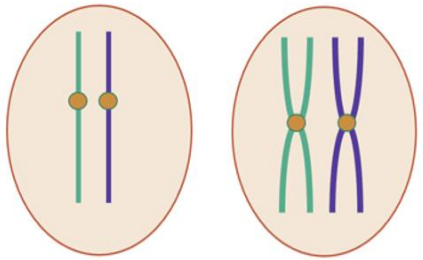
Abdelhalim M (Modarai B) et al. Circulation 2022



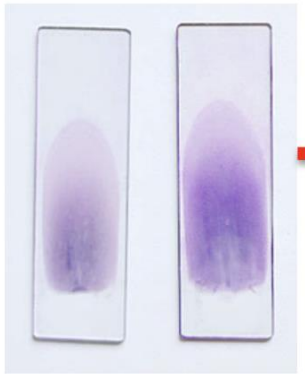
Why we need X-ray free aortic procedures: Patients

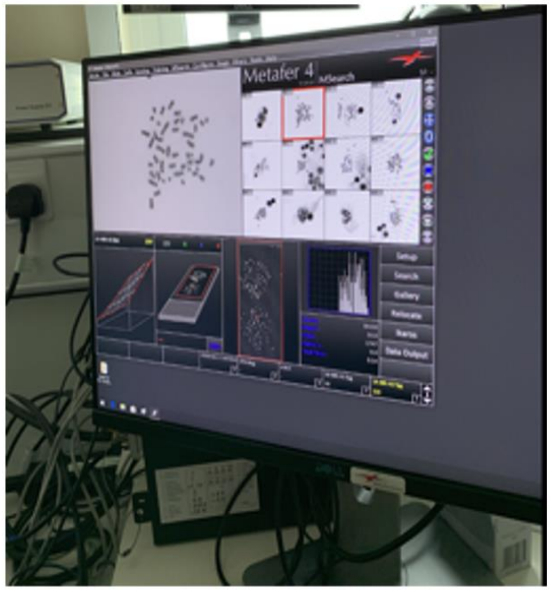
Lymphocytes isolated from peripheral blood

Stimulation of mitosis and arrest at metaphase

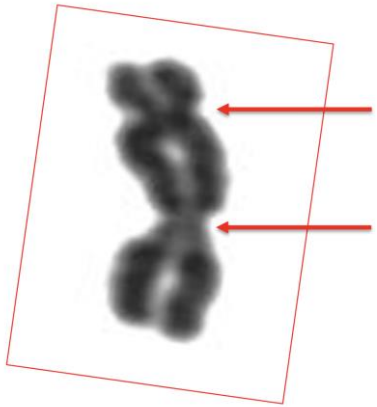


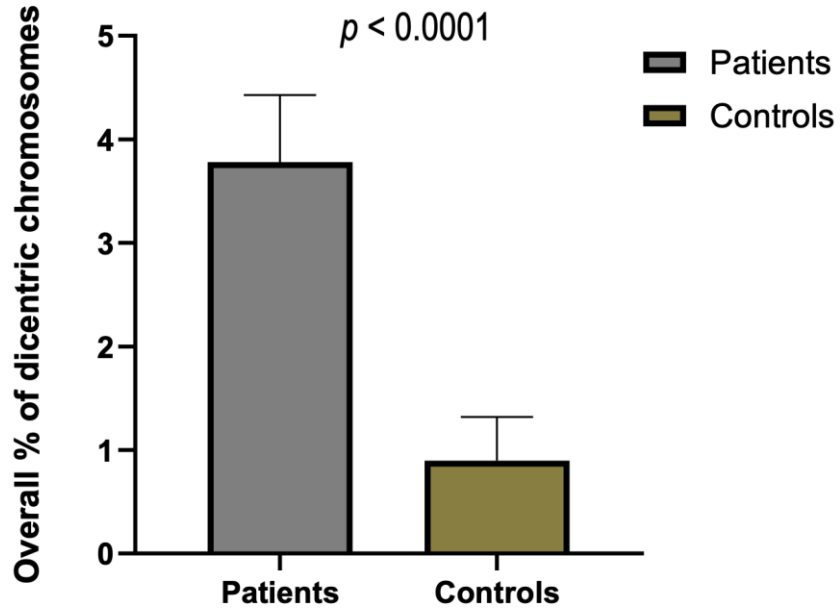
Resting state *Metaphase*





DICENTRIC CHROMOSOME





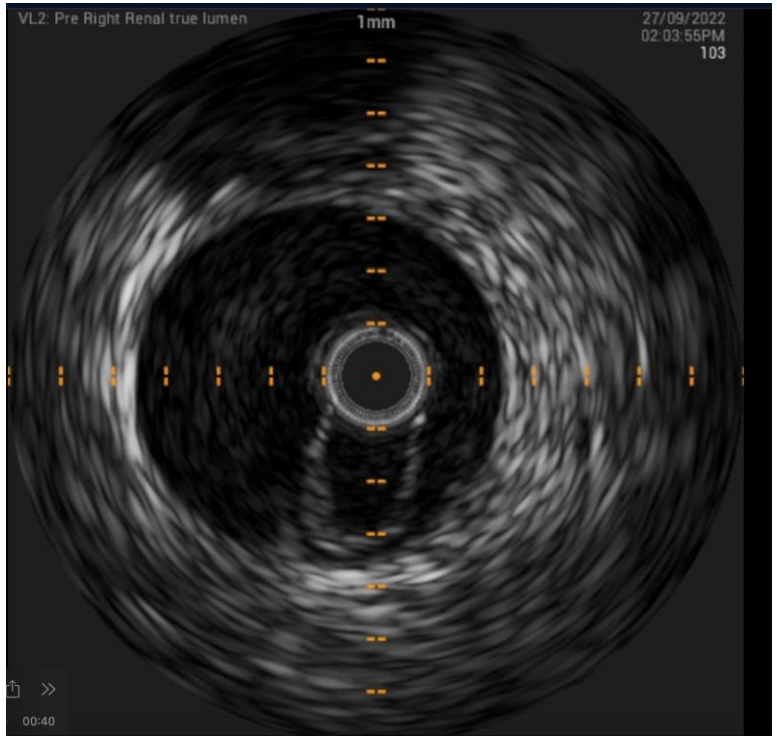
X-ray use reduction

Hardware

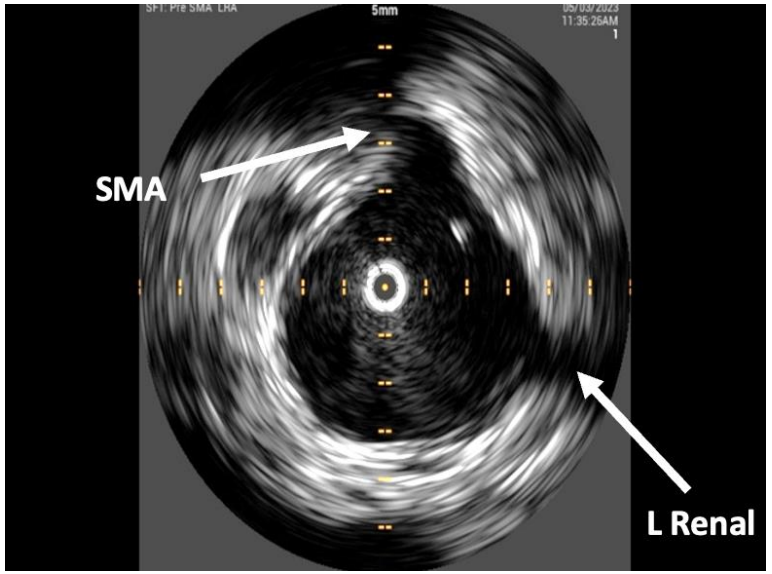
Software

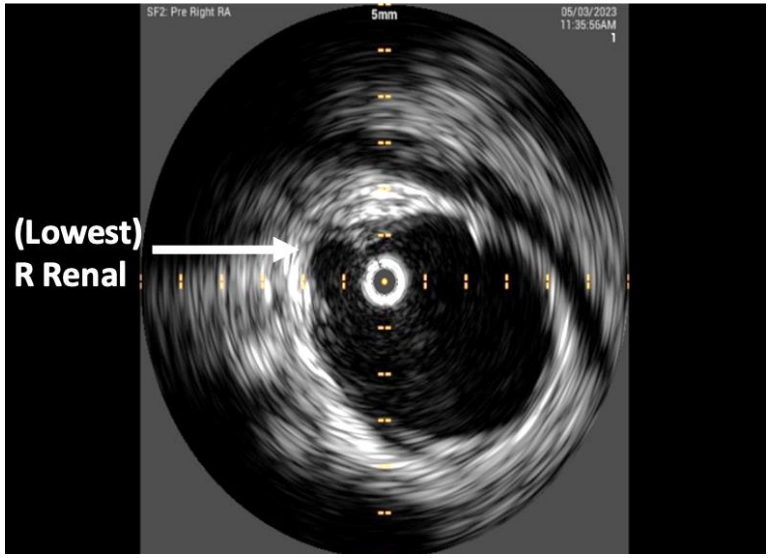
Image Fusion

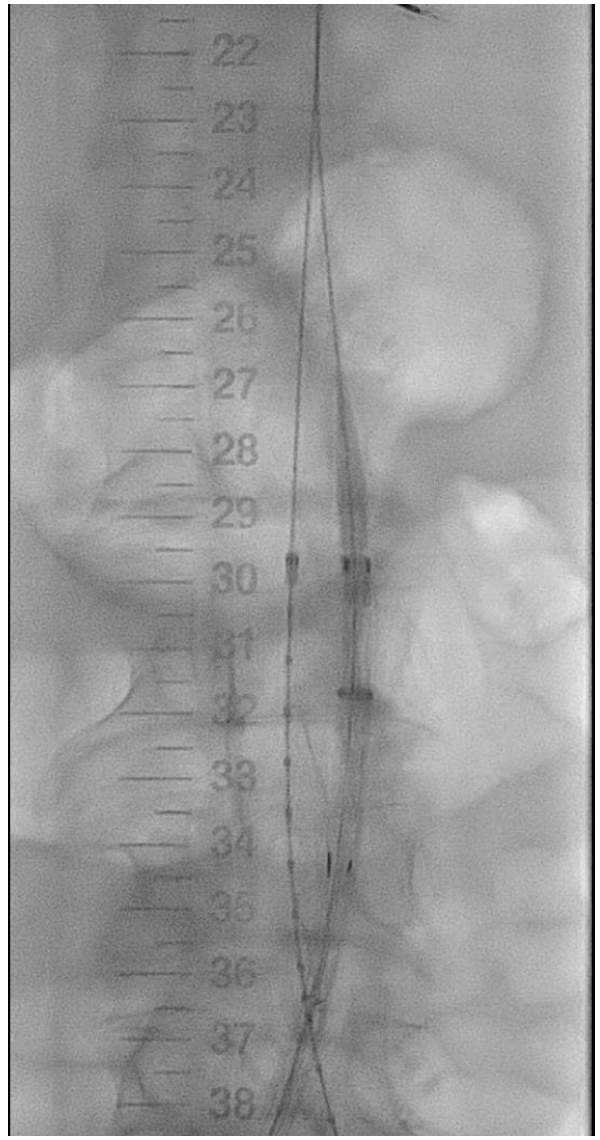
IVUS



IVUS guided ruptured infra-renal AAA repair



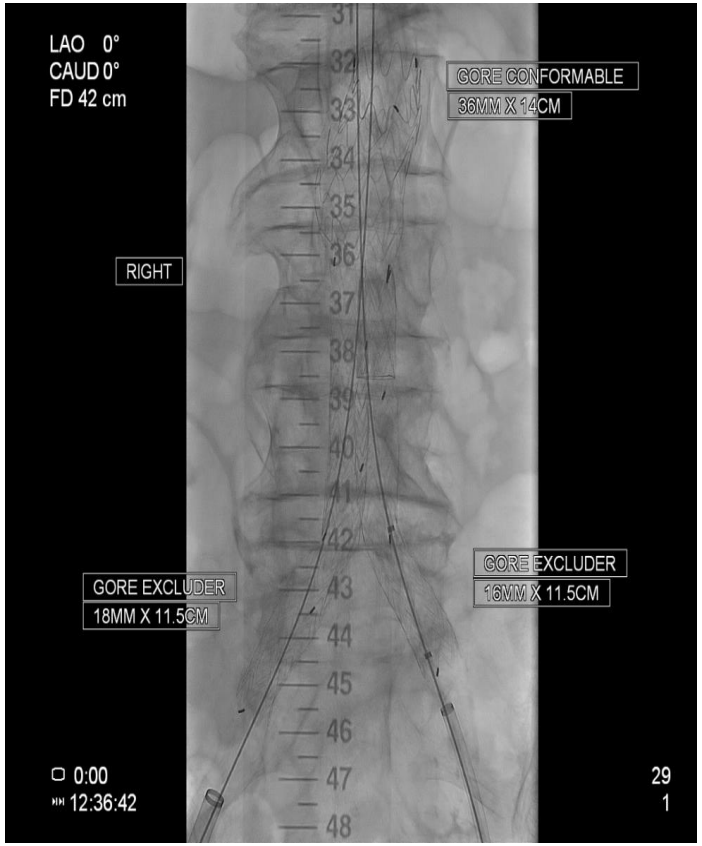




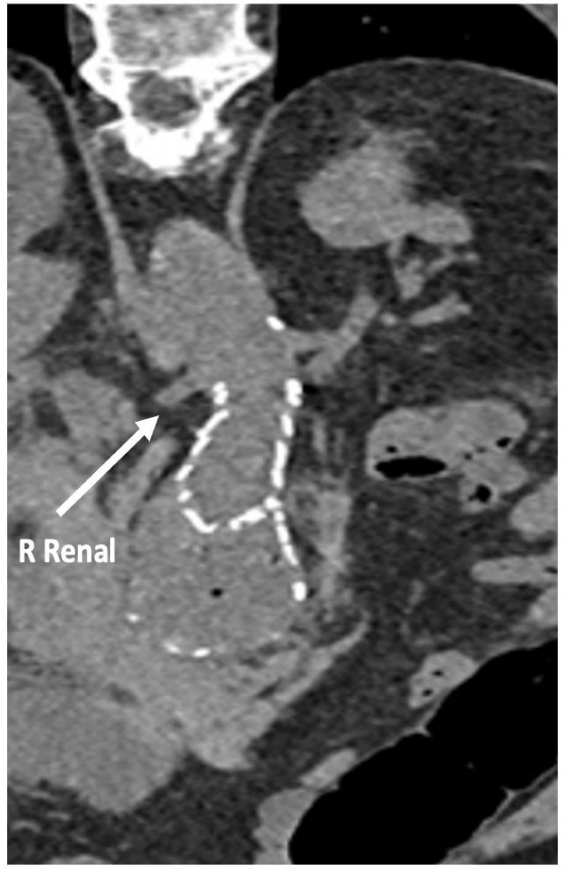
Courtesy of Ashish Patel

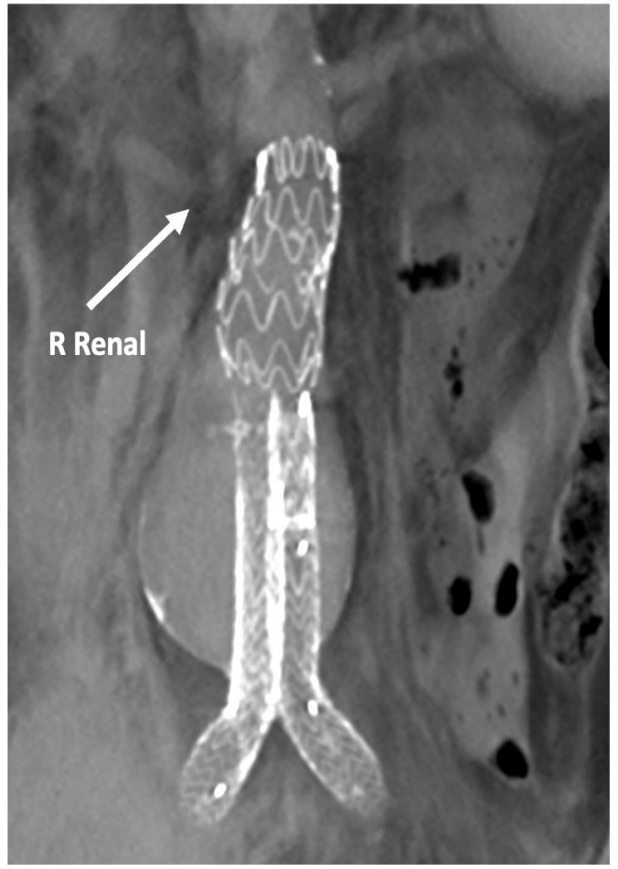
IVUS guided ruptured infra-renal AAA repair

IVUS confirmed limb cannulation



Deployed graft





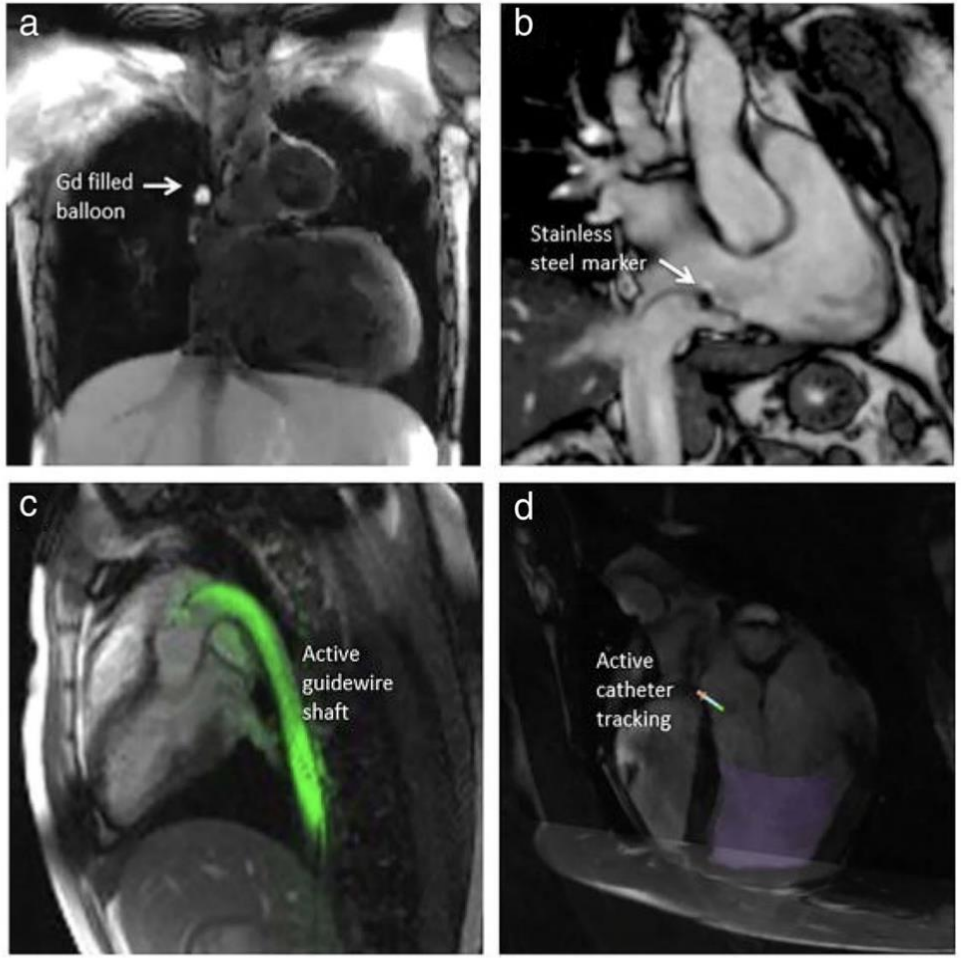
Post-implant CT

Courtesy of Ashish Patel

MRI guided endovascular arterial intervention

Passive Visualization

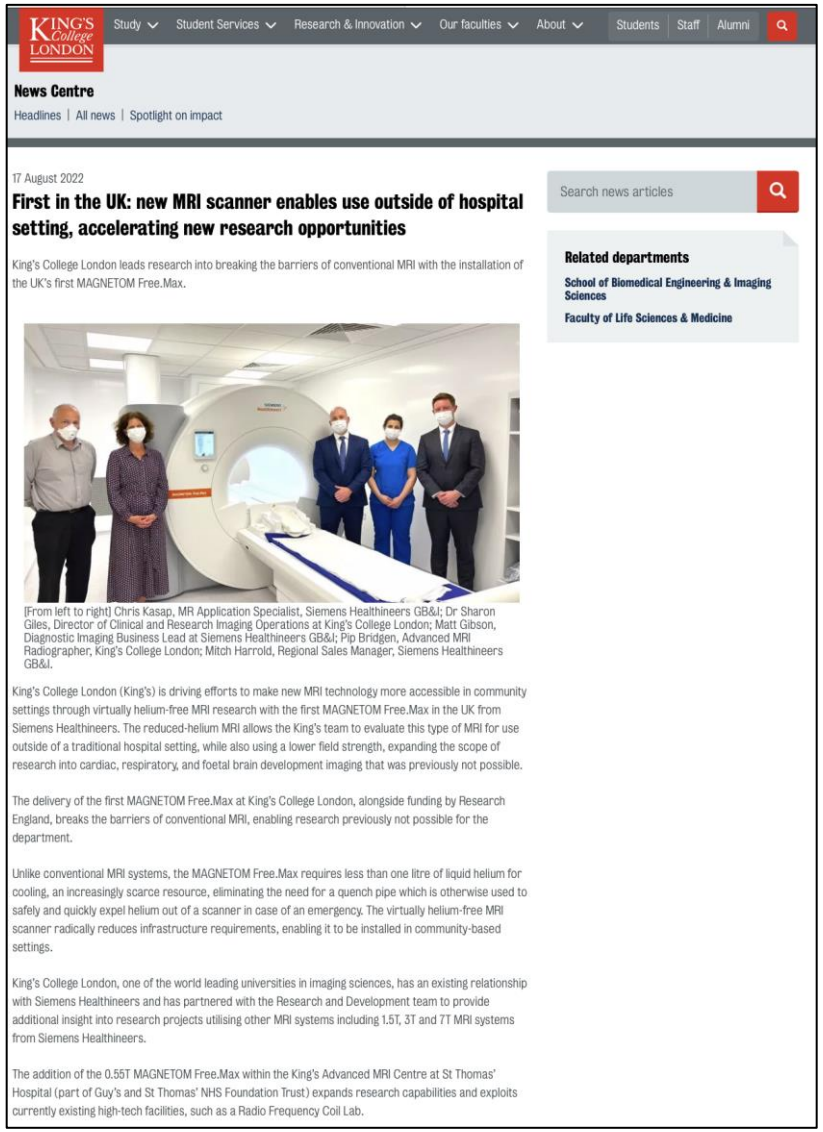
Active Visualization



- No x-ray/radiation exposure
- Intrinsic blood-tissue contrast
- 3D and functional imaging
- Limited applications currently

Nijsink et al. J Magn Reson Imaging 2022

0.55T low field wide-bore MR



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17 August 2022

First in the UK: new MRI scanner enables use outside of hospital setting, accelerating new research opportunities

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King's College London leads research into breaking the barriers of conventional MRI with the installation of the UK's first MAGNETOM Free.Max.

King's College London (King's) is driving efforts to make new MRI technology more accessible in community settings through virtually helium-free MRI research with the first MAGNETOM Free.Max in the UK from Siemens Healthineers. The reduced-helium MRI allows the King's team to evaluate this type of MRI for use outside of a traditional hospital setting, while also using a lower field strength, expanding the scope of research into cardiac, respiratory, and foetal brain development imaging that was previously not possible.

The delivery of the first MAGNETOM Free.Max at King's College London, alongside funding by Research England, breaks the barriers of conventional MRI, enabling research previously not possible for the department.

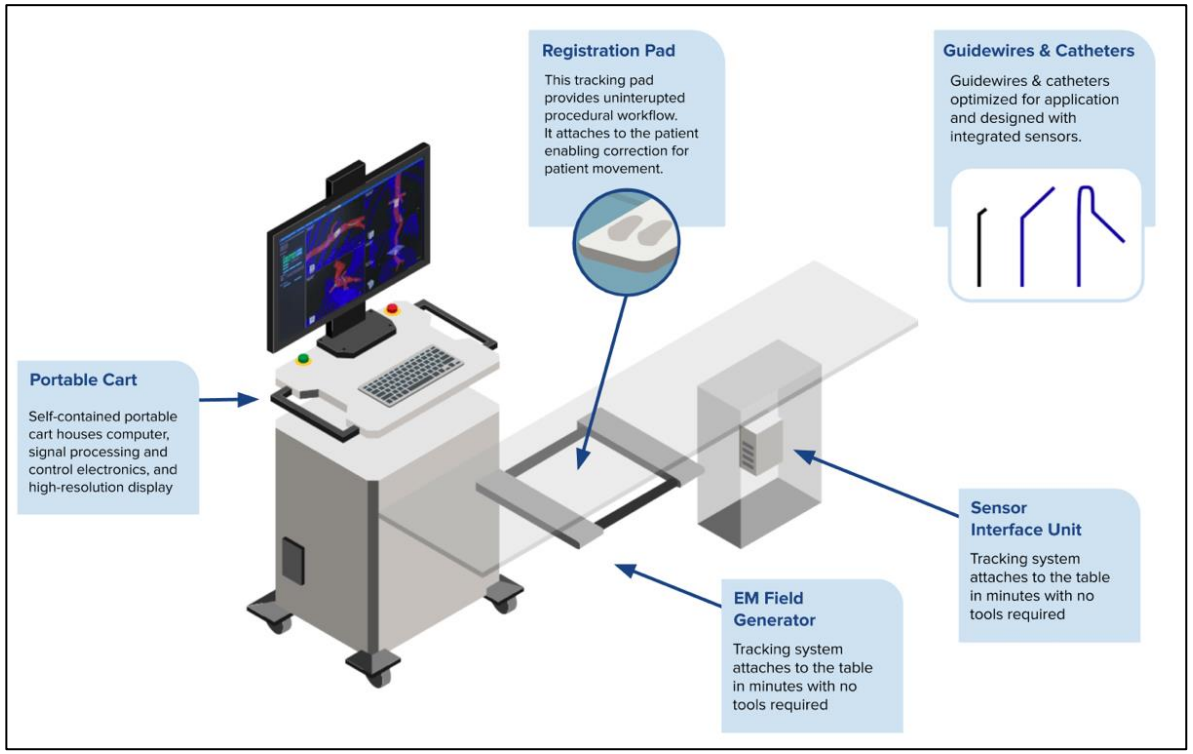
Unlike conventional MRI systems, the MAGNETOM Free.Max requires less than one litre of liquid helium for cooling, an increasingly scarce resource, eliminating the need for a quench pipe which is otherwise used to safely and quickly expel helium out of a scanner in case of an emergency. The virtually helium-free MRI scanner radically reduces infrastructure requirements, enabling it to be installed in community-based settings.

King's College London, one of the world leading universities in imaging sciences, has an existing relationship with Siemens Healthineers and has partnered with the Research and Development team to provide additional insight into research projects utilising other MRI systems including 1.5T, 3T and 7T MRI systems from Siemens Healthineers.

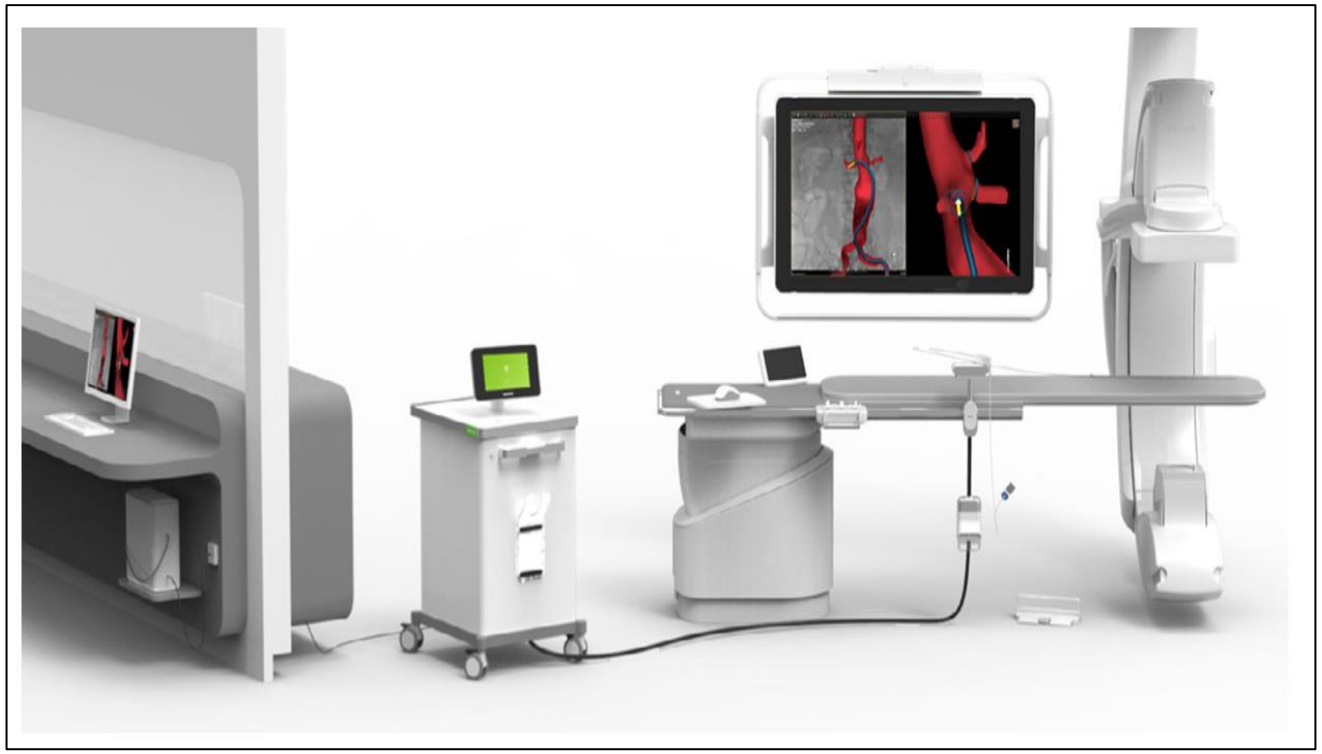
The addition of the 0.55T MAGNETOM Free.Max within the King's Advanced MRI Centre at St Thomas' Hospital (part of Guy's and St Thomas' NHS Foundation Trust) expands research capabilities and exploits currently existing high-tech facilities, such as a Radio Frequency Coil Lab.

- Can be used with implanted devices
- No heavy shielding or helium
- Ease-of-use (AI-guided sequences)
- Wider bore

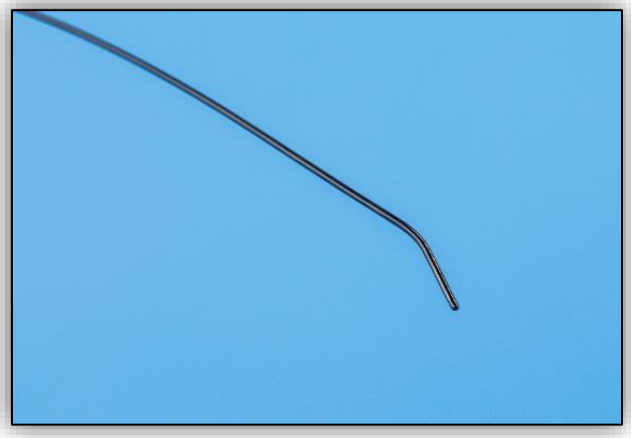
Intra-operative positioning system (IOPS)

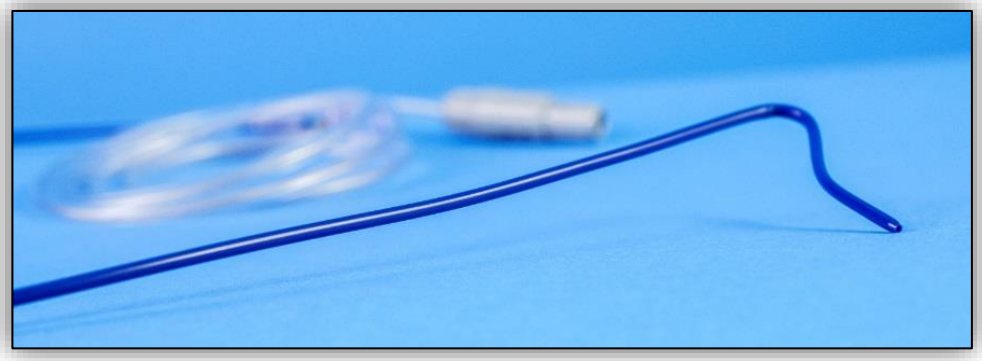


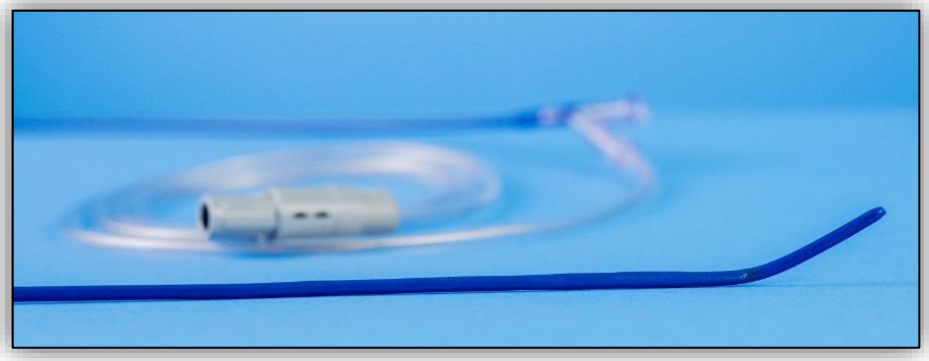
Fiber Optic Realshape (FORS) Technology



Intra-operative positioning system (IOPS)







Centerline Biomedical

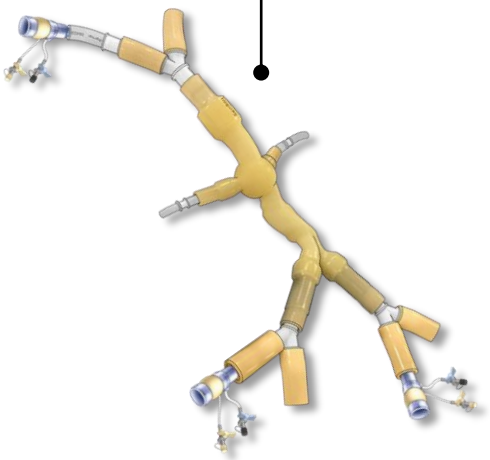
Courtesy of Gustavo Oderich

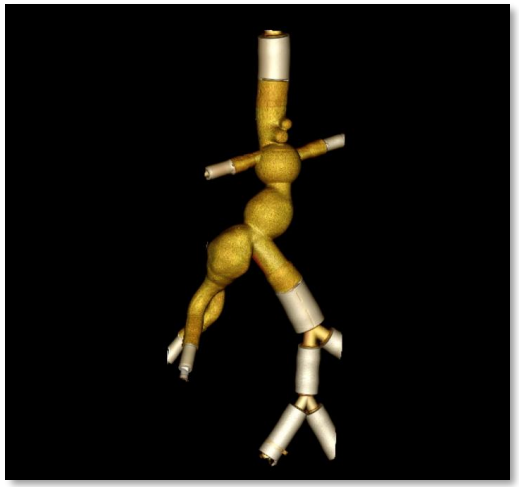
Ex-vivo experiment

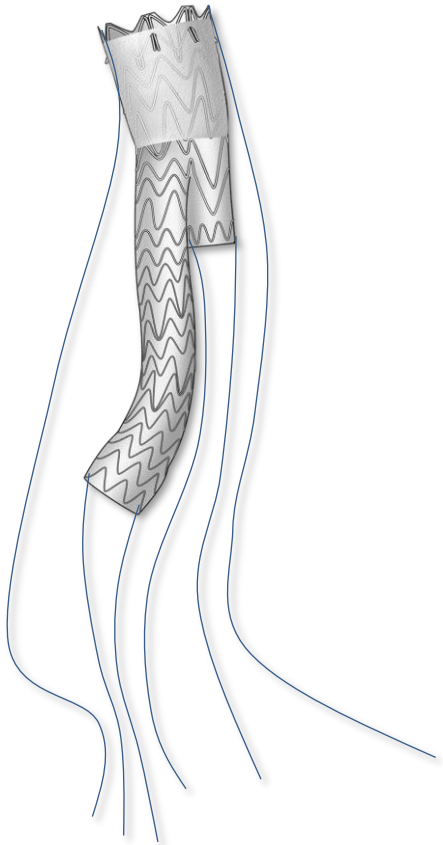
3D Printed Aortic Model

CTA of 3D Aortic Model

IOPS-Endograft Modification







Courtesy of Gustavo Oderich

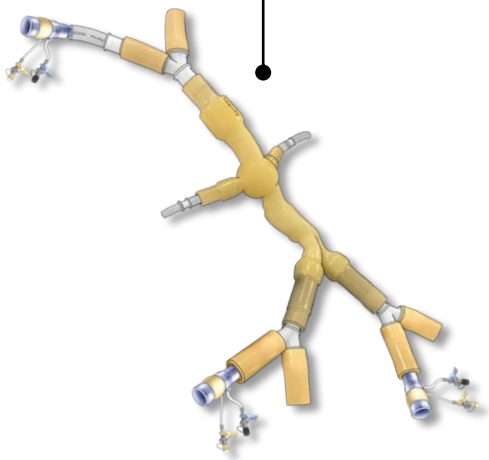
Ex-vivo experiment

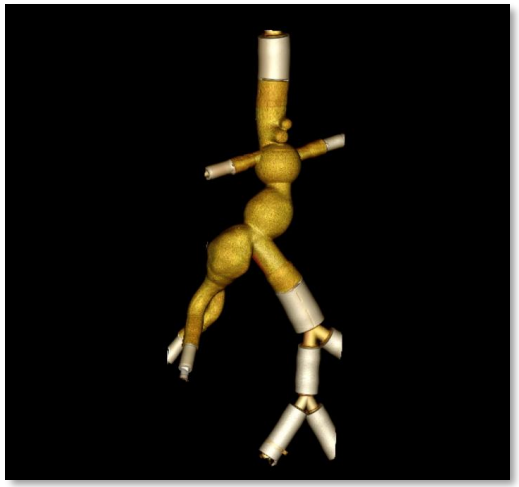
3D Printed Aortic Model

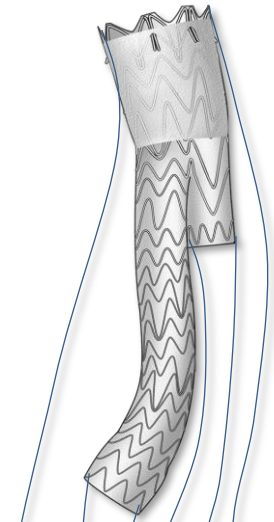
CTA of 3D Aortic Model

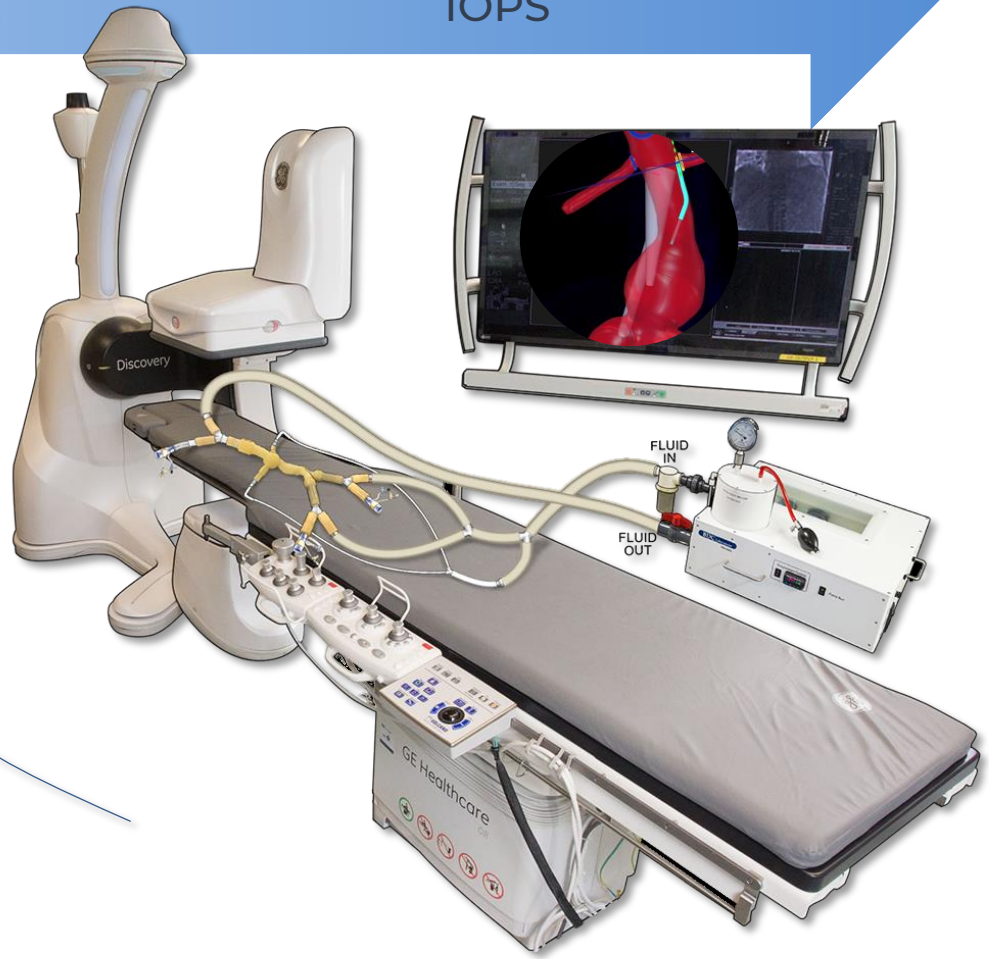
IOPS-Endograft Modification

EVAR guided by IOPS









Courtesy of Gustavo Oderich

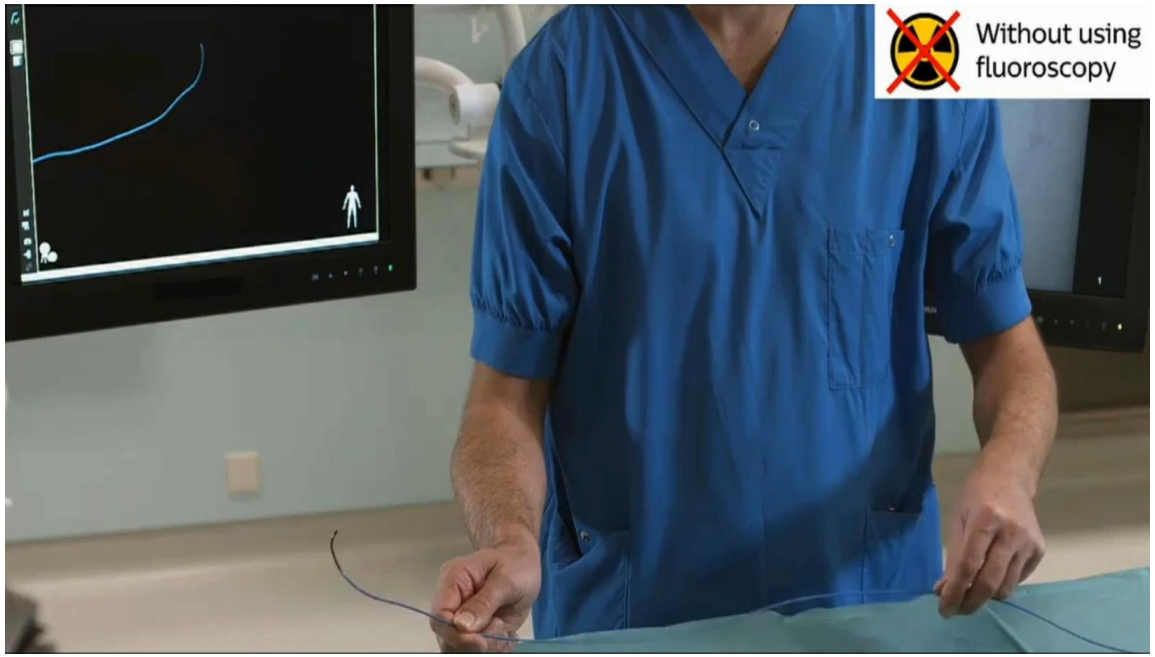
Augmented reality navigation

Courtesy of Gustavo Oderich

Fiber Optic Realshape (FORS) Technology

Wire/catheter visualized using light traveling through optical fibers

- Displays the full shape of devices in 3D
- In real-time and in colour
- Provides dual views on split-screen with independent views (Biplane)
- Radiation sparing

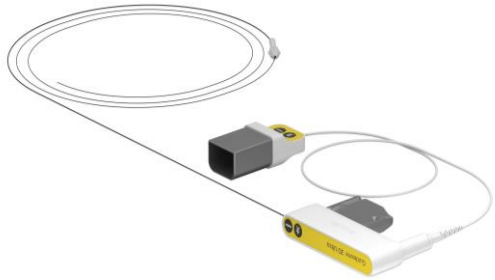


LumiGuide System

CR Workstation

Docking Base

Engine



0.35” 120 cm guidewire

3D Hub

Docking Top

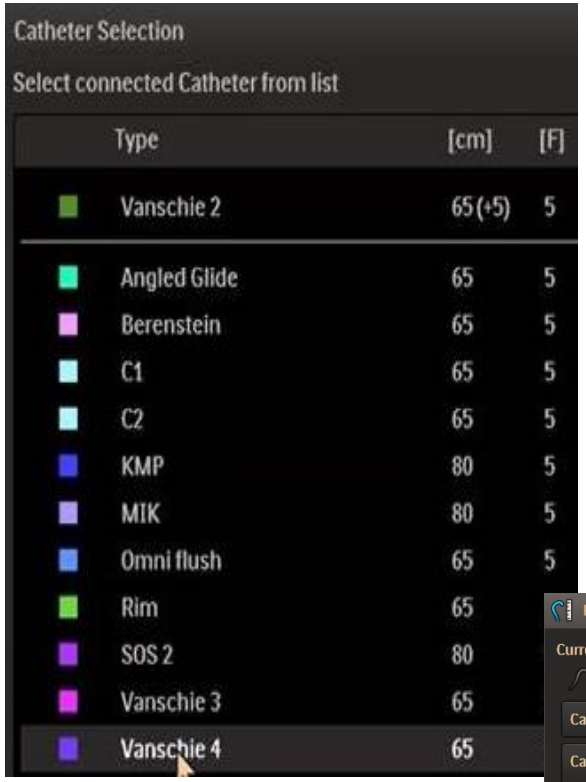
Hardware

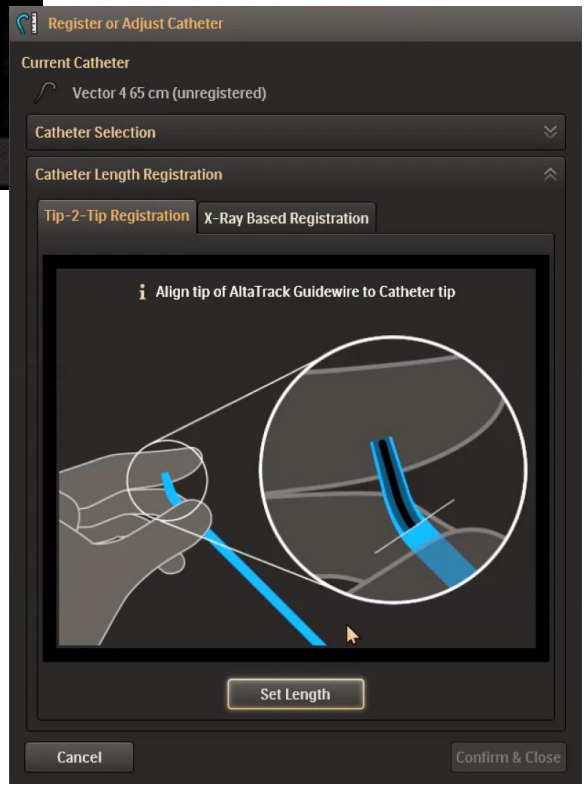
Disposables

Docking Top

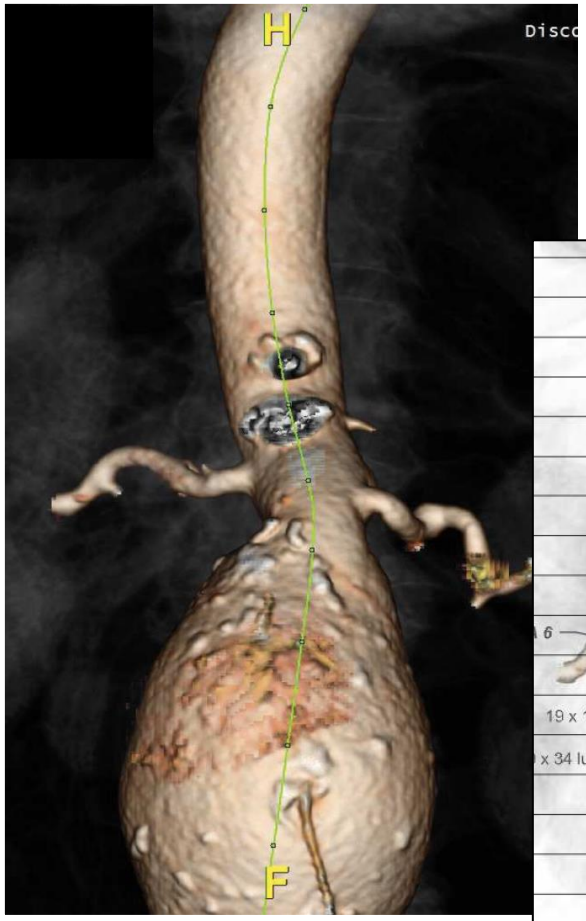
3D Hub

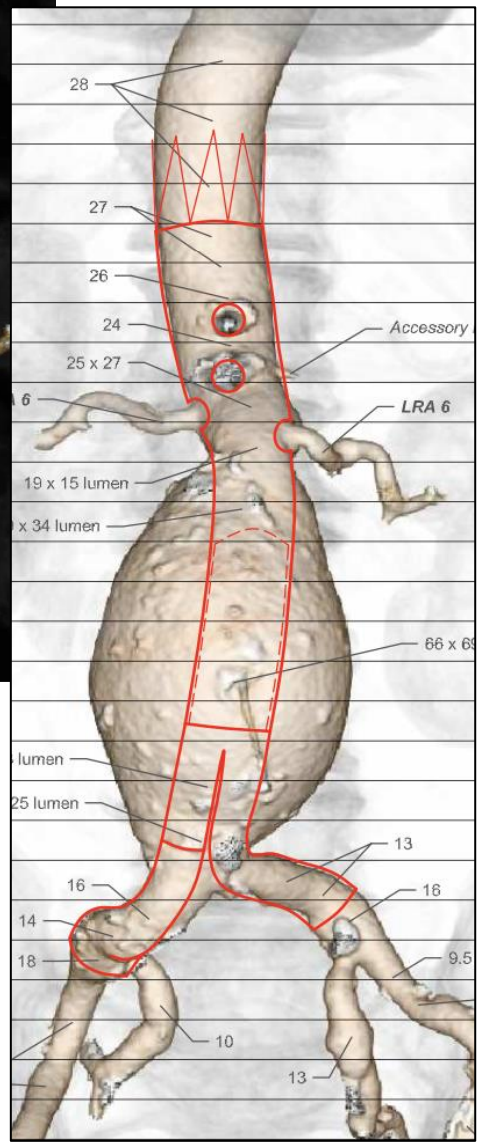
3D Hub: Catheter agnostic guidance



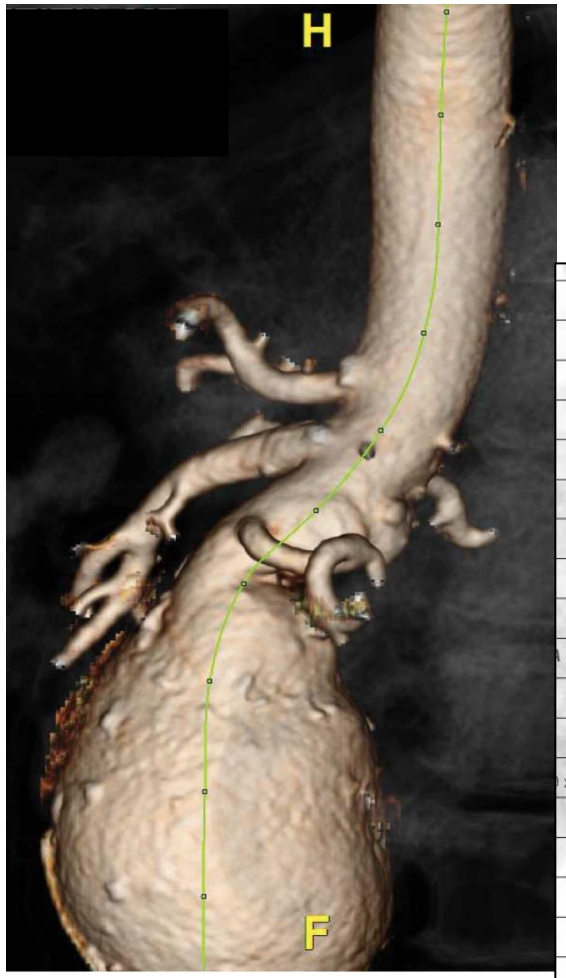


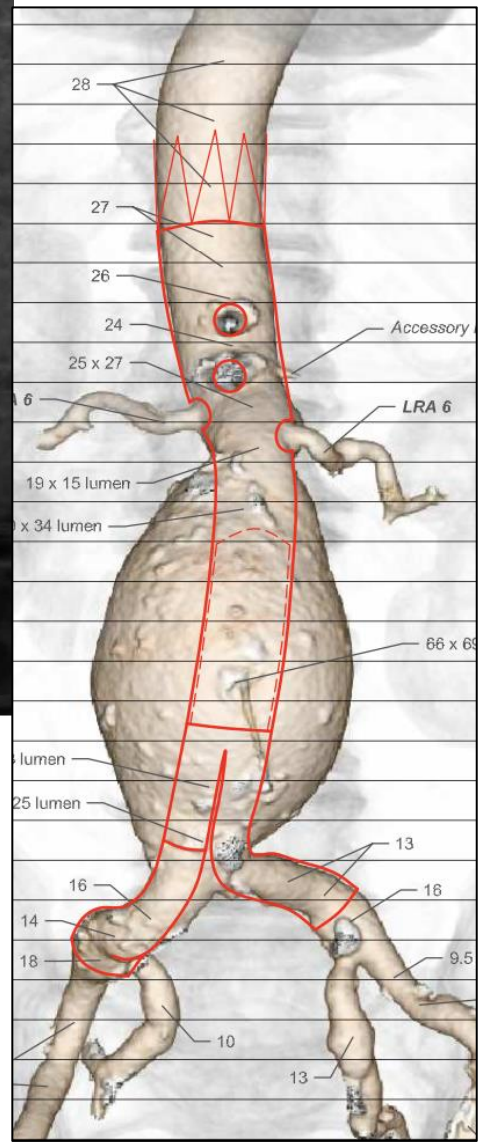
Left renal artery cannulation

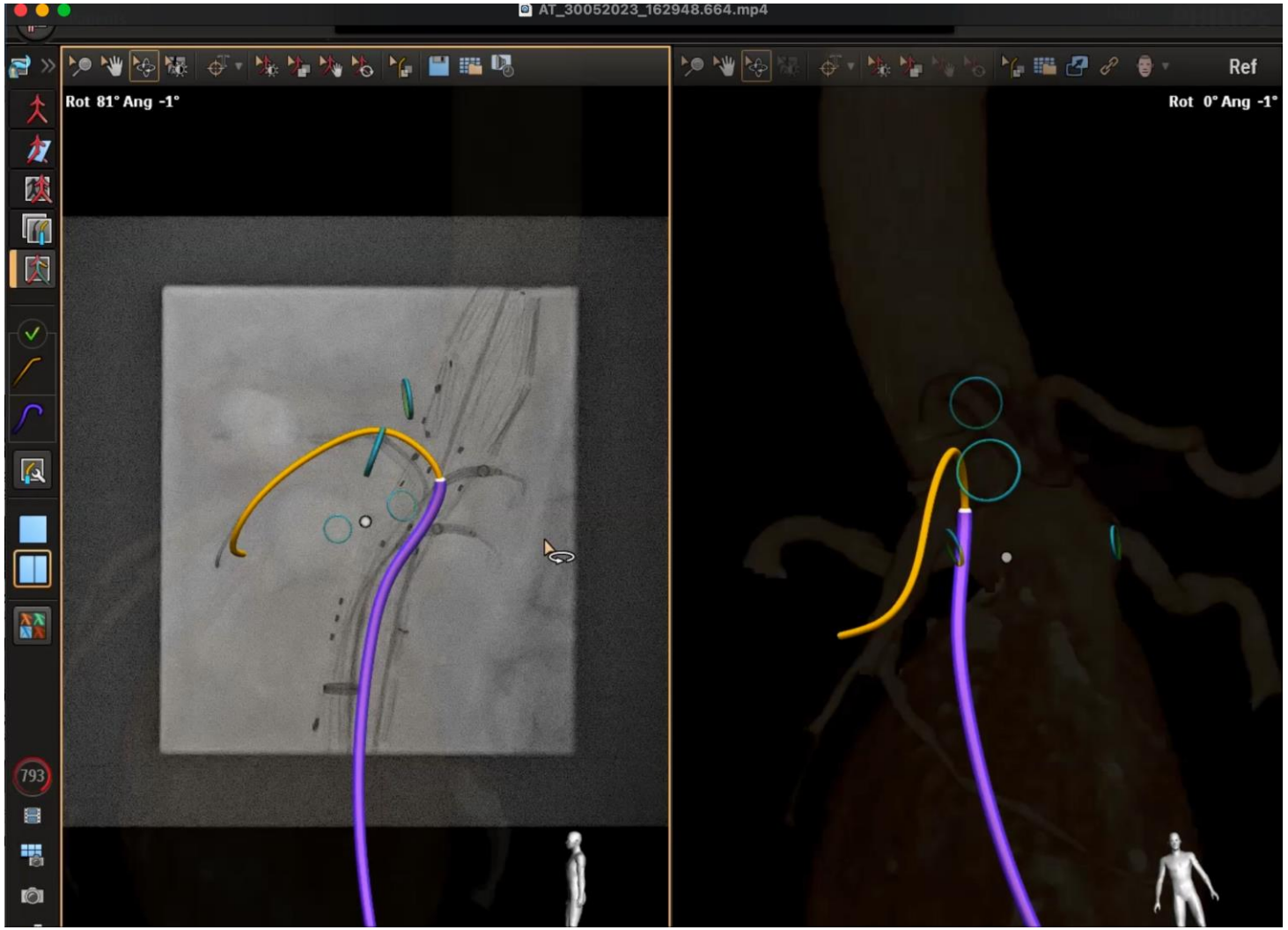




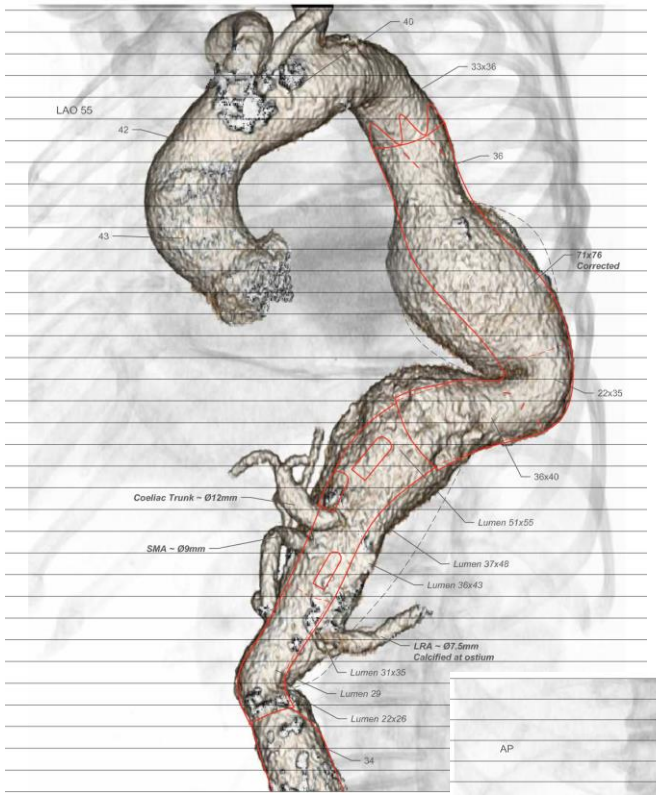
Superior mesenteric artery cannulation

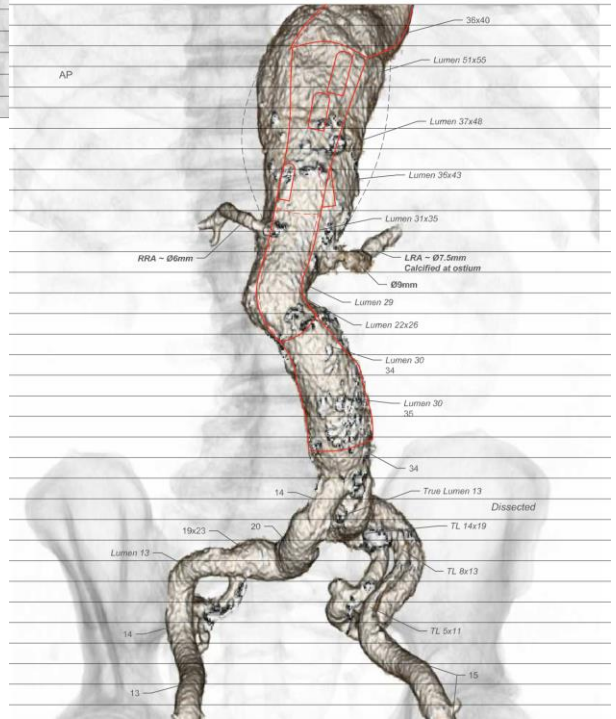






Retrograde branch cannulation





LumiGuide experience to date

FORS Investigators

- CE marked
- 900 procedures with FORS to date
- FORS Learn Registry study completed
- Prospective randomised study in planning
- Expanded release to additional centers

  (Total 14 installs to date)

Second generation LumiGuide

- Auto AI registration: Faster + accurate
- Catheter agnostic (3dHub)
- Bend radius improvements
- Reduced error message and warnings
- Zoom in/out user customizable
- Reduced jitter
- Bug fixes + signal stability improvements

First in human

UMC-Utrecht, The Netherlands

Limited Edition

Europe &USA

Limited Market Release

Europe &USA

Initial single-center experience using Fiber Optic RealShape guidance in complex endovascular aortic repair

Eric J. Finnesgard, MD, MS, Jessica P. Simons, MD, MPH, Douglas W. Jones, MD, MS, Dejah R. Judelson, MD, Francesco A. Aiello, MD, MBA, Laura T. Boitano, MD, MPH, Caitlin M. Sorensen, MD, Tammy T. Nguyen, MD, PhD, *and* Andres Schanzer, MD, *Worcester, MA*

FORS compared to fluoroscopy: Single-center historic cohort comparison

37% Fluoro time reduction

31% Fluoro dose reduction

56% DAP reduction

Finnesgard et al. J Vasc Surg 2022

From the New England Society for Vascular Surgery

The effect of Fiber Optic RealShape technology on the reduction of radiation during complex endovascular surgery

Andrew P. Sanders, MD,[a] Nicholas J. Swerdlow, MD,[a,b] Gabriel Jabbour, MS,[a] *and* Marc L. Schermerhorn, MD, FACS,[a] *Boston, MA*

FORS compared to fluoroscopy: Single-center historic cohort comparison

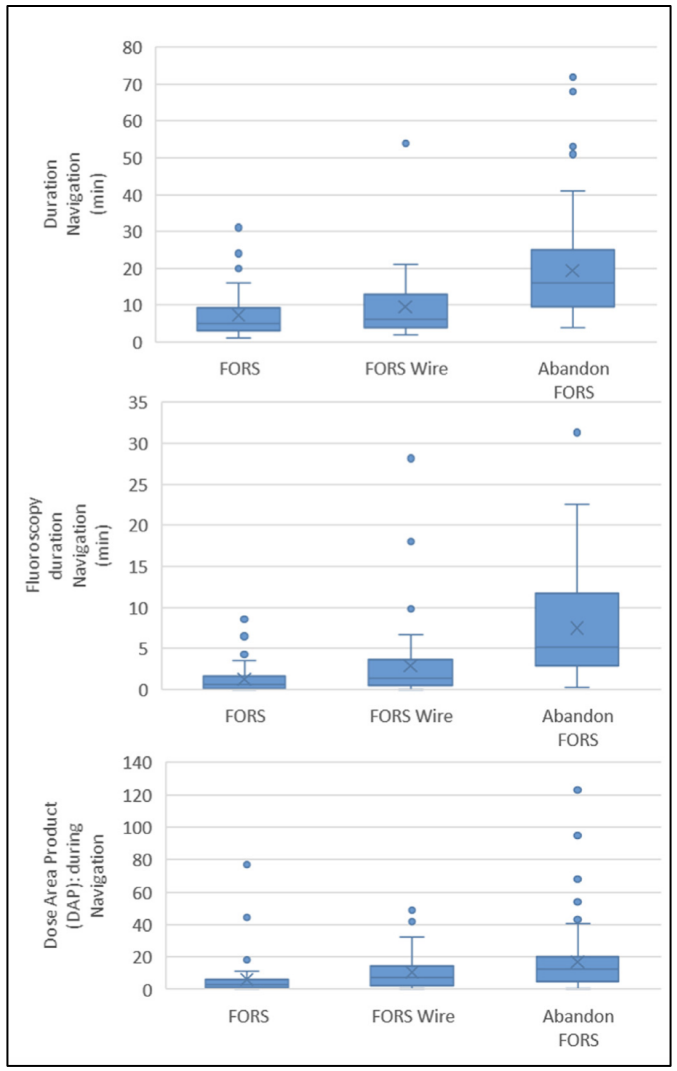
37% Fluoro time reduction

45% Fluoro dose reduction

35% DAP reduction

Sanders et al. J Vasc Surg 2023

Endovascular navigation with Fiber Optic RealShape



201 Navigation tasks

FORS Catheterisation: DAP 4.4cGy/cm^2 vs 12.5cGy/cm^2 (P<0.001)

60% success rate: vessel angel, vessel stenosis, renal arteries

Pannucio et al. J Vasc Surg 2023

Opportunities for improvement

Wire length:

Catheter choice limited by 120cm wire

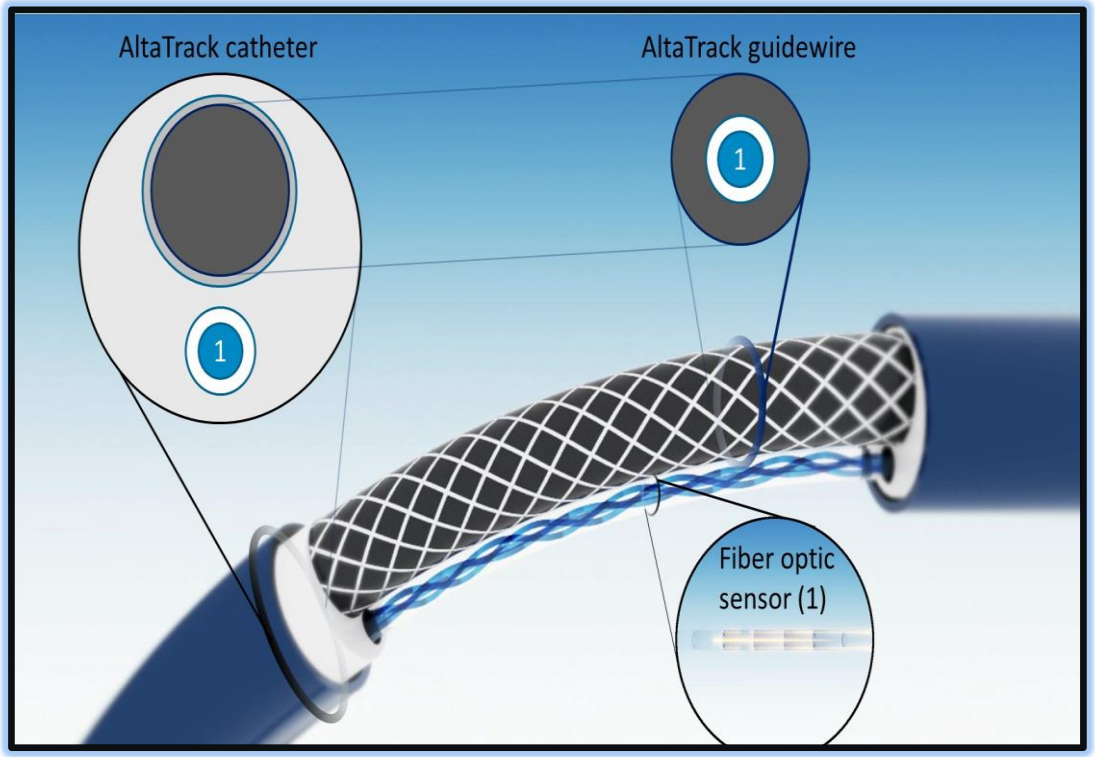
3D Hub takes up additional length

Wire iterations:

Additional profiles and lengths

Stiffness/Torqueability to be improved

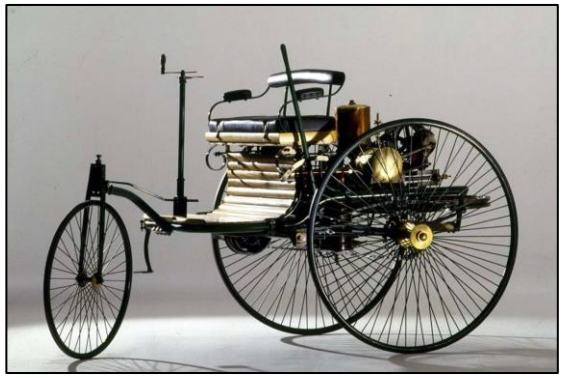
Back loadable



X-ray free aortic procedures: Dream or reality?

- Recognition that X-ray exposure has biological consequences
- Paradigm shift in workflow
- Multimodal visualisation
- Apply to all X-ray requiring steps not just navigation
- Device/manufacturer agnostic Clinical trials
- Regulatory approval

Nicolas Cugnot (1770)
Steam engine
Maximum speed 2mph



Carl Benz Motorwagen (1886)
<1 horse power

Henry Ford Model T (1908)
15 horse power

Aston Martin DB12 (2024)
671 horse power


St. Thomas' Hospital