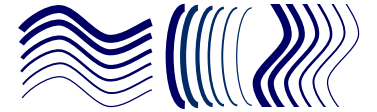


# Radiation hygiene in IR

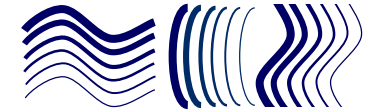
Radiation hygiene in IR practice From Dr MW de Haan

Michiel de Haan  
Maastricht University Medical Center  
The Netherlands



No potential conflicts of interest to disclose

Radiation hygiene in IR practice Prof dr MW de Haan



# Lay-out presentation

---

## Introduction in Interventional Radiology

origin

present position

## Current state of radiation hygiene in IR

awareness

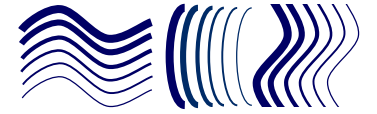
protection

## Future developments

Radiation hygiene in IR practice Prof dr MW de Haan

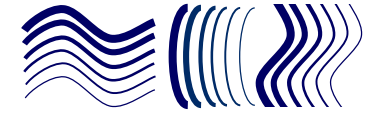
# Interventional Radiology

---



Relatively young (sub) specialism, part of (diagnostic) radiology

Radiation hygiene in IR practice Prof dr MW de Haan



# Interventional Radiology

Relatively young (sub) specialism, part of (diagnostic) radiology

Image-guided interventions

fluoroscopy

ultrasound

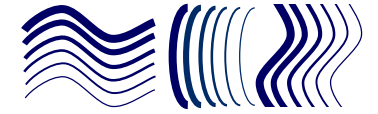
computer tomography



W de Haan



Radiation hygiene



# Interventional Radiology

Relatively young (sub) specialism, part of (diagnostic) radiology

Image-guided interventions

fluoroscopy

ultrasound

computer tomography

Minimal invasive procedures

endovascular

percutaneous

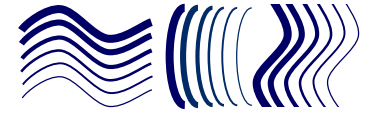


W de Haan

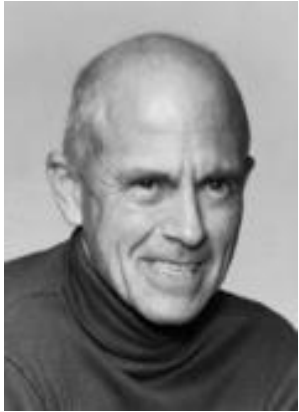


Radiation hygiene

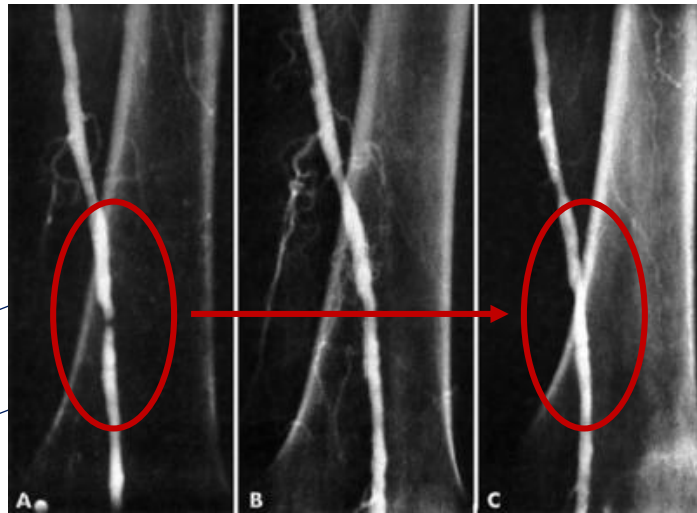
# Interventional Radiology



## The fathers of IR

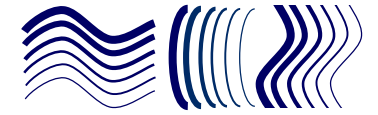


Charles  
Dotter  
1920 - 1985

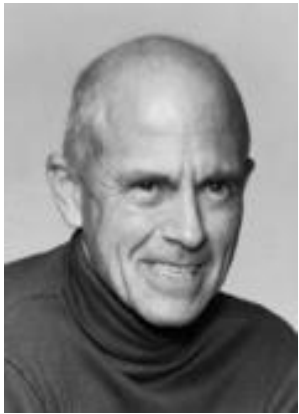


practice Prof dr MW de Haan

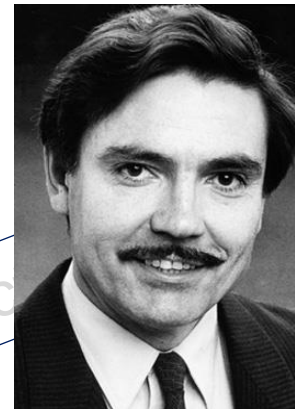
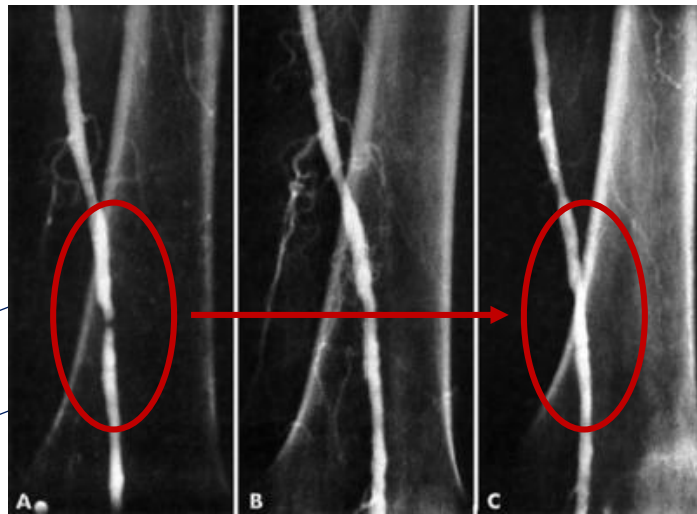
# Interventional Radiology



## The fathers of IR



Charles  
Dotter  
1920 - 1985

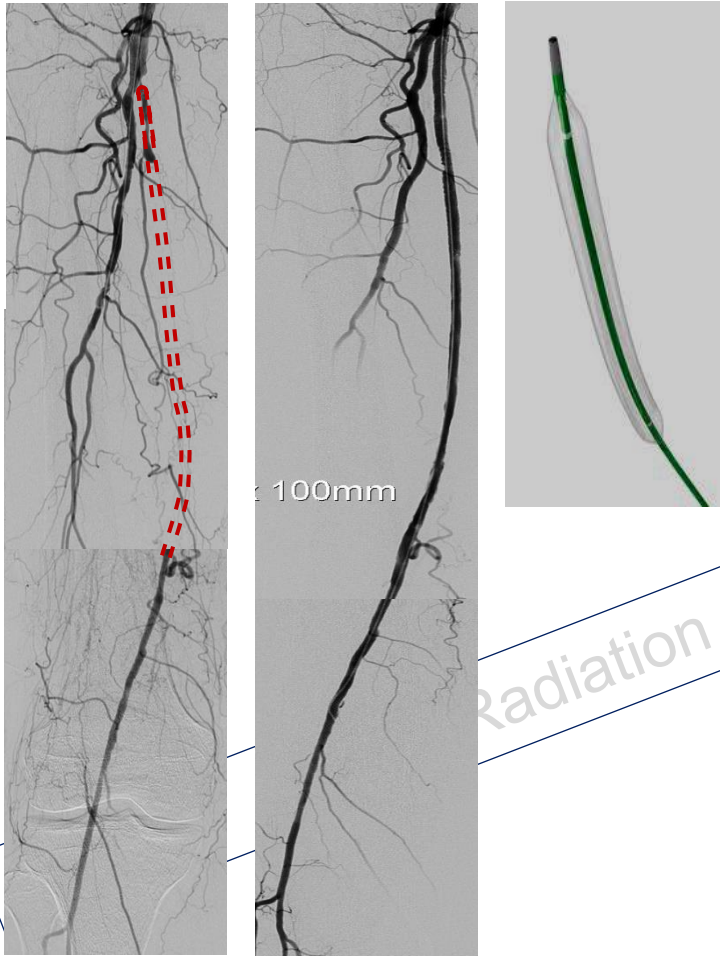
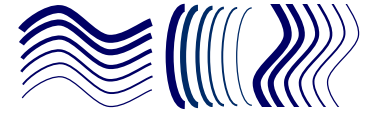


Andreas  
Grüntzig  
1939 - 1985



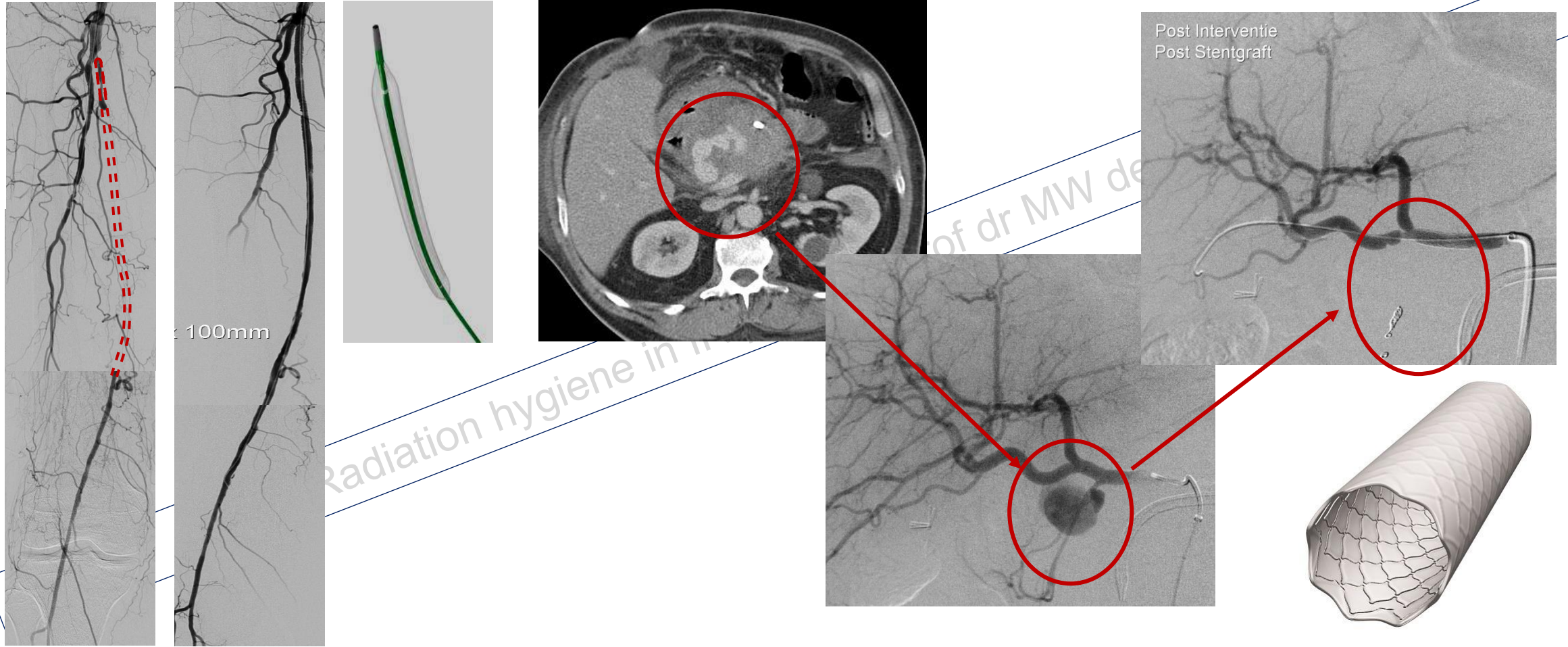
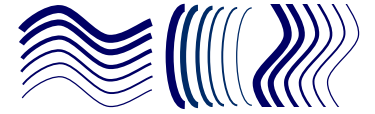


# IR: vascular procedures

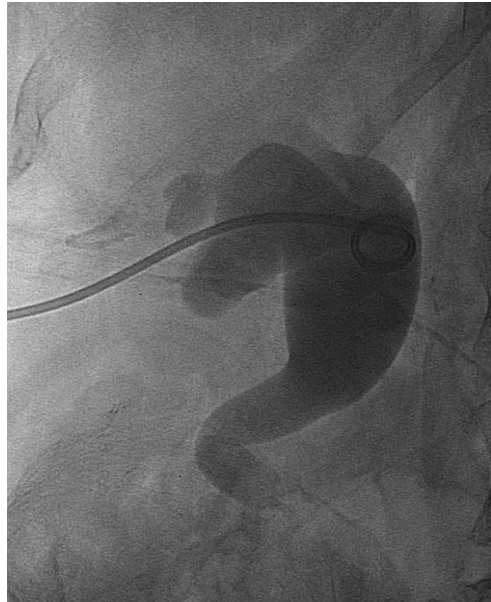
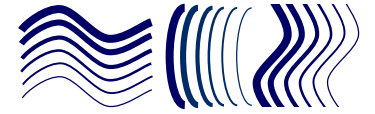


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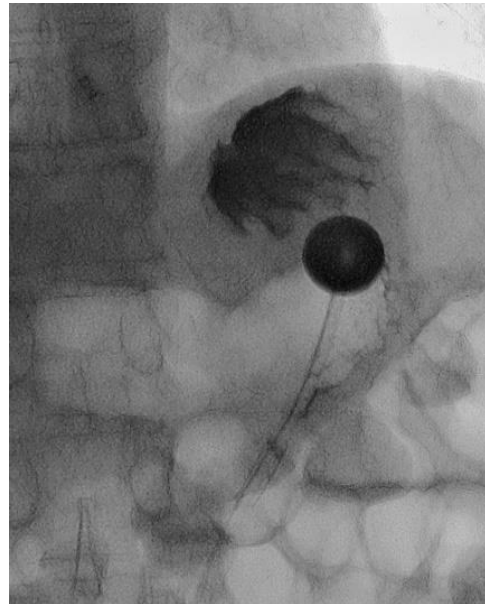
# IR: vascular procedures



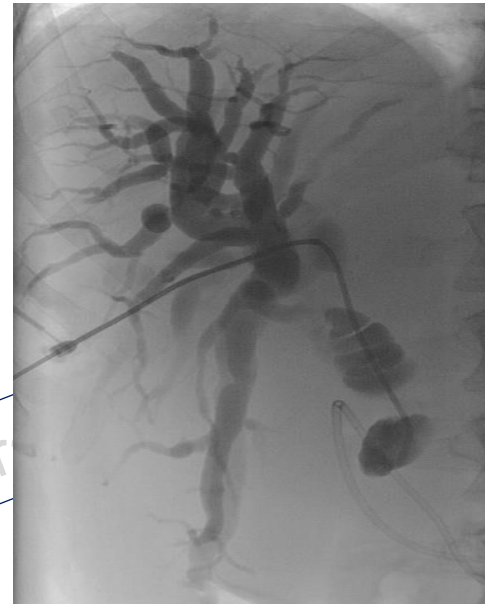
# IR: non-vascular procedures



Nephrostomy



Feeding tube

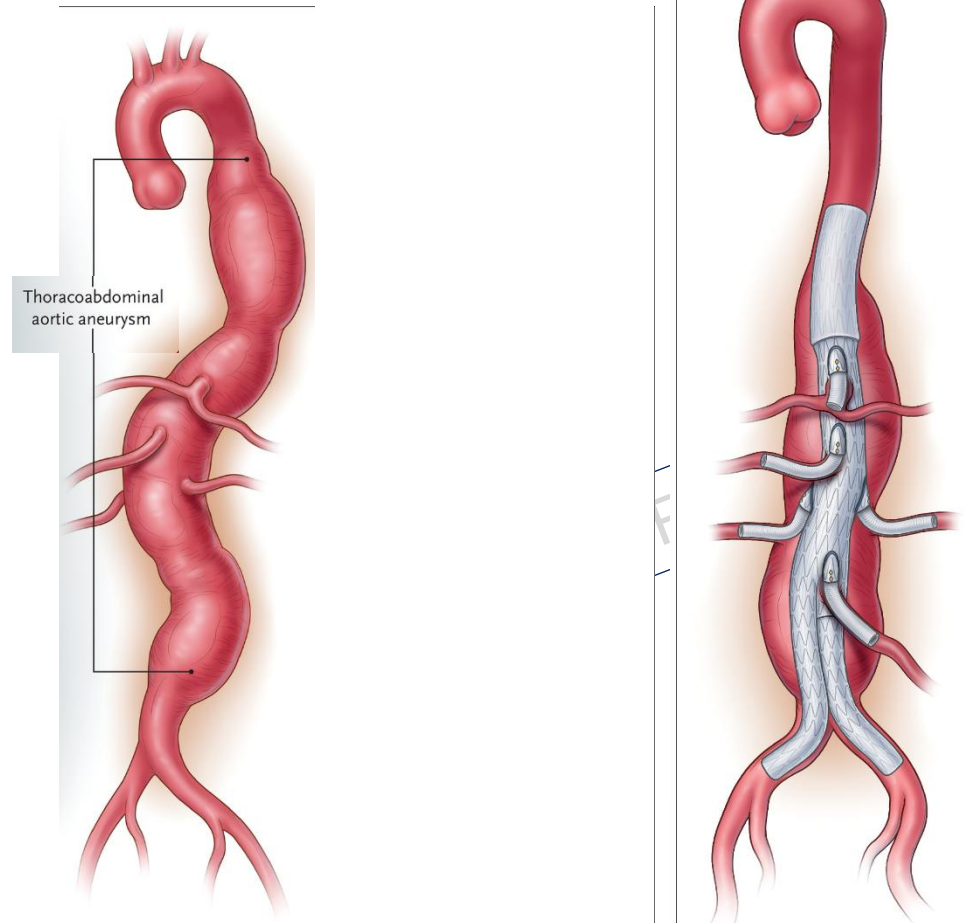
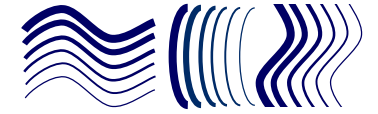


PTCD



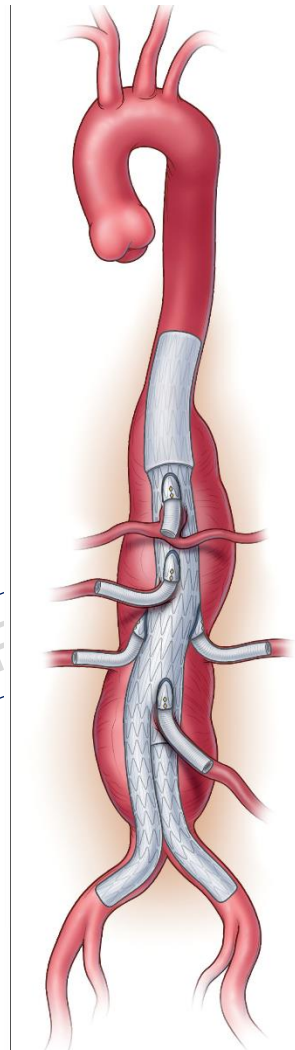
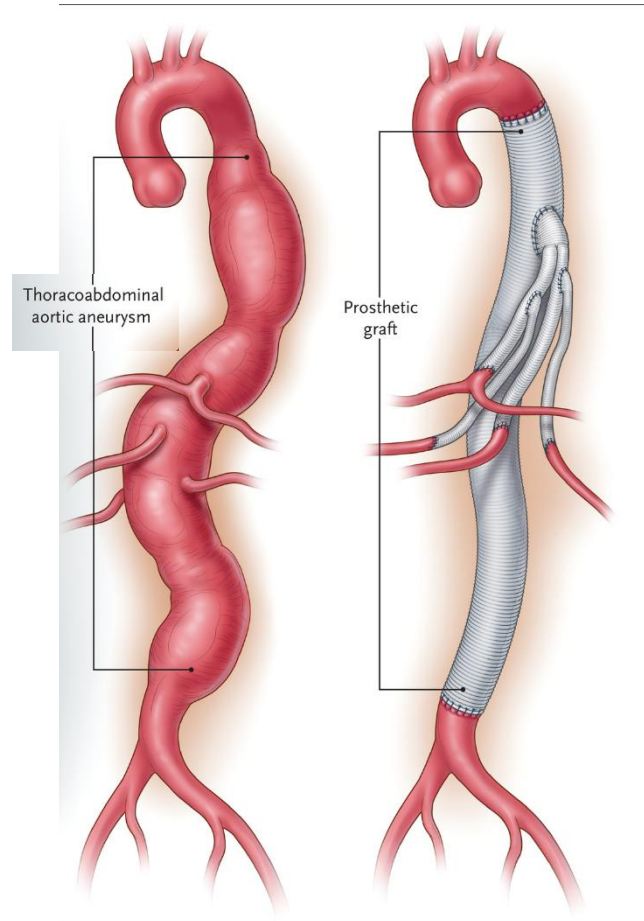
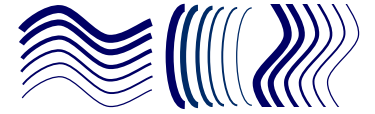
Abces drains

# IR: aortic procedures

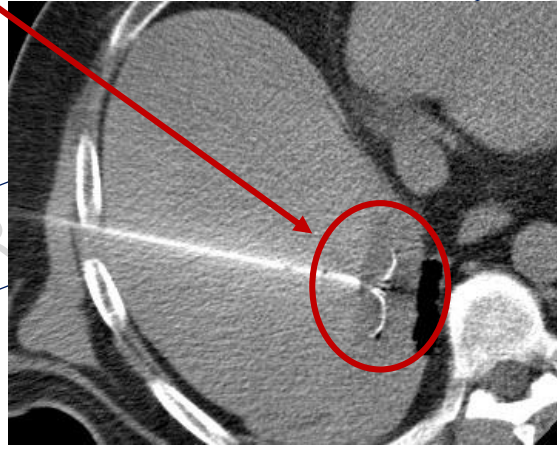
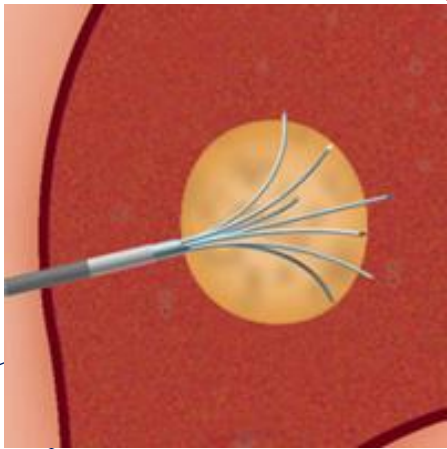
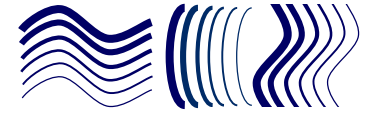


rof dr MW de Haan

# IR: aortic procedures

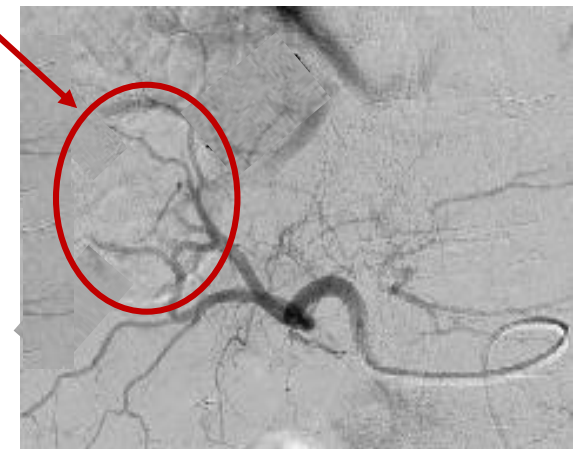
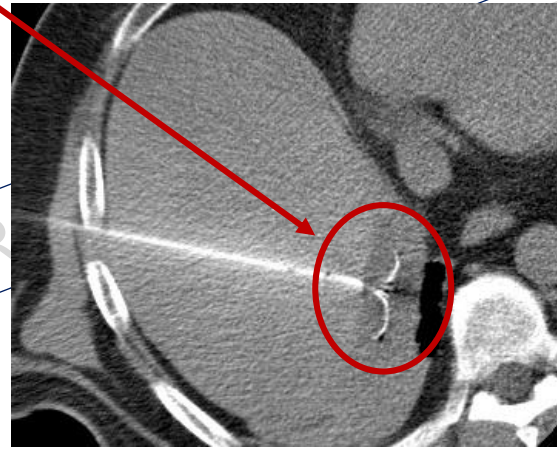
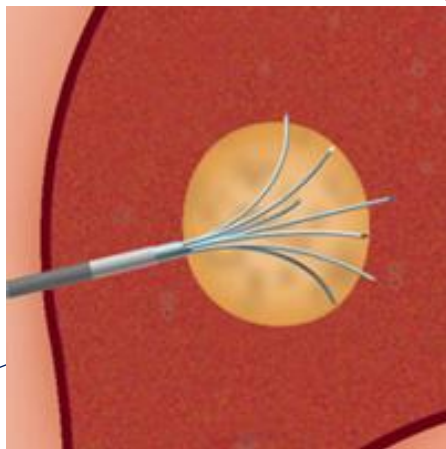
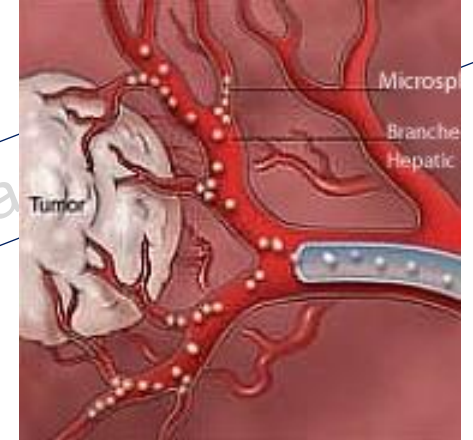
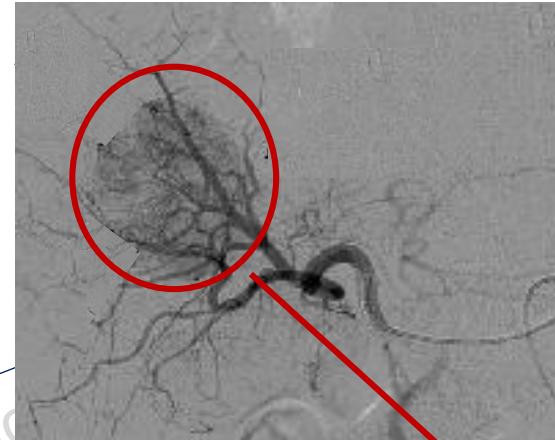
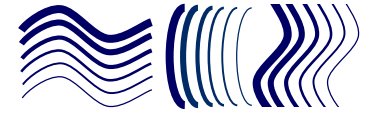


# IR: oncological procedures

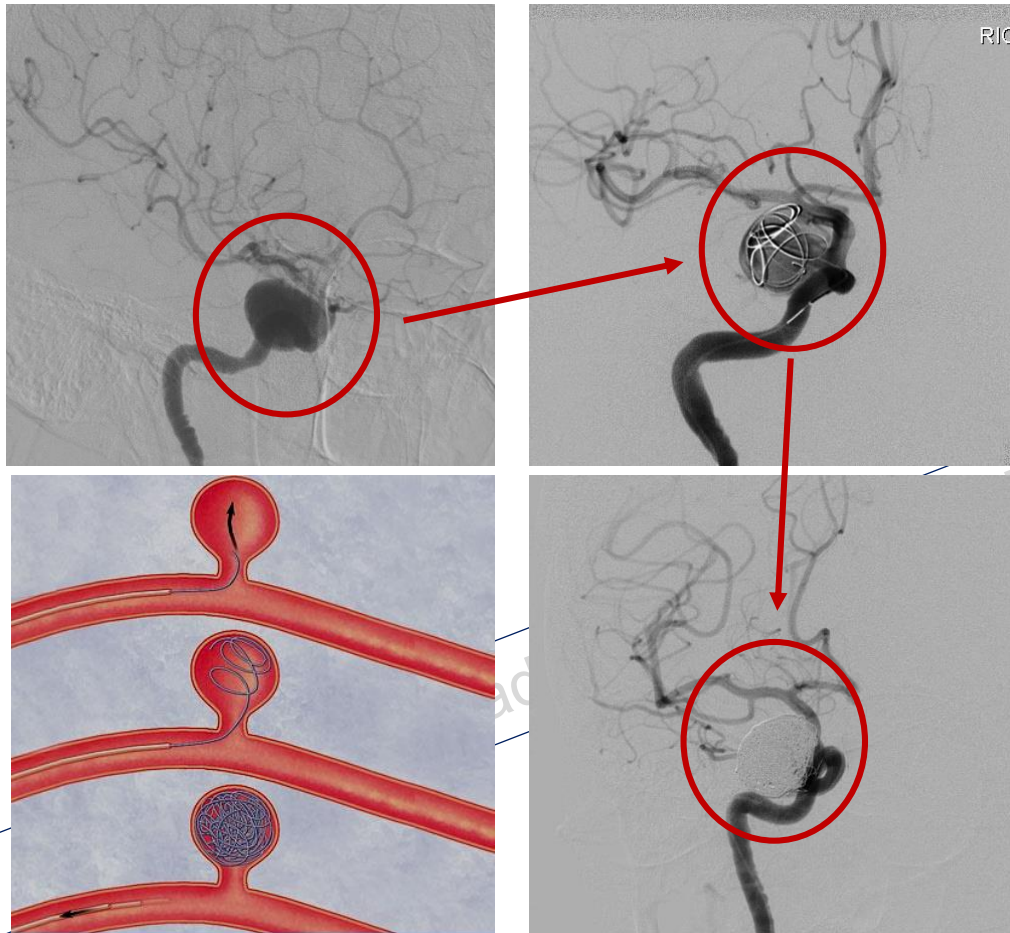
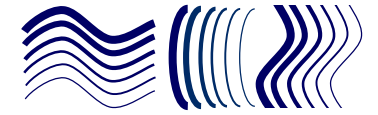


IR practice Prof dr MW de Haan

# IR: oncological procedures



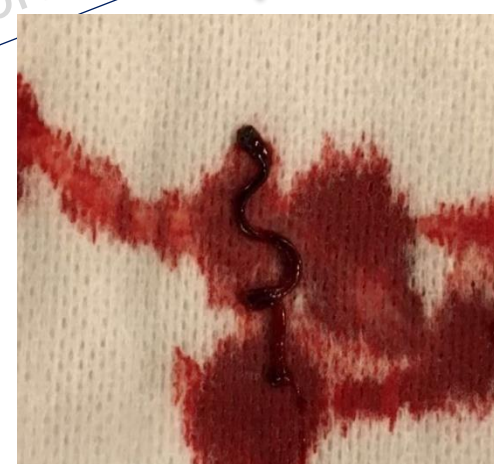
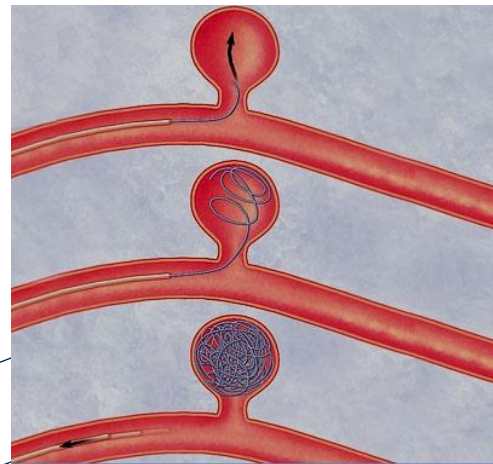
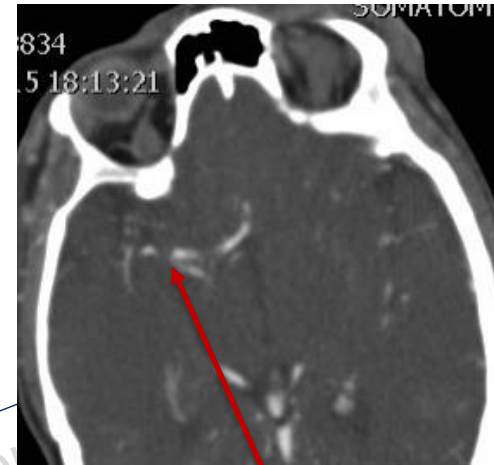
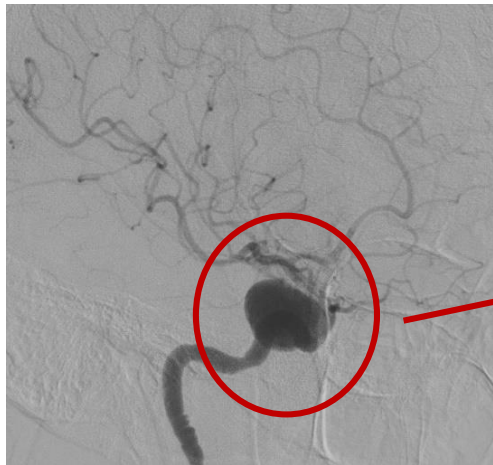
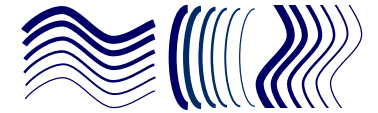
# IR: neuro interventional procedures



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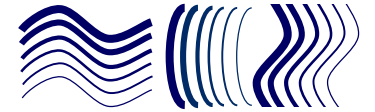


# IR: neuro interventional procedures



# Interventional Radiology

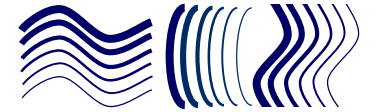
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The number and complexity of vascular and non-vascular fluoroscopy-guided interventions is rapidly growing

Radiation safety is crucial for both patient and professionals

# Interventional Radiology



The number and complexity of vascular and non-vascular fluoroscopy-guided interventions is rapidly growing

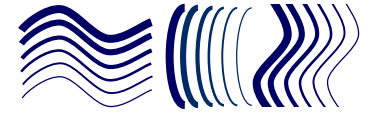
→ *Increased radiation exposure for IR's, surgeons and staff*

Radiation safety is crucial for both patient and professionals

→ *Medical staff working should be aware of the radiation dose during procedures and which factors determine the level of these doses\**

Knowledge on personal and procedural radiation dose allows for optimal use of the ALARA principles

# Radiation hygiene in IR



Awareness

BE AWARE  
CREATE AWARENESS



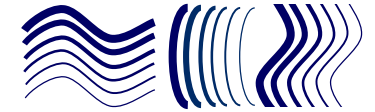
Protection

Future developments



Radiation hygiene

# Awareness



## Training / education

basic training, incl. exam (all residents)

advanced training (all IR residents)

hands-on

exam

5-yearly refresher

CIRSE

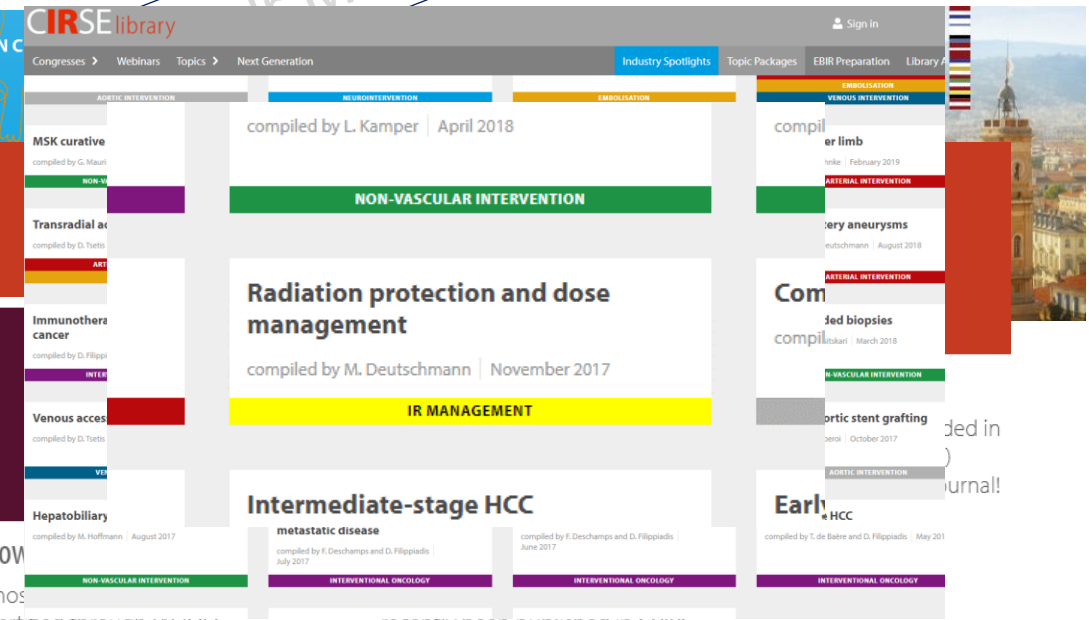


Take the EBIR exam online

Apply now to take the remote, online-proctored exam on March 17!

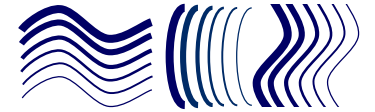
IASIOS now

Get your hospital services certified through IASIOS!



# Awareness

---



## Training / education

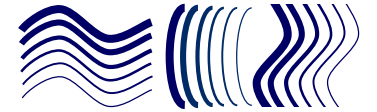
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basic training, incl. exam (all residents)

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# Awareness

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## Training / education

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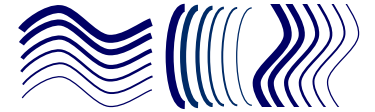
hands-on

exam

Radiation hygiene in IR practice Prof dr MW de Haan

# Awareness

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## Training / education

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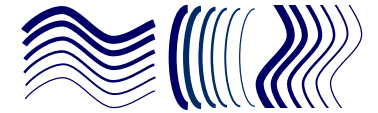
exam

5-yearly refresher

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# Awareness



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CIRSE

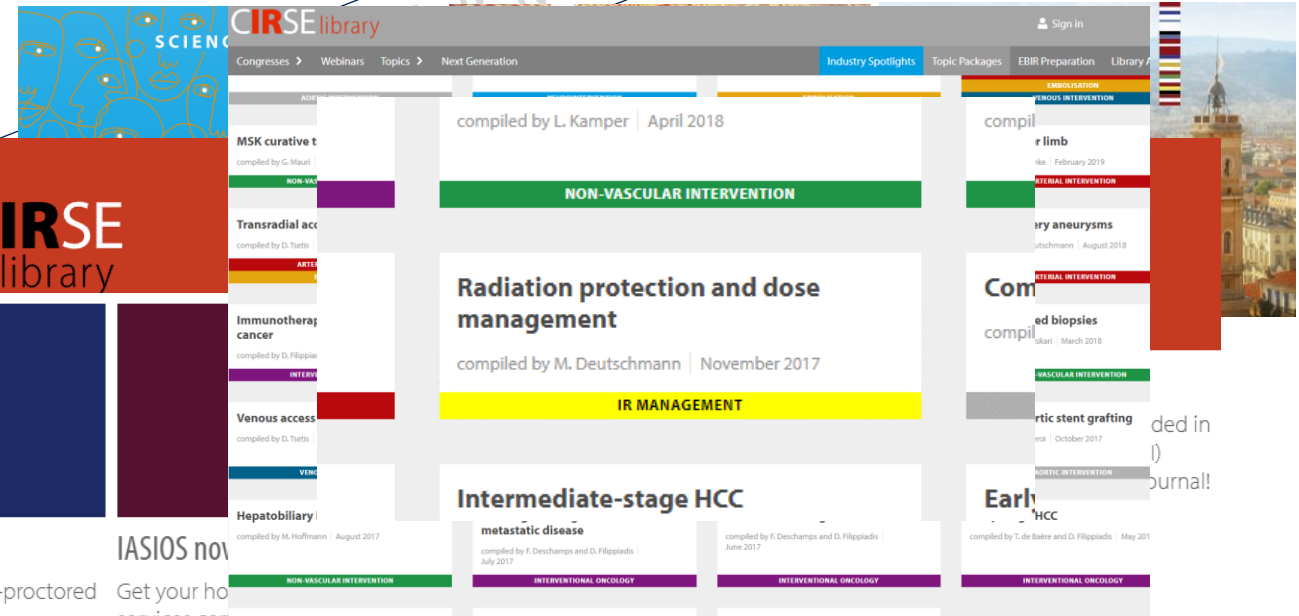


Take the EBIR exam online

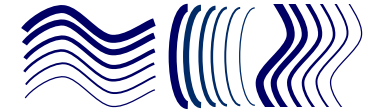
Apply now to take the remote, online-proctored exam on March 17!

IASIOS now

Get your hospital services certified through IASIOS:



# Awareness



Training / education

Dose Wise system

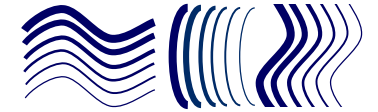
Dedicated real-time, patient and staff dose monitoring system

Automatically registers patient and staff dose for each procedure

Radiation hygiene in IR practice Prof. dr. M. de Haan



# Awareness



Training / education

Dose Wise system

Dedicated real-time, patient and staff dose monitoring system

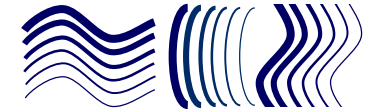
Automatically registers patient and staff dose for each procedure

Identify types of intervention with a high staff dose

Increase radiation awareness



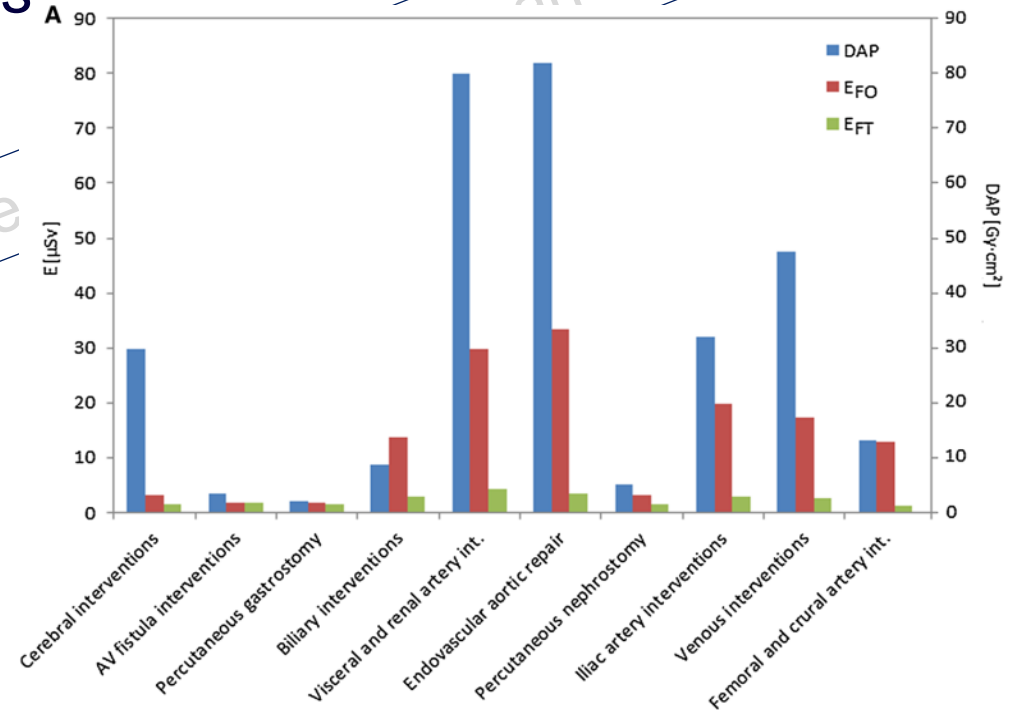
# Staff dose analysis study



Median procedural and staff doses vary widely between procedure types

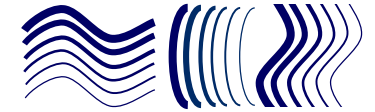
Mean DAP highest in abdominal interventions  
(lowest for AV fistula interventions)

Highest FO dose in abdominal interventions  
(lowest for AV fistula and PRG's)



Radiation hygiene in IR practice

# Staff dose analysis study

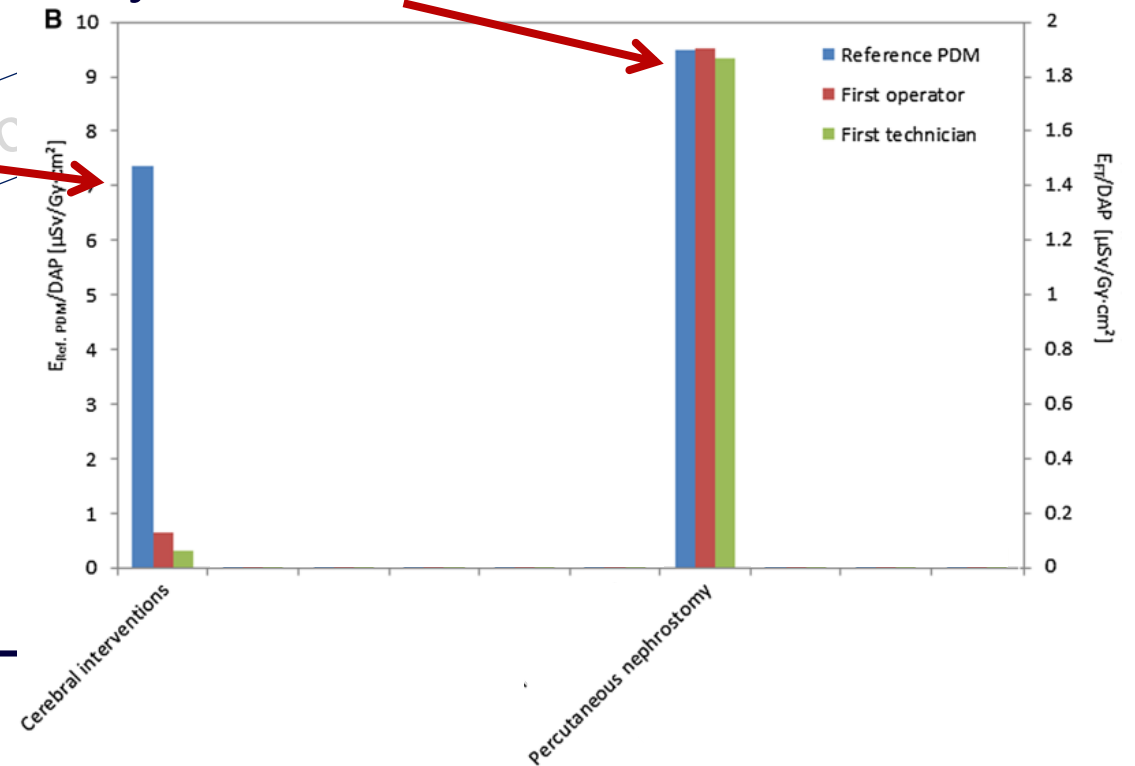


Corrected for the procedural DAP

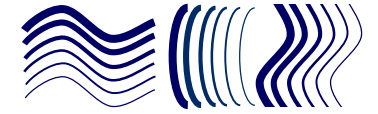
The relative dose FO and FT was

highest in “small” procedures e.g. biliary, PRG, nephrostomies

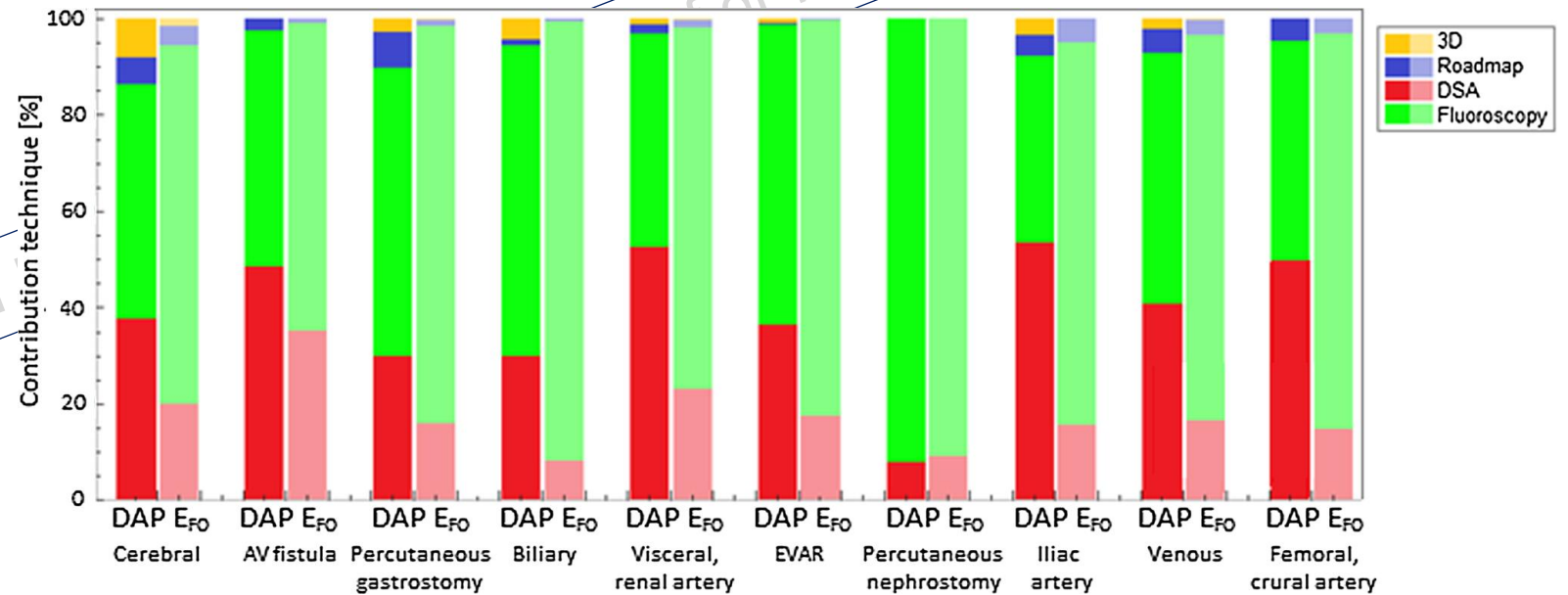
lowest for cerebral interventions



# Staff dose analysis study

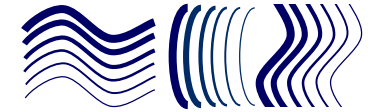


Acquisition technique:

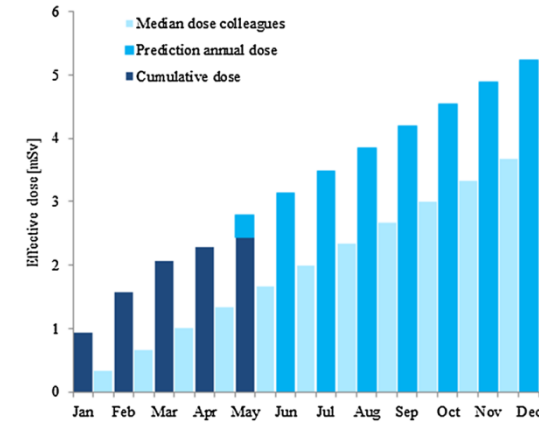


Radiation

# Personalized Feedback



## Providing medical staff with personal feedback



Radiation hygiene in I

### Detailed information:

Date	Procedure	Duration [min]	Staff dose [E* in $\mu$ Sv]	Fluoro*** [in %]	DSA*** [in %]	Roadmap*** [in %]	3D*** [in %]	Relative dose** [in %]	Median Relative dose**** [in %]
4/28/2016	Biliary duct – stenting/angioplasty	13	2.721	97	3	0	0	26	6
4/26/2016	PTA External iliac artery	19	1.389	100	0	0	0	29	12
4/26/2016	PTA Superficial femoral artery	69	0.081	81	0	19	0	1	35
4/28/2016	Embolisation ovarian artery	83	8.737	41	58	1	0	23	15
4/26/2016	PTA + Stenting Superficial femoral artery	63	0.400	100	0	0	0	12	20
4/26/2016	Cerebral thrombectomy	61	0.632	73	26	1	0	8	27

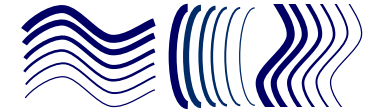
\* E = Effective dose

\*\* Relative dose = dose Staff member/dose on C–arm

\*\*\* Contribution to dose Staff member

\*\*\*\* Median relative dose of all similar procedures since November 2015, calculated for the first operator

# Personalized Feedback



Providing medical staff with personal feedback

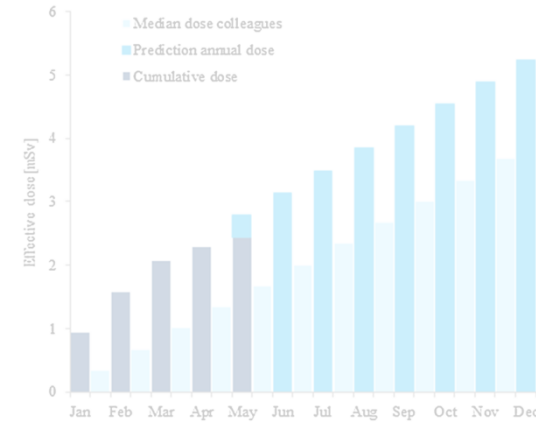
Increase dose awareness

Lead to optimized behaviour

Significant decrease FT dose

A trend towards FO dose reduction

The use of the radiation protection tools increased:  
table drape, table shield ceiling shield by 2, 15 and 28% resp.



Detailed information:

Date	Procedure	Duration [min]	Staff dose [E* in $\mu$ Sv]	Fluoro*** [in %]	DSA*** [in %]	Roadmap*** [in %]	3D*** [in %]	Relative dose** [in %]	Median Relative dose**** [in %]
4/28/2016	Biliary duct – stenting/angioplasty	13	2.721	97	3	0	0	26	6
4/26/2016	PTA External iliac artery	19	1.389	100	0	0	0	29	12
4/26/2016	PTA Superficial femoral artery	25	0.408	100	0	19	0	1	35
4/26/2016	Embolic protection over the carotid artery	63	2.737	100	58	1	0	23	15
4/26/2016	PTA + Stenting Superficial femoral artery	63	0.400	100	0	0	0	12	20
4/26/2016	Cerebral thrombectomy	61	0.632	73	26	1	0	8	27

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\*\* Relative dose = dose Staff member/dose on C-arm

\*\*\* Contribution to dose Staff member

\*\*\*\* Median relative dose of all similar procedures since November 2015, calculated for the first operator



# Protection

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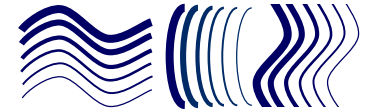
## Personal protection

lead apron

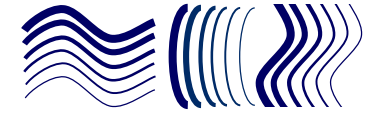
thyroid protector

X-ray safety glasses

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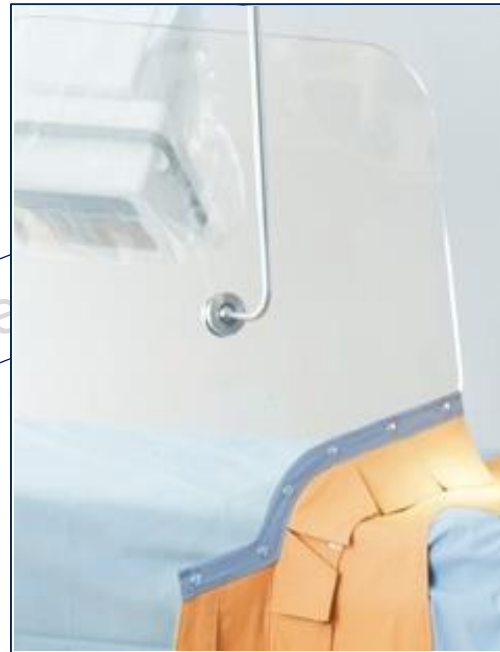


# Protection



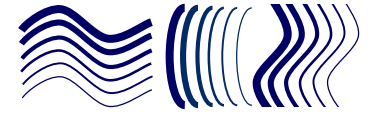
## General protection

- upper body shield
- lower body drapes
- disposable pads



dr MW de Haan

# Protection



## Alternatives

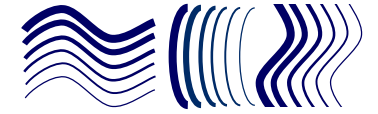
- no-brainer
- “bus shelter”
- zero-gravity systems



hygi



# Protection



## Alternatives

no-brainer

“bus shelter”

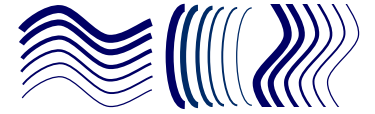
zero-gravity systems



Radiation hygiene

# Future developments

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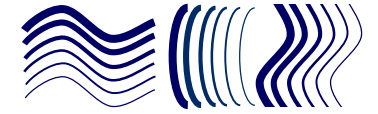


Interventional MRI (iMRI)

FORS

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# Interventional MRI



Magnetic Resonance Imaging offers:

- superior soft tissue contrast

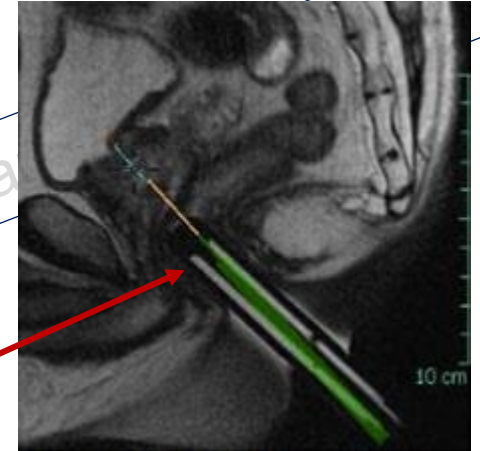
- sufficient spatial resolution

- multi-planar 3D reconstructions in any direction

- functional parameters:

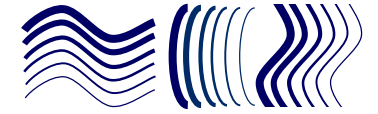
  - flow, temperature, perfusion, tissue oxygenation

  - end-point of an IR procedure



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# Interventional MRI

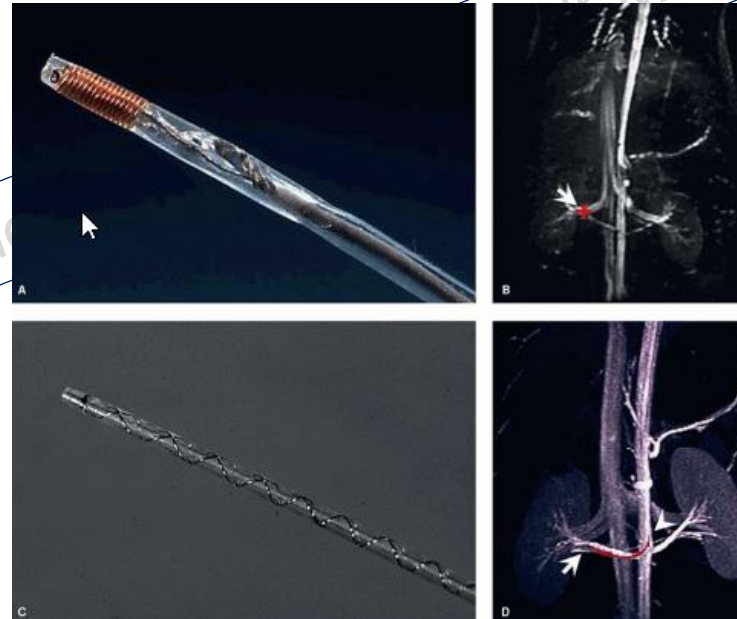


## Disadvantages of Magnetic Resonance Imaging:

exam time

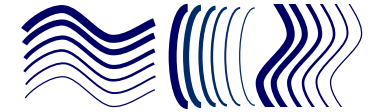
lack of compatible equipment

long learning curve



Radiation hygiene

# Interventional MRI



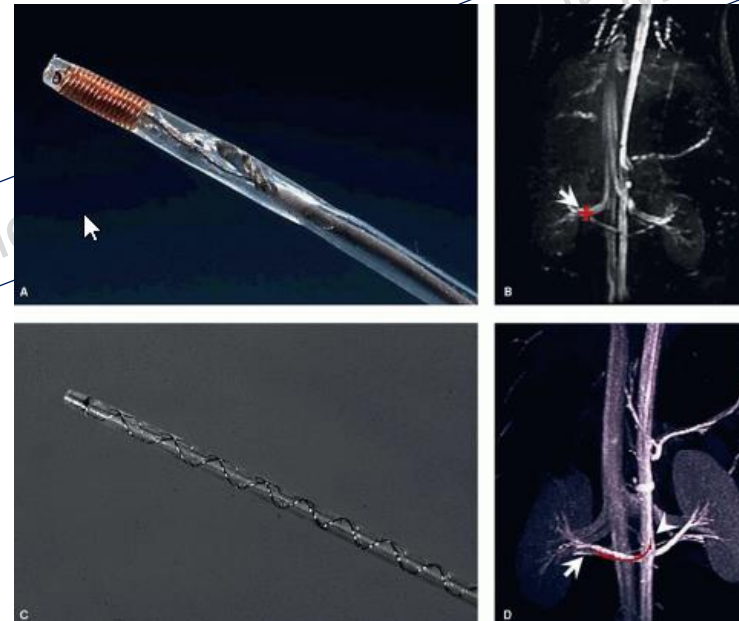
## Disadvantages of Magnetic Resonance Imaging:

exam time

lack of compatible equipment

long learning curve

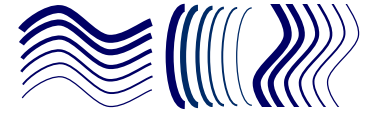
costs



Radiation hygiene

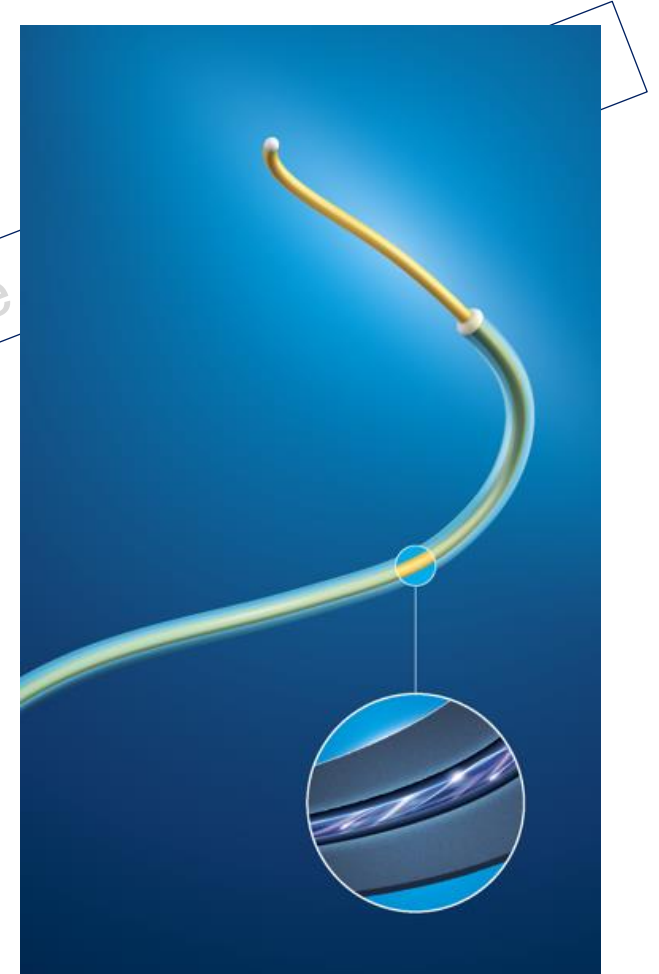


# Fiber Optic Realshape technology (FORS)



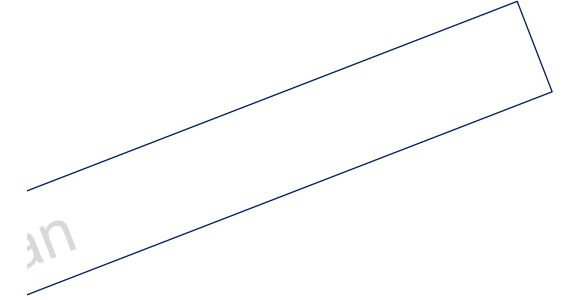
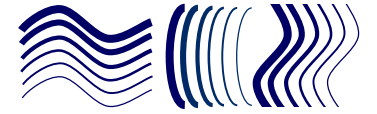
- Multicore optical fiber integrated in wires and catheters
- Analysis of wavelength spectra of received laser light
- Allows radiation-free visualization in real time and 3D

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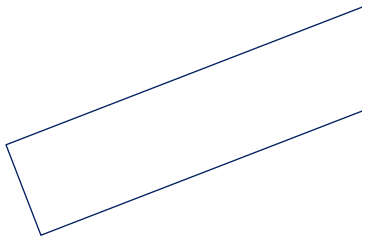


# FORS

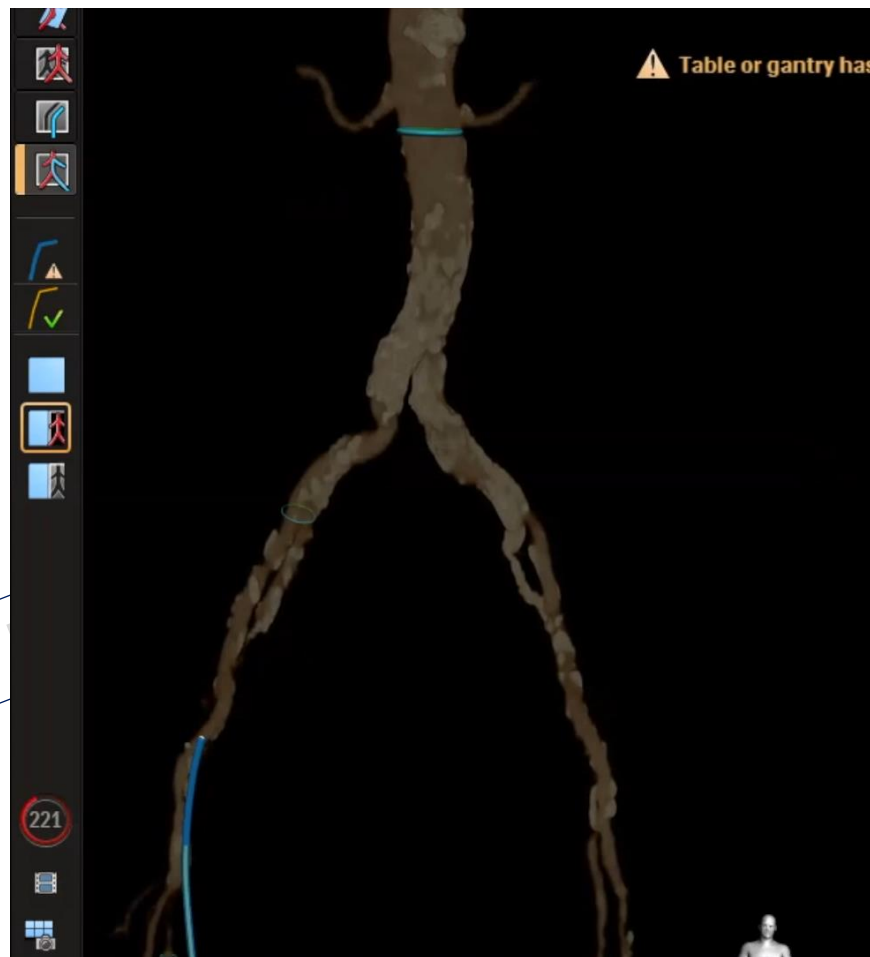
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## 3D device visualization using light



# FORS

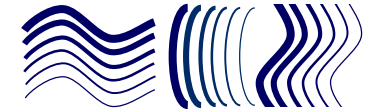


Radiation

de Haan

# Fiber Optic Reshape technology (FORS)

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Early days

Lot of challenges

First-in-man studies are running

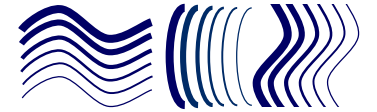
Fluoroscopy remains necessary

Costs?

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# Conclusion

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- Interventional Radiology is the best!
- Success comes at a cost: radiation
- Training is essential
- Alternatives are on their way

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Thank you for your attention!



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