Implementation of advanced RT Techniques

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Current RT equipments at NIO, Budapest

1 TrueBeam - Varian

1 Artiste - Siemens (IMRT, IGRT with MV-CBCT and on-rail kV-CT)

~~2 Primus - Siemens (6 and 18 MV, +electrons)~~ 2 VitalBeam

1 Primus - Siemens (6 MV)

~~1 Theratron cobalt unit~~ Unique

+ Lantis, Pinnacle, Aria, Eclipse


VARIAN
medical systems
trueBEAM

Road map to first treatment

Removal of Mevatron	**15 January, 2014**
Bunker reinforcement	**January 2014**
Installation	**February - March 2014**
Commissioning, training	**April 2014**
Measurements	**April-May 2014**
First treatment	**15 May, 2014**

Before TrueBeam experience with

- **3D-CRT**
- **IMRT with „step and shoot” technique**
- **IGRT with MV-CBCT, on-rail kV-CT and EPID**
- **Pinnacle, Lantis**

New challenges with TrueBeam

- **IMRT with sliding window technique and RapidArc**
- **IGRT with kV-CBCT and kV 2D imaging**
- **Eclipse – Aria (+IGRT) integration**
- **New treatment techniques (SBRT, radiosurgery, SIB, APBI)**

Available beams and energies

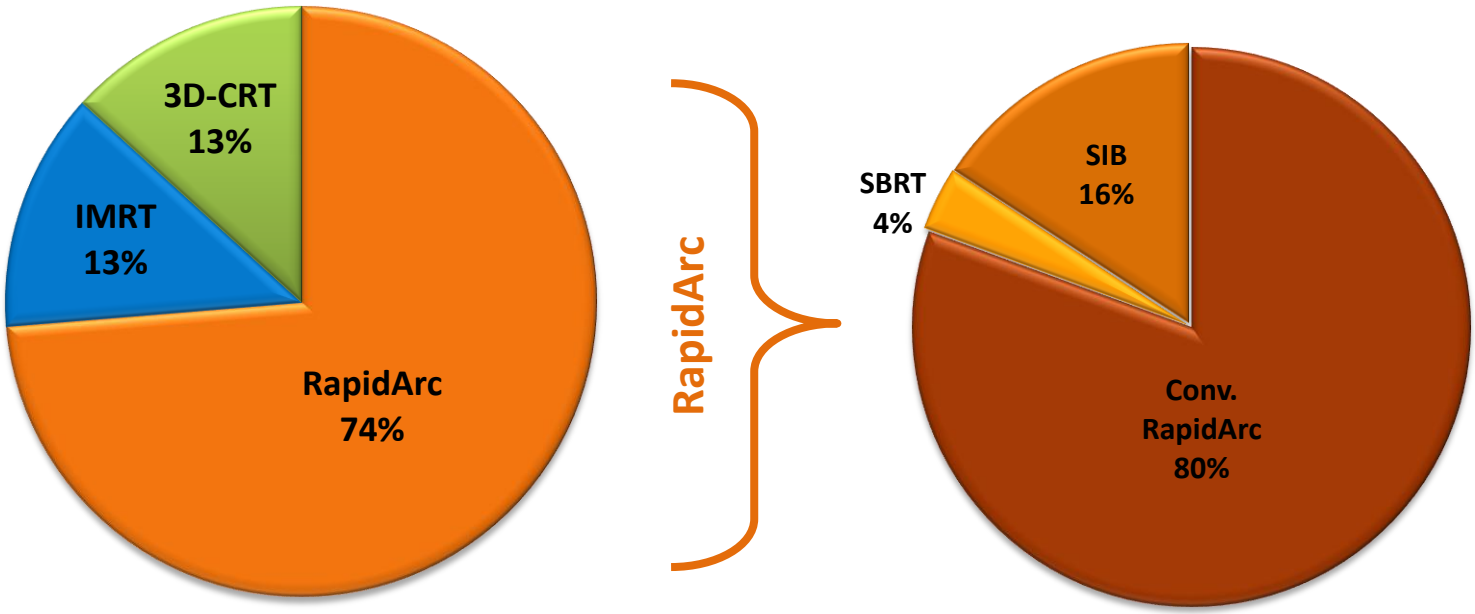
Photons

- **6, 10 and 18 MV (600 MU/min)**
- **6 MV FFF (1400 MU/min)**
- **10 MV FFF (2400 MU/min)**
- **6 MV SRS (1000 MU/min)**

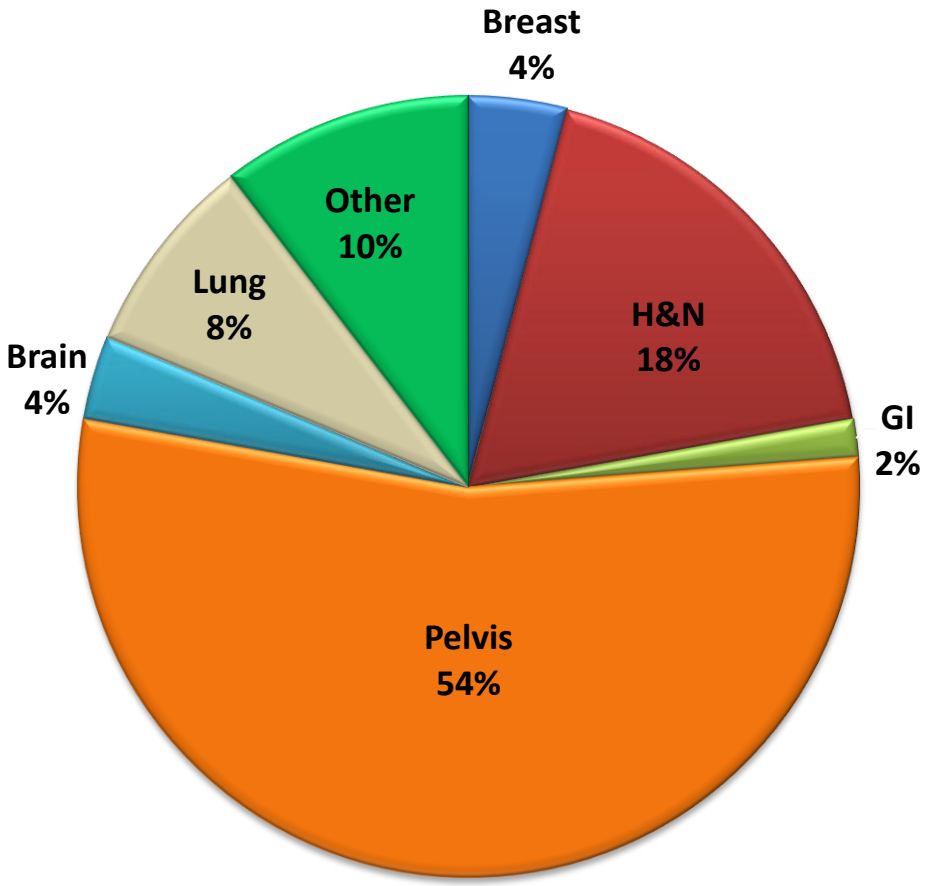
Electrons

- **6, 9, 12 and 15 MeV (1000 MU/min)**
- **6 MeV HDTSE (2500 MU/min) – High Dose Total Skin Electron**

Distribution of treatment techniques in 2015



Distribution of tumor sites treated in 2015

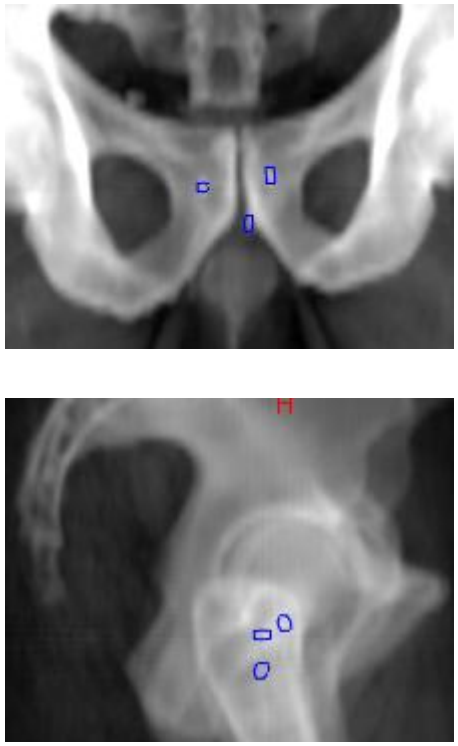


Total patient number = 635

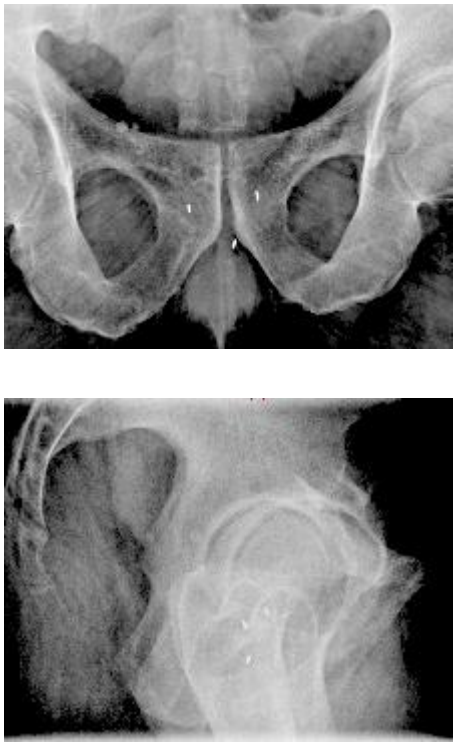
Special treatments on TrueBeam

- prostate IMRT/IGRT with gold markers
- simultan integrated boost (SIB) - prostate
- stereotactic body radiotherapy (SBRT) - lung
- stereotactic radiosurgery (brain)
- accelerated partial breast irradiation (APBI)
- total skin irradiation

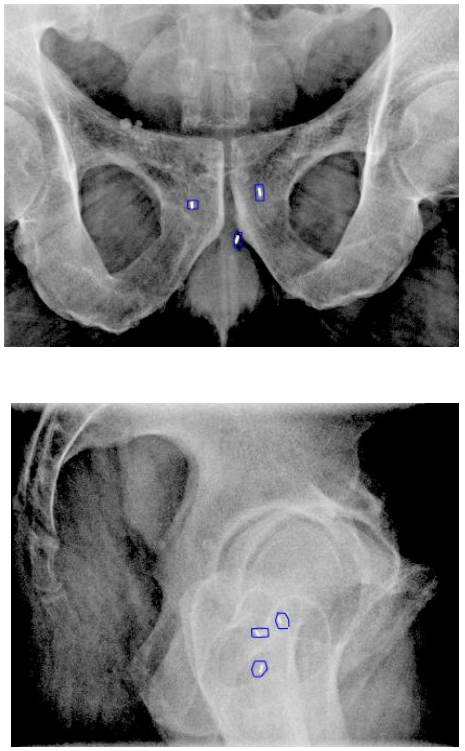
Prostate IGRT with gold markers and 2D imaging



DRR-s



kV X-ray images

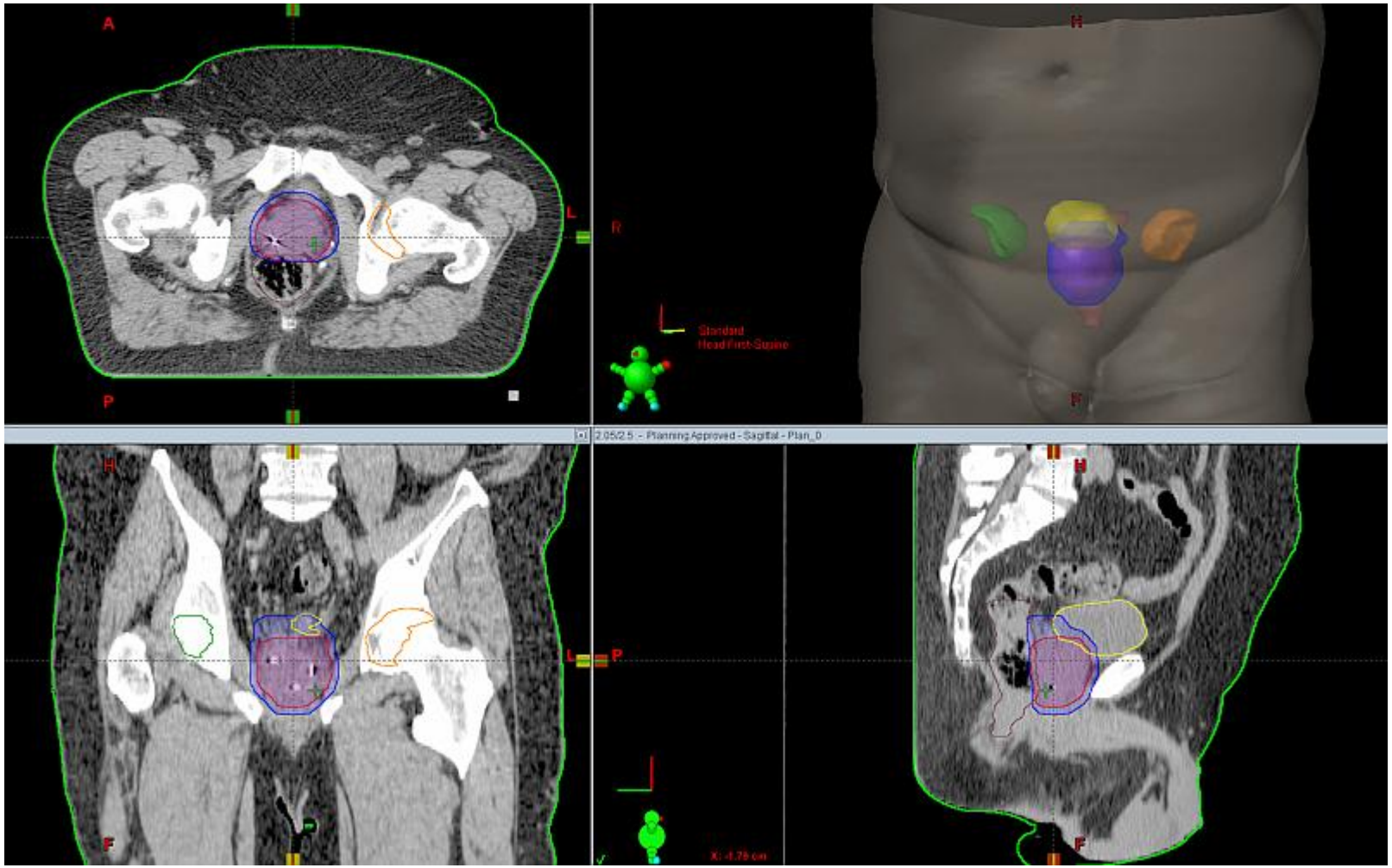


fused images

Prostate IGRT with gold markers and 3D imaging

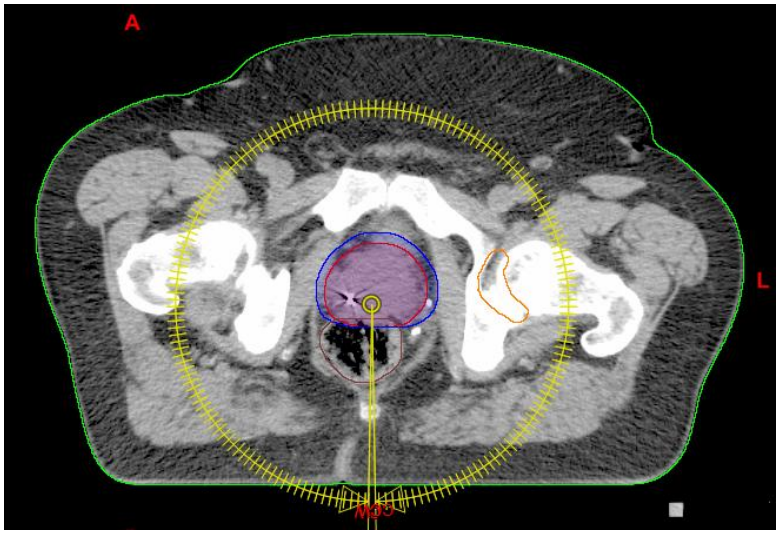
Session	Vrt [cm]	Lng [cm]	Lat [cm]	Pitch [deg]	Roll [deg]	Rtn [deg]
Thu 8/4/20	-0.40	+0.20	0.00	0.0	0.0	0.0

Simultan integrated boost (SIB) technique

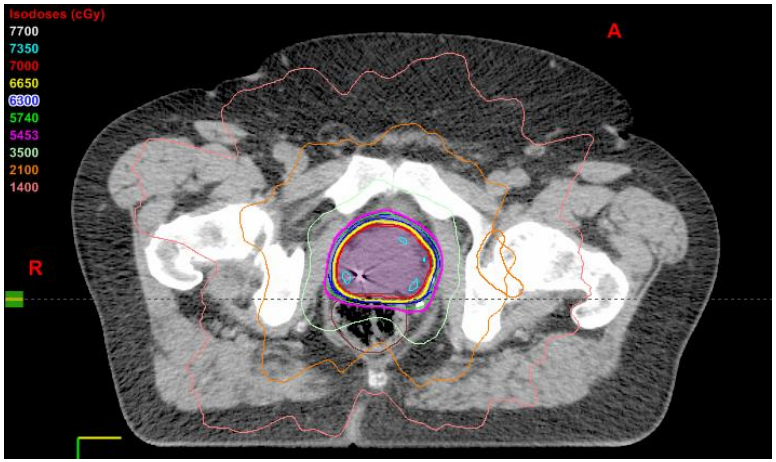


Prostate gland: **70 Gy** **28 x 2.5 Gy**
Vesicula seminalis: **57.4 Gy** **28 x 2.05 Gy**

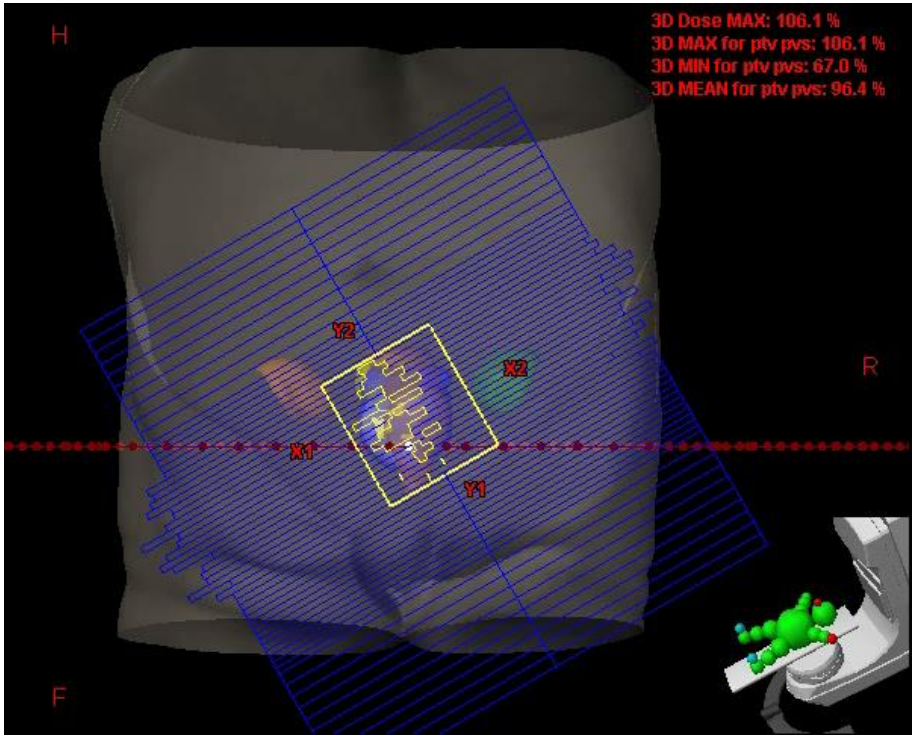
Simultan integrated boost (SIB) technique



2 full rotation with RapidArc



dose distribution



RapidArc technique

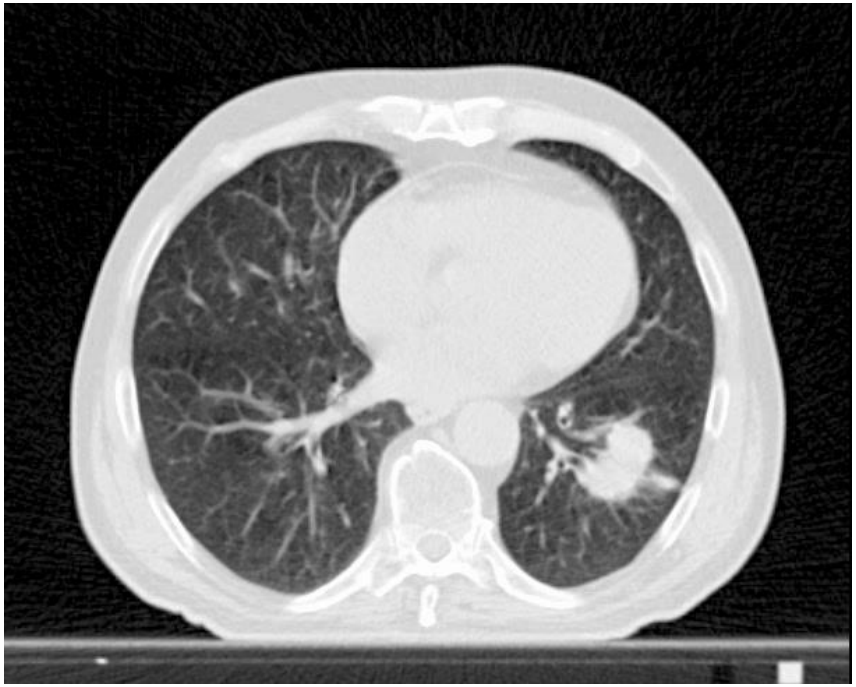
Stereotactic Body Radiotherapy (SBRT)

- 4D CT with Anzai belt system (slow CT with respiratory curve)
- GTV delineations on CT series reconstructed in 7 phases
- ITV creation with union of GTVs followed by CTV/PTV definition
- RapidArc treatment plan for PTV with 2 partial arcs
- Treatment delivery with 6 MV FFF (8 x 7.5 Gy)
- IGRT with kV-CBCT before each fraction
- On-line correction with 6DoF table

Irradiation time: **< 2 min**
Treatment time: **~12 min**

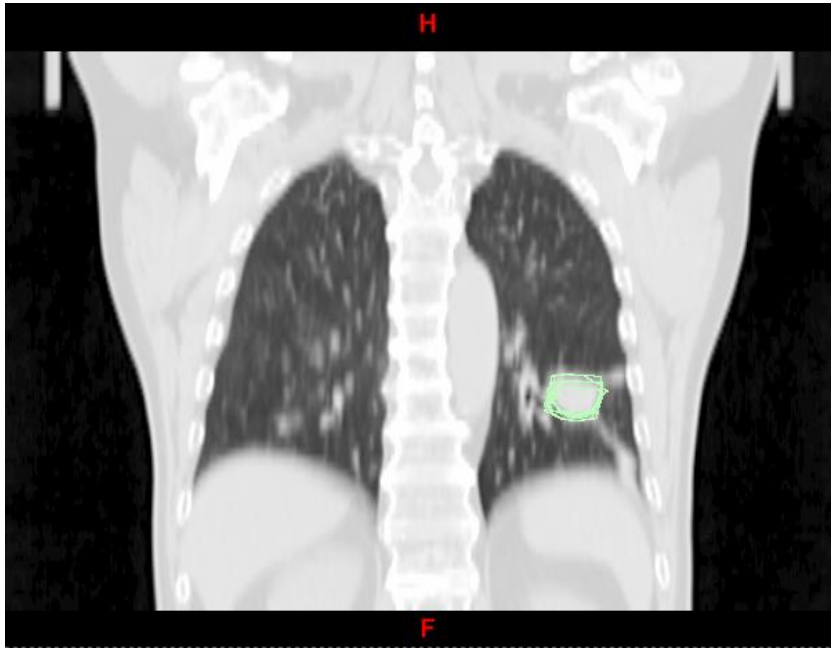
4D imaging for SBRT

4D CT with Anzai belt

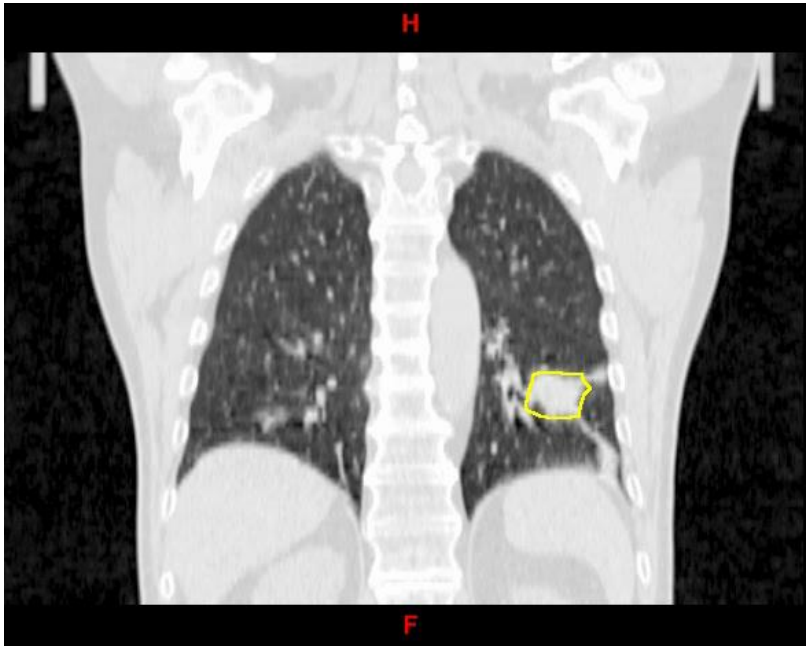


evaluation of target movement

Definition of ITV

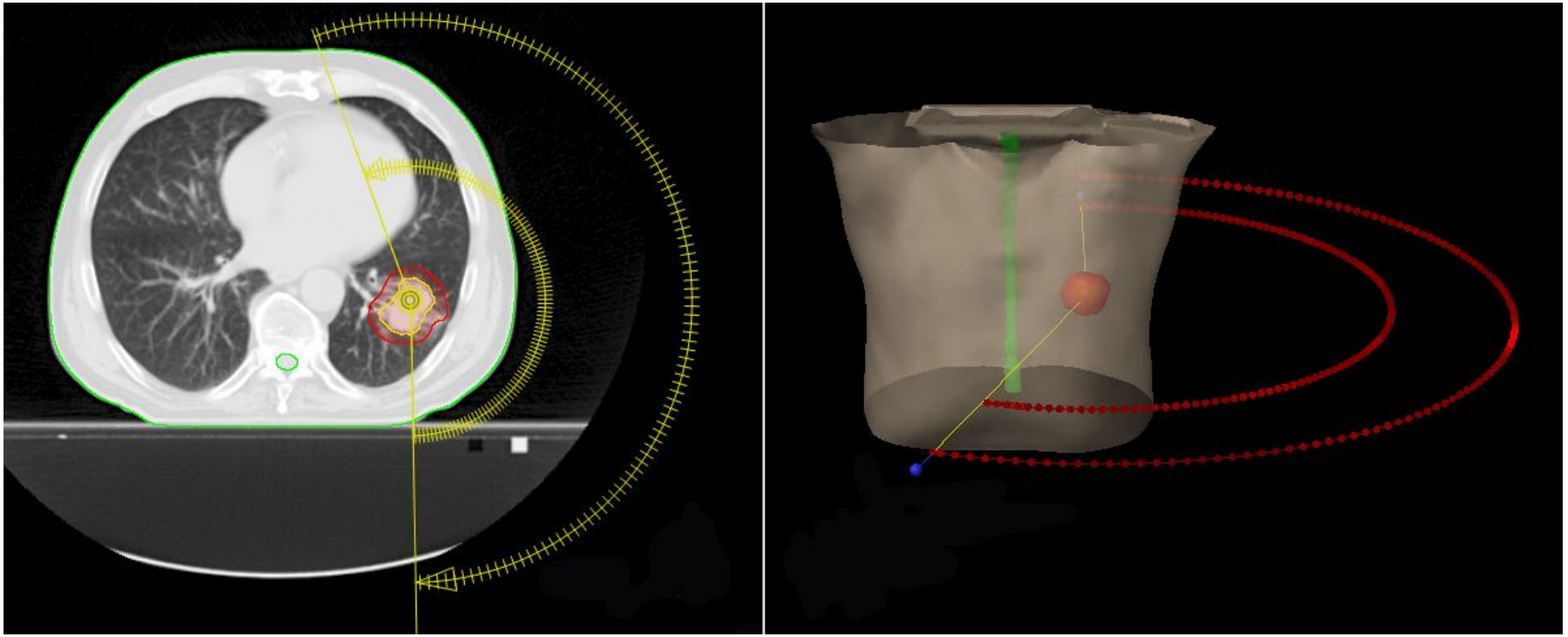


GTV contours in each phase



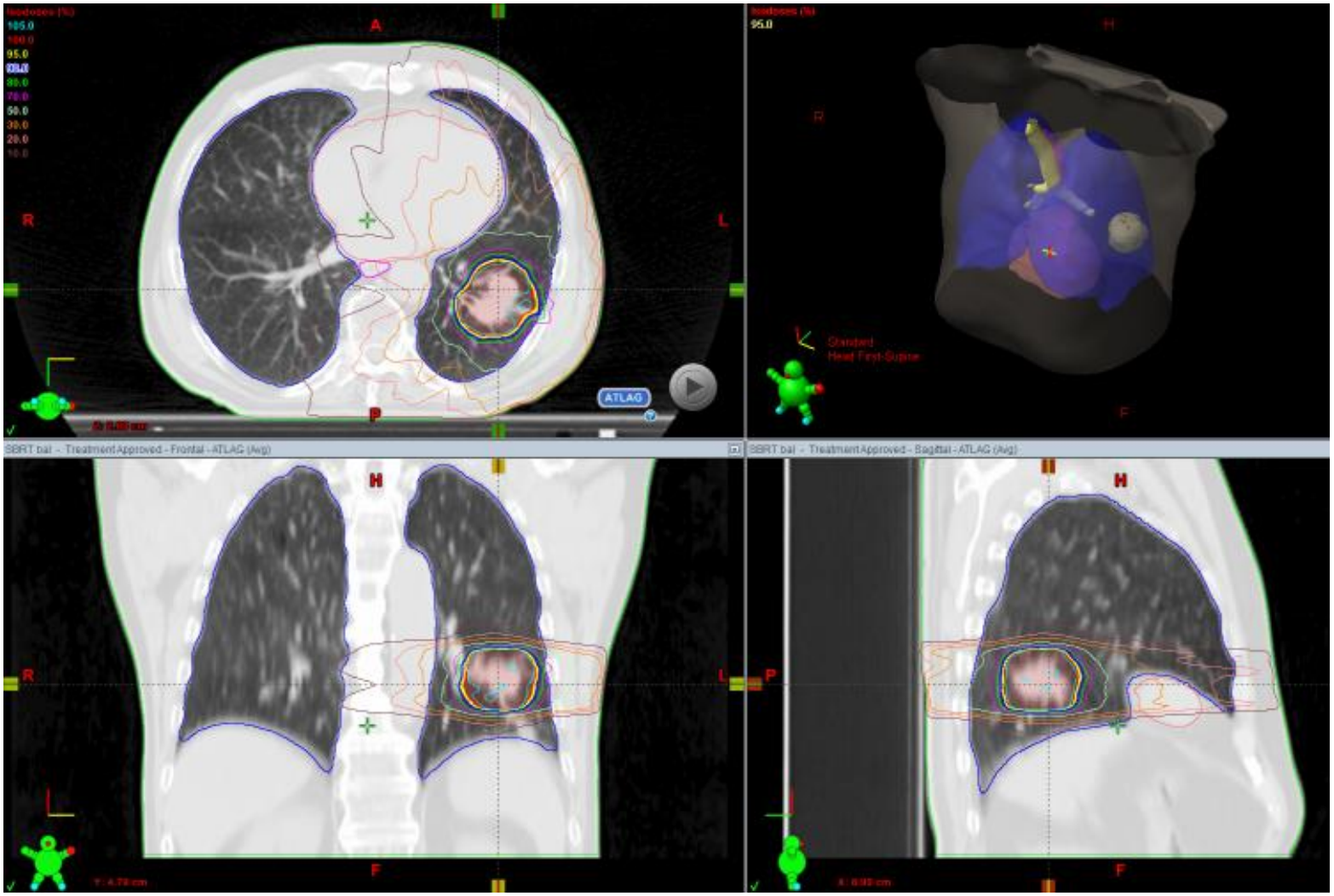
ITV includes all GTV contours

Irradiation with RapidArc technique

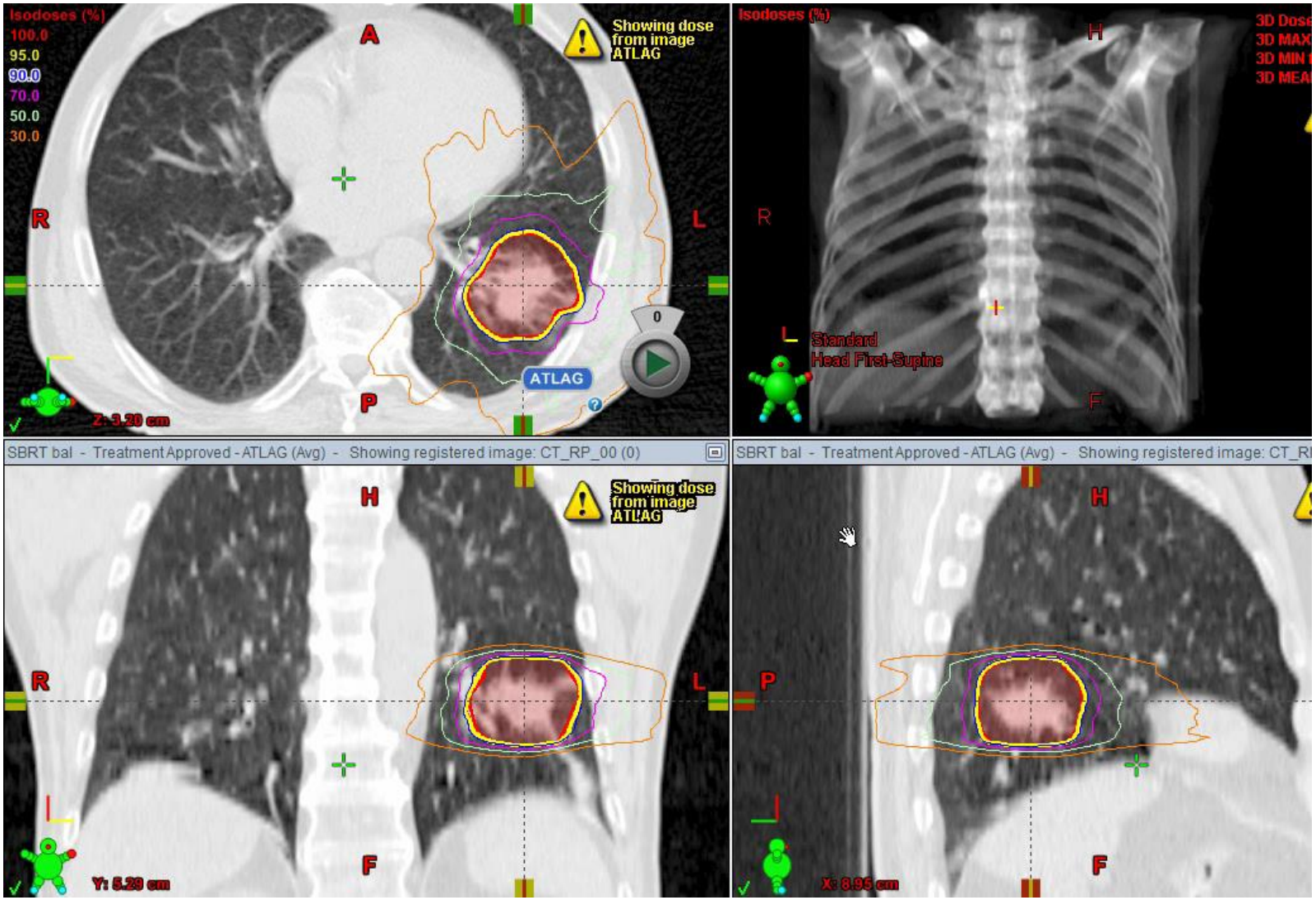


Treatment with two partial arcs

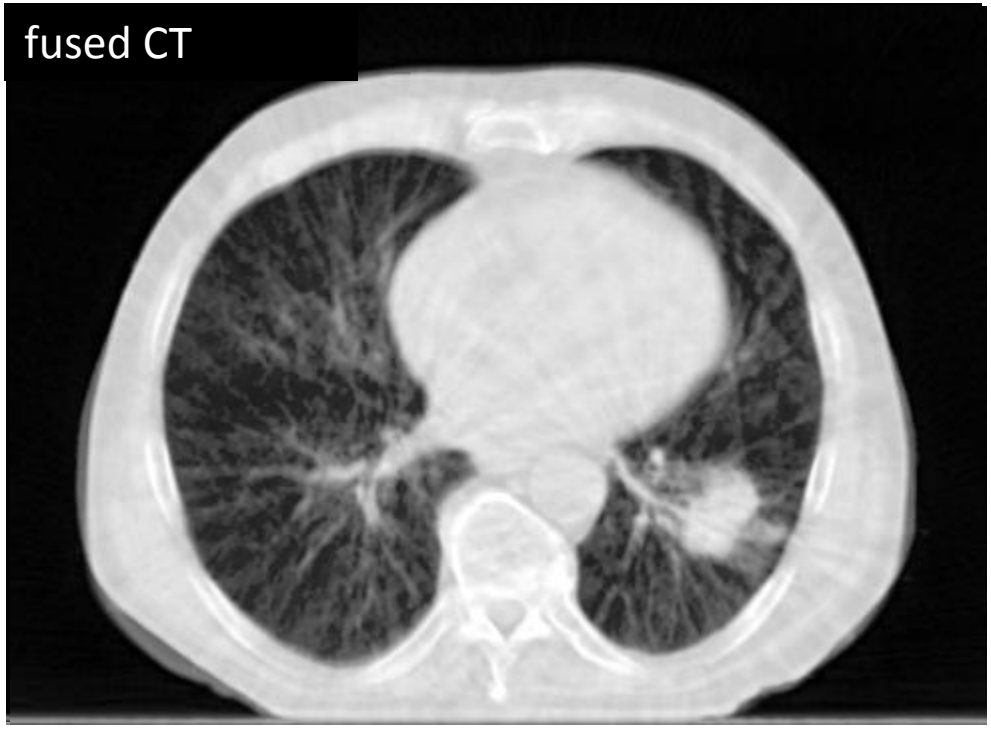
Conformal dose distribution in 3D

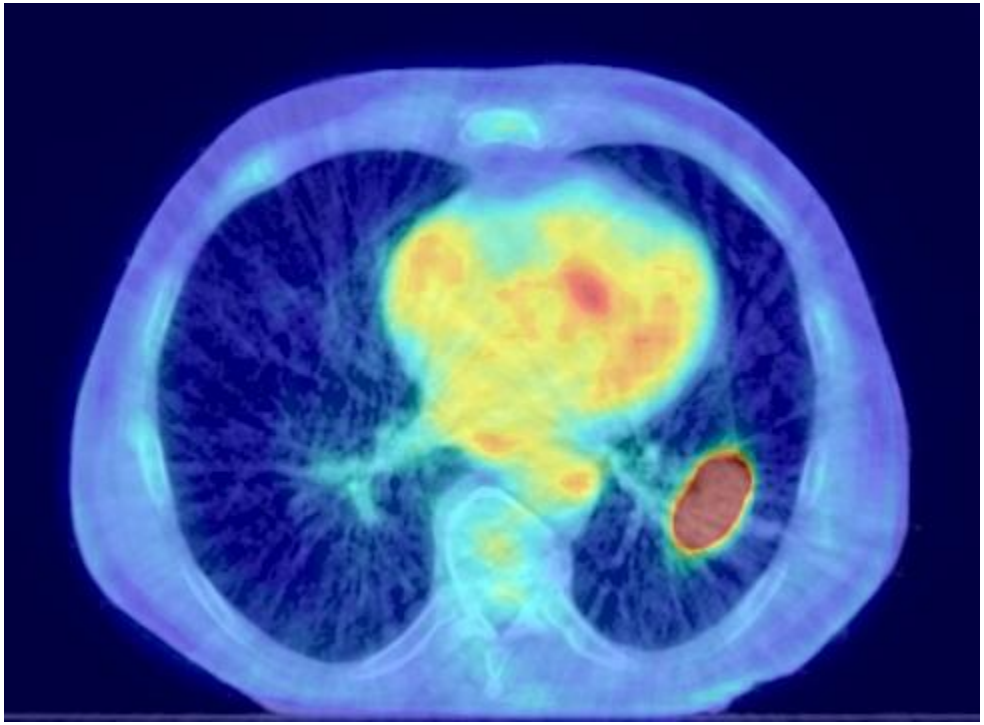


Static dose distribution with moving target



IGRT with daily kV-CBCT

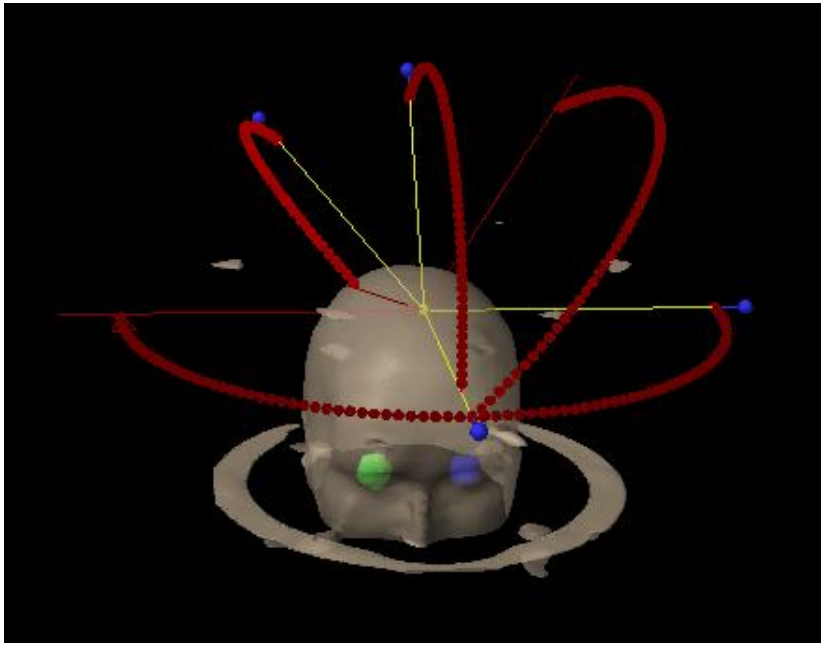




planning PET and kV-CBCT

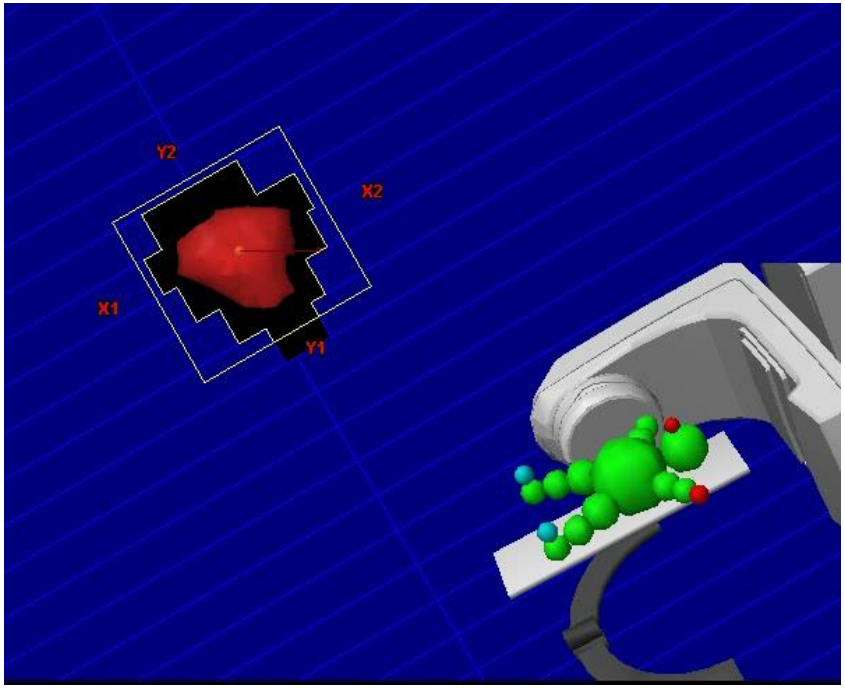
Stereotactic radiosurgery

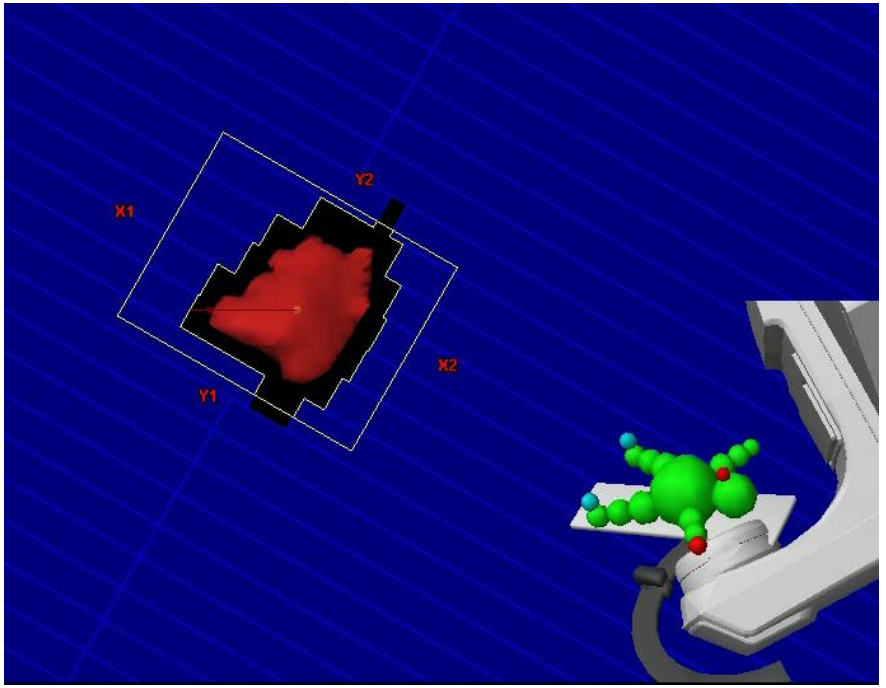
Head fixation with invasive frame



Treatment with four non-coplanar beams

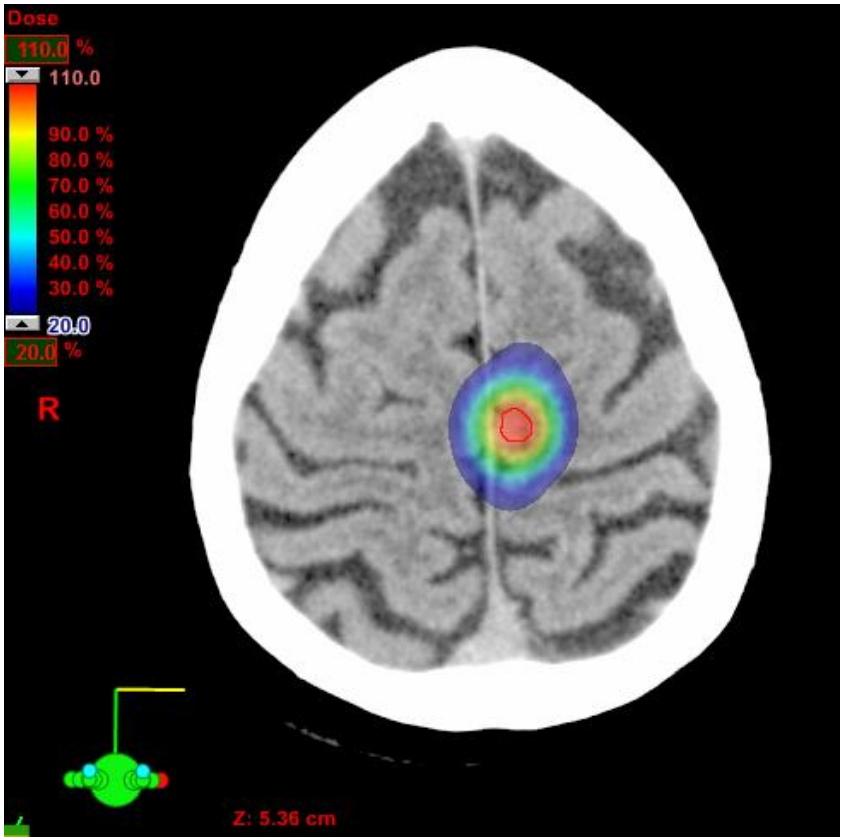
Dynamic conformal arc irradiation

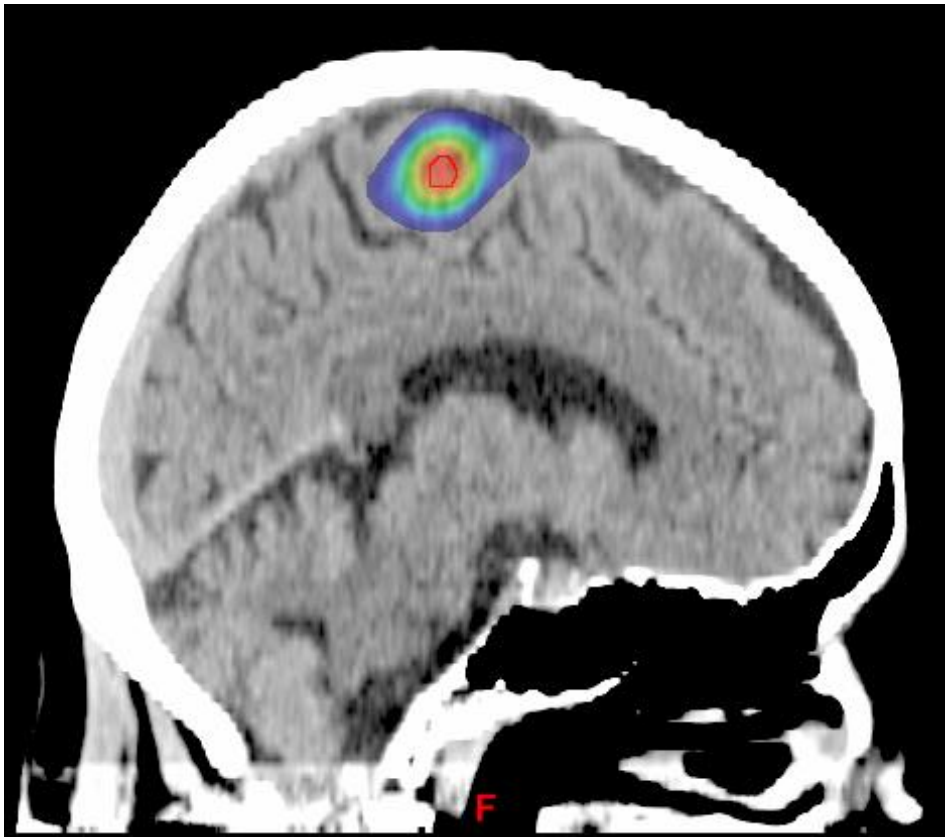




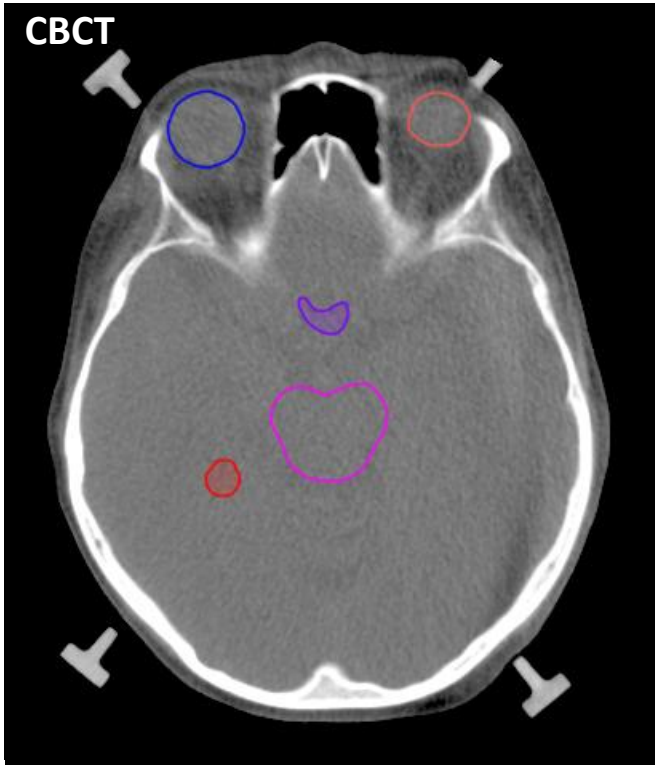
Beam aperture continuously conforms to the shape of the PTV

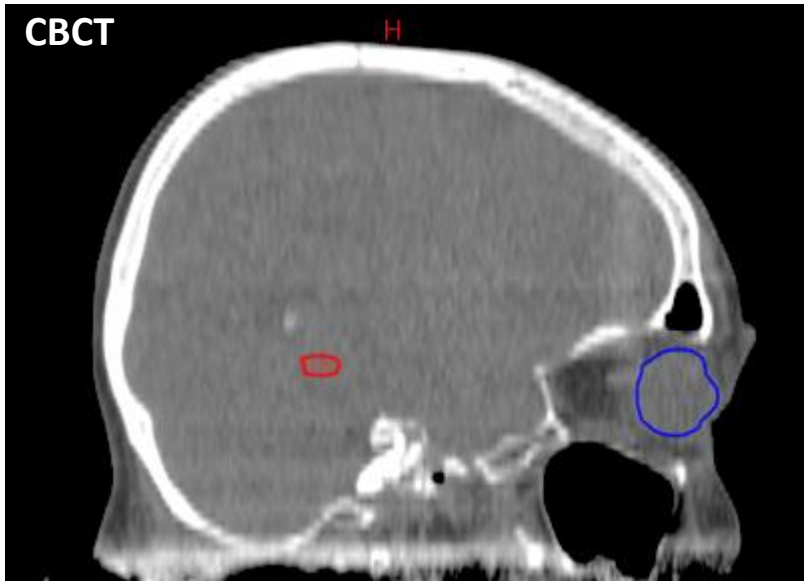
Dose distribution in transversal and sagittal planes





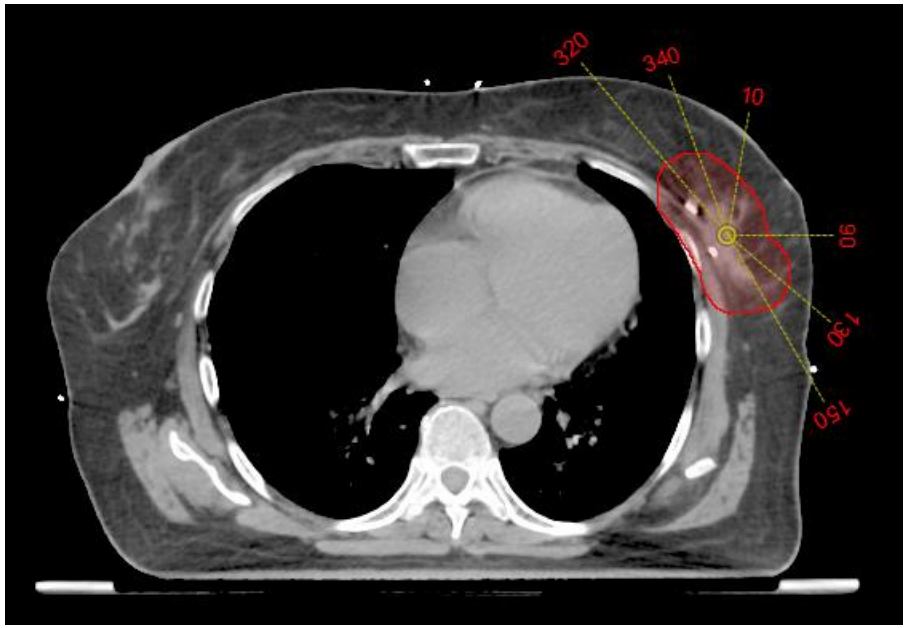
Verification with kV-CBCT

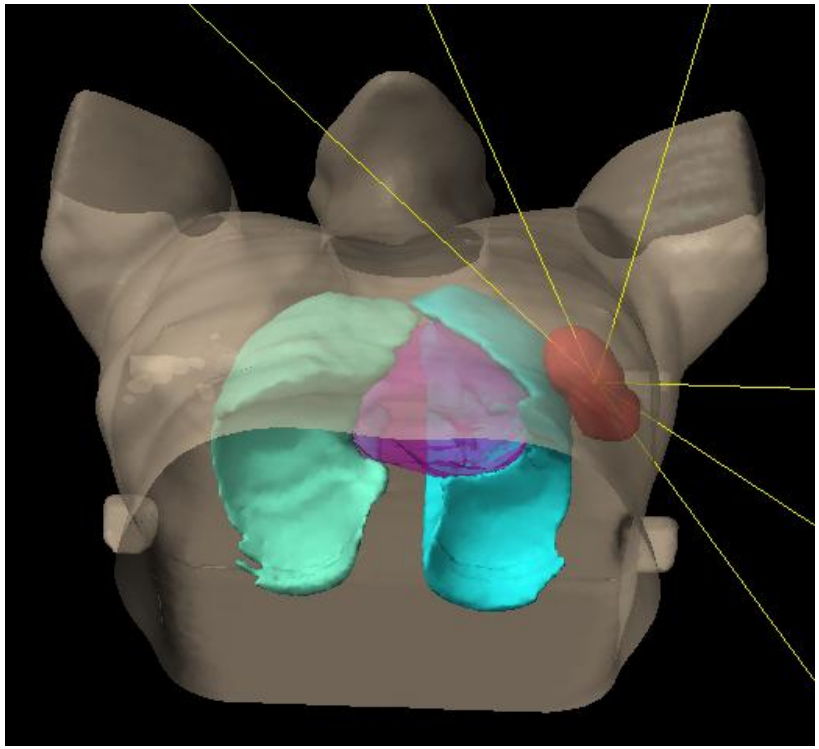




Session	Vrt [cm]	Lng [cm]	Lat [cm]	Pitch [deg]	Roll [deg]	Rtn [deg]
Thu 4/28/2	0.00	-0.10	0.00	+0.1	-0.2	+0.1

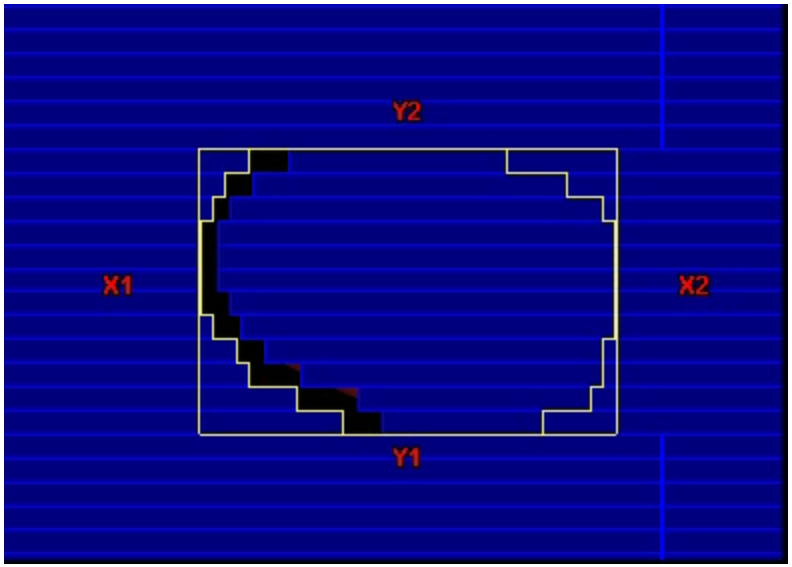
Accelerated partial breast irradiation (APBI)





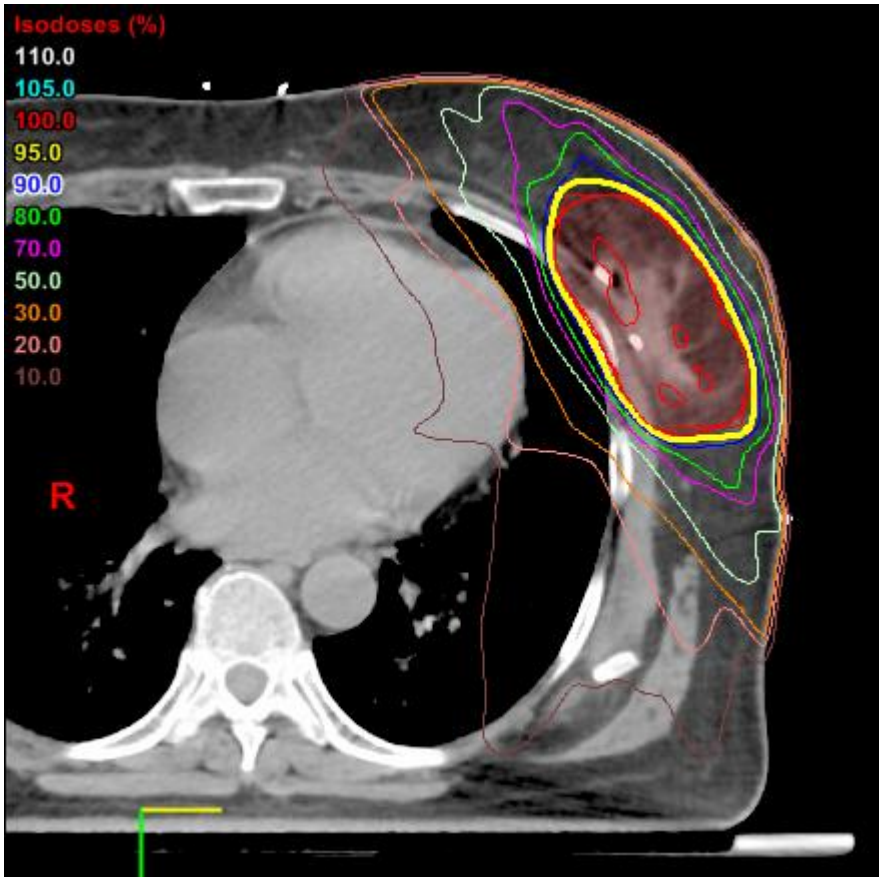
Beam arrangements for APBI (5-6 co-planar IMRT beams with sliding window)

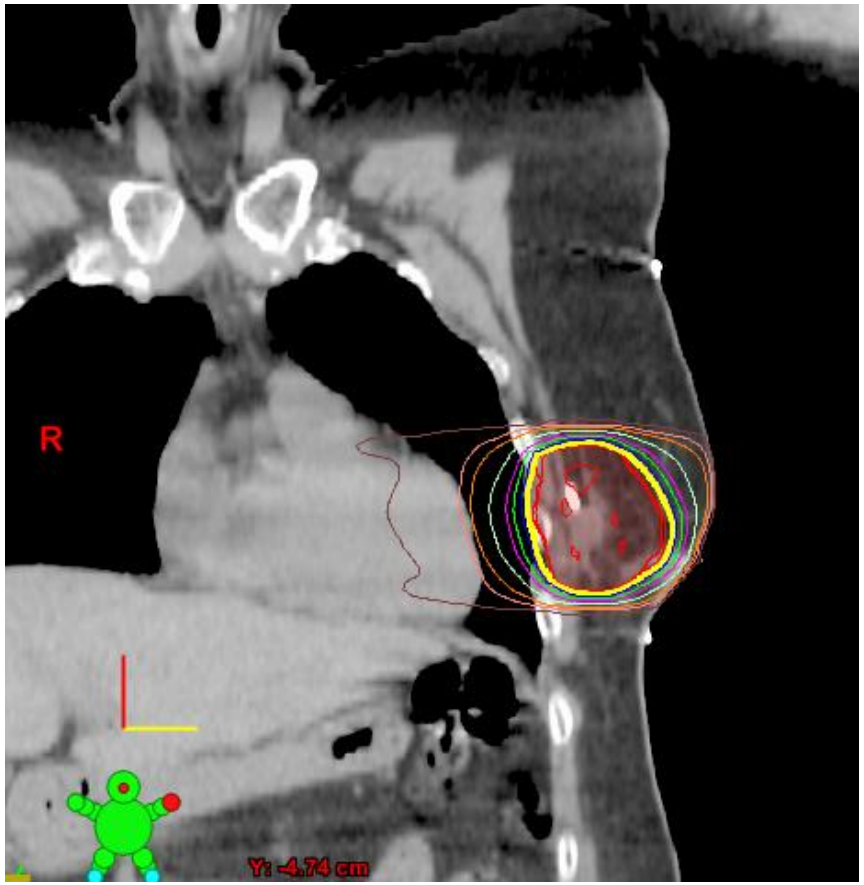
IMRT with sliding window technique



At fix gantry angle the MLC-s are moving while the beam is on

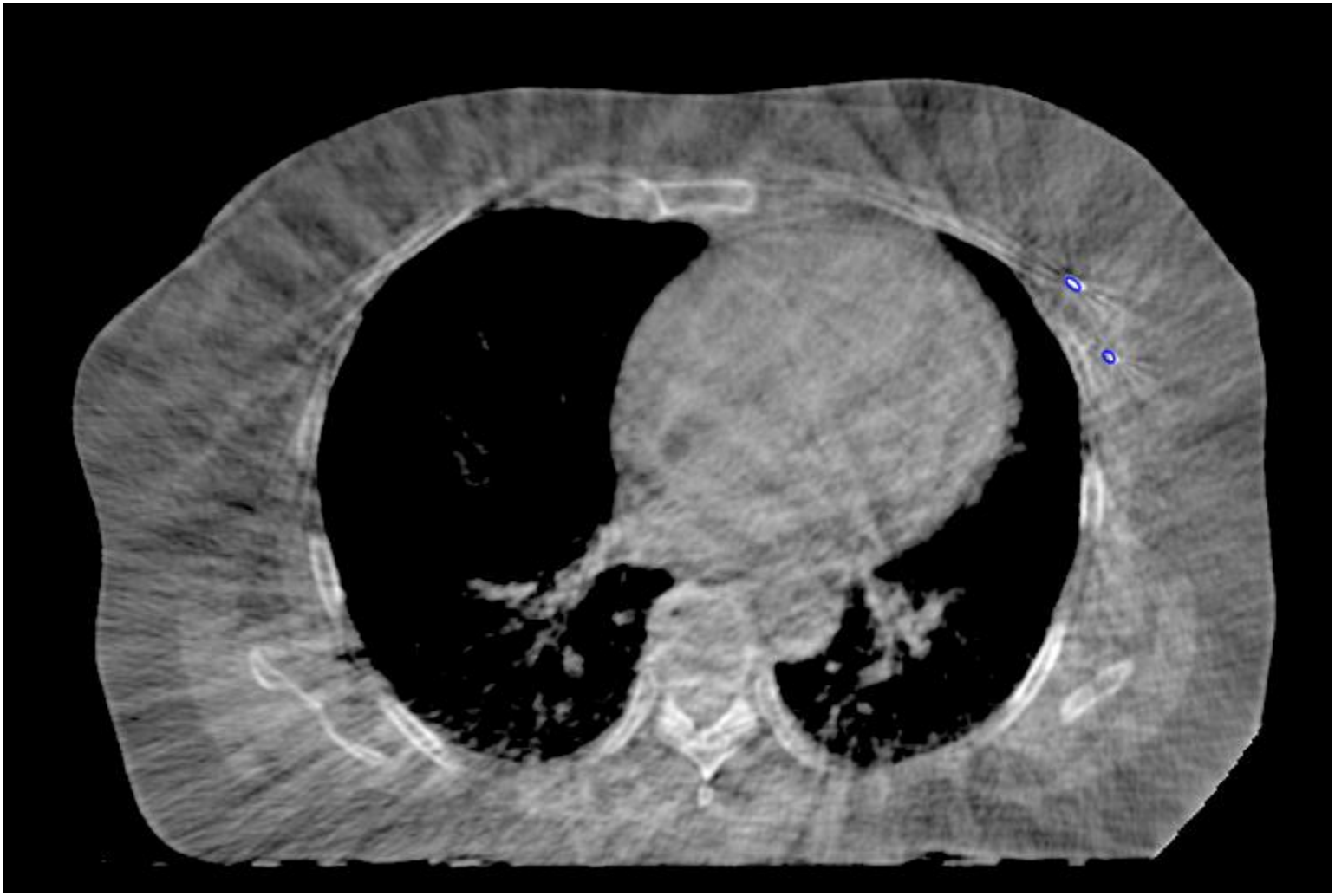
Dose distributions in transversal and coronal planes



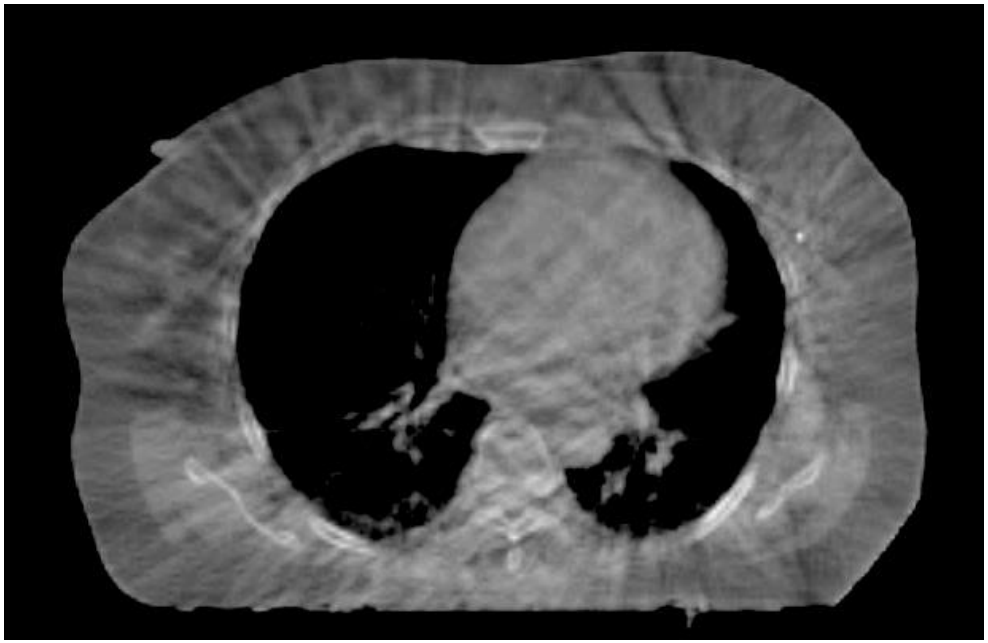


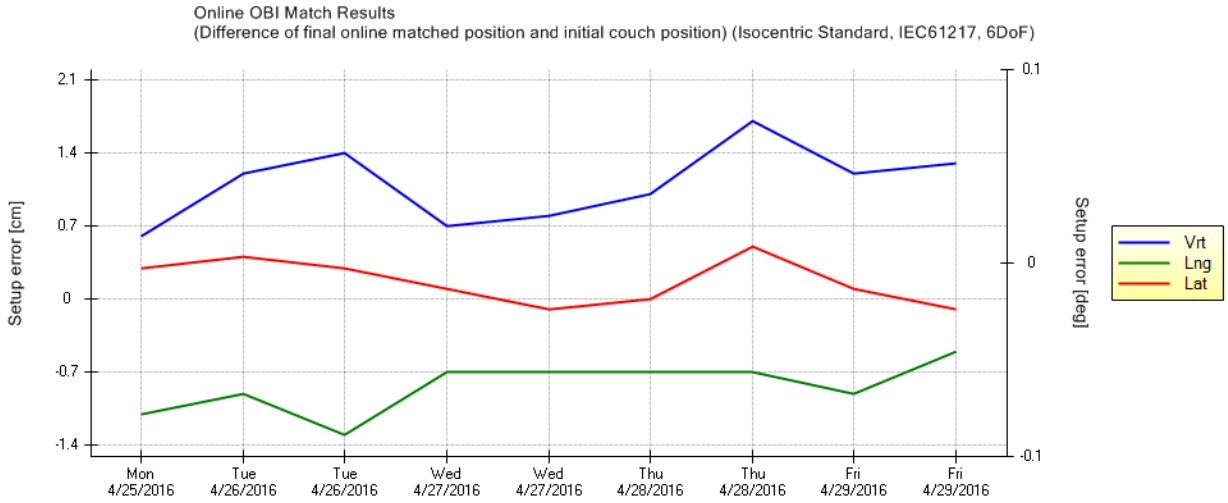
Prescribed dose: 9 x 4.1 Gy

IGRT with kV-CBCT using the clip positions

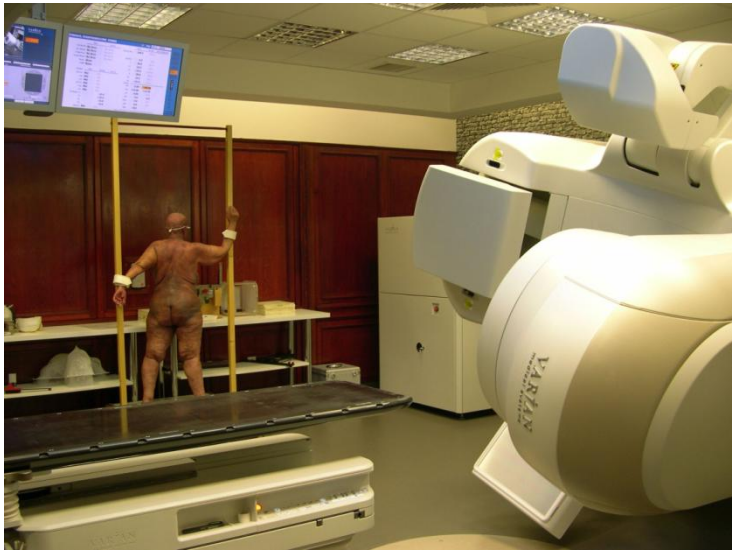


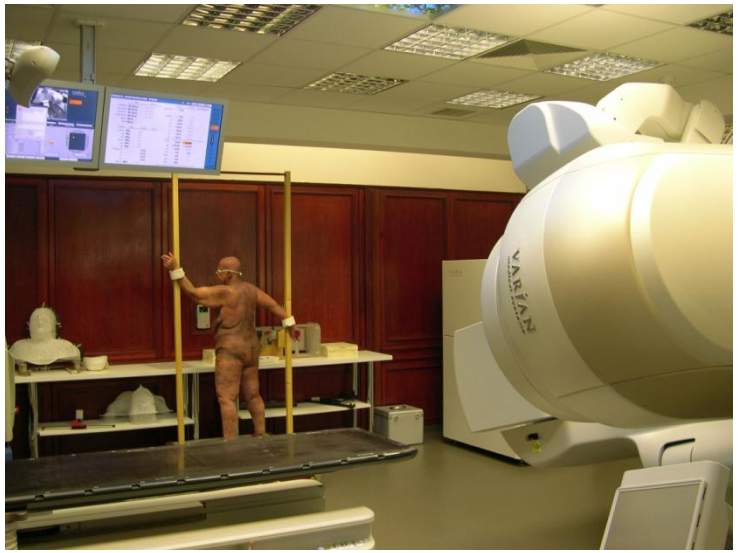
Setup errors without corrections





Total skin irradiation





- large source – skin distance (430 cm)
- 6 MeV HDTSE – 2500 MU/min
- 6 patient positions (3 + 3 in two days)
- 2 gantry angles (106.5° and 73.5 °) for each position

User's statements about TrueBeam

- Versatile equipment for all needs in radiation oncology (simple and complex treatments for cancer anywhere in the body)
- Flawless integration with treatment planning and R&V system
- Fast imaging and accurate dose delivery
- Automated workflow with optimized patient throughput
- Very reliable with high uptime (> 98%) – good service
- Extensive training and continuous support from the company

Thank you for your attention!