

Radiation therapy

Planning and Treatment

Aaron Asfaha

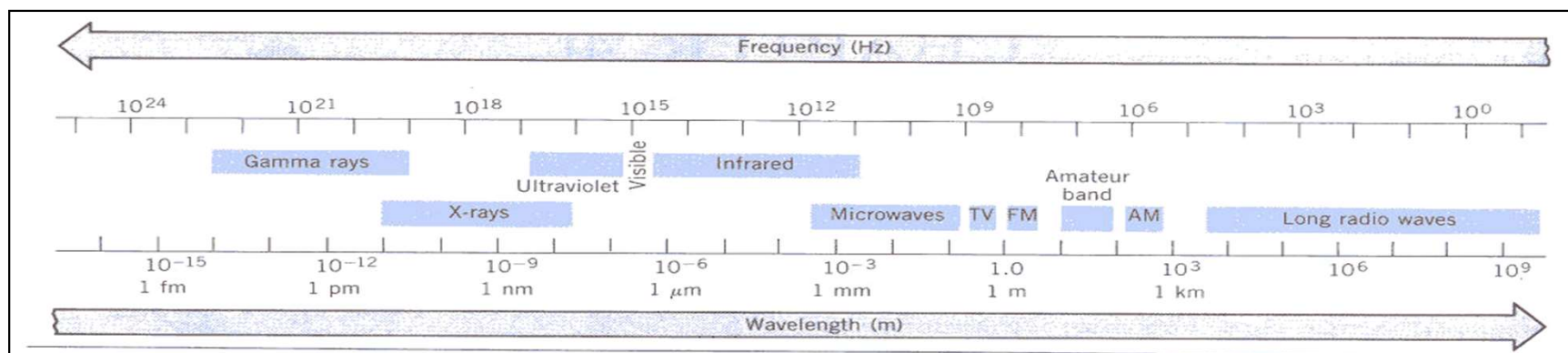
Radiation therapist

Division of cancer medicine

Oslo university hospital

Radiotherapy

- Treatment of cancer by using high energy radiation
- The treatment aim can be:
 - radical in order to cure the patient only with radiotherapy or in combination with other modalities
 - local control (stop tumor growth)
 - relieve pain (palliation)



RT- Treatment

External radiation therapy by high energy photons, electrons, protons or other particles

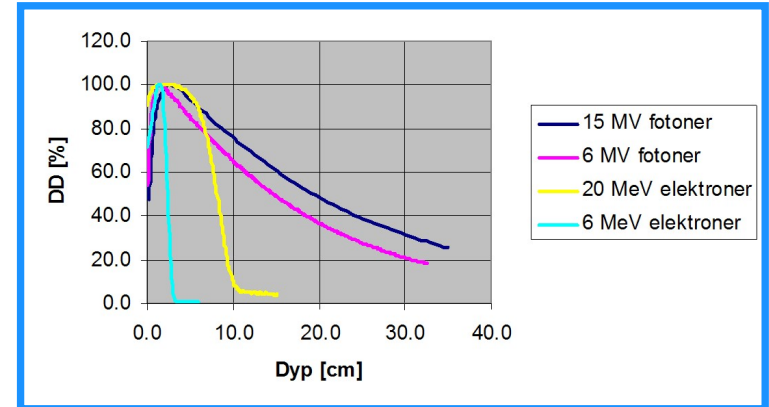
Internal; brachyterapi, radioactive sources

Radiation causes permanent DNA damage

Unrepaired DNA damage leads to cell death

Fractions:

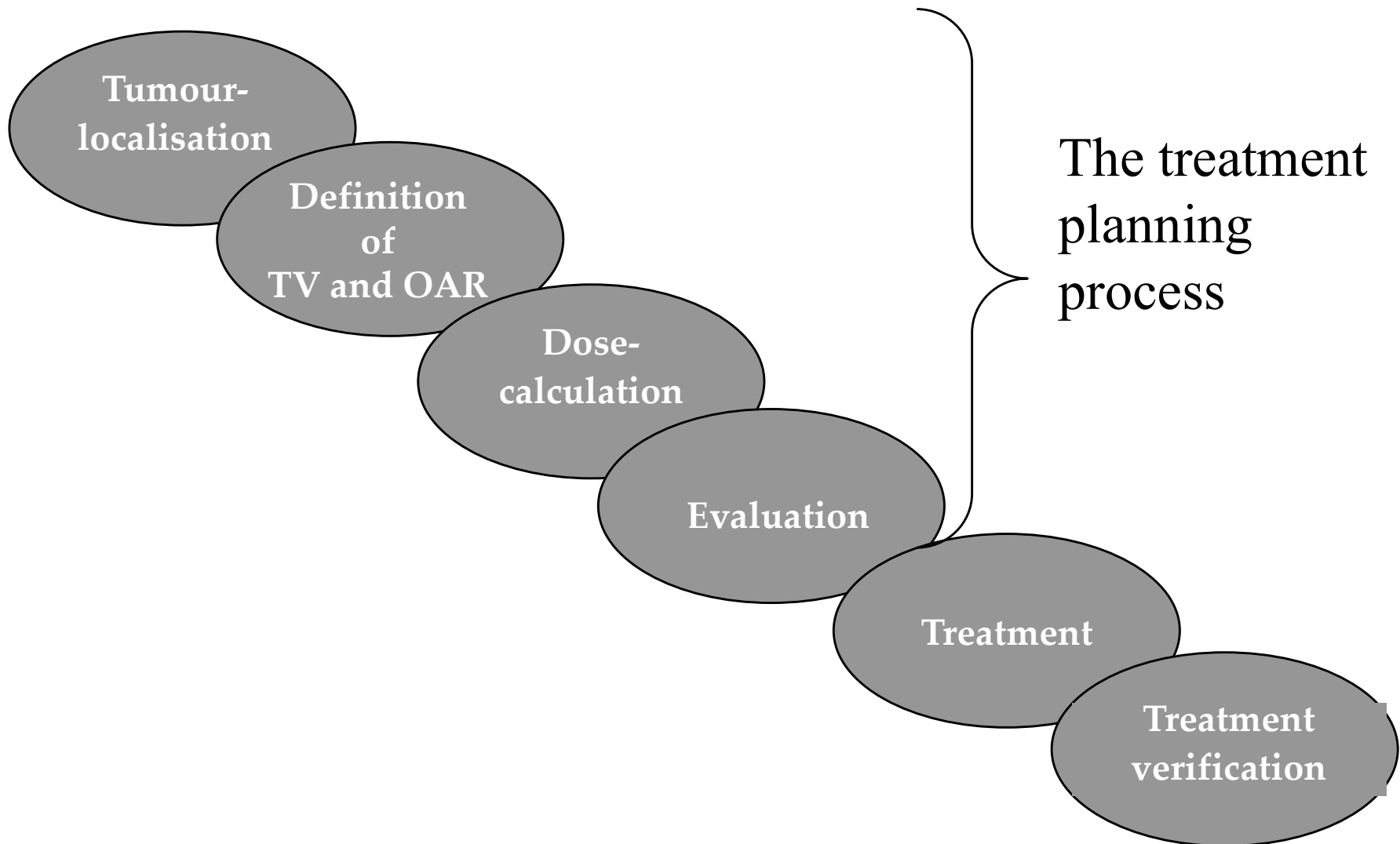
- smaller doses over a period of several days, there are fewer toxic effects on healthy cells
- healthy cells repair damage better than cancer cells



The principle for curative
treatment is to
kill all the cancer cells without
destroying too many normal cells

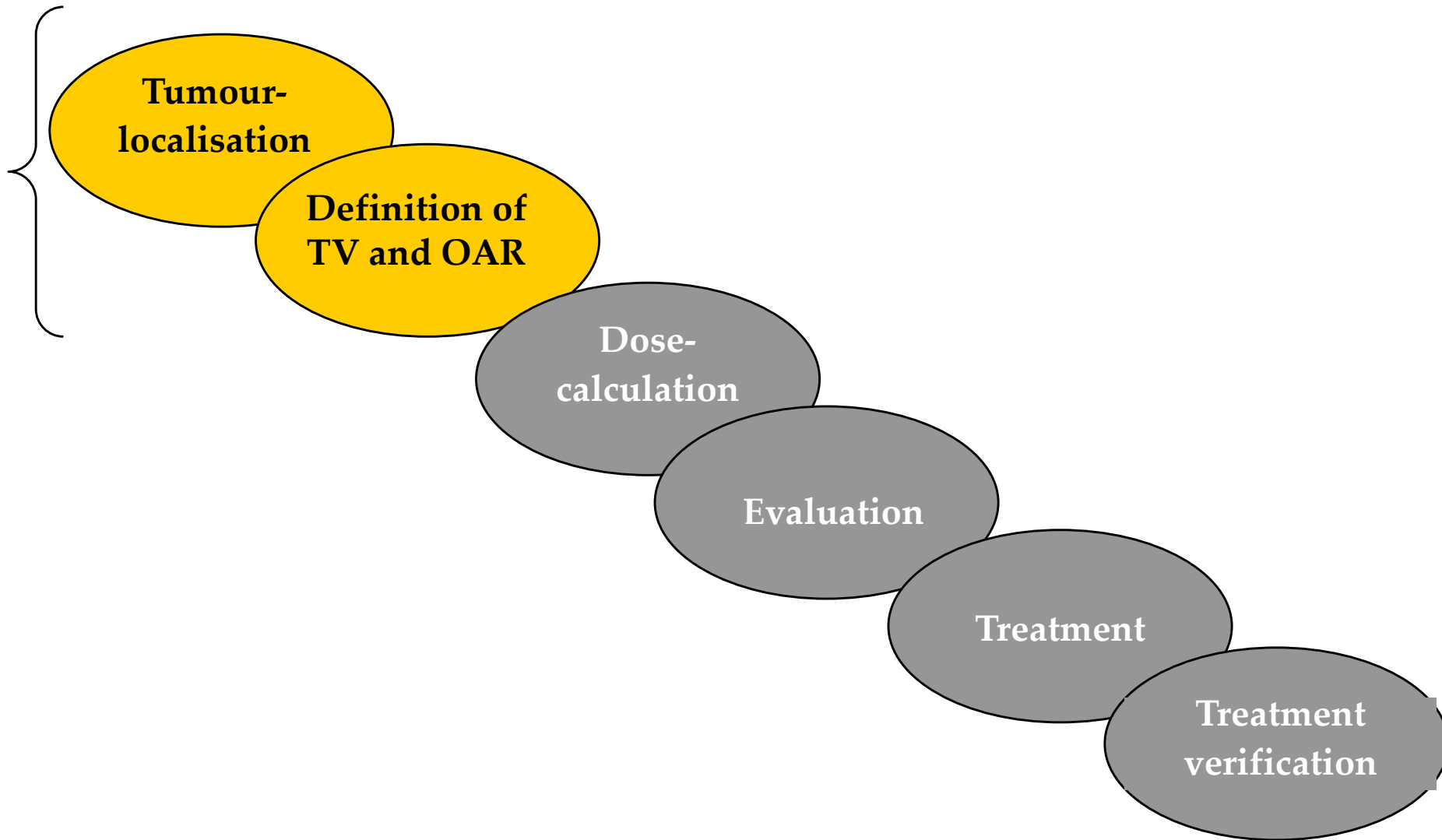
How do we achieve that???

The chain of radiotherapy



Tumour localisation and target definition

The chain of radiotherapy



Tumour localisation

- X-ray
- CT
- MR
- PET
- Ultrasound
- Combination of modalities

CT-based 3D planning

- High geometrical precision
- Difficult to distinguish between different soft tissues
- Tissue density information for dose calculation



MR

- Based on small variations in the magnetic properties of the tissue
- High resolution (however, geometrical distortions)
- High contrast between different soft tissues
- No tissue density information



CT vs MR

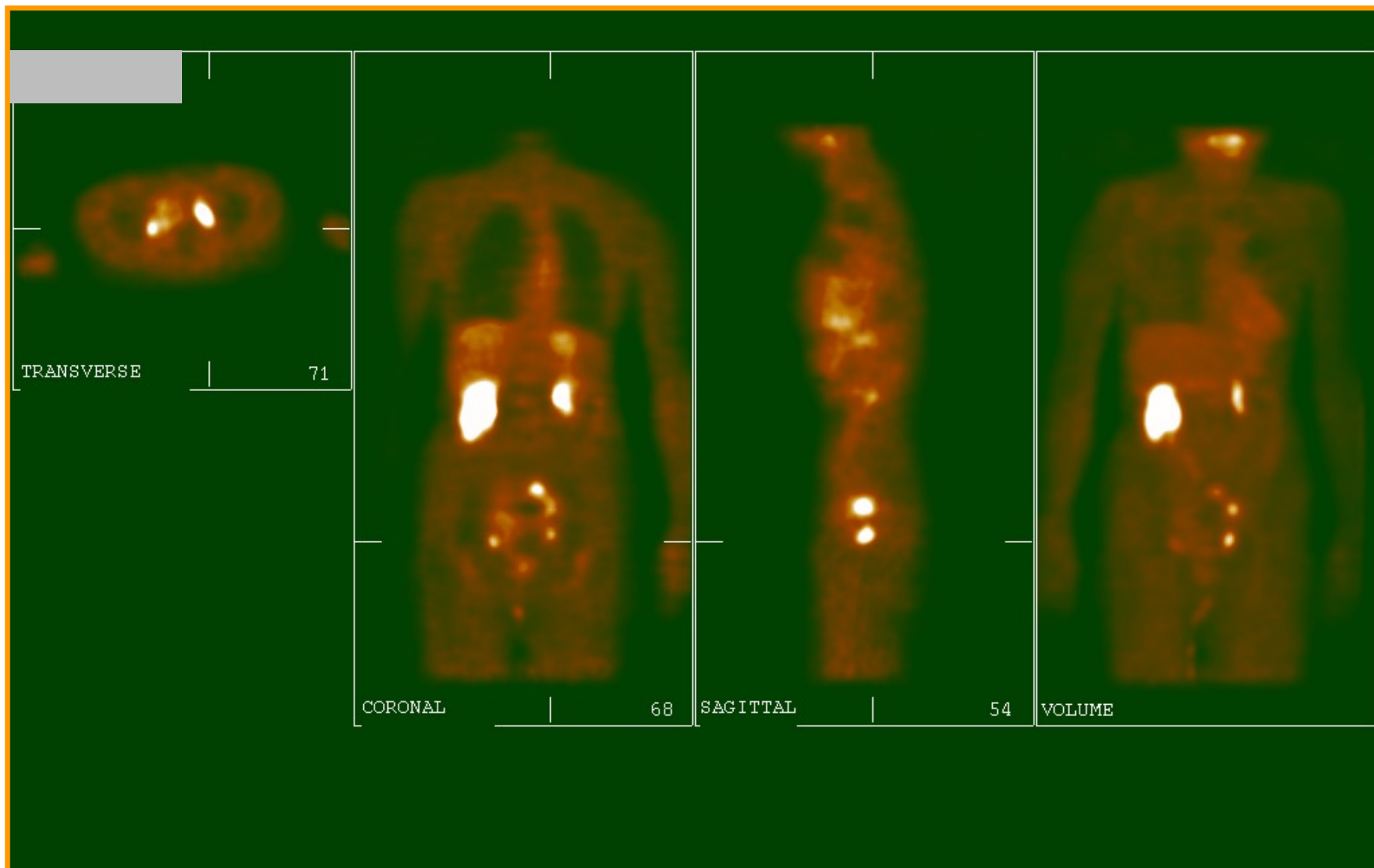


Observer 1



Observer 2

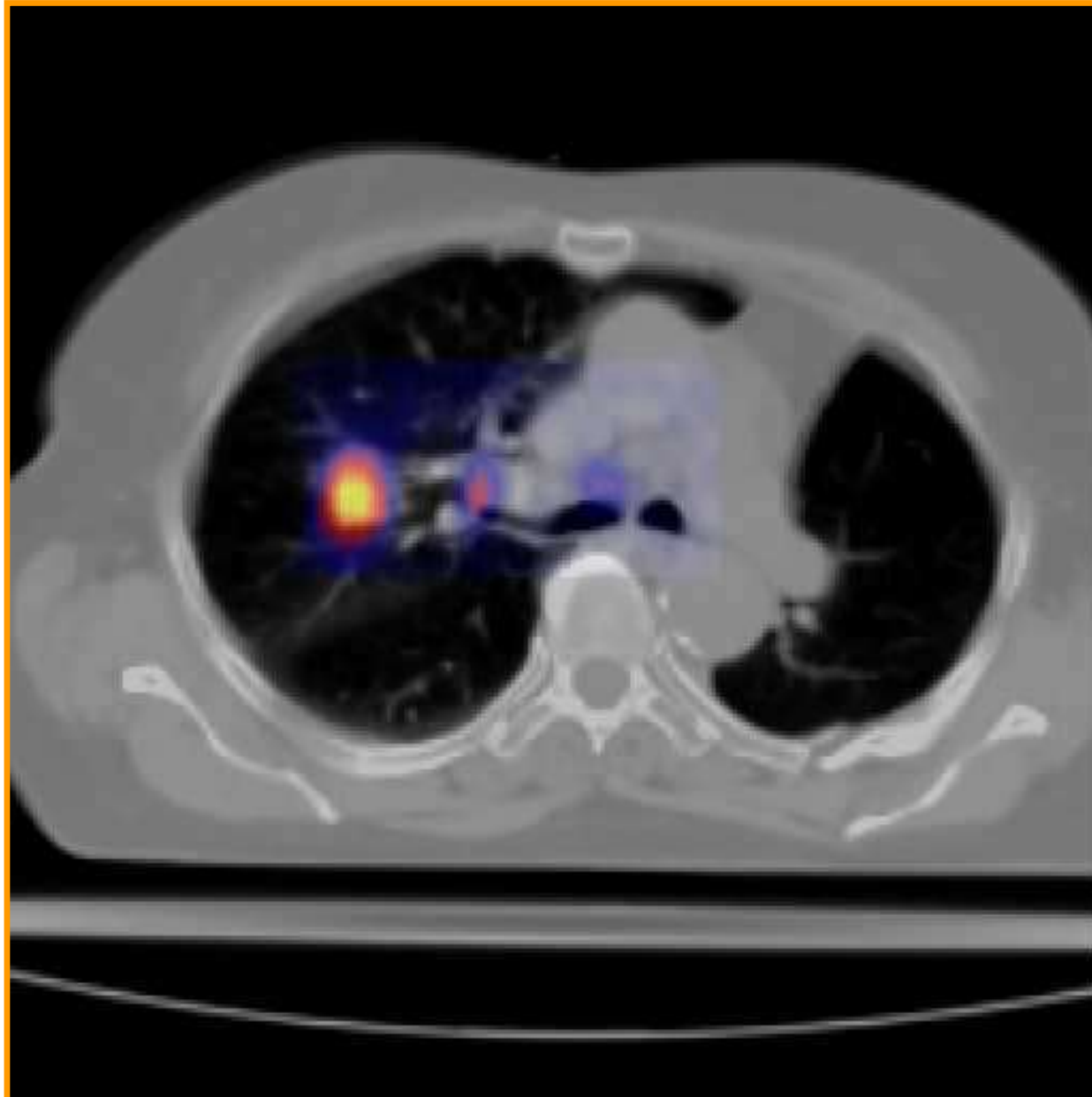
PET



PET&CT

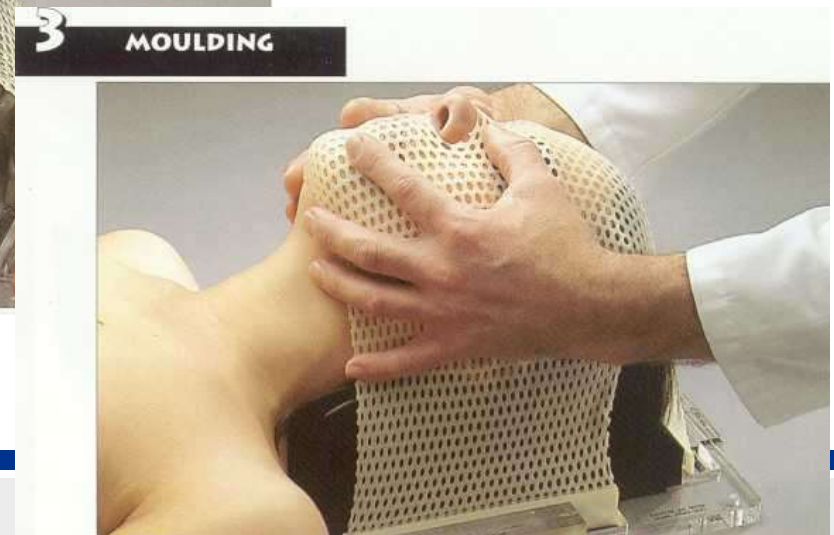
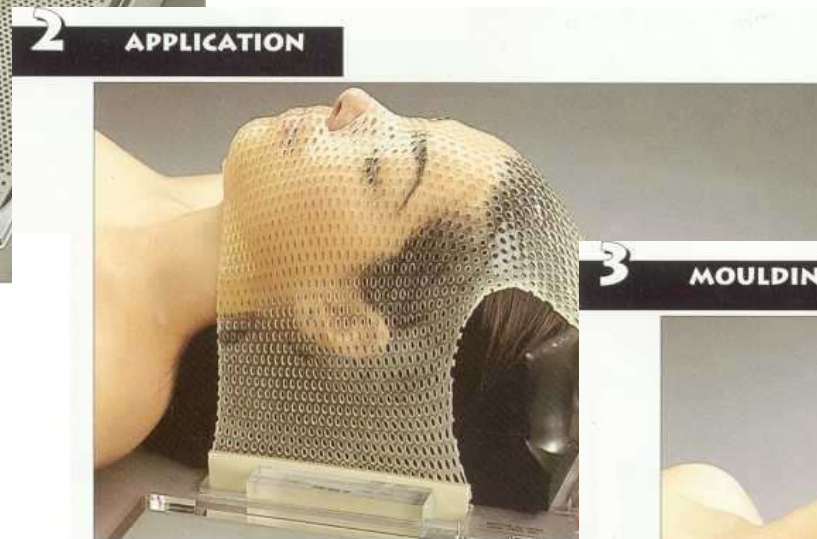


CT + PET



Fixation – positioning the patient optimally

Aim: to allow reproduction of planned patient position and minimize intra fractionation movements



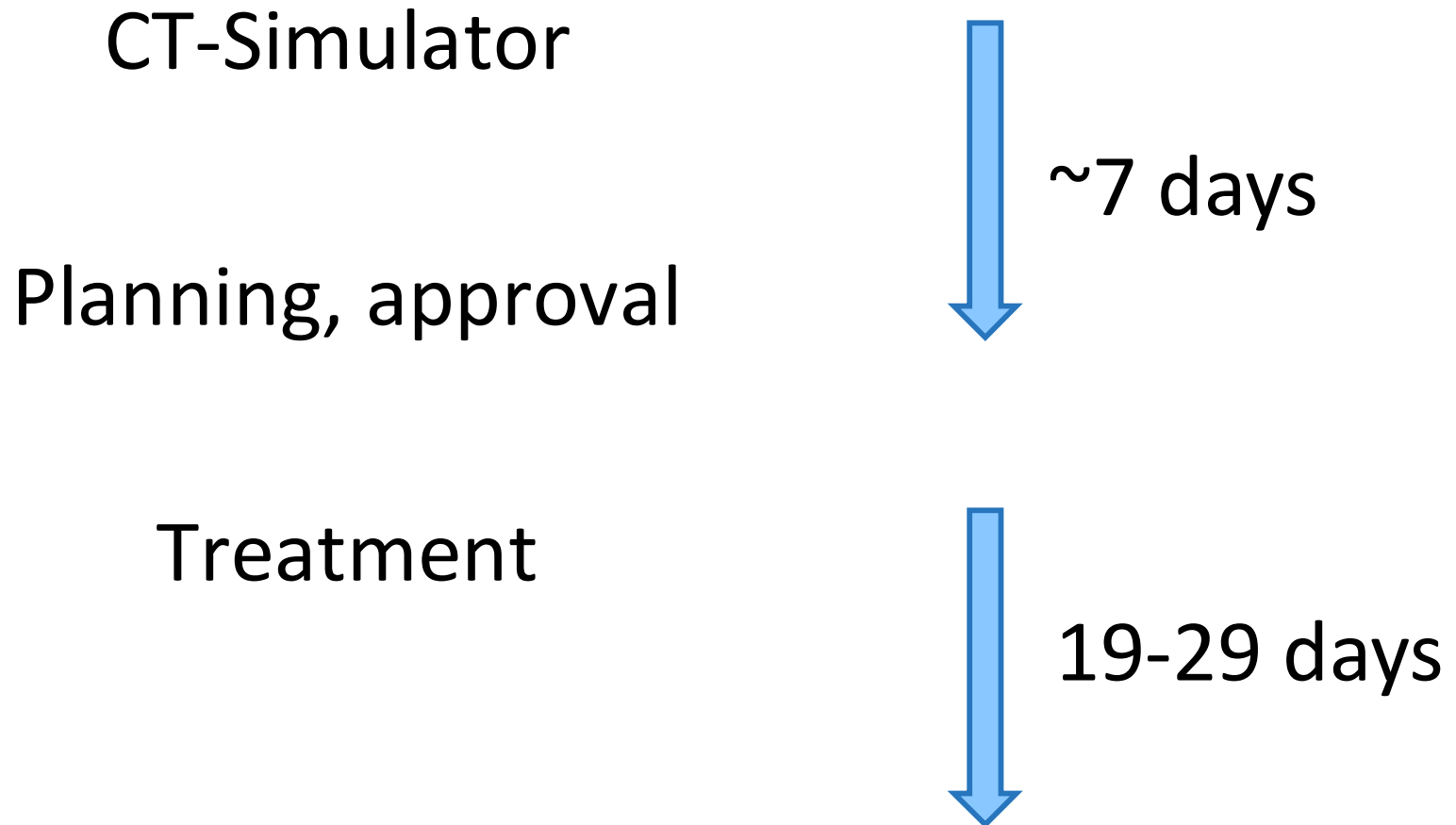
Various fixation devices



Treatment

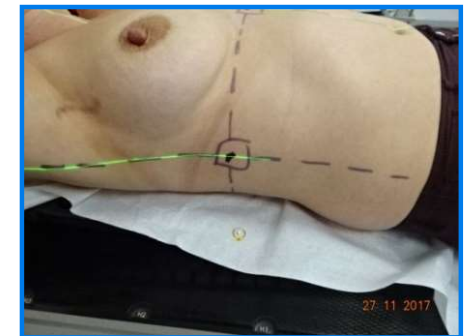


Journey, Breast treatment

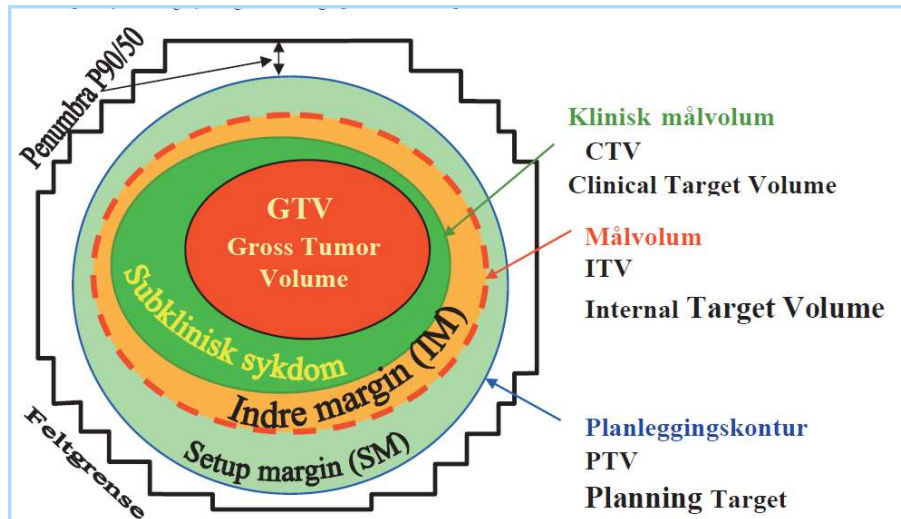
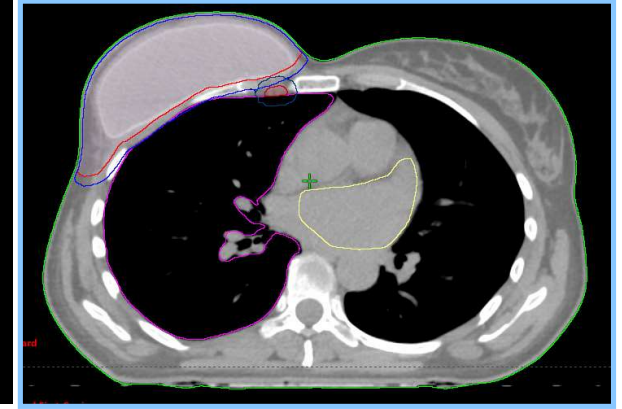
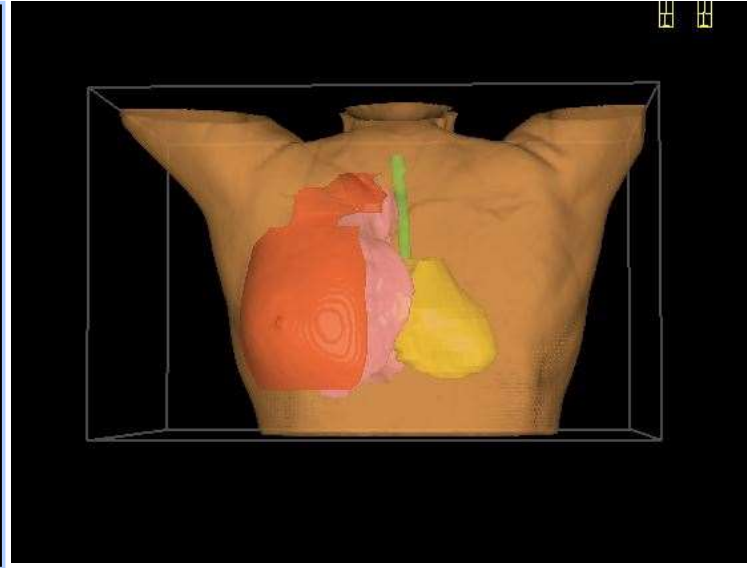
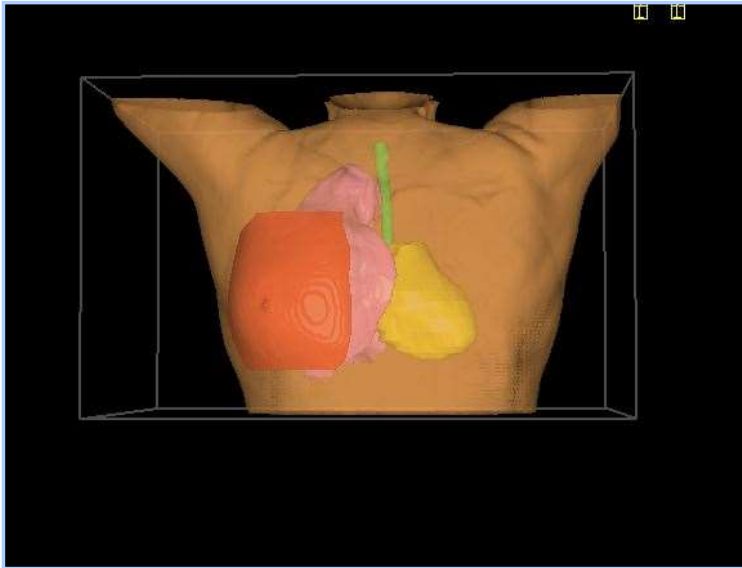


CT simulator breast

- 3D for planning
- Immobilization device; Wingstep, kneefix
- Reference points
- Small mark on the skin or tattoo (Align RT 2022)
- «Gating» DIBH CT (Deep inspiration breath hold)
- CT scan



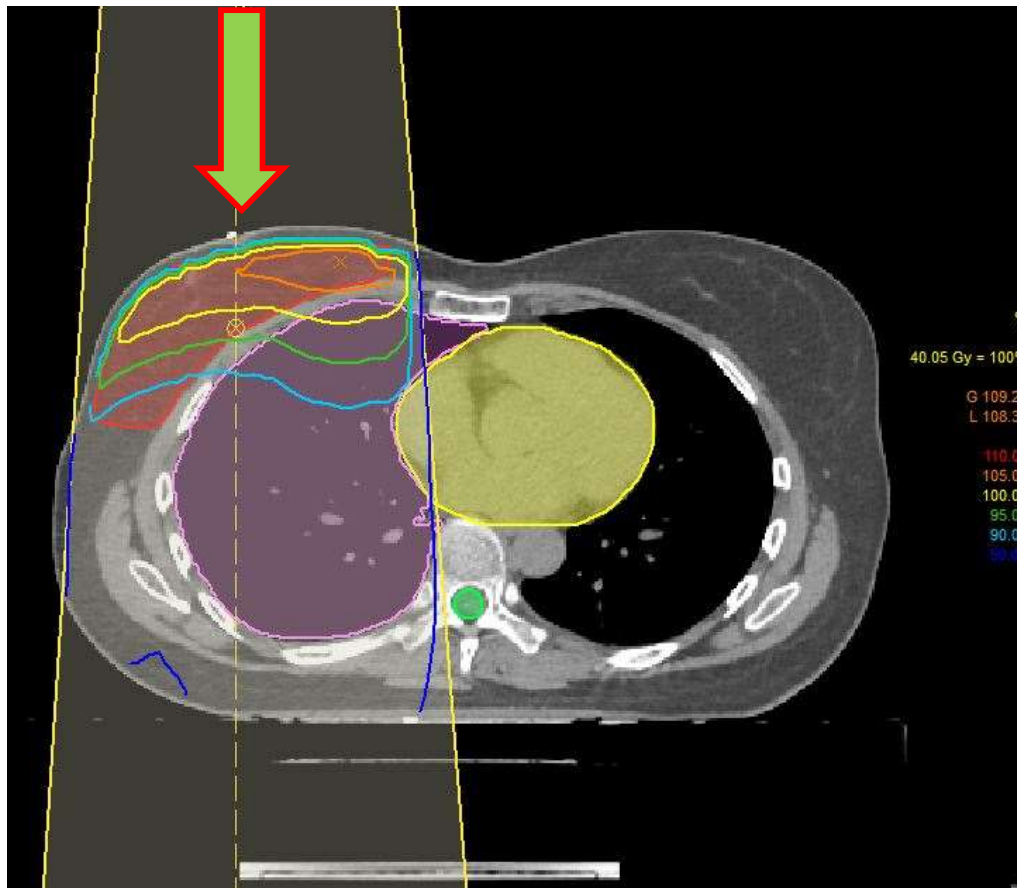
Dose planning



- Based on CT-image
- Fusion with other image modalities
- Correcting for inhomogenous anatomy
- Target volume delineation
- Organs at risk delineation

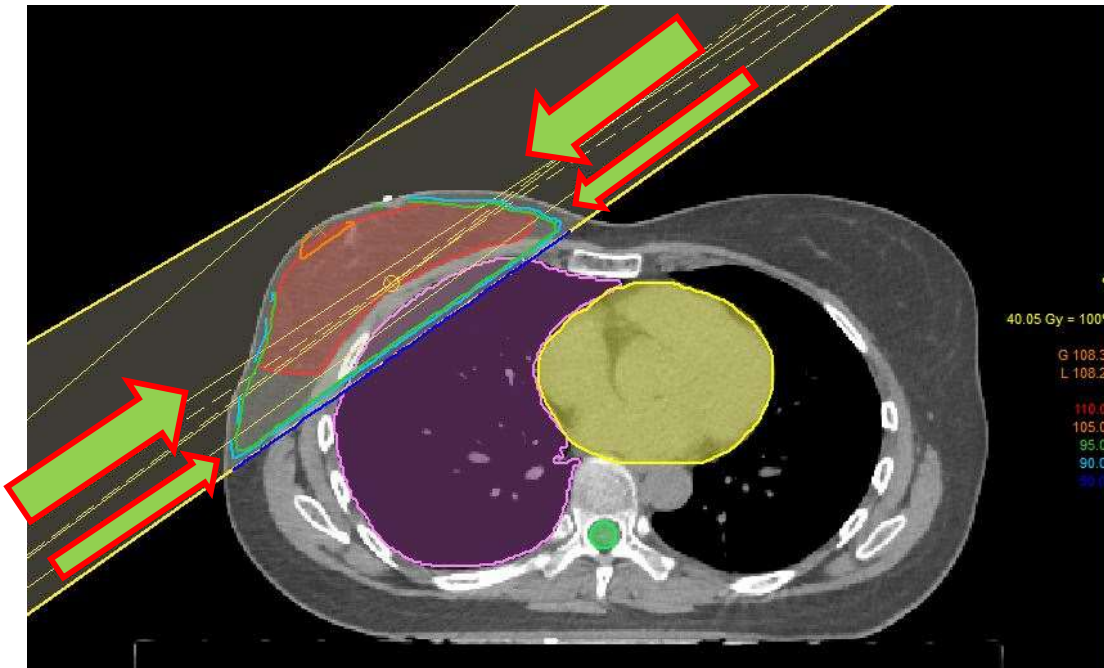


Dose planning of ca mammae



- One treatment field
- Gantry 0°
- Uneven dose distribution
- Ipsilateral lung
- Heart
- Normal tissue

Dose planning of breast



- Two fields + segments
- Gantry $\sim 50^\circ$ / 310°
- Dose distribution
- Ipsilateral lunge
- Heart
- Normal tissue
- Include lymph node = multiple fields

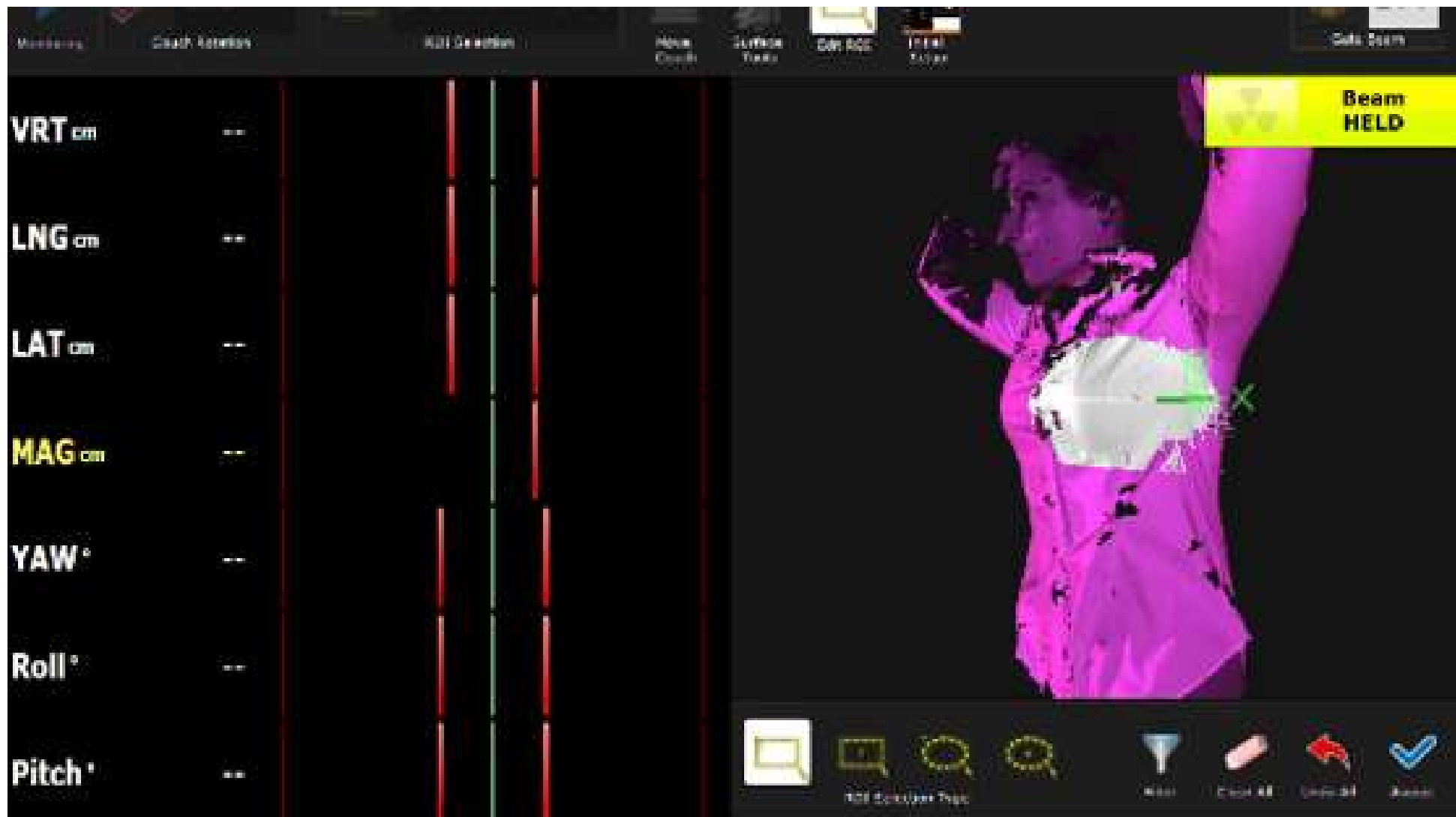
AlignRT



AlignRT

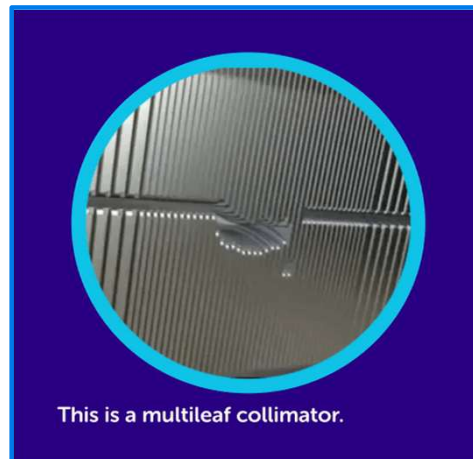
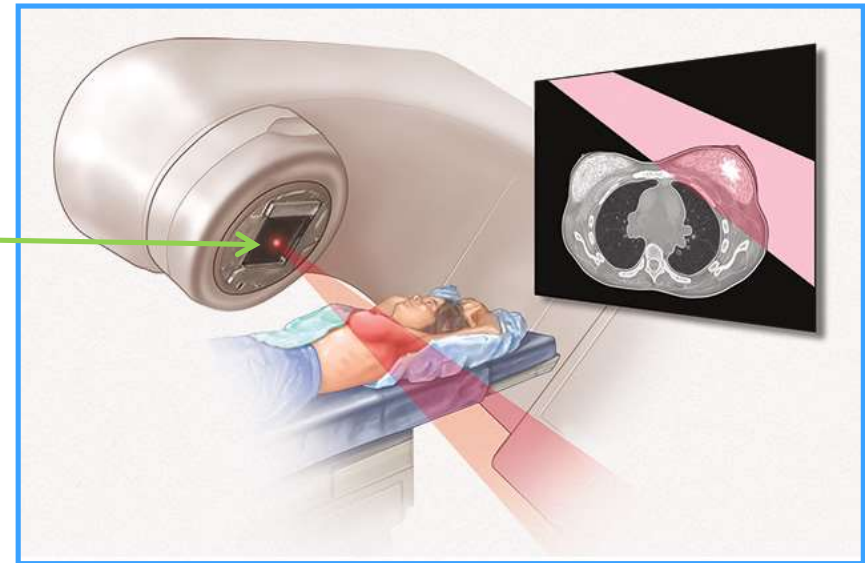


AlignRT



Treatment

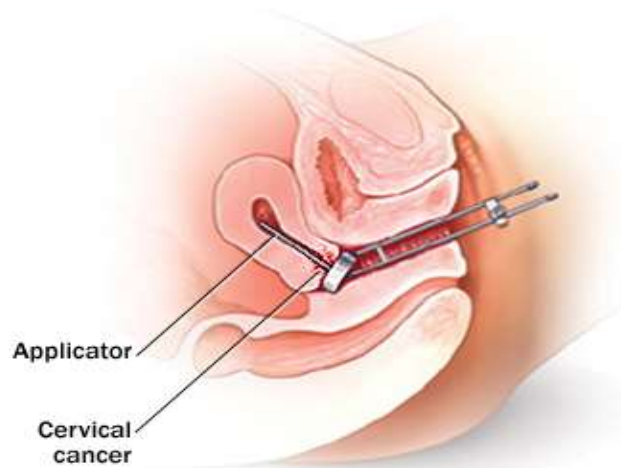
- Linear accelerator rotates 360°
- MLC (Multi leaf collimator)
- Lead blades for individual shaped treatment field



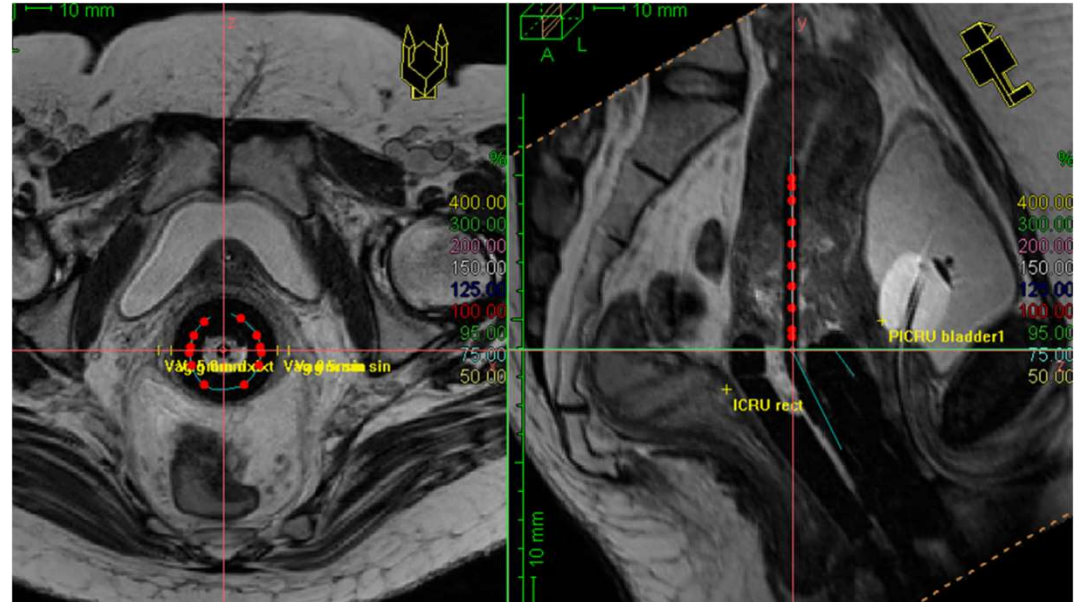
Brachytherapy



Applicator



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Source: ^{192}Ir Iridium

Background

- Radiotherapy only curative treatment option for locally advanced cervical cancer
- Challenge:
 - A centrally placed tumor in the pelvis positioned directly between radiosensitive organs (bladder, rectum, sigmoid and small bowel)

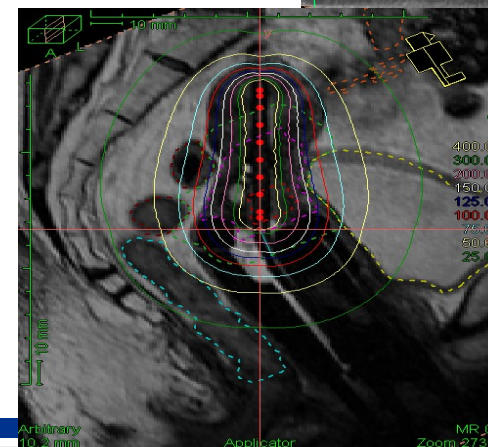
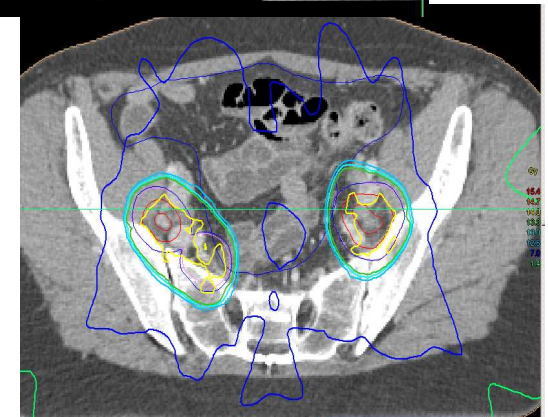
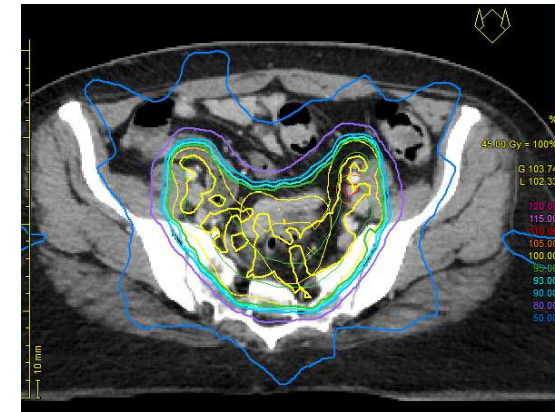


Gynecological cancer

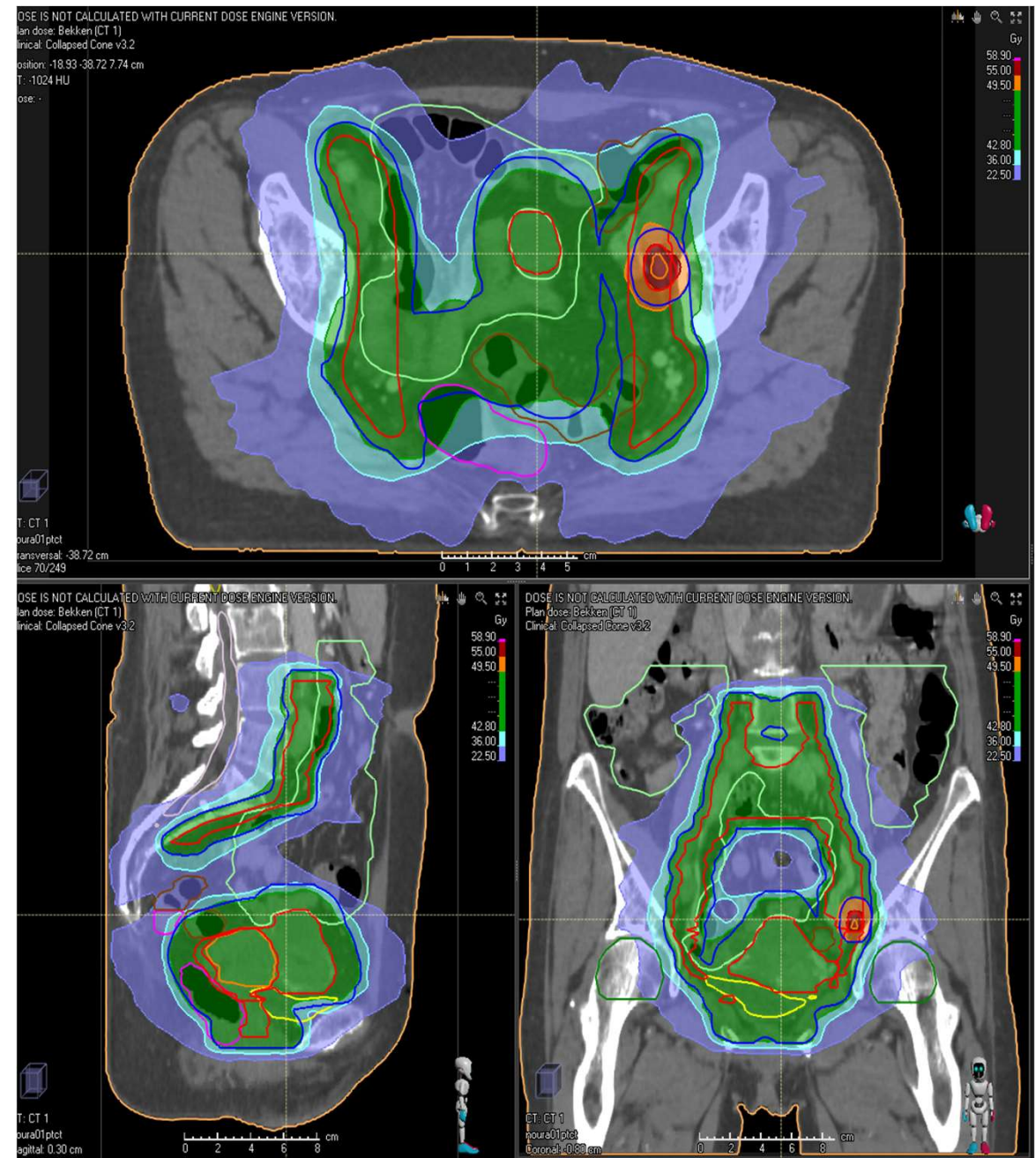
- Radiotherapy only curative treatment option for locally advanced cervical cancer
- Challenge:
 - A centrally placed tumor in the pelvis positioned directly between radiosensitive organs (bladder, rectum, sigmoid and small bowel)
- 85-90 Gy to tumor/cervix is required to cure the patient
- Tolerance of the above mentioned OAR lies well below these doses
- How to achieve an effective but safe dose distribution?

Treatment locally advanced cervical cancer

- External RT 1.8 Gy x 25 to the pelvis
- External RT boost 2 Gy x 10 to pathological lymph nodes
- Brachytherapy 7.2 Gy x 4 to tumor/cervix
- Weekly concomitant cisplatin 40 mg/m²



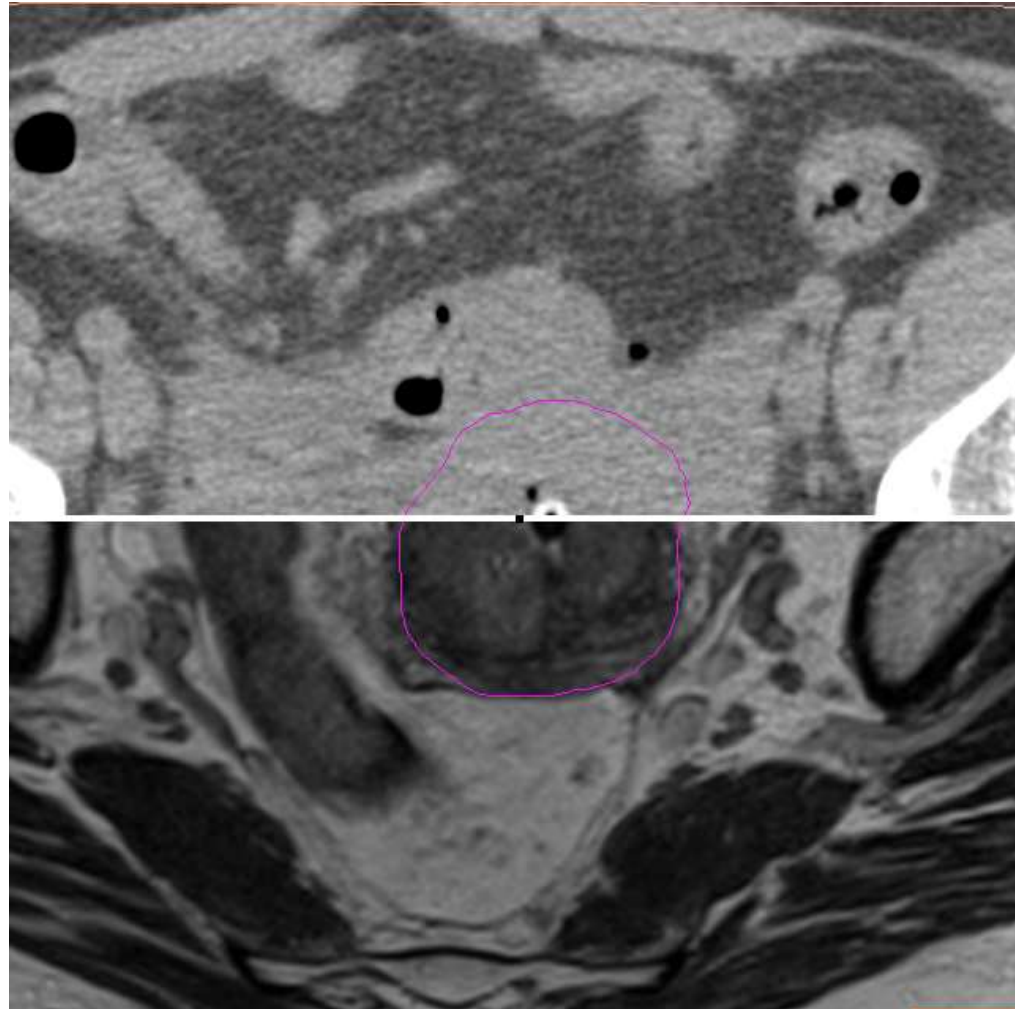
Everyone gets treatment with Volumetric Modulated Arc Therapy (VMAT)



But where is the target?

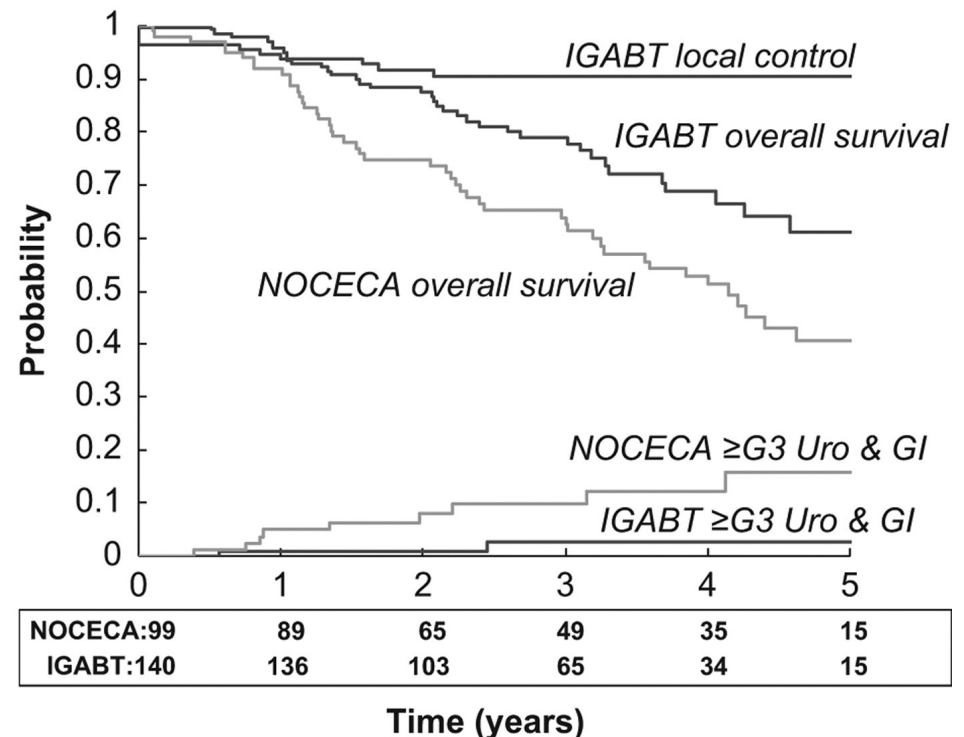


MRI



Does MRI based BT improve Overall Survival?

- 140 patients treated with MRI-based brachytherapy (IGABT) 2005-2011. GEC-ESTRO guidelines
- 99 patients treated with CT based brachytherapy 1994-2000. Dose prescription to point A (NOCECA)



Significant improved overall survival (79 vs 63%) and ~ 50% decrease in toxicity

Conclusion:

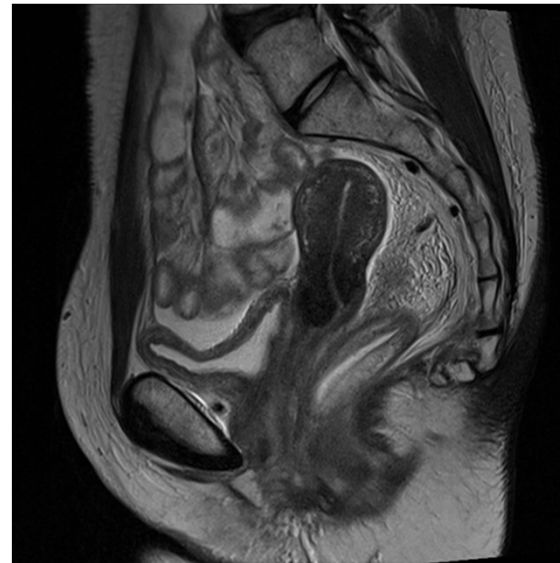
Advantages of MRI based image guided brachytherapy (IGABT)

- Improved tumor coverage (especially large volume disease)
- Decreased dose to critical organs (especially for small cervix)
- ***A favourable therapeutic ratio (High local control rate – minor treatment related morbidity)***

BEFORE



AFTER



Thank you for your attention

