

IMRT for Pelvic Sites

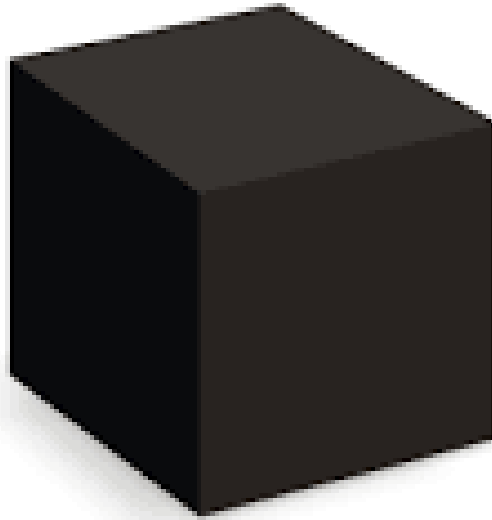
Minimising toxicity with technology

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Disclosures

- None

Radiation Therapy



Radiation Planning and Delivery

Does it matter to the non-radiation oncologist?

Yes! Because it matters to the patient.

Acute side effects: diarrhea, urinary symptoms, skin reaction

Bone marrow toxicity, acute and long term

Toleration of combined modality therapy

Treatment **compliance**

Treatment duration

Treatment outcome

RTOG bowel toxicity scoring

1. Mild diarrhea, Mild cramping
Bowel movement 5 times daily
Slight rectal discharge or bleeding
2. Moderate diarrhea and colic
Bowel movement >5 times daily
Excessive rectal mucus or intermittent bleeding
3. Obstruction or bleeding
requiring surgery
4. **Necrosis/ Perforation**
Fistula

RTOG Bladder toxicity scoring

1. Slight epithelial atrophy. Minor telangiectasia (**microscopic hematuria**)
2. Moderate frequency. Generalized telangiectasia. **Intermittent macroscopic hematuria**
3. **Severe frequency and dysuria**. Severe generalized telangiectasia (often with petechiae). **Frequent hematuria. Reduction in bladder capacity (<150 cc)**
4. Necrosis/ **Contracted bladder (capacity <100 cc). Severe hemorrhagic cystitis**

Evolution of radiation planning

1970s-1980s

2 D: 2 D imaging and treatment plan in a single anatomic plane.

1990s

3 D conformal: treatment plan based on a 3-D volume, CT scan with externally shaped fields. Volumetric planning.

Since 2000

IMRT: intensity modulated radiation therapy. Uses 3 D imaging,
Inverse treatment plan: Target (tumor) and organs at risk (OAR),
Computer planning defines a solution.

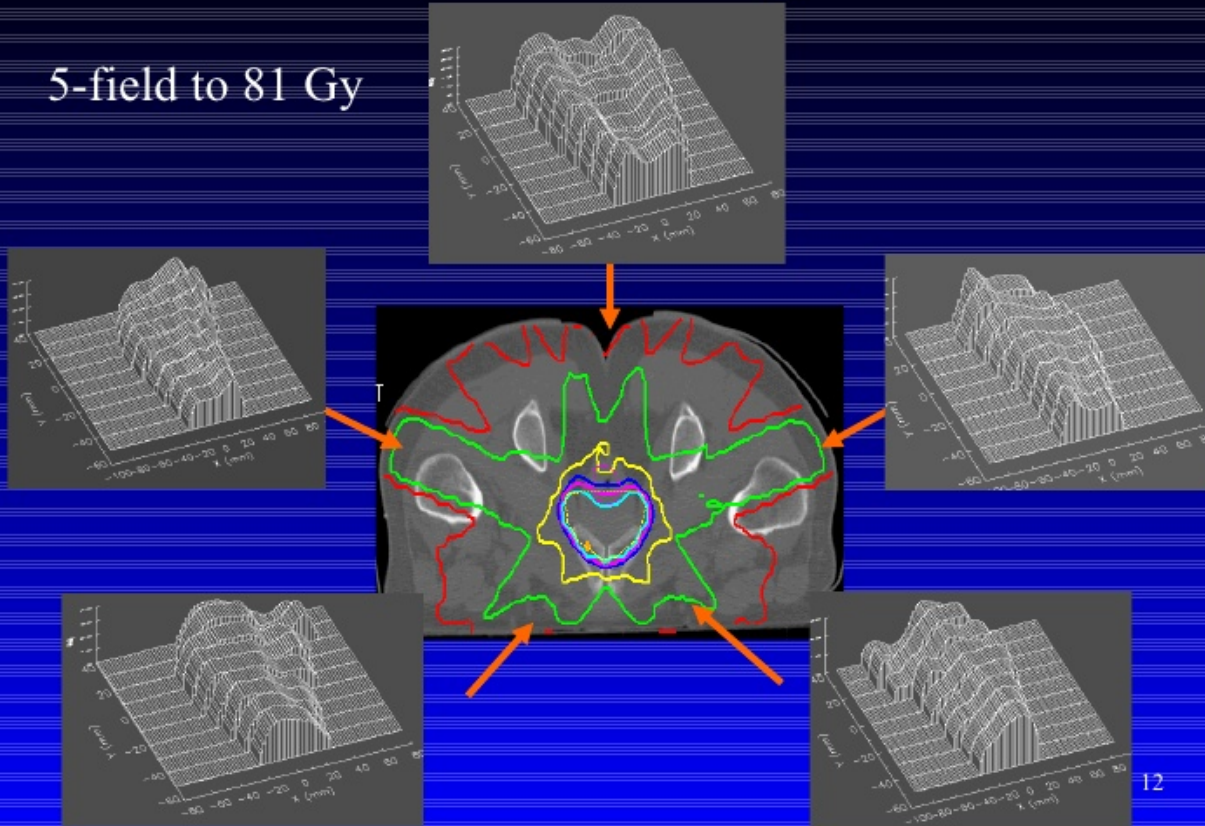
IMRT

- Intensity modulated radiation therapy (IMRT)
- Can create a dose distribution around an irregular target volume.
- Delivers non-uniform beam intensities to a target volume by changing the intensity of the beam.
- Requires 3-D planning image: CT. Can register PET or MRI.
- Definition for treatment Target and avoidance structures.
- Exact patient positioning and motion management.
- Image guidance: ability to image patient daily at time of treatment

IMRT plan

Prostate IMRT plan

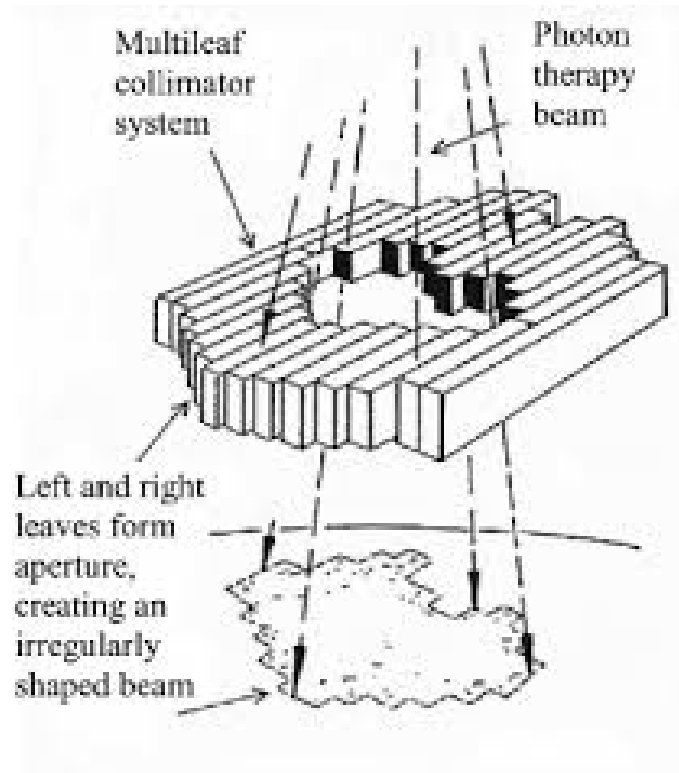
5-field to 81 Gy



Modern treatment delivery



Multileaf collimator



On board imaging



Pelvic IMRT

- **Prostate**
- **Rectal**
- **Cervix**
- Endometrial
- Anal canal
- Vulva

Prostate cancer

Randomized trials and observational studies suggest that outcomes with external beam radiation or radical prostatectomy are similar in men with clinically localized prostate cancer.

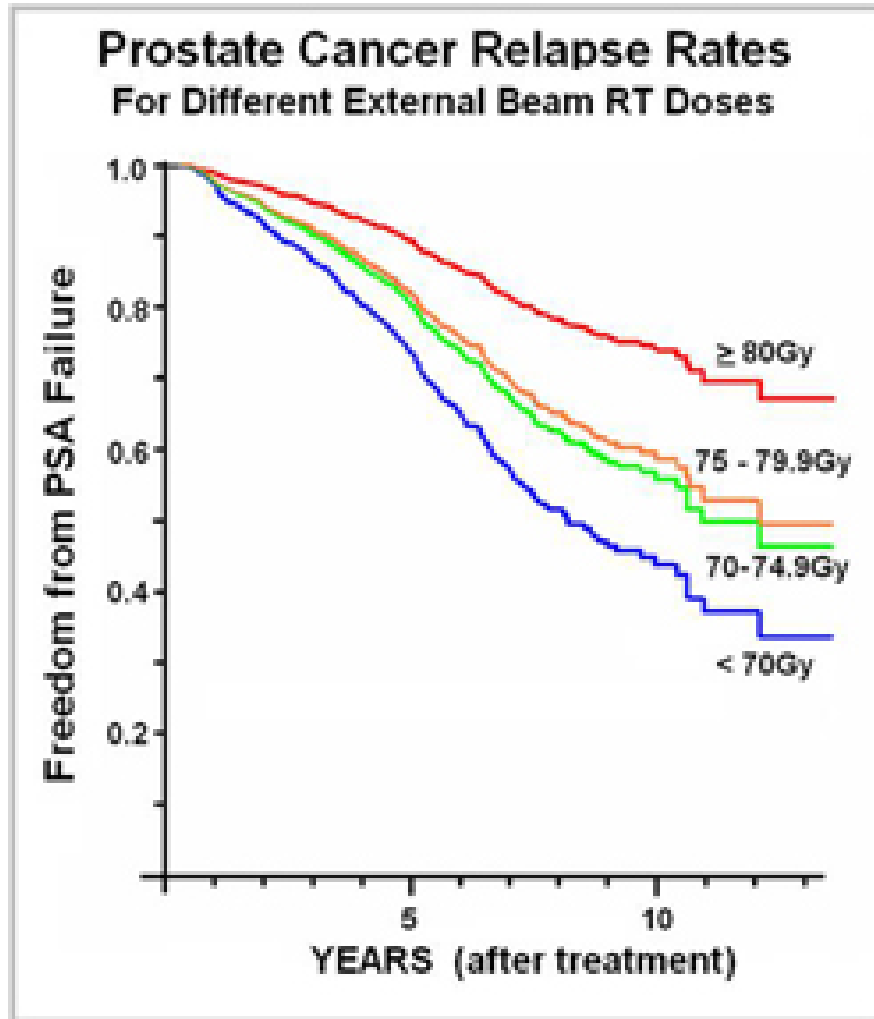
Roach M. Radiat Oncol Biol Phys 2015;93:1064

Hamdy FC. NEJM 2016;375:1415

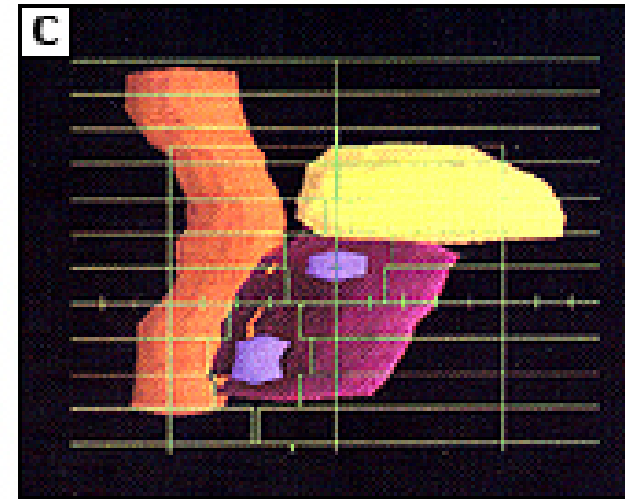
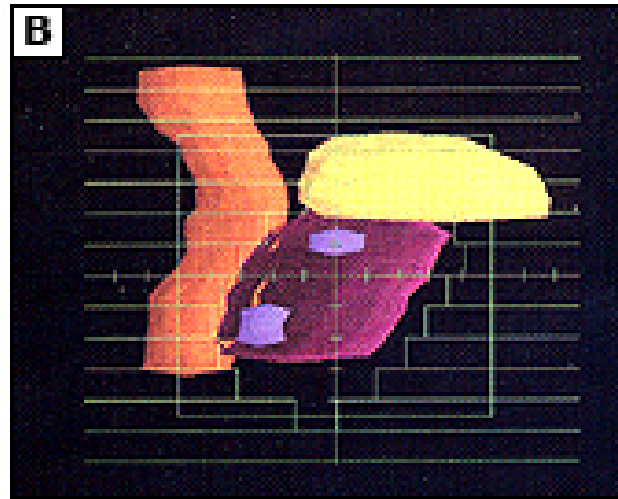
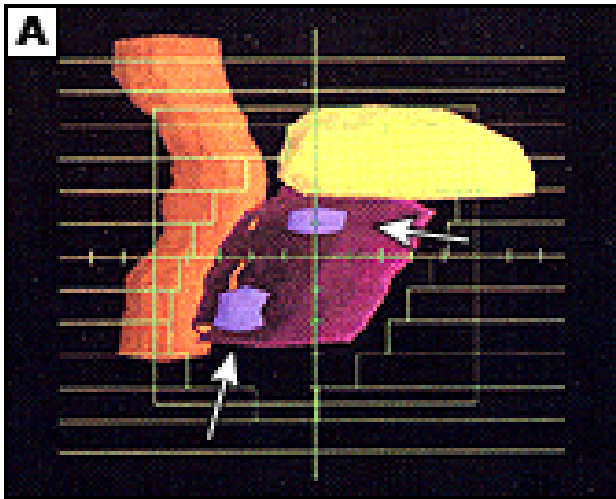
Prostate Cancer

- This was one of the first sites in which IMRT was widely adopted.
- Curative treatment of prostate cancer is dose dependent.
- RTOG 0126:improved biochemical control for 79.2 Gy vs 70.2 Gy
- Doses above 70 Gy too morbid with conventional RT.
- Organs at risk (OAR) in close proximity to prostate.

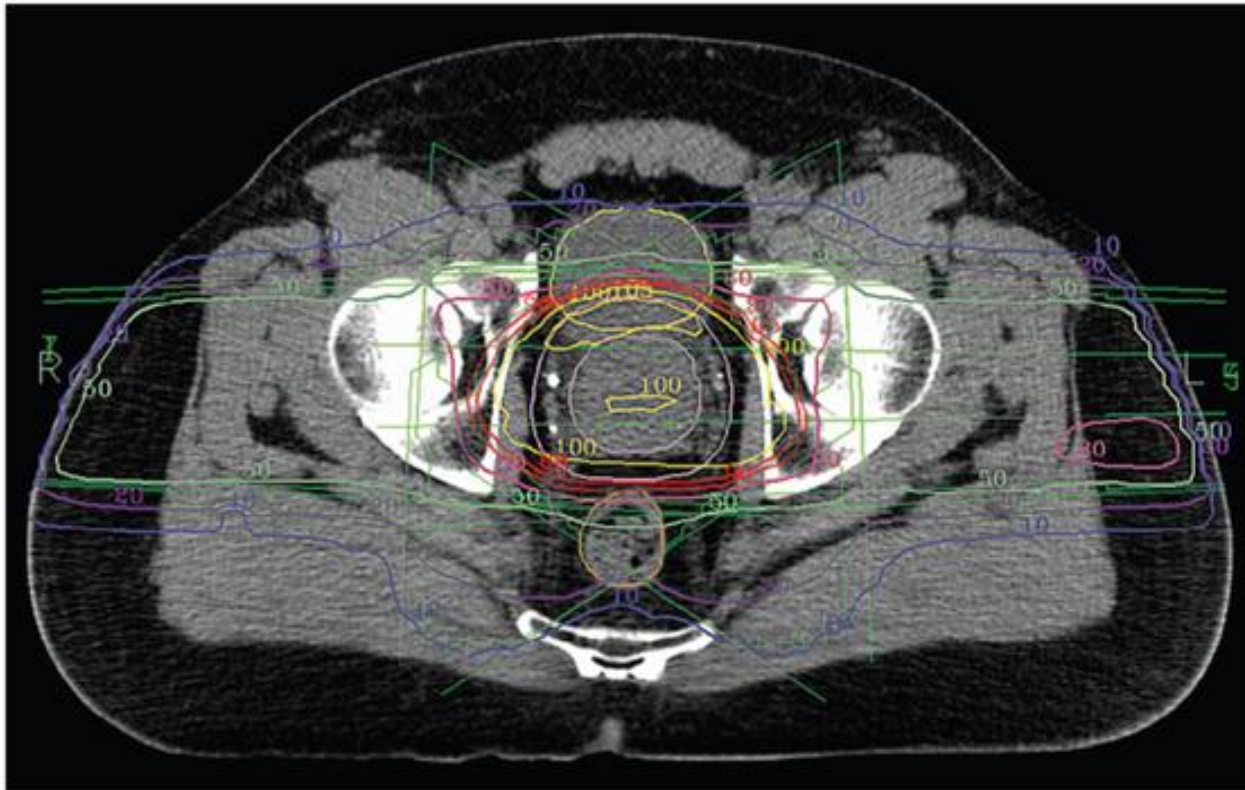
Dose and local control for prostate cancer



Prostate, rectum, and bladder

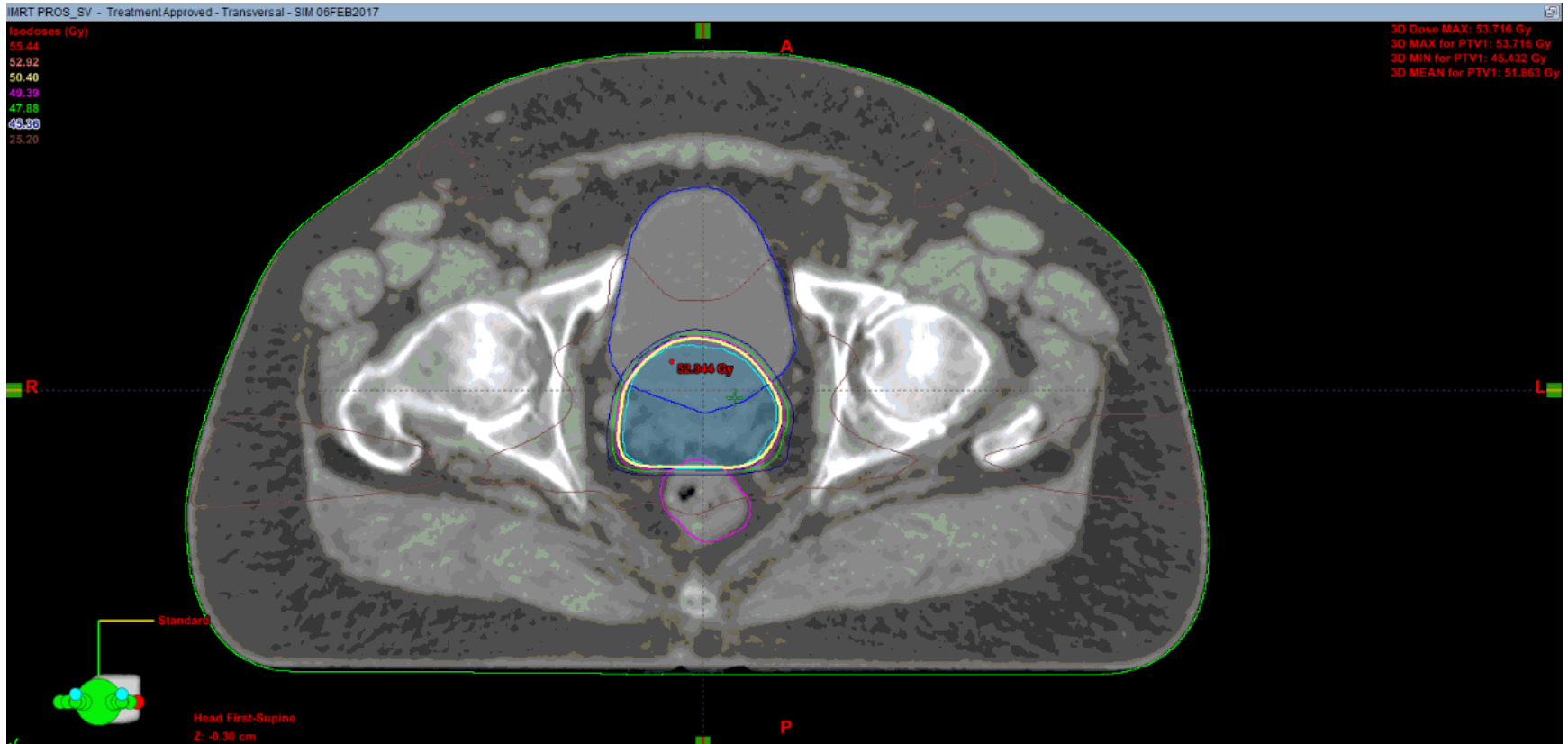


conformal prostate field

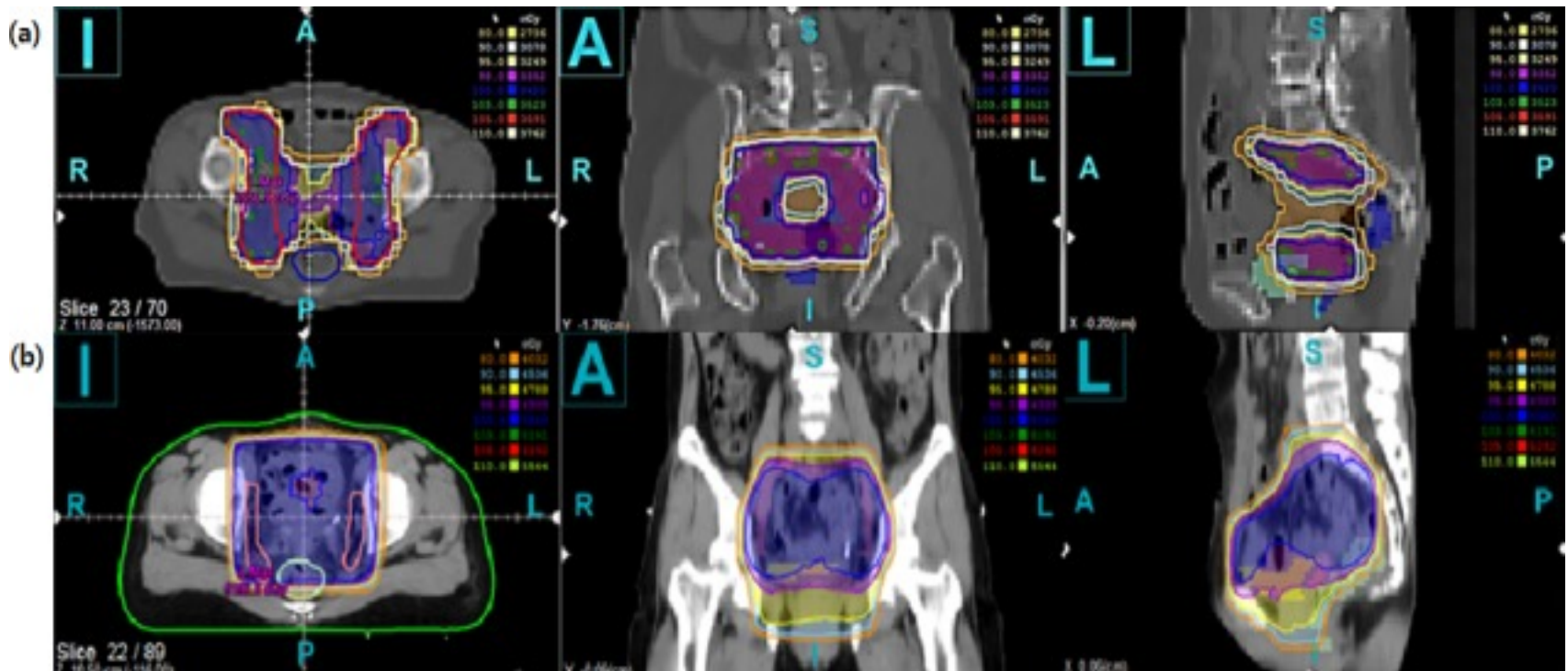


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Axial prostate plan



CT slice of IMRT (a) and cRT (b) radiotherapy plans with isodose lines (80%, orange; 95%, yellow; 100%, blue; 103%, green). Note that small bowel and rectum in IMRT plan are spared. (a) IMRT, Intensity-modulated Radiotherapy. (b) cRT, Conventional Radiotherapy.



Prostate radiation side effects

- Prostate is located between rectum and bladder, sensitive to radiation side effects.
- RTOG 0126 compared 3DRT and IMRT.
- Grade 2 or higher GI or GU toxicity less frequent with IMRT.

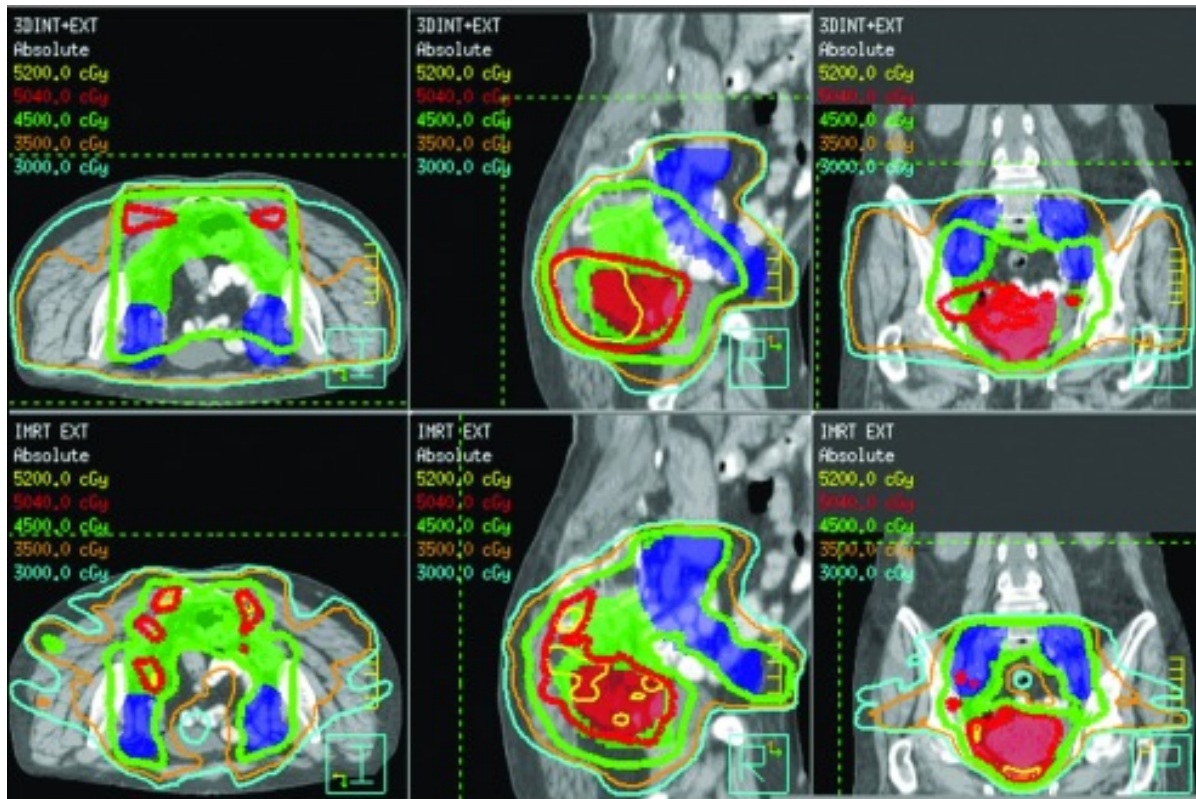
IMRT for prostate cancer

- IMRT is the standard of care for definitive prostate radiation.
- Enables delivery of a curative dose, greater than 74 Gy.
- With reduced bowel and bladder toxicity compared to 3D RT.
- One of the first sites where 3rd party payers covered IMRT.

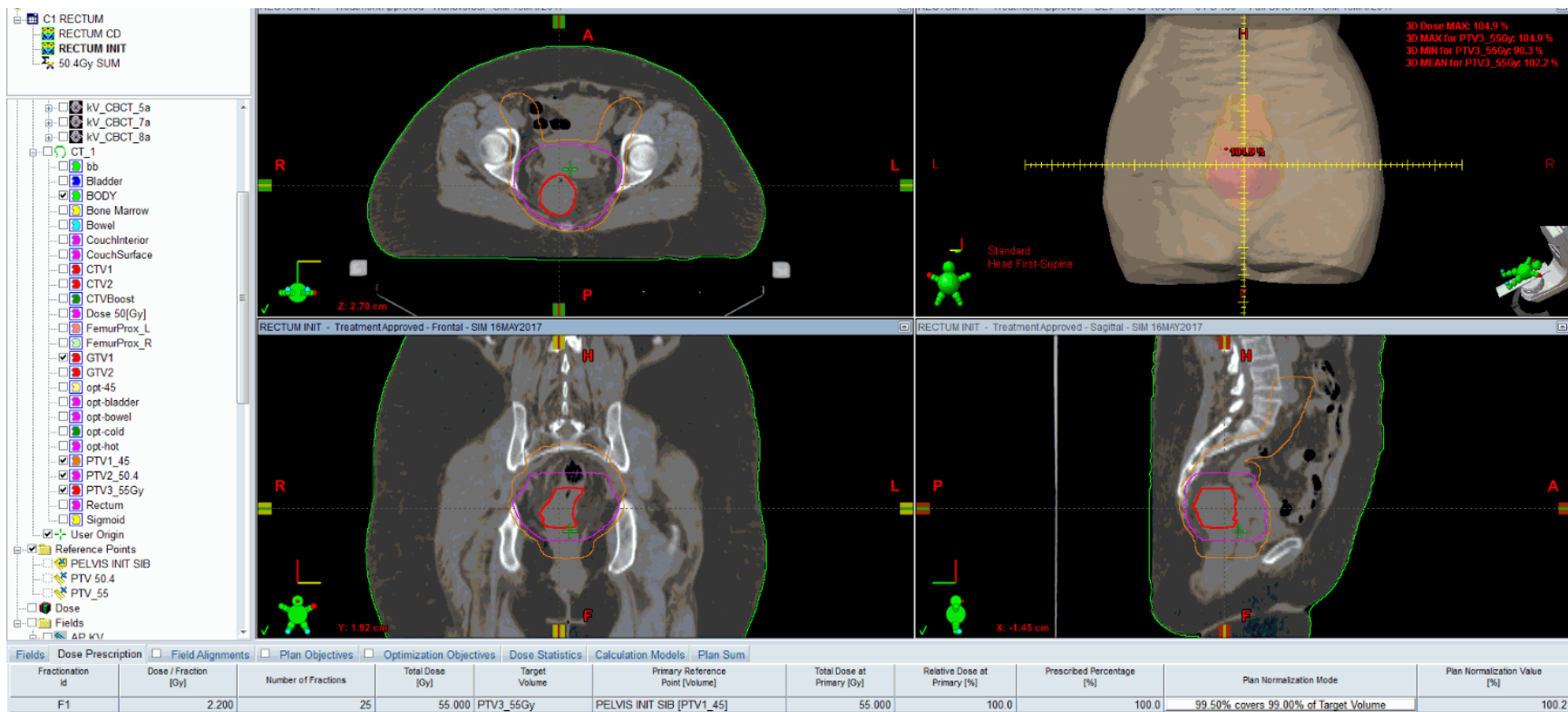
IMRT for rectal cancer

- Neoadjuvant chemo radiotherapy is a widely used strategy for patients with rectal adenocarcinoma.
- Indicated for patients with T3 T4 tumors, or N1 N2 tumors
- NCCN guidelines recommend an initial dose of 45 Gy to volume including primary site and lymph nodes and a 5.4 Gy boost, limit of small bowel dose to 45 Gy.
- NCCN suggest conformal RT, IMRT on study only
- Small bowel constraints: V45 <195 cc

3 D conformal vs IMRT rectal cancer



Pre-op rectal IMRT plan



IMRT for rectal cancer

- GI toxicity is increased with the addition of chemotherapy,
- Acute GI toxicity is reduced in IMRT vs 3 D plans.
- A retrospective analysis showed reduction in grade 2 or higher GI toxicity, fewer treatment breaks, and decreased duration of treatment in IMRT vs 3D CRT*
- We prefer IMRT in our own practice, ability to treat recommended target volumes and meet small bowel constraints, and decreased acute toxicity.
- *Parekh A. Gastrointest cancer Res 2013 Sep; 95-6):173-42

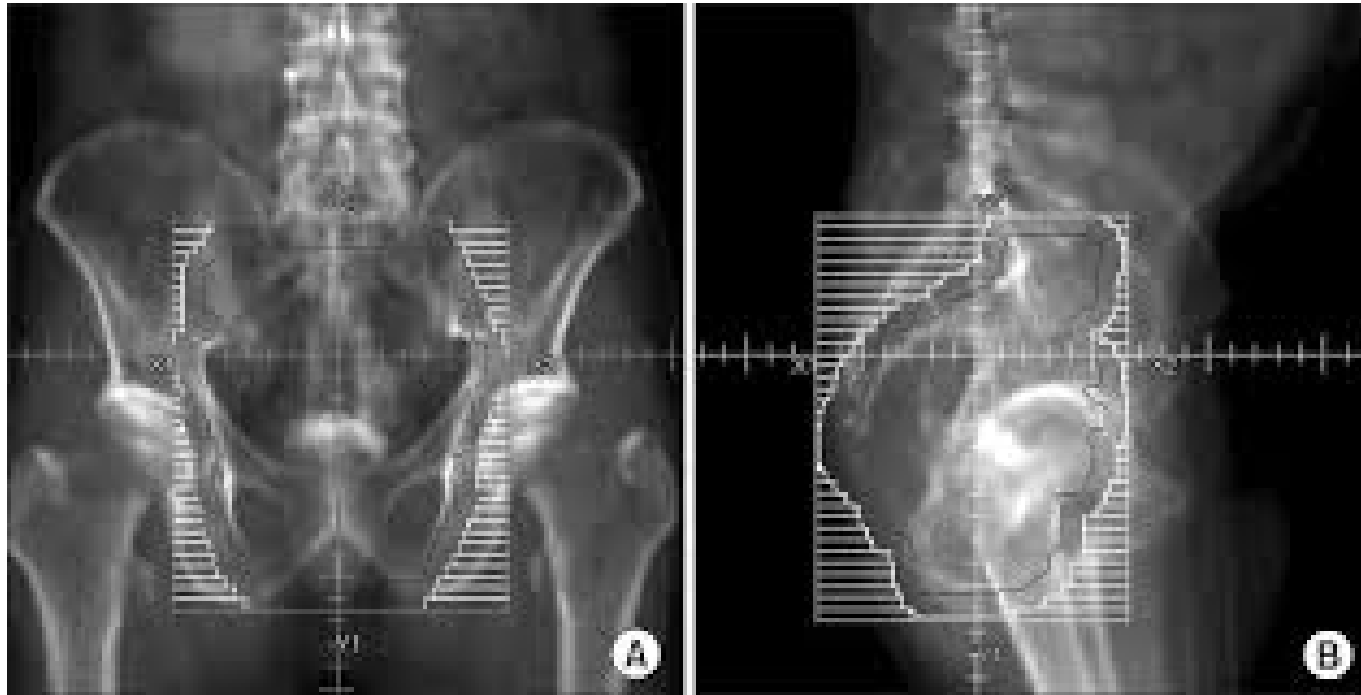
IMRT for cervical cancer

- Standard treatment for non-metastatic locally advanced cervix cancer is pelvic radiation, 45 Gy and weekly cisplatin, 40 mg/M sq.
- Followed by brachytherapy 4-5 HDR insertions.
- Outcome is directly related to overall treatment time.
- Survival decreases 1% for each treatment day past 56 days.
- Acute toxicity is GI, GU and hematologic (decreased blood counts.)

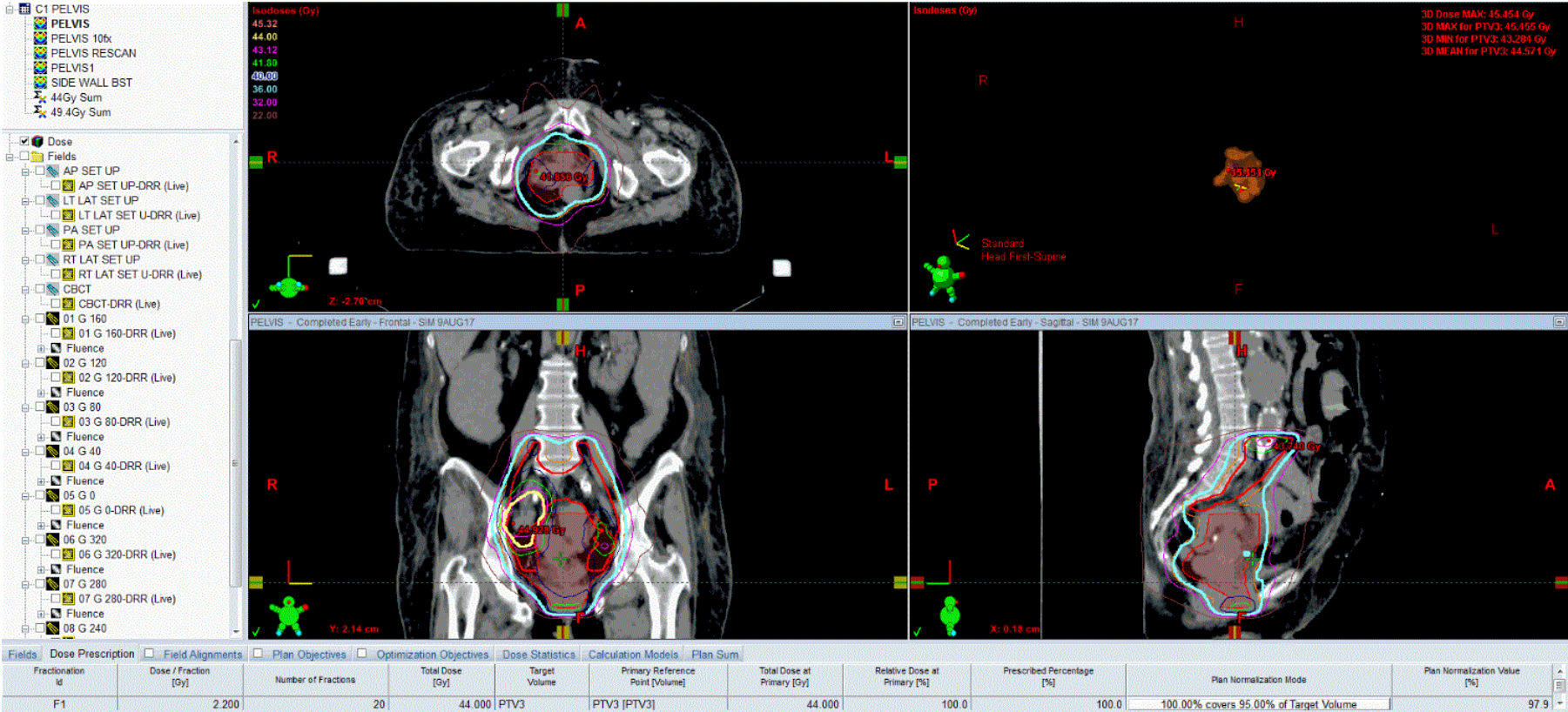
Pelvic irradiation portal in cervical cancer 4-field box technique



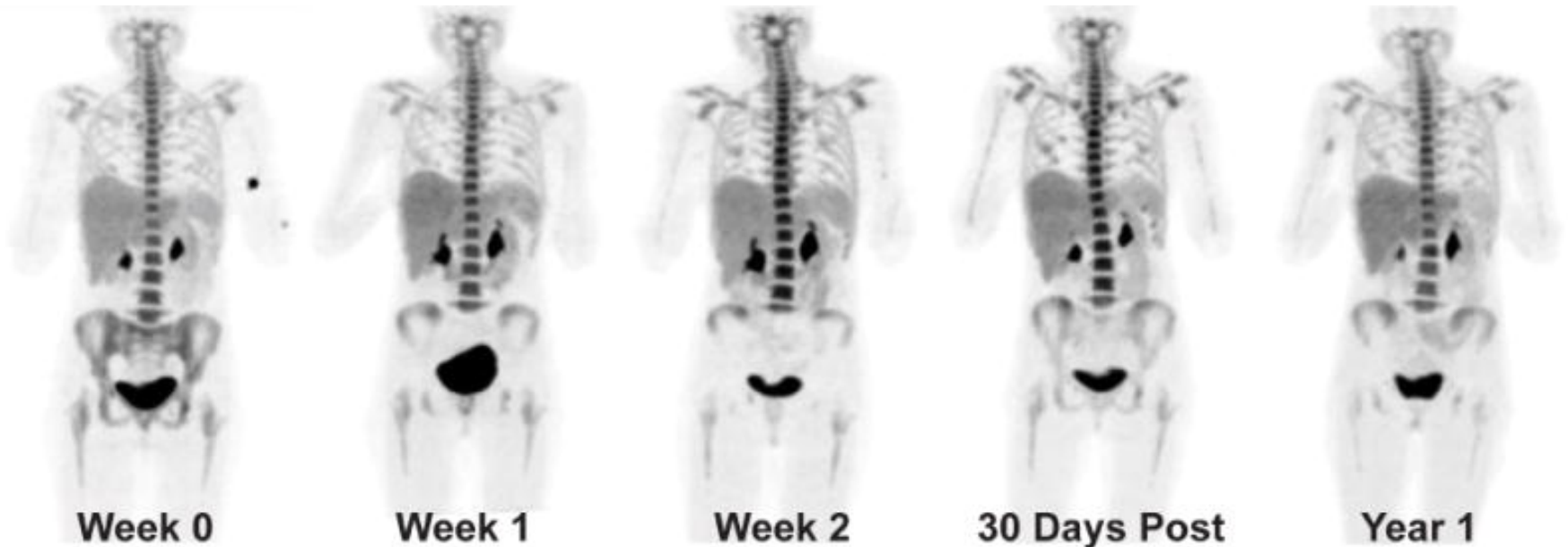
4-field conformal pelvis field



IMRT cervix plan



FLT/PET imaging shows loss of active bone marrow during chemo/RT. McGuire S. Int J Radiat Oncol Biol Phys. 2016



IMRT for cervix cancer

- Total dose for pelvic radiation is 45-50 Gy
- Lower rationale to use IMRT compared to prostate.
- International trial of IMRT for cervix cancer showed decreased hematologic and GI toxicity compared to historical data. Mell L. IJROBP, Vol 97, 536-545, 2017
- A randomized study comparing quality of life during pelvic radiation using IMRT compared to 3DRT showed decreased GI and GU toxicity in the IMRT arm and better quality of life (QOL.) Klopp AH. ASTRO Annual Meeting 2016.

IMRT for cervix cancer

- Use of IMRT in cervix cancer decreases acute GI and GU toxicity
- Decreased hematologic toxicity
- Associated with improved QOL during treatment

Summary

- IMRT is a radiation planning technique that is highly conformal.
- Requires 3-D imaging, computer based planning, patient motion management, on board imaging, and modern treatment delivery.
- Clinical target and organs at risk are defined volumetrically.
- Plan is assessed for Target coverage and normal tissue avoidance.
- IMRT allows high dose to target such as prostate, while minimizing dose to normal structures.
- IMRT in all pelvic sites is associated with decreased acute toxicity, better patient tolerance, and improved QOL.

Thank you

