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Spatially Fractionated GRID Radiation Therapy (SFGRT) Using a Brass Collimator

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Sunday, June 21, 2015 (ORL)

AAMD American Association of Medical Dosimetrists

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On Demand Design and Delivery of Custom Treatment Devices

4 Learning Objectives

1. Understand the historical perspective on the use of SFGRT

2. Understand the physics behind SFGRT

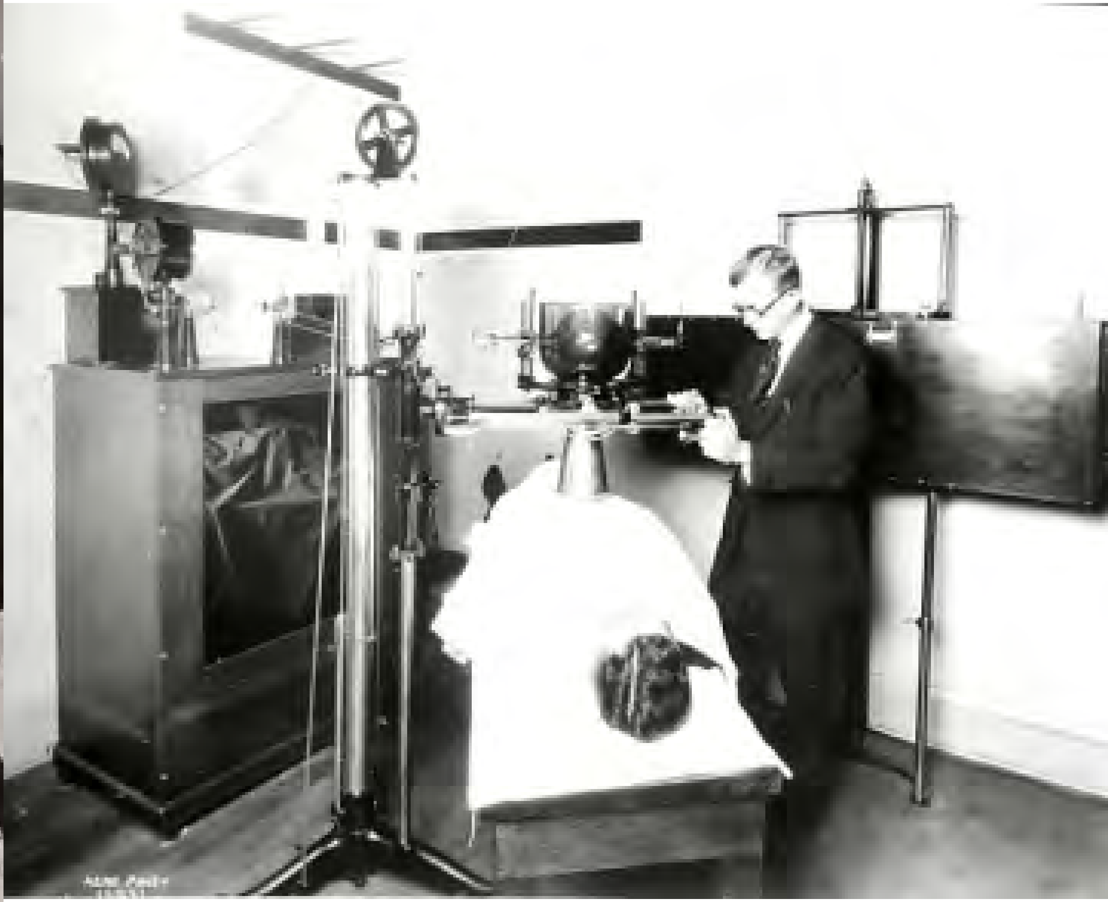
3. Updates on GRID planning

4. Understand the clinical application of SFGRT

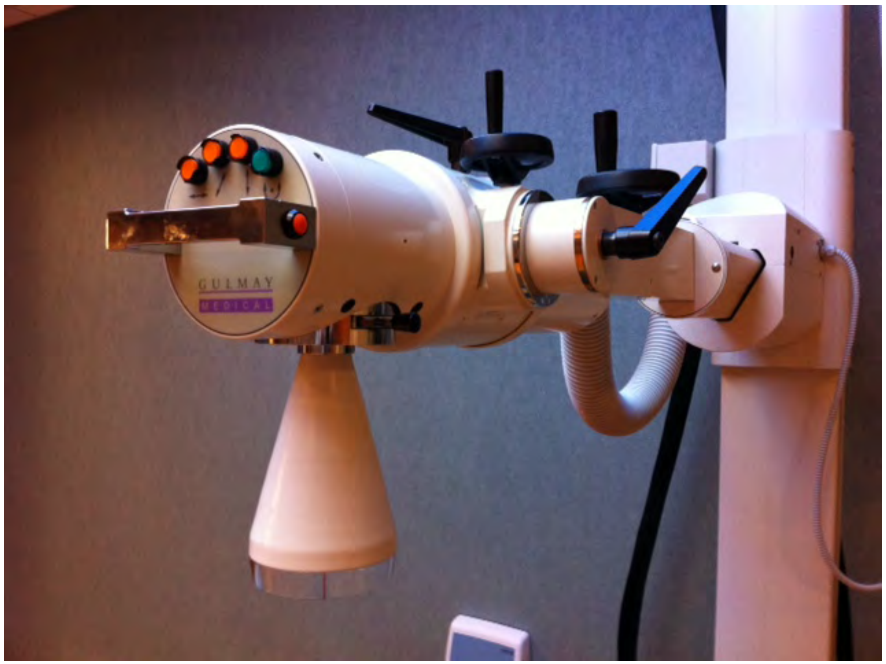
History of Radiation Therapy

- 1895 Roentgen discovered X-rays
- 1901 Roentgen received the Nobel prize in Physics
- 1902 First reported treatment using radiation
  - Swedish general practitioners: Sjogren; Stenbeck
  - Austrian practitioners: Holzknecht; Kienbock

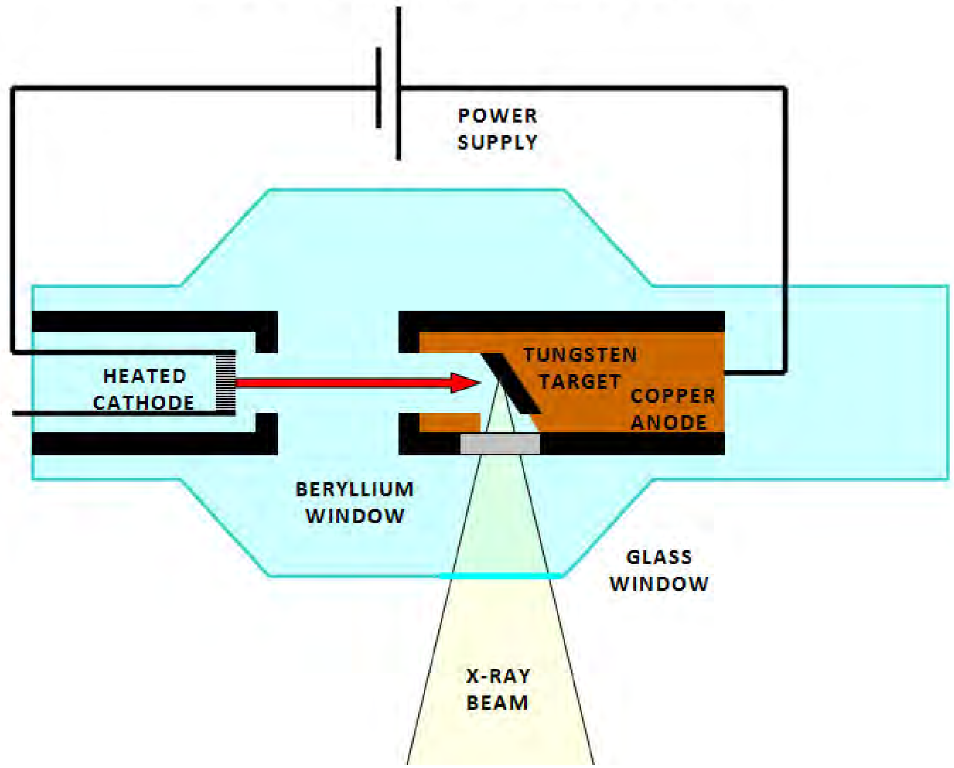
The Ortho-voltage: Machine

The Ortho-voltage: X-ray unit



SCHEMATIC OF KILOVOLTAGE X-RAY UNIT



The Ortho-voltage Era

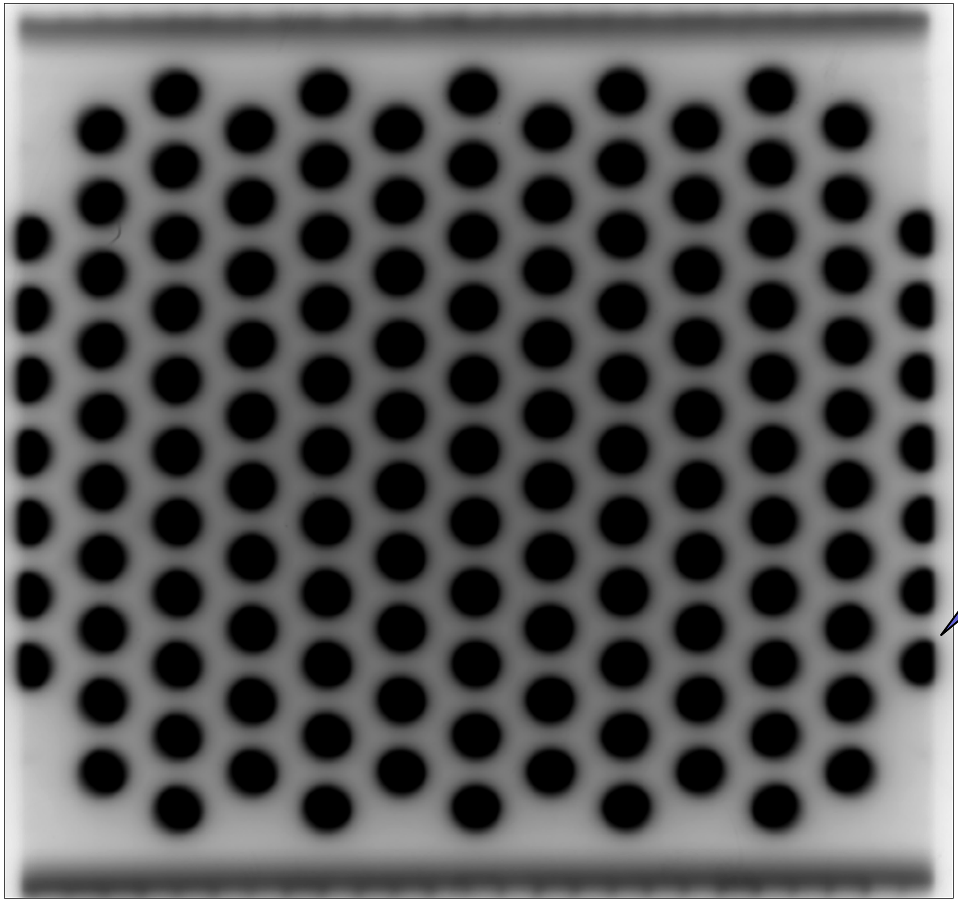
- Only means of delivering radiation was with 100-400 kVp X-rays.

- Maximum dose on the skin.
- No skin sparing effect
- Poor depth doses
- All of these factors contributed to inadequate doses to deep-seated tumors (skin dose is prohibitive!)

Early History of GRID treatment

**1909 Alban Kohler – **in Germany, used a "*perforated screen*" called a sieve (grid), creating an effect similar to treatment with a multitude of small pencil beams.

Simulation of grid used in the earlier part of the century



Perforated Screen /
later made of lead & rubber and put directly on patient's skin

Early History of GRID treatment

Liberson (1933) – In the United States, Liberson used the same *"grid"* technique to limit the damage to skin and subcutaneous tissue while treating deep seated tumors with high doses.

The *"grid"* at that time was made of lead & rubber with equally spaced, 1cm circles cut into it which divided the area into 50:50 open vs shielded areas.

Early History

- Small volumes of tissue could tolerate high doses of radiation and doses of >120 Gray could be delivered.

- Protecting areas of skin, within treatment area, which served as centers of re-growth of normal skin, allowing up to 6 times the dose given.

Then and Now

Radiation Energies

Type	Energy Range
Grenz-ray therapy	less than 20 KV
Contact therapy	40 - 50 KV
Superficial therapy	50 - 150 KV
Orthovoltage therapy	150 - 500 KV
Supervoltage therapy	500 - 1000 KV
Megavoltage therapy	greater than 1000 KV

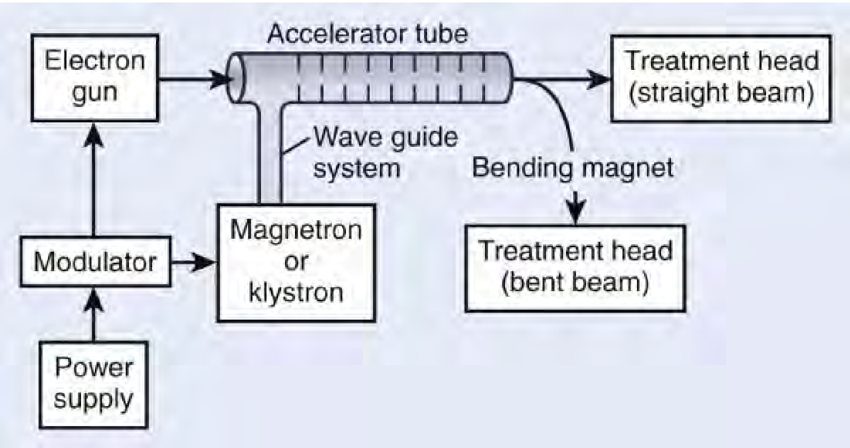
1900

↓

1950

1970

Now: Linear accelerator



Decline of Grid Usage

- Advent of megavoltage X-Ray machines provided
  - skin sparing effect
  - better depth doses
  - led to the eventual abandonment of the Grid technique.

“NOW”

A problem and question remains!

“How do you treat bulky/recurrent tumors when all other options have failed”?

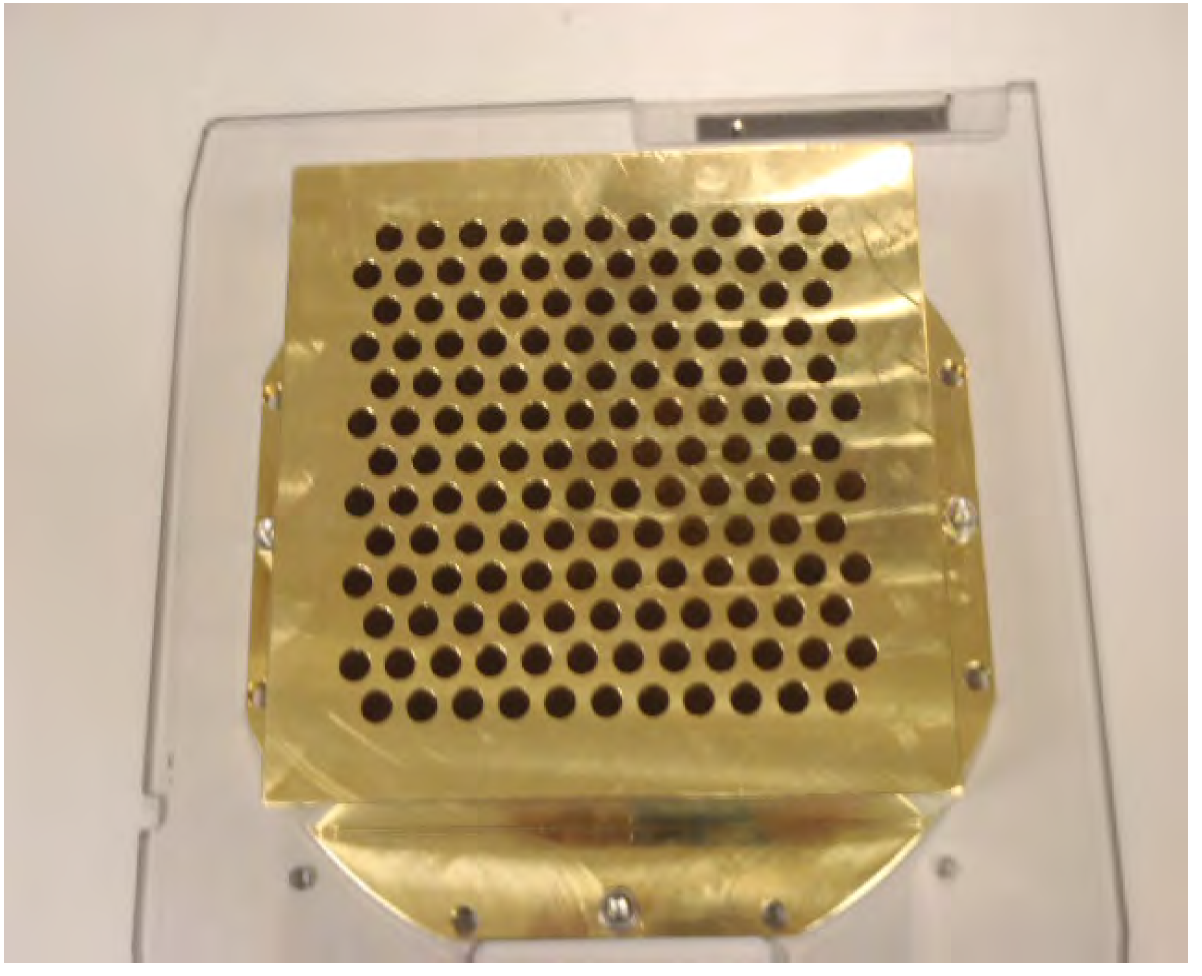
Resurrection of the GRID

"The more you study the past,

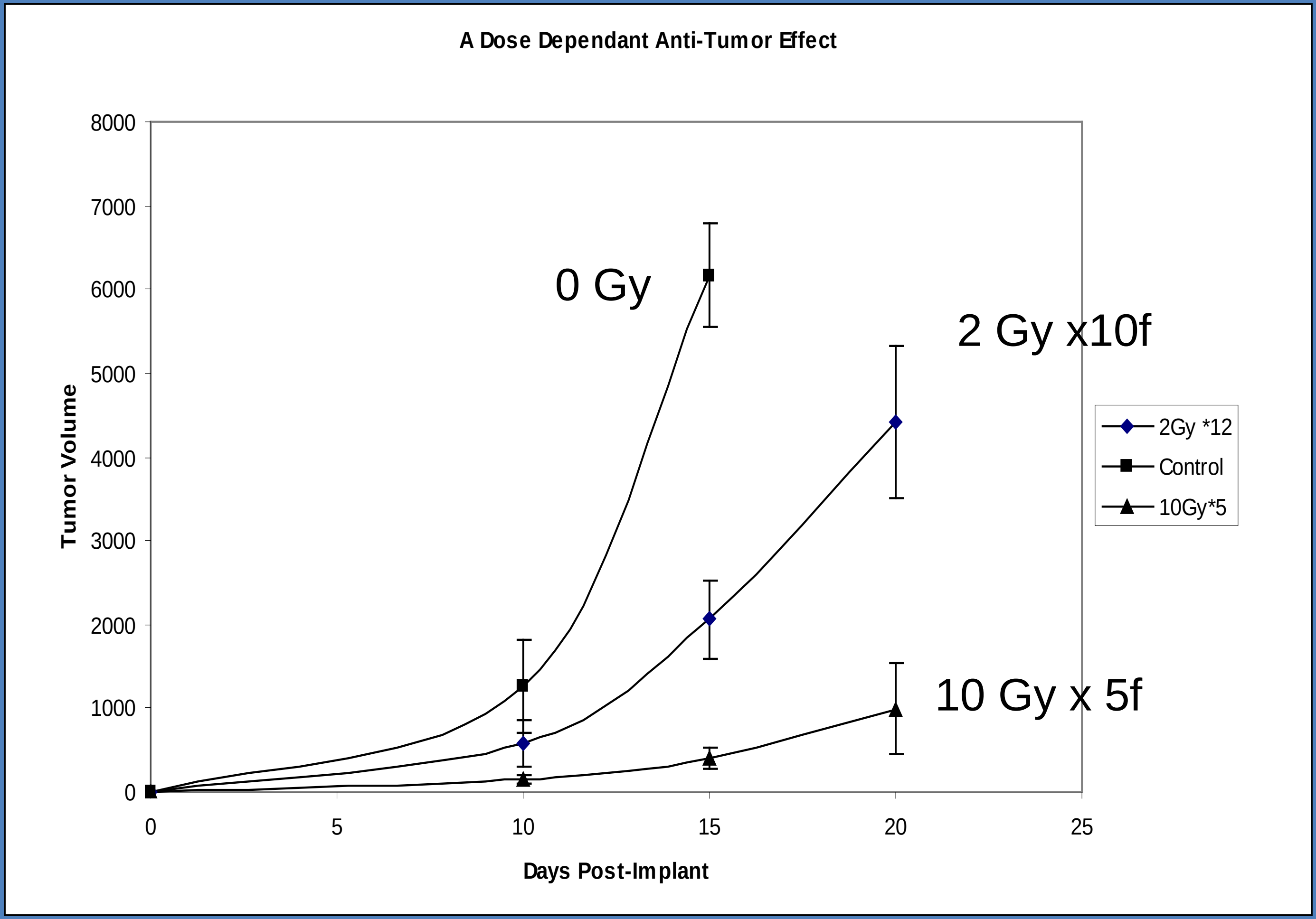
The further you will go in the future."

--Winston Churchill

Solution = GRID + modern LINAC



Tumor Killing is Dose Dependent



Camphausen et al, IJROBP 54 (2), Pg 226

The trick

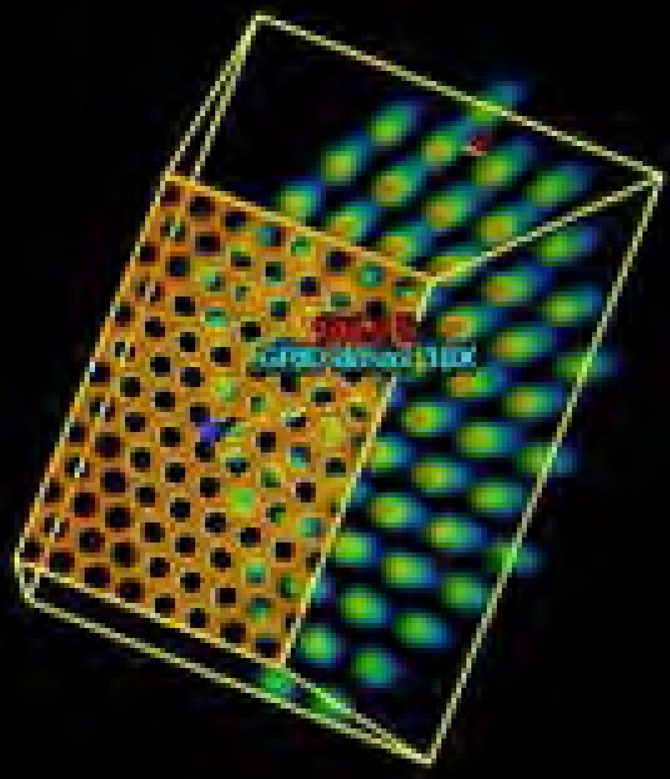
•No way you can treat the whole tumor with an open field without having major skin breakdown and side-effects (limits you to low dose)

• GRID allows for skin sparing by using beamlets and allows the use of high doses (like SBRT)

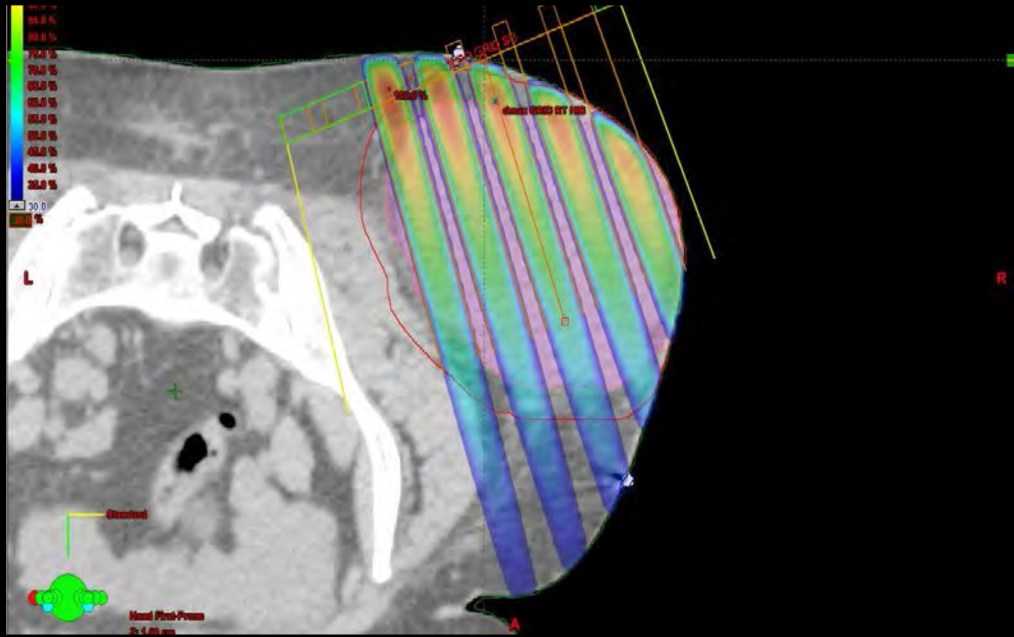
•Modern Linac still allows deep beam penetration

•Combination creates many high dose beamlets that act like:

"Stereotactic Virtual Brachytherapy"



"STEREOTACTIC BRACHYTHERAPY"



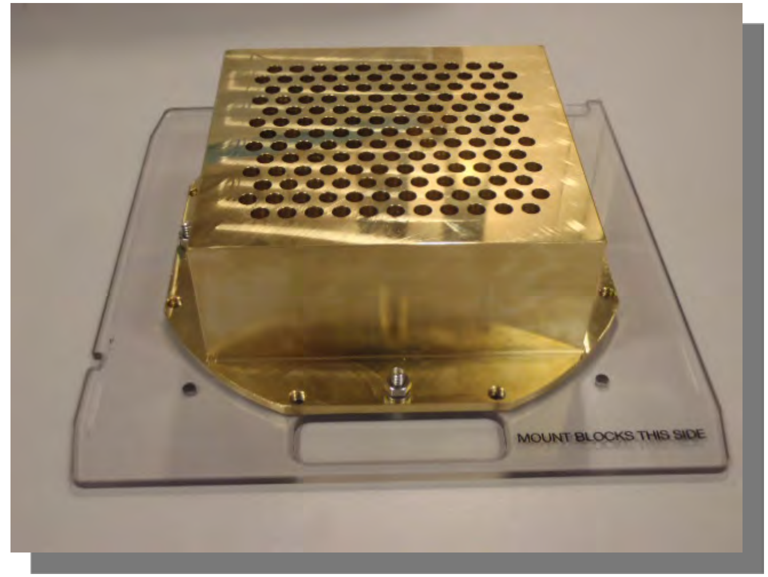
Case Presentation

- 71-year old Caucasian male with Hepatocellular carcinoma metastatic to left scapula, Stage IV
- Pain in left shoulder area 8/10
- No range of motion of left arm

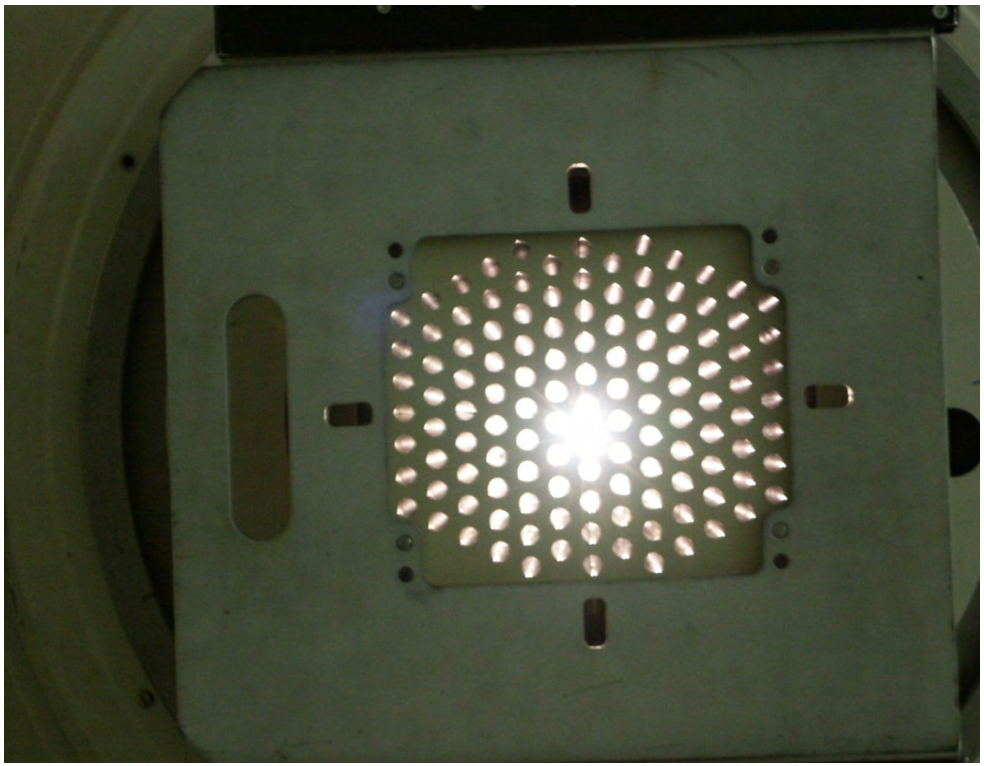
Grid Block Commissioning

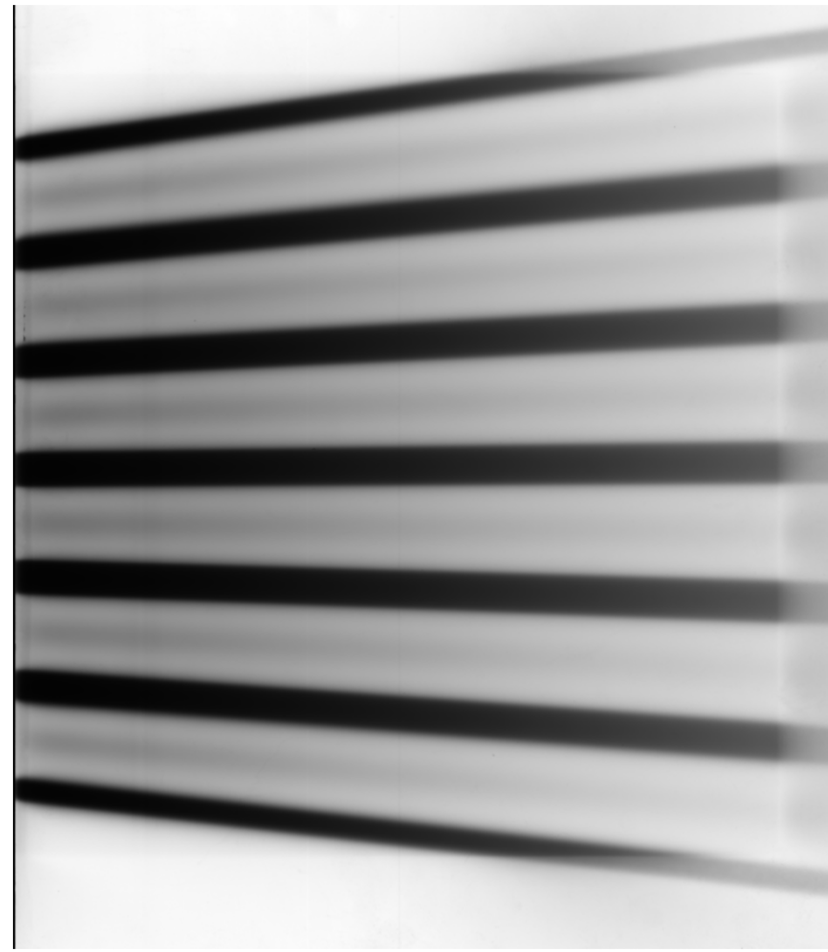
Equipment

- Brass GRID Block
  - ➢25 cm x 25 cm at isocenter
  - ➢Hole diameter 1.43 cm
  - ➢Hole spacing: 2.11 cm
  - ➢Placed into accessory tray
  - ➢34.2 pounds (vs 48 cerrobend)
- Water Measurements
  - ➢Tanks (3D & 1D)
  - ➢Unshielded Diode Detector
- Film and OSL Measurements
  - ➢Solid Water
  - ➢EBT3 Gafchromic Film
  - ➢NanoDot OSL (Landauer)



View of rid showing beam divergence





Grid Block Commissioning

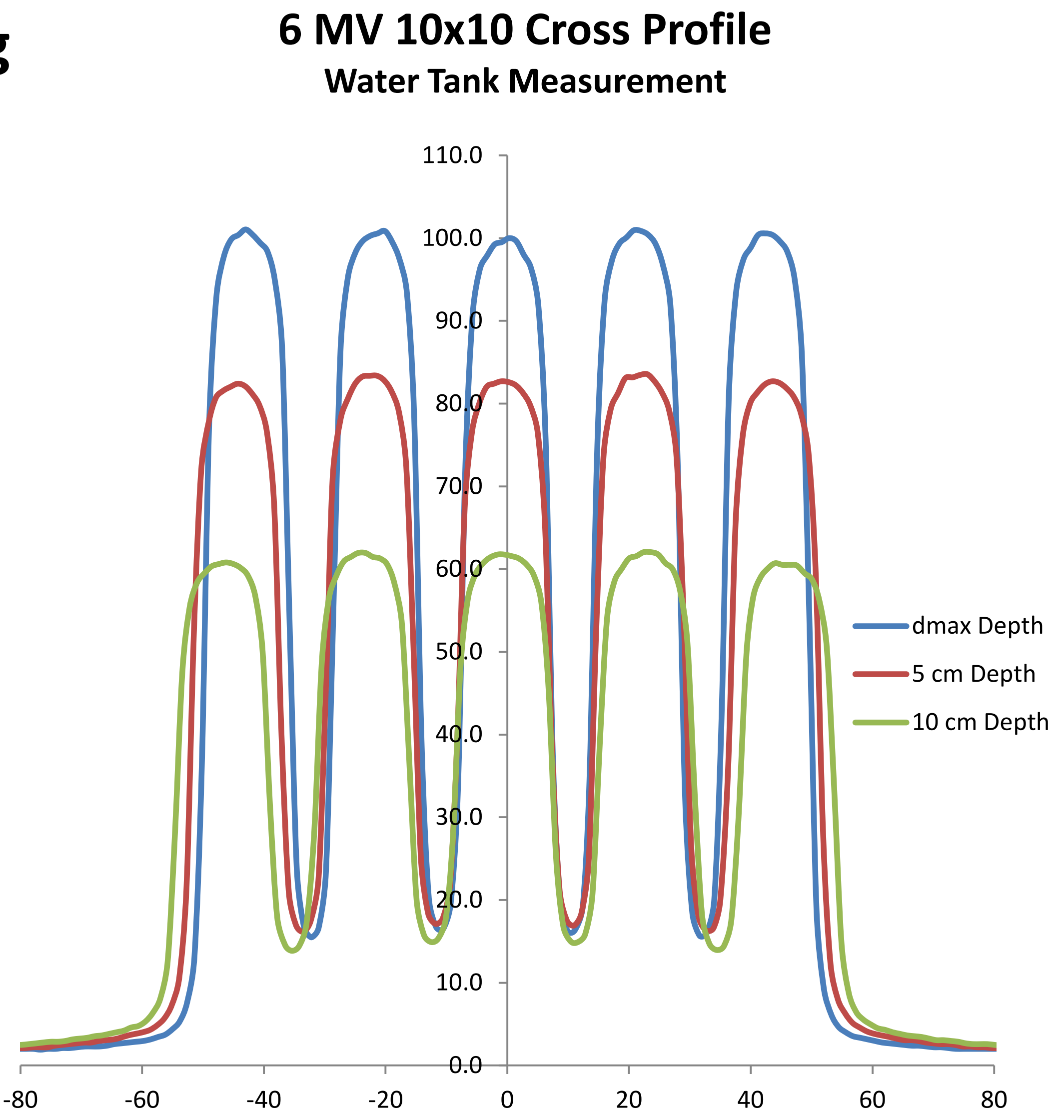
Output Factors

- Water tank measurements using diode detector along CAX
- Field Sizes from 5x5 to 25x25 with GRID measured at dmax
- Normalized to open field 10x10 at depth of dmax

Grid Block Commissioning

Profile Measurements

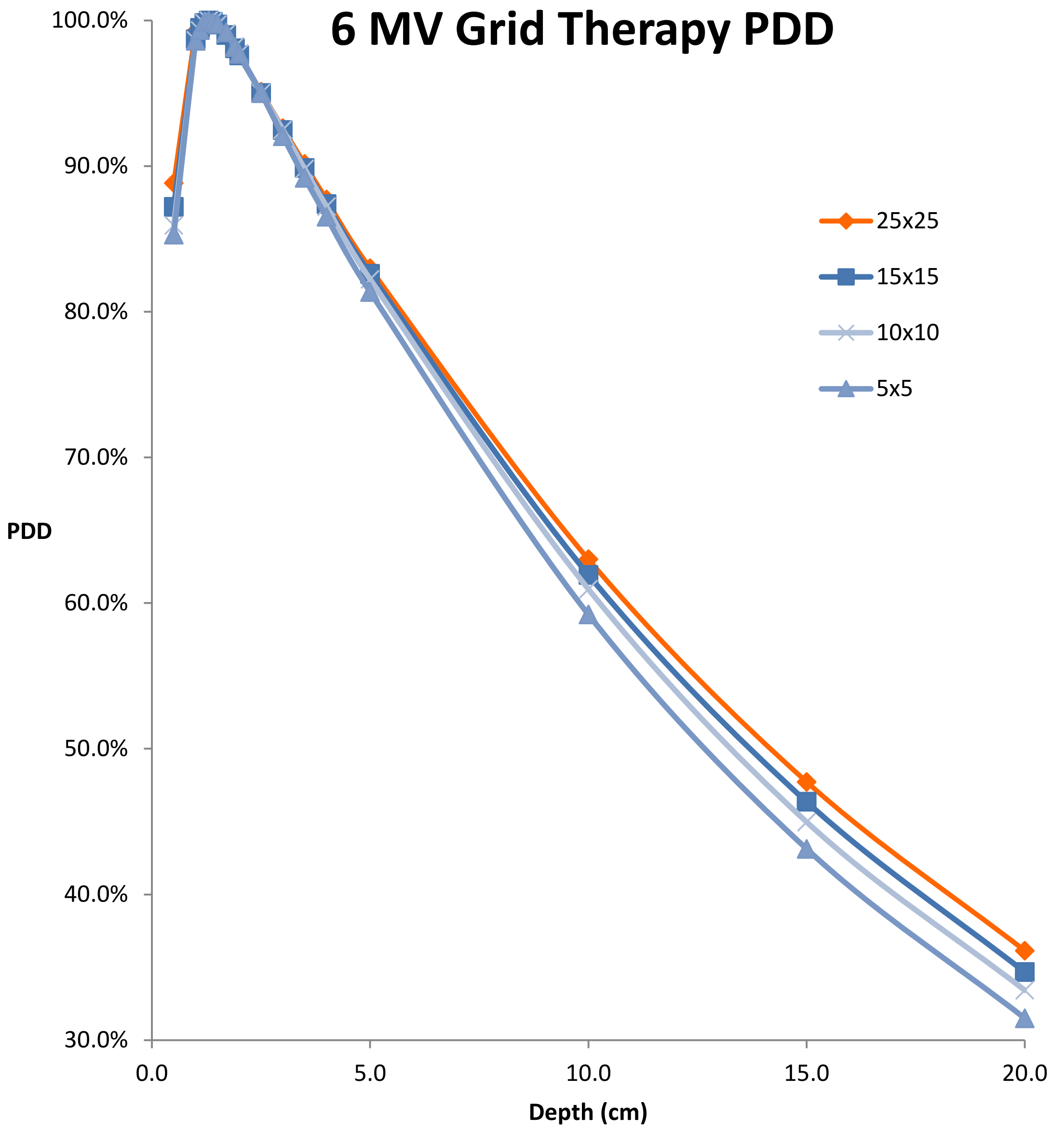
- Taken with film and in water
- Film measurements done with solid water at depths of dmax, 5 cm and 10 cm
- Water measurements taken with 3D water tank and unshielded diode detector
- Used to determine "valley-to-peak" ratio



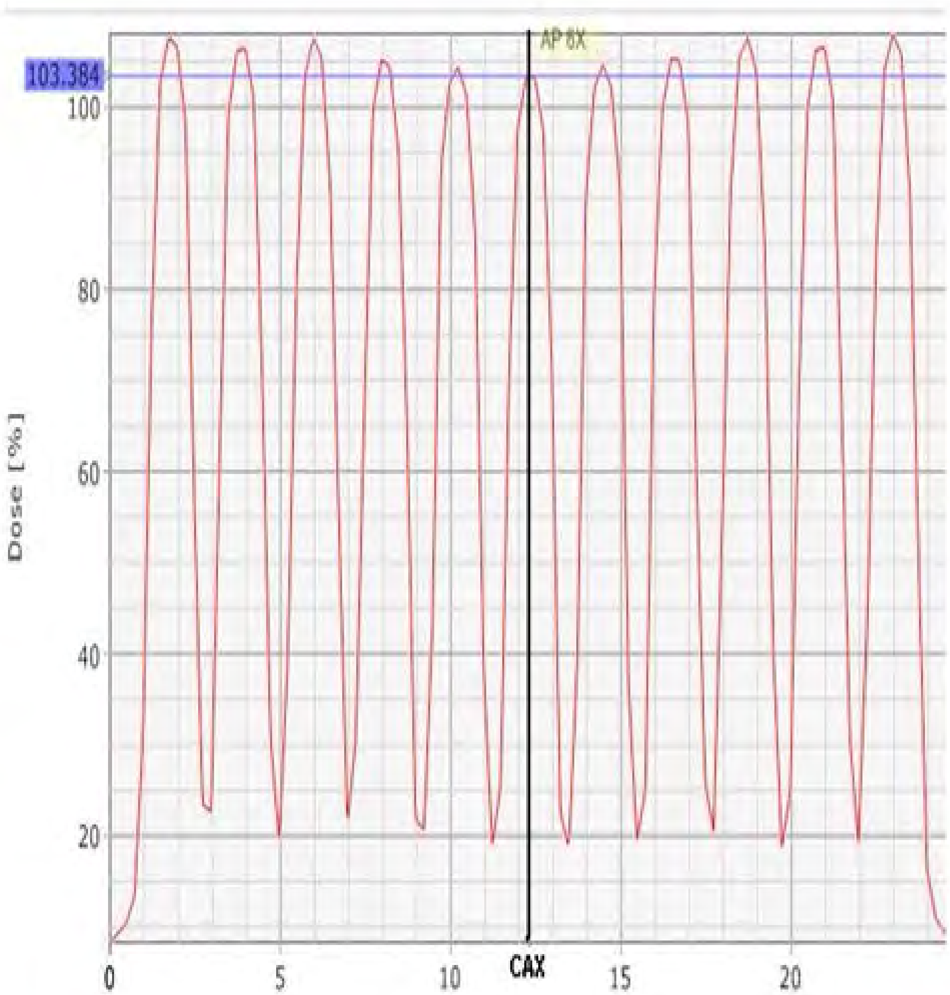
Grid Block Commissioning

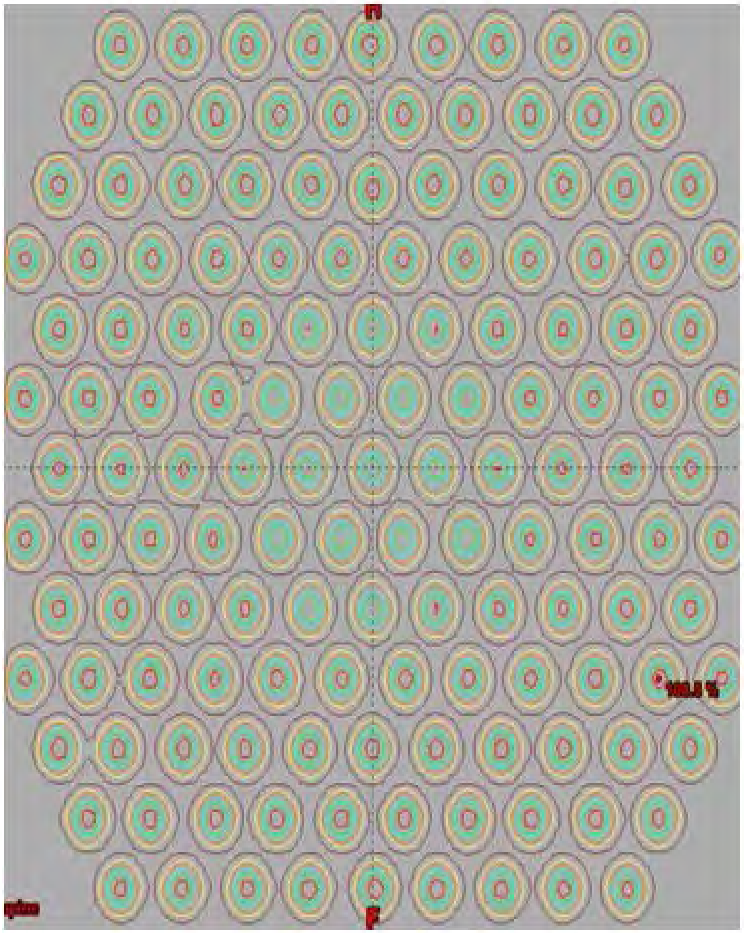
Depth Dose Curves

- Water tank measurements using diode detector along CAX
- Field Sizes from 5x5 to 25x25 with GRID in place



What does this dose distribution remind you of?

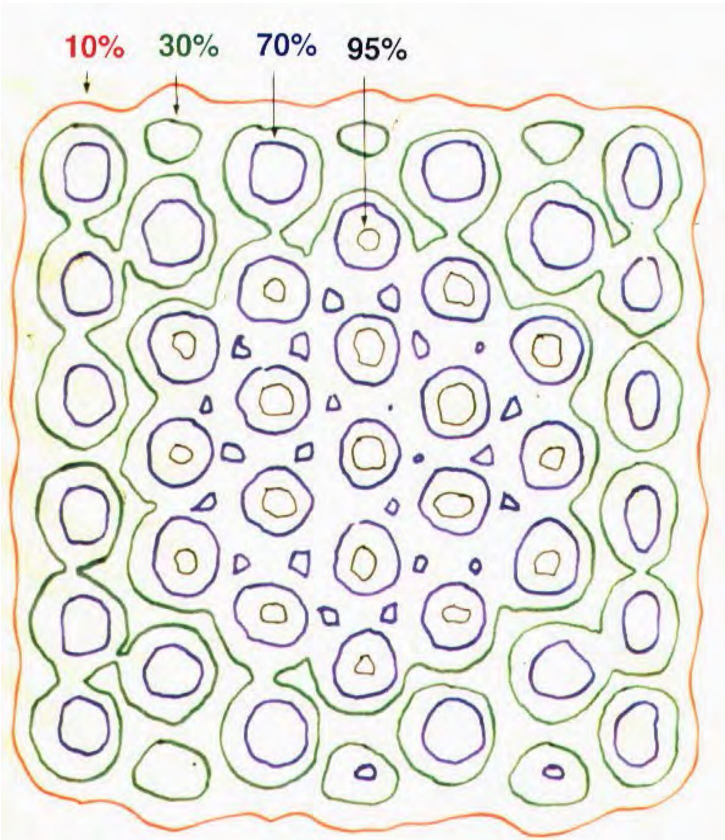




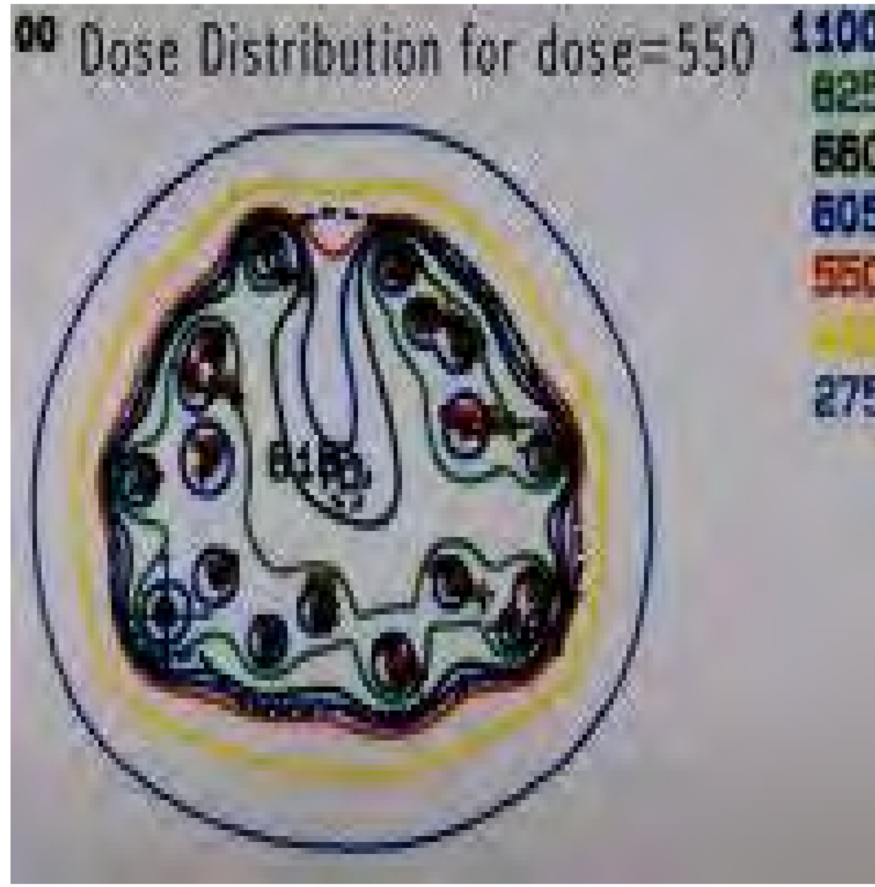
“Spatial fractionation”

- Mimics the dose distribution obtained with HDR.
- Small core areas of high dose with surrounding transitional zones of lower dose gradients.
- As, with brachytherapy, the inhomogeneous dose distribution delivers a safe and higher integral dose.

Comparison between GRID & HDR dose distributions



Dose Distribution at 10 cm Depth in Tissue



Grid Block Dose Calculation

Dose Determination and MU Calculation

- Output factor for field without MLCs interpolated from output factor table
- Fields with MLC blocking have output factor measured in water tank and diode
- MU Calculation:

$$MU = \frac{Dose\ (cGy)}{Calibration\ \left(\frac{cGy}{MU}\right) \times ISF\ \times Output\ Factor}$$

Grid Block Dose Calculation

Dose (Gy)	20
Energy (MV)	10
X1	5.5
X2	5
Y1	3.4
Y2	6
Equivalent Square	9.9
Percent Blocking	7%
Blocked Eq Square	**9.2**
Output Factor	0.890
SSD	100
Depth of dmax	2.2
MU	**2347**

Radiation Oncology Department
University of Maryland Medical System

DOSIMETRY CALCULATIONS USING THE GRID BLOCK

Output Factor with Grid Block

Filed Size	6MV	18 MV
5 x 5	0.846	0.670
10 x 10	0.860	0.723
15 x 15	0.873	0.742
20 x 20	0.882	0.757
25 x 25	0.892	0.768

MU calculation for 100 cm SSD Technique:

$$MU = \frac{\text{Tumor Dose}}{D_0 \times PDD(d,r) \times \text{Grid Output Factor}(r) \times \left[\frac{100}{100 + d_{max}}\right]^2}$$

where d is the prescription depth, r is the MLC shaped equivalent field size at 100 cm SSD, and D_0 is the reference dose at d_{max} for an open 10 X 10 cm field size at 100 cm source to calibration point distance.

Patient Name: ____________________
Patient No: ____________________ Date: ____________________

Prescription: ____

MU = --

Calculation performed by: ____________________ Calculation checked by:

Grid Block Planning

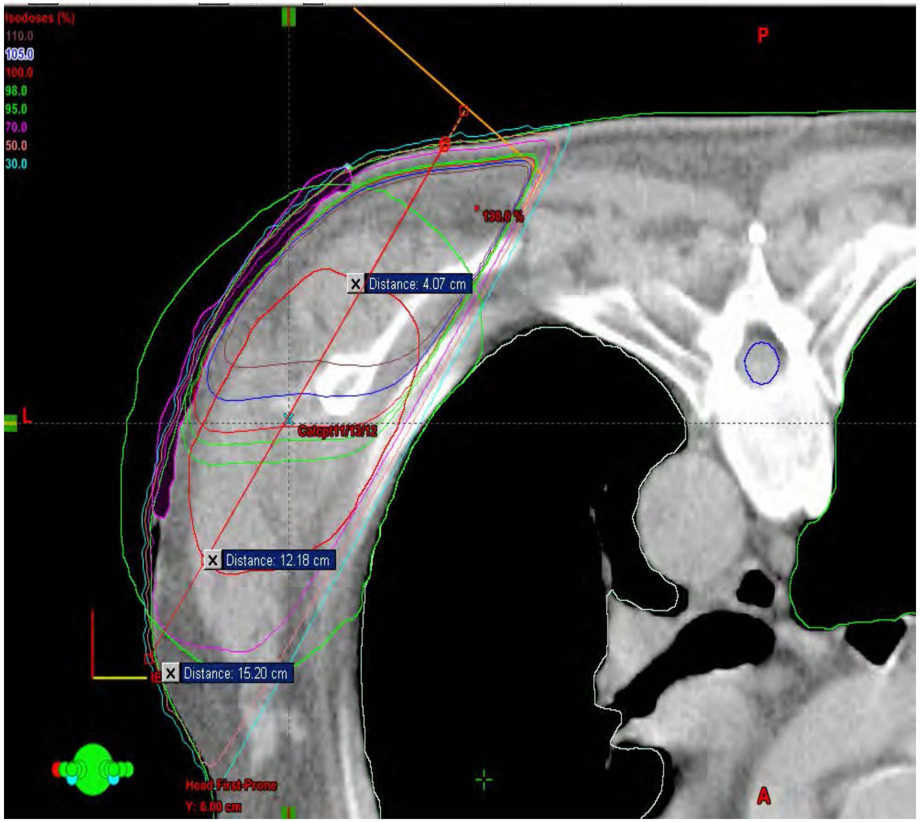
Dose Determination and MU Calculation

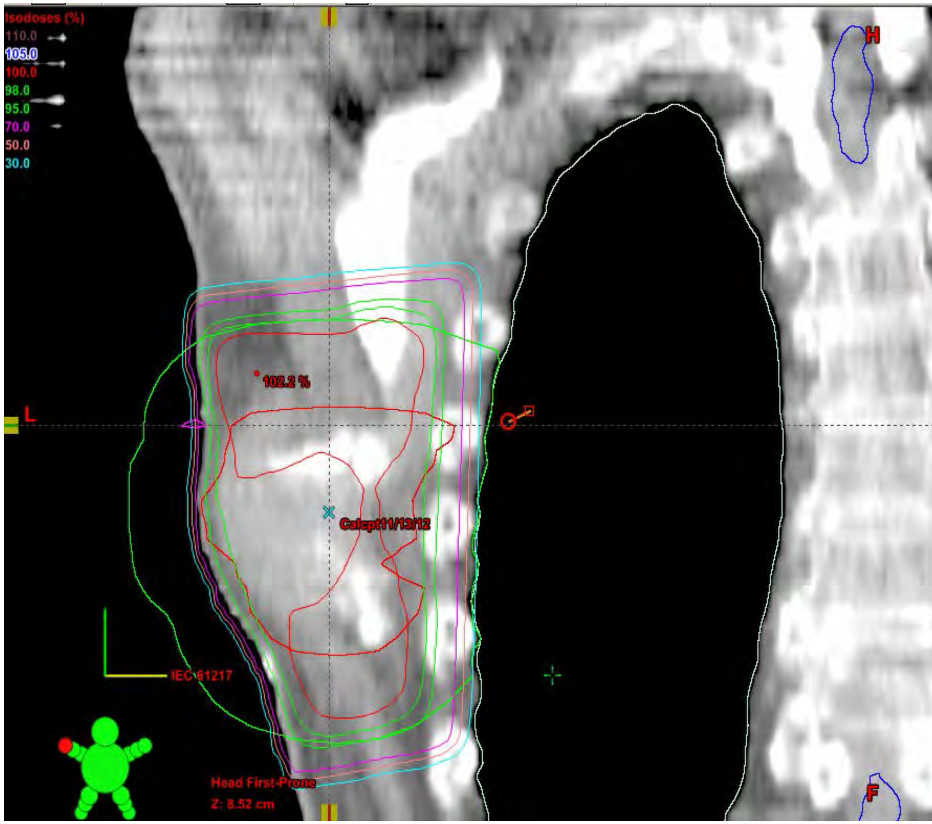
- 100 cm SSD used for patient treatment
- Field modeled in TPS to determine best isocenter placement, gantry angle, field size, and MLC blocking (if needed)
- Measurements taken at various points from skin surface to selected points in GTV
- PDD data used to estimate dose delivered at these selected points
- Energy and dose are chosen

Grid Prescription

- 2000 cGy x 1 Fx
- 10 MV photon beam
- Dose Spec: 100% to Dmax

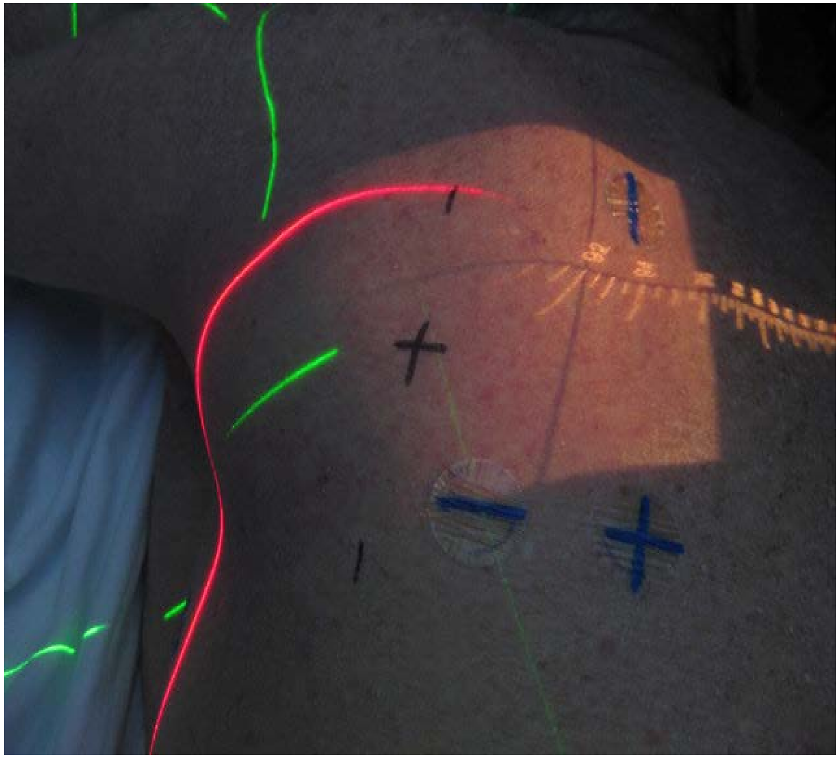
TPS: Eclipse 8.6
Surface to depth measurements taken to determine energy and dose. Measurements include surface to proximal point in GTV, surface to distal point in GTV and surface to exit point
Open field used to determine entry/exit angle, targeting of GTV and avoidance of OARs

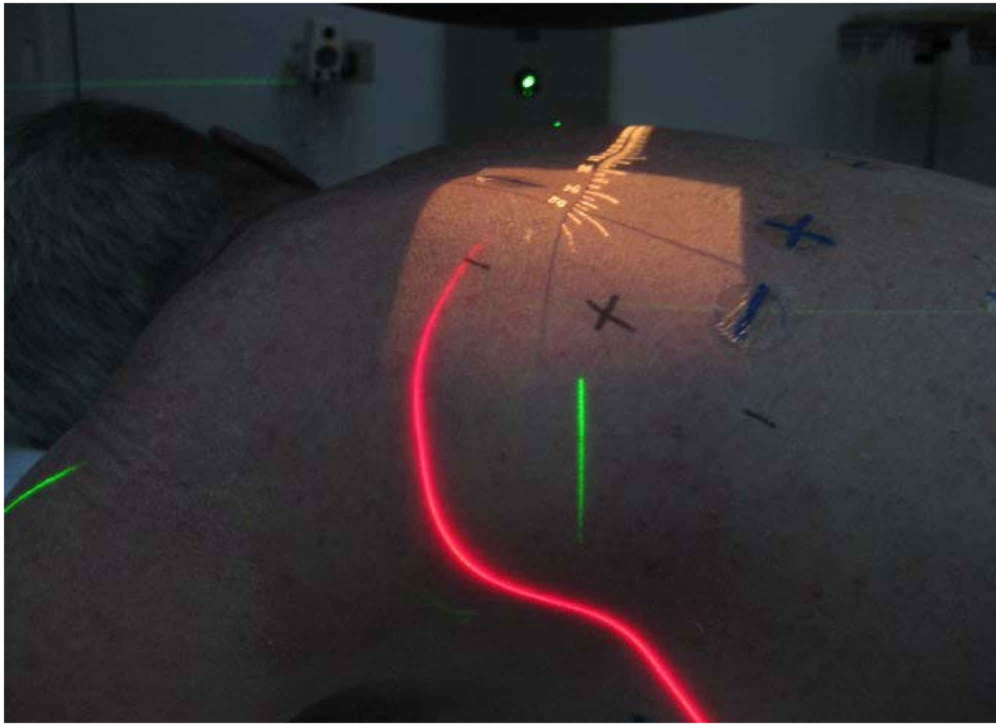




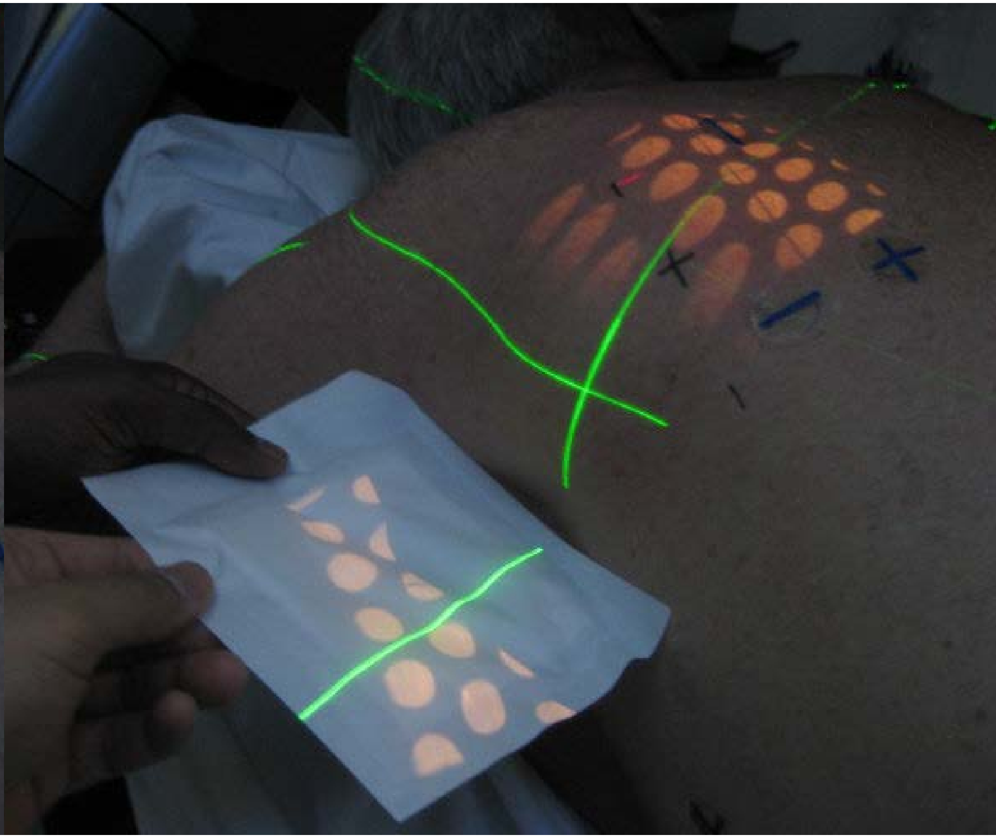
Slide in GRID block

Set up to 100 SSD

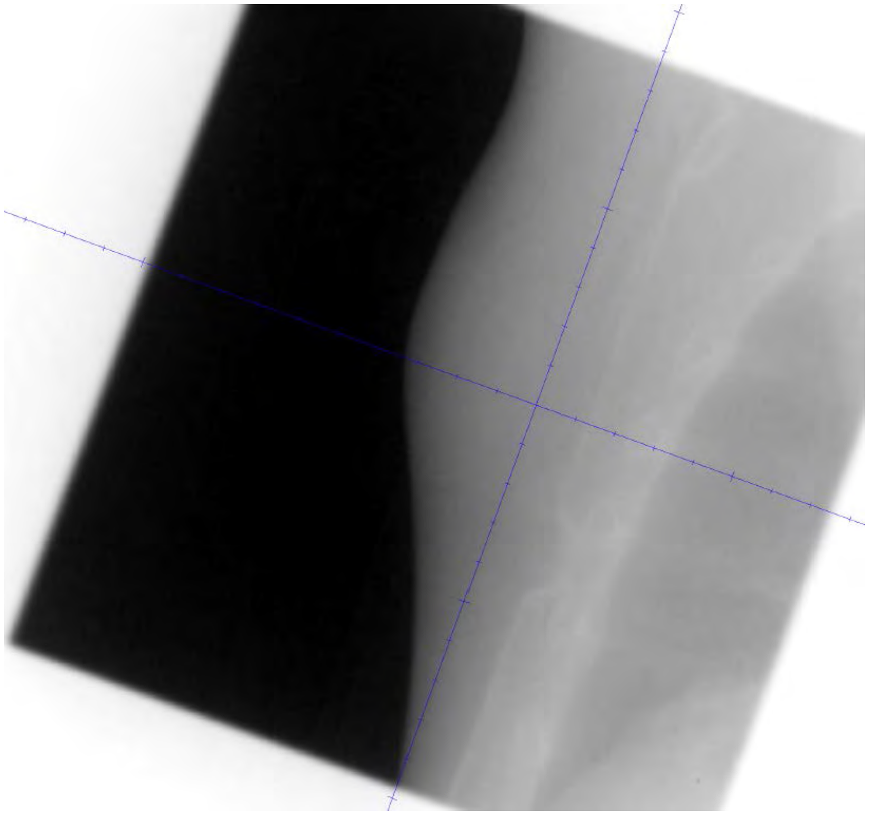


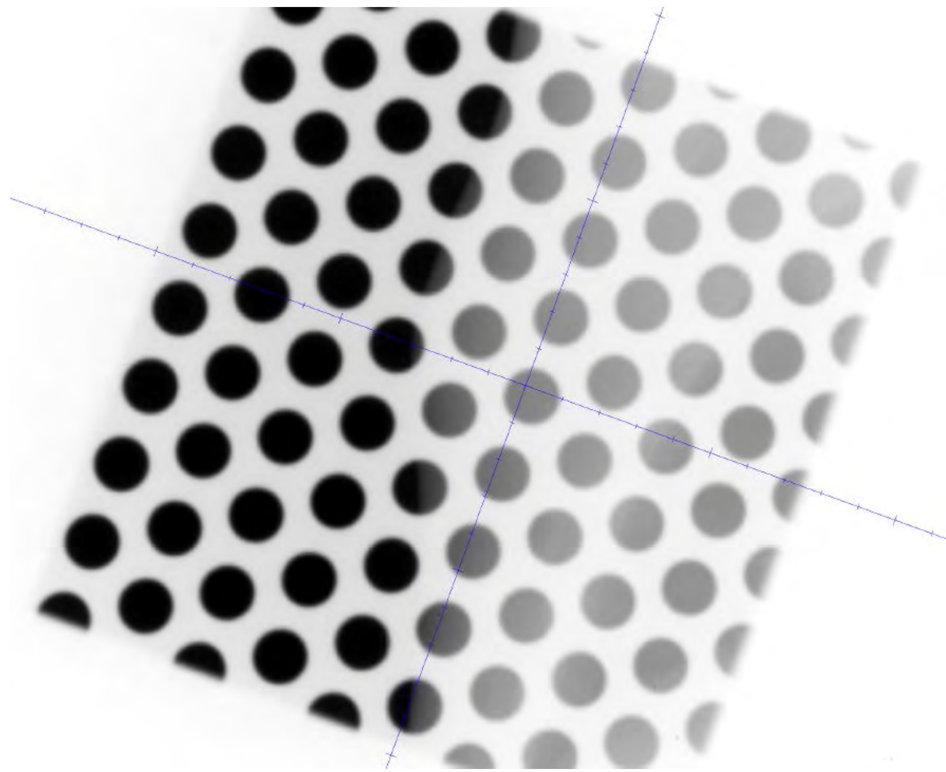


Verify light field

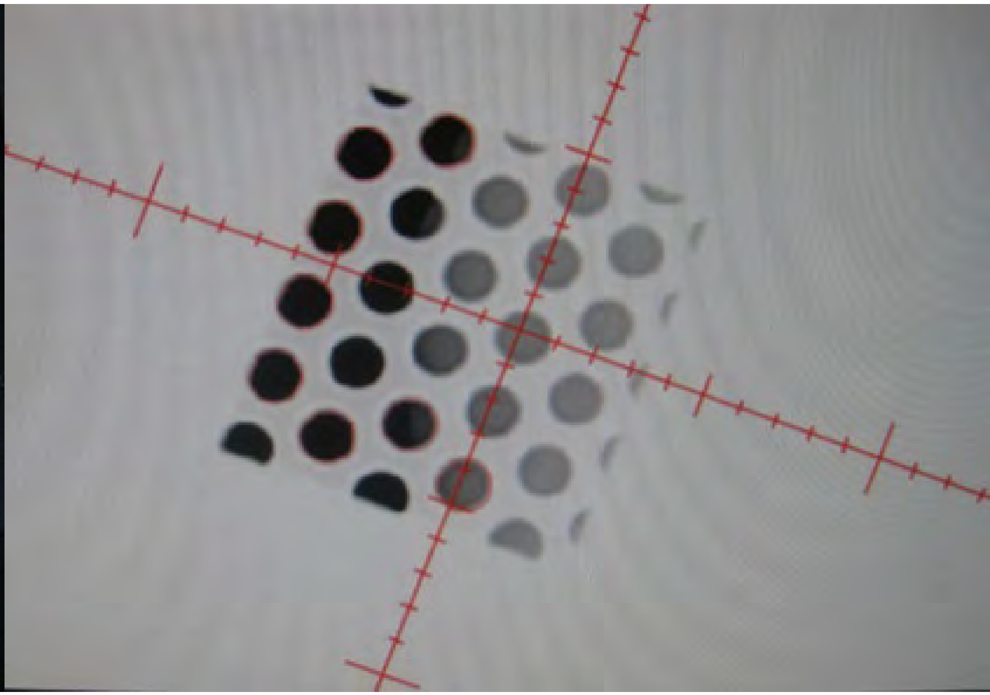


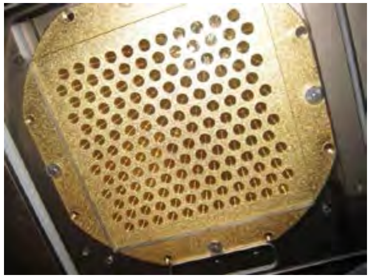
Take Films





Use MLCs to block GRID field





Follow up: 5 days

Follow up: 5 days

Follow up: 2 weeks

Follow up: 6 weeks

Follow up: 6 weeks

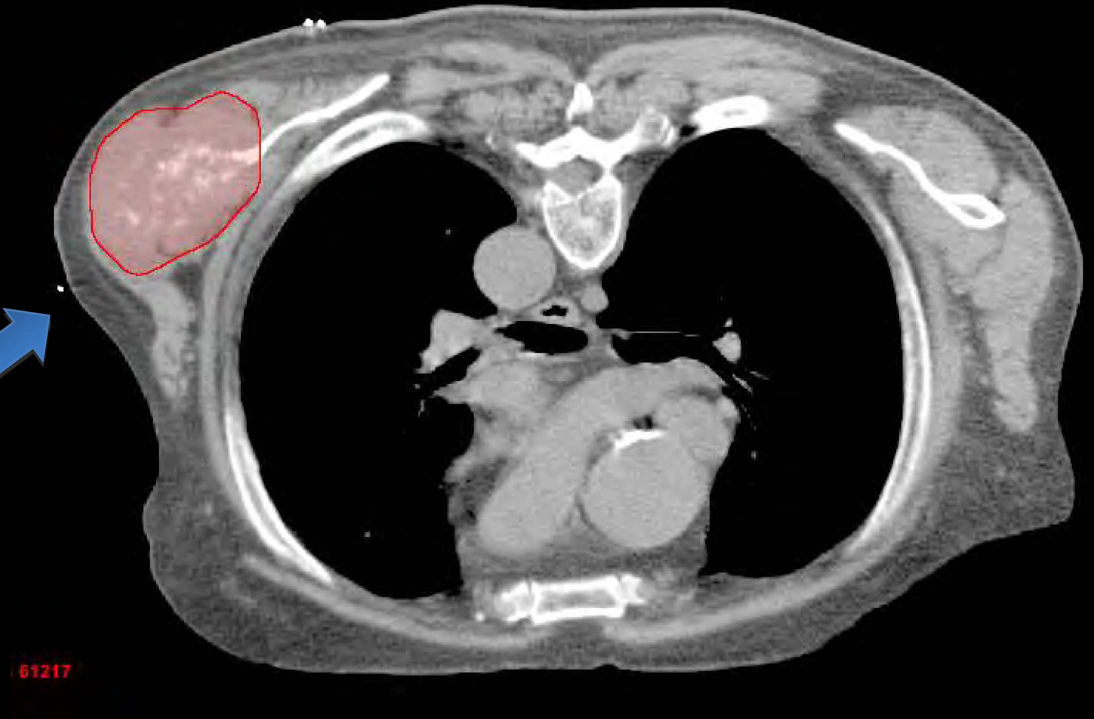
Follow up: 6 weeks

Follow up: 4.5 months

Follow up: 7 months

Follow up: 7 months

Pre-GRID
(Prone)



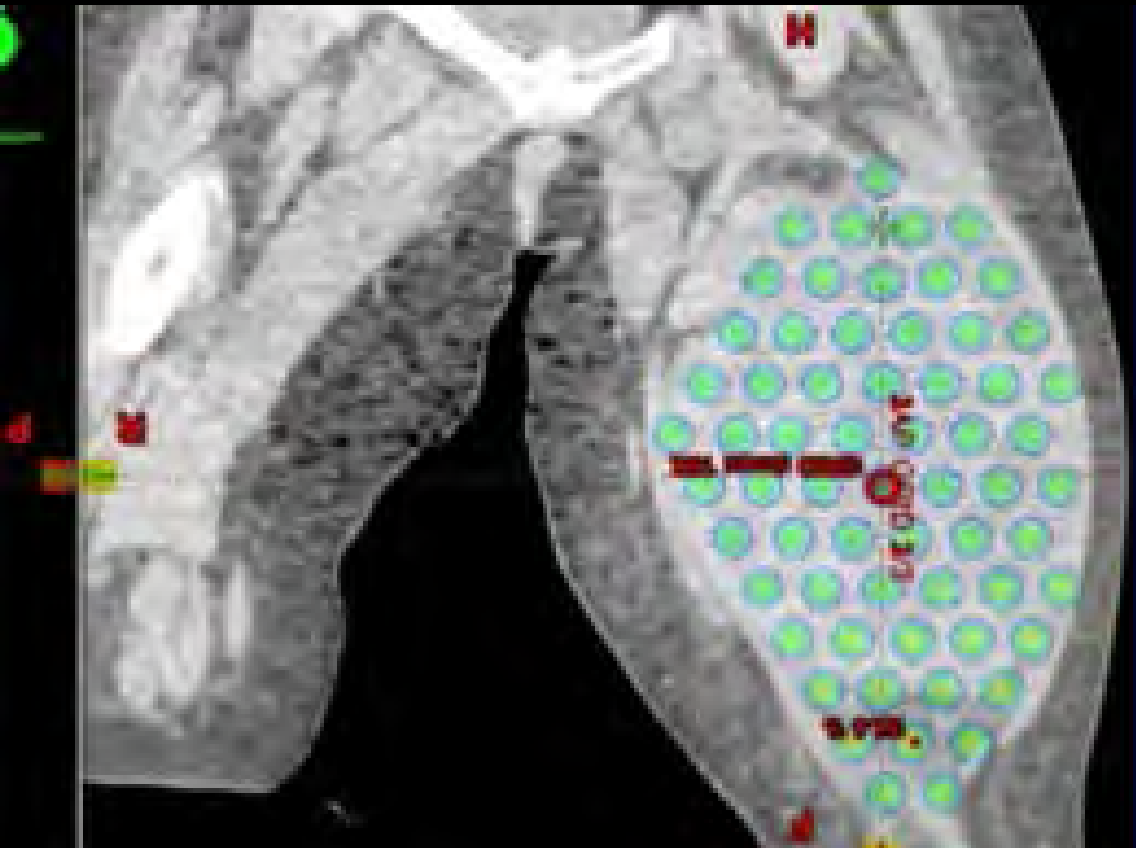
7 months later

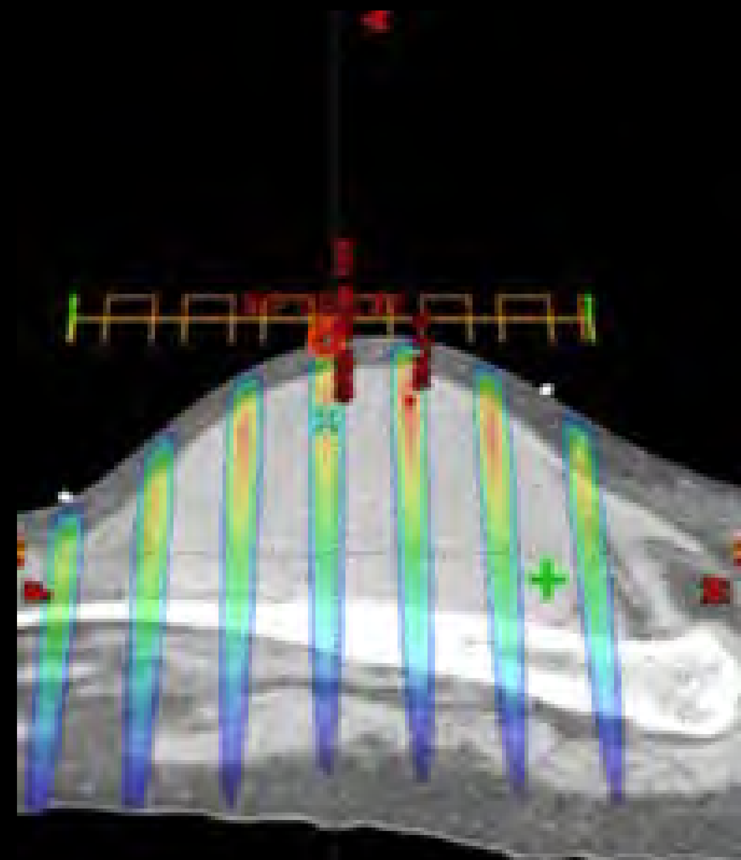
Post-GRID
(Supine)

All kinds of tumors and sites

Distribution of Patients by Histology

	No. of treatments
Sarcoma	46
Lung	50
Gynecological	37
Head & Neck	64
Melanoma	67
Sarcoma	20
Gastrontestinal	44
Genitourinary	33
Skin	10
Other	30
Total	357

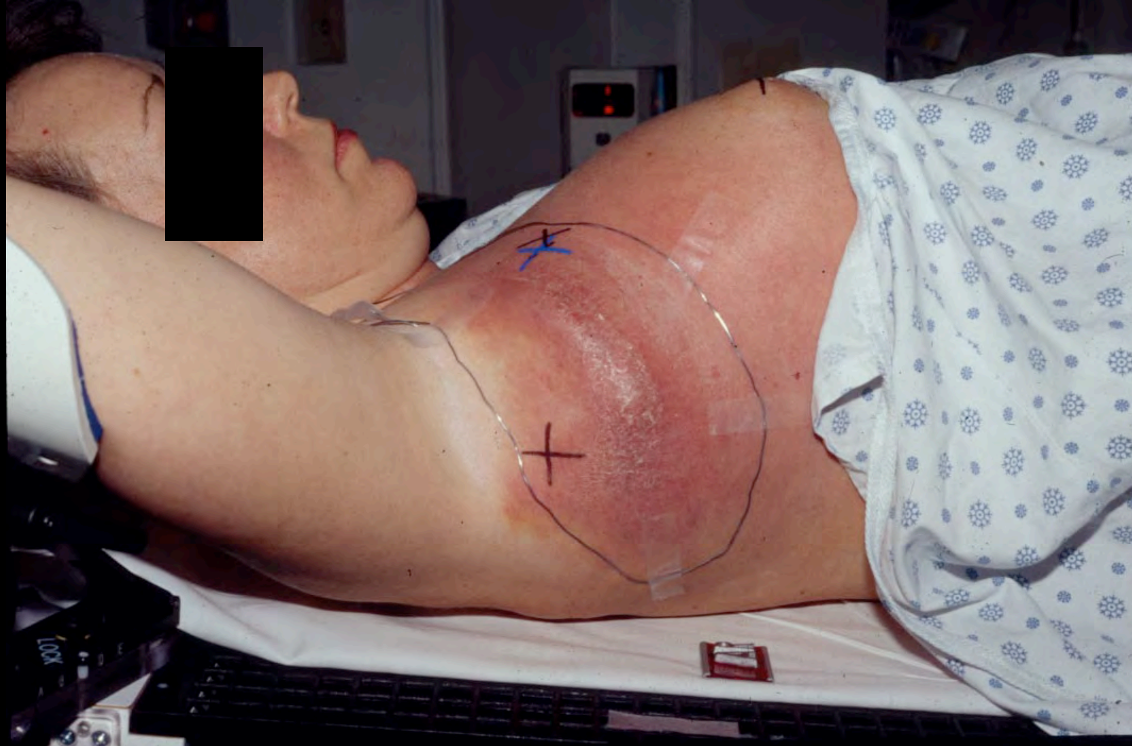




Pre SFGRT

Post Treatment

Squamous Cancer



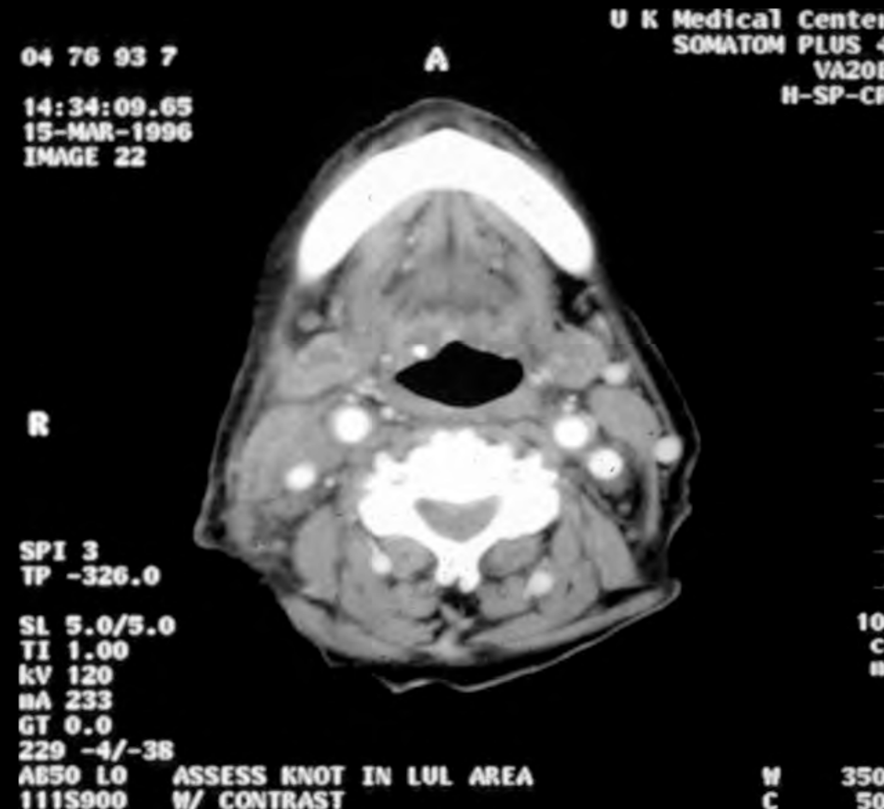
Recurrent Melanoma

Pre SFGRT

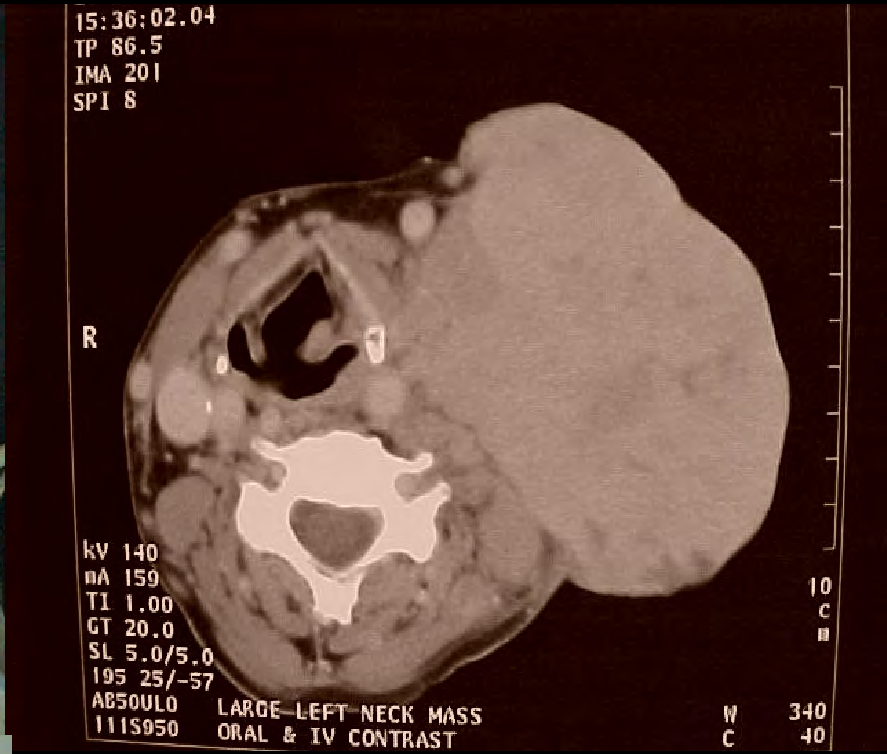
Post Treatment

Recurrent Large Cell Lymphoma

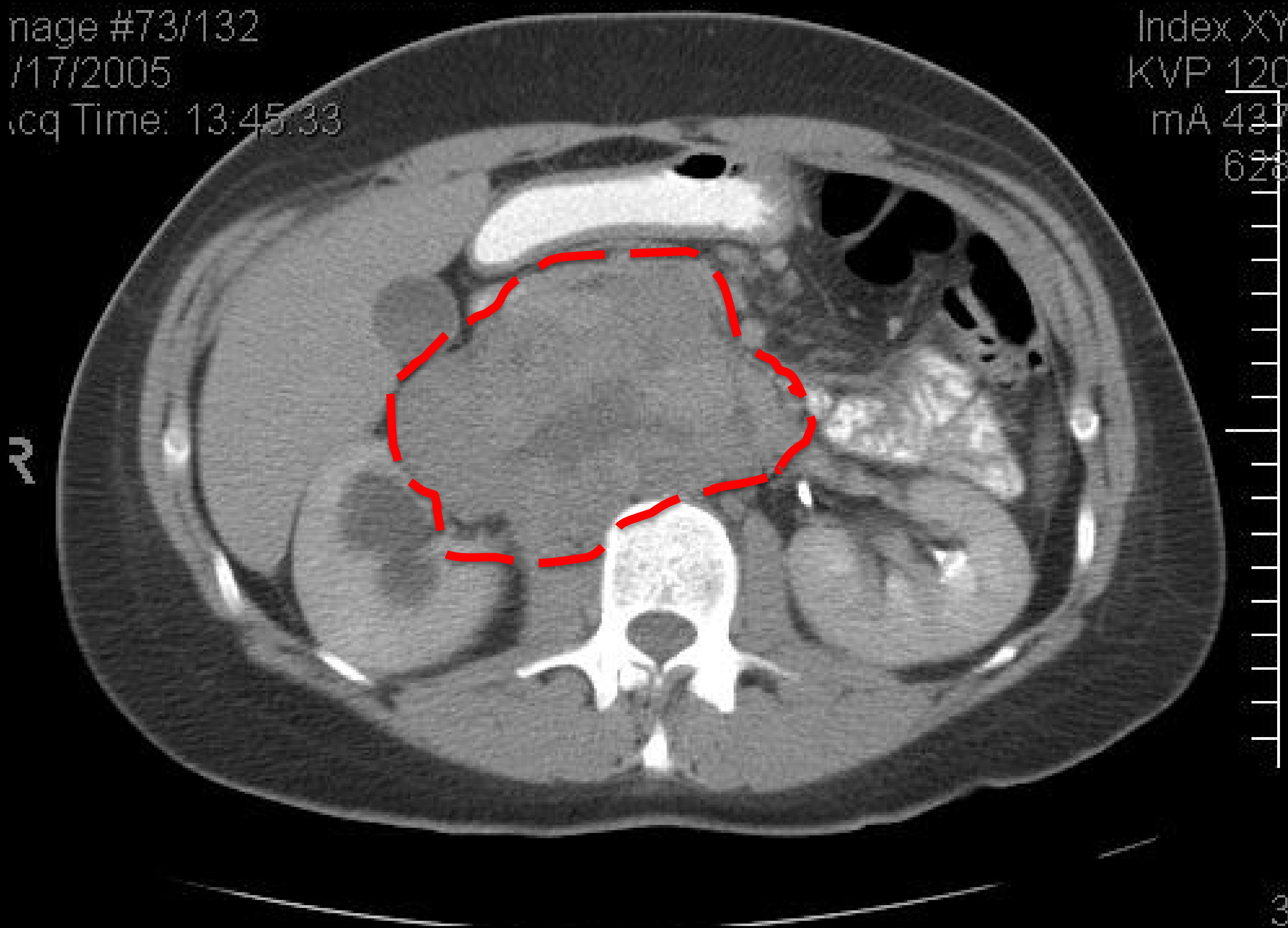
Pre SFGRT



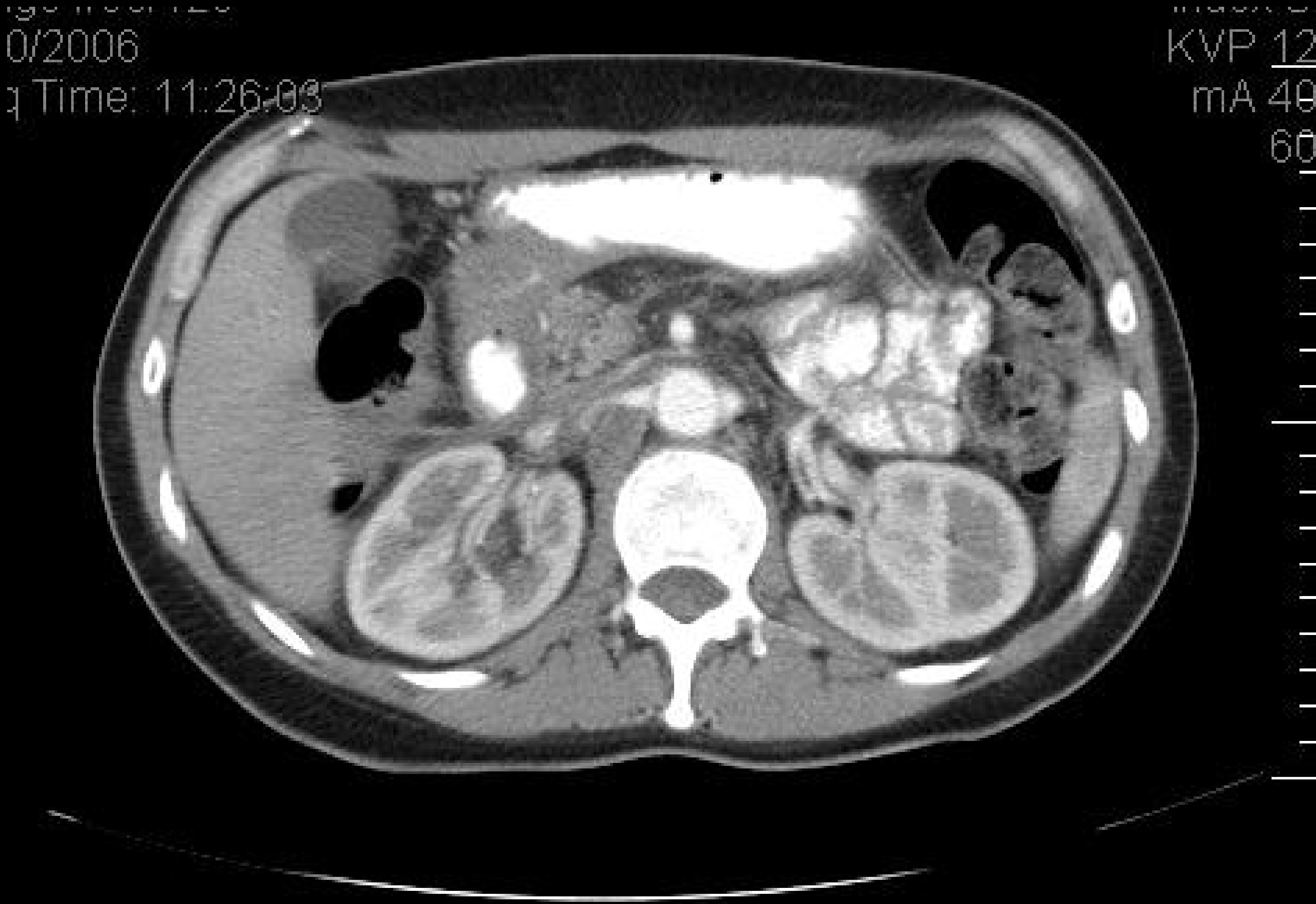
Post Treatment



Metastatic Neuroendocrine Tumor



MFH Pre-treatment



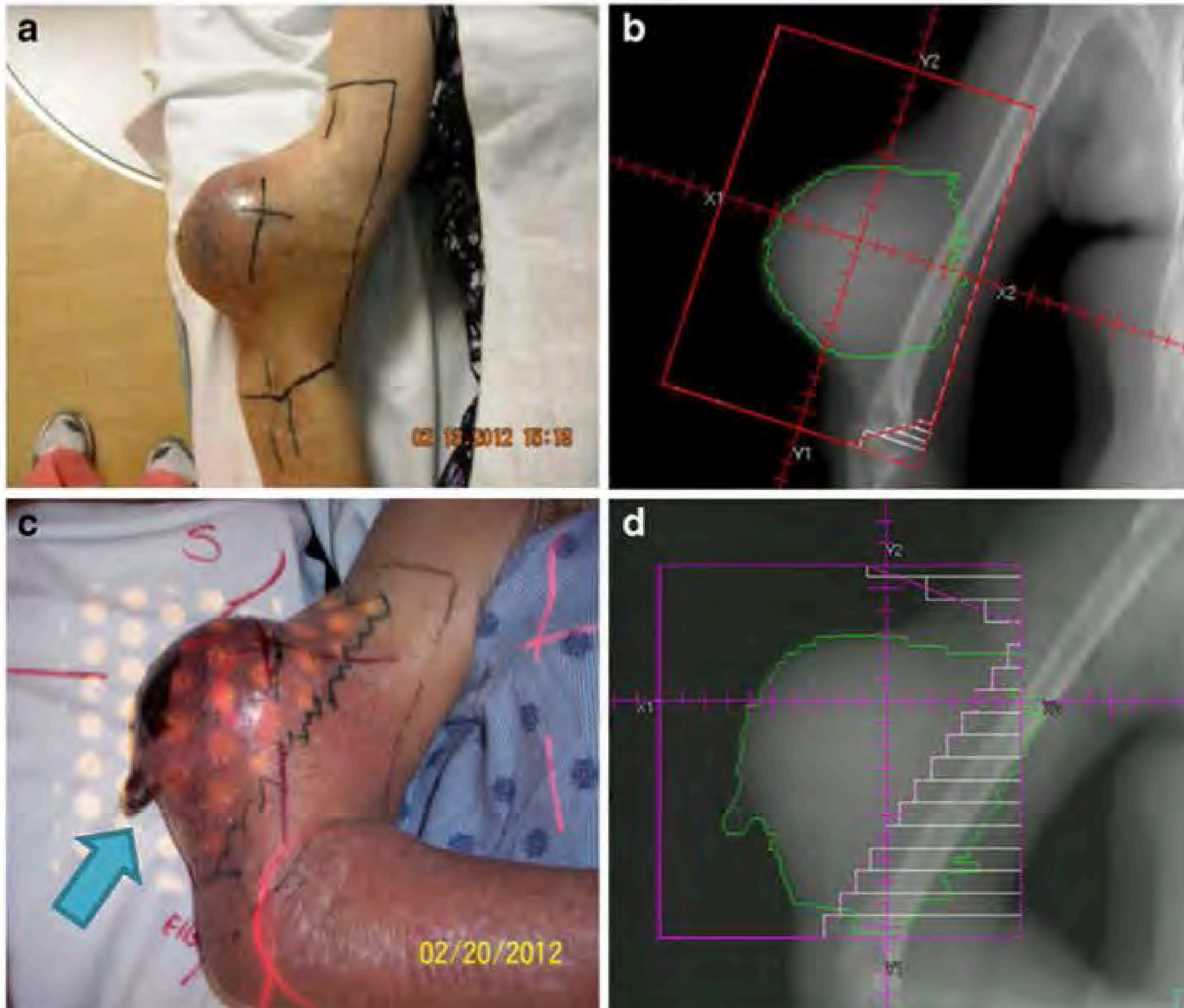
MFH Post treatment


2nd Case

- Refer you to the case report that was handed out for a very dramatic example of sarcoma:
- Treated to 18Gy GRID since it was growing on treatment, and only 32Gy regular field (needs 50Gy)
- 99% pathological complete response
- Patient kept arm from amputation

2nd Case

Fig. 1 Neoadjuvant radiation treatment. **a** Right upper arm light field for conventional external beam radiation (cEBRT). **b** Digitally reconstructed radiograph showing field borders for right upper arm cEBRT with gross tumor volume (GTV) outlined in *green*. **c** Right upper arm light field for spatially fractionated GRID radiotherapy with tumor penetrating through the skin indicated by a *blue arrow*. **d** Digitally reconstructed radiograph showing field borders for right upper arm GRID field with GTV outlined in *green* (note: the medial aspect of the GTV is blocked by multi-leaf collimators with 1-cm margin around the humerus)



2nd Case

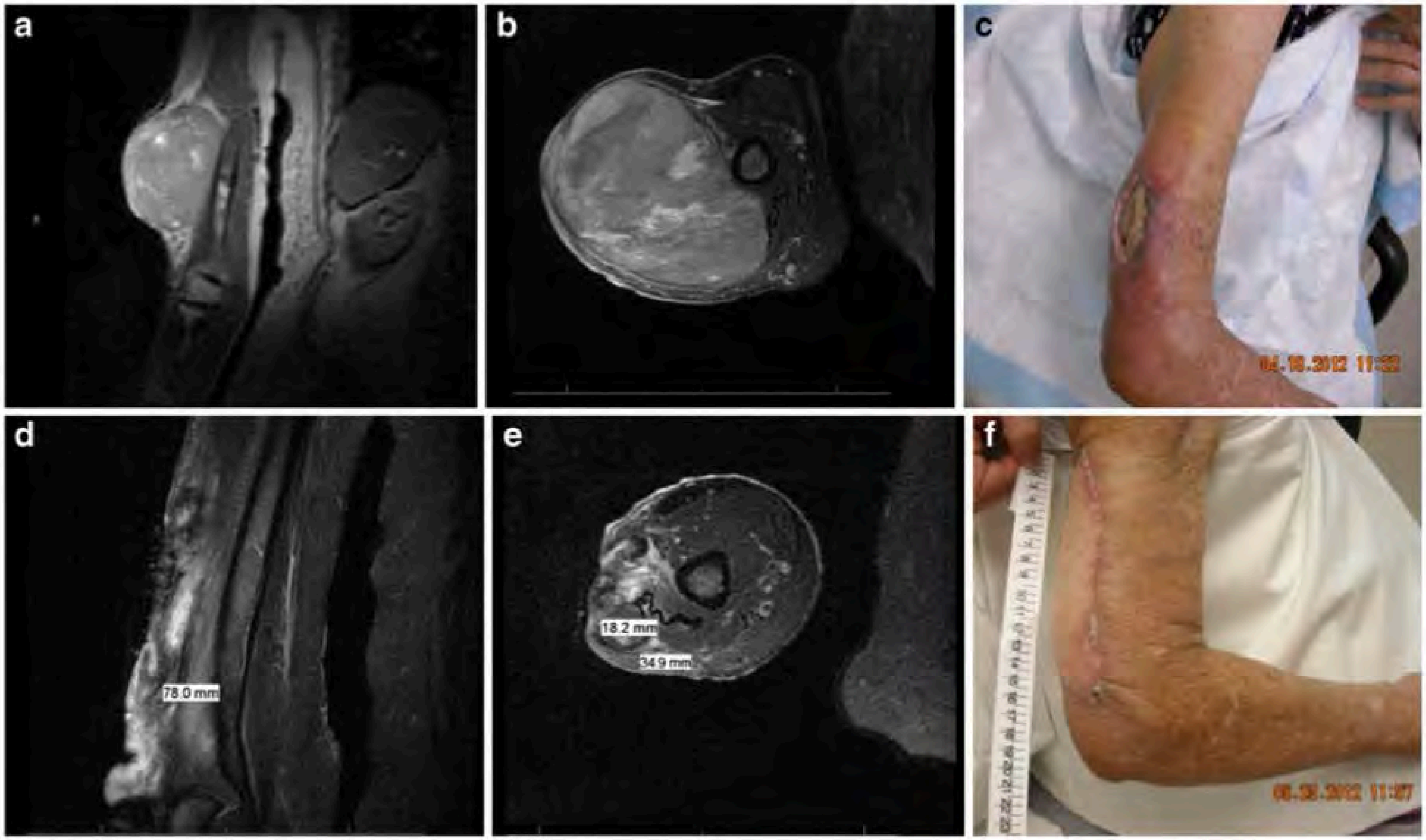


Fig. 2 Clinical and radiographic tumor response to neoadjuvant radiation. **a** Coronal MRI of right upper arm prior to start of radiation treatment. **b** Axial MRI of right upper arm prior to start of radiation treatment. **c** Right upper arm before surgery and 6 weeks after completion of radiation. **d** Coronoal MRI of right upper arm 6 weeks after completion of radiation. **e** Axial MRI of right upper arm 6 weeks after completion of radiation. **f** Right upper arm 4 weeks after radical resection and innervated right latissimus dorsi myocutaneous flap placement

Guidelines for Beam Design

- Always use 100 SSD.
- Prescribe to Dmax.
- Do not need to add any margin to GTV.
- The whole GTV does not have to be covered by the beam.
- Always spare bone-marrow producing bones.
- Always try to avoid as much normal tissue as possible, especially critical organs.
- Any energies, low and high can be used, depending on depth of GTV.

Spatially Fractionated Radiation Therapy (GRID) Treatment Planning with Commercially Available Treatment Planning System

Harold Park, MS

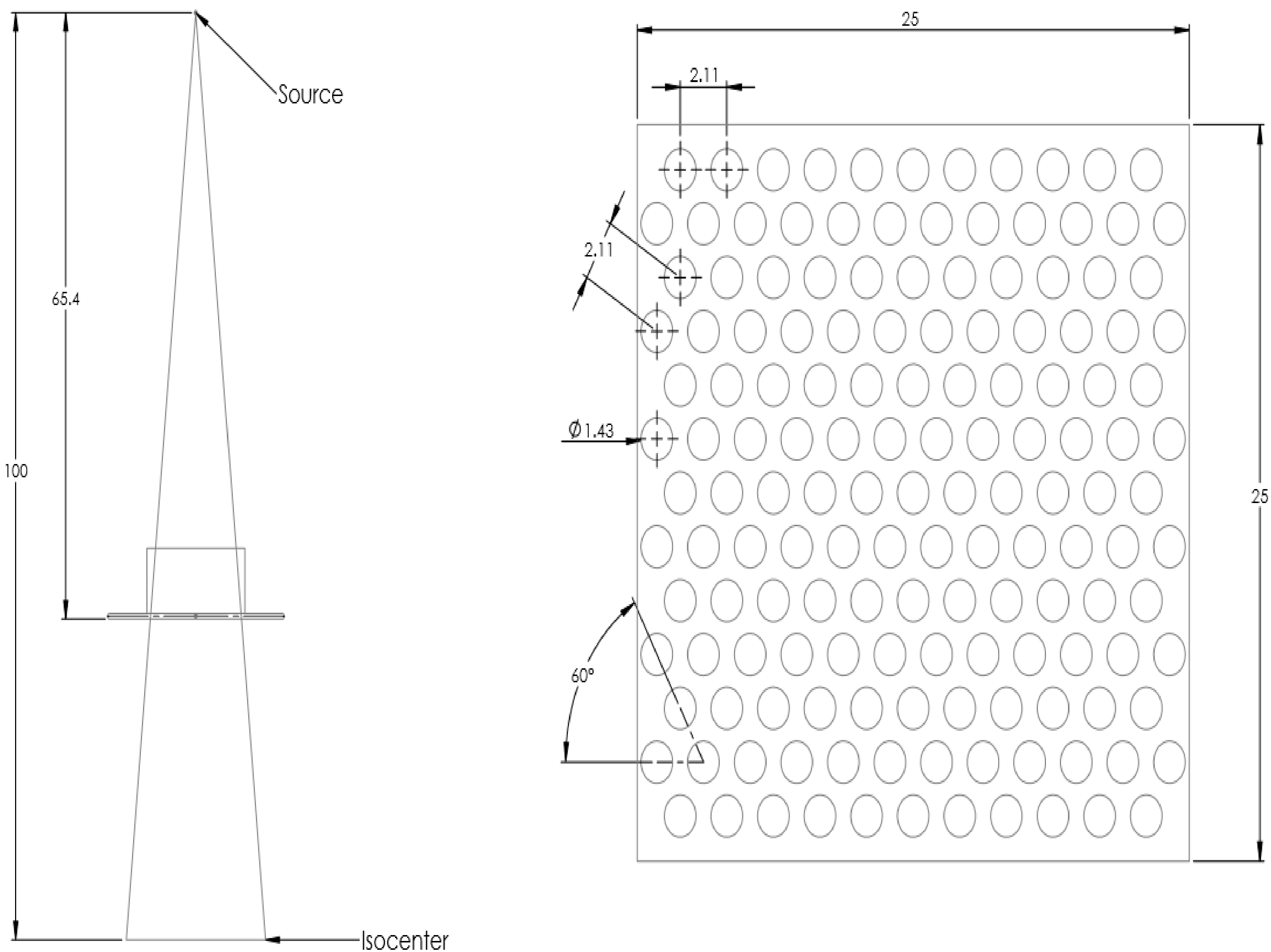
INTRODUCTION

CURRENT DISADVANTAGES

- Typical planning based on output factor table, PDD, and peak/ valley ratios
- Treatment parameters based on CT (gantry angle, field size)
- When MLCs are incorporated, output factors based on blocked field needed. Extra time needed for measurement
- MU Calculation based off point dose in water. Does not take into account patient contour
- Manual digitization of block into TPS has been achieved, but very laborious and may be subject to error
- MLC-Grid has high MU, increased leakage dose to patient; reduced skin sparing

SOLUTION

An accurate, efficient method of creating the GRID block in a TPS in order to correctly model the dose distribution in a patient.

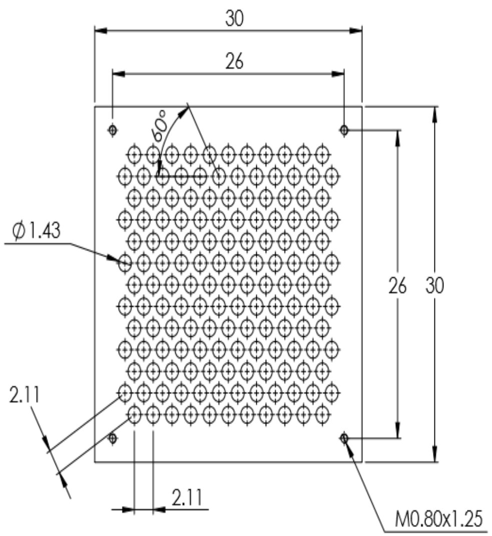


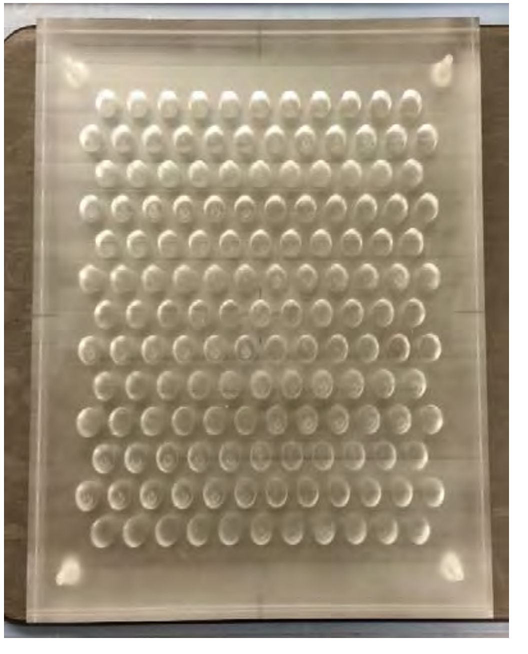
Source
65.4
100
Isocenter
25
2.11
2.11
Ø1.43
60°
25

MATERIALS AND METHODS

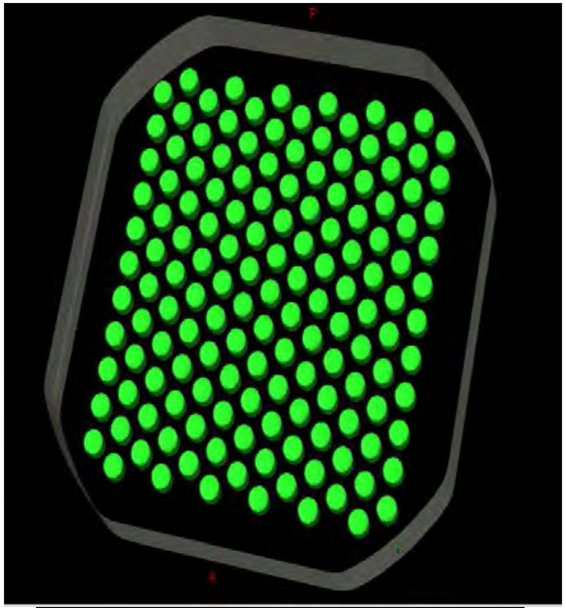
Acrylic GRID Block

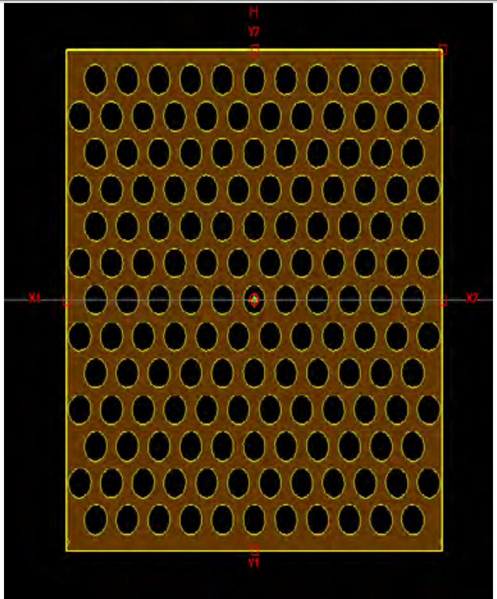
- Hole size and spacing at isocenter is drilled uniformly into block
- Holes are NOT divergent, depth of 1 cm
- Lid was created to reduce artifacts from air and allow us to fill holes with other materials if desired
- Scanned in the coronal position using axial slices with 0.625 mm thickness





MATERIALS AND METHODS





Acrylic GRID Block

- Structures were created from each of the holes. From these hole structures, a block was generated that matched the dimensions and pattern of the grid block.
- A GRID block was created in the Eclipse beam configuration and assigned a transmission value that allowed it to agree with film and water measurements. **No other beam parameters were changed.**

MATERIALS AND METHODS

Treatment Planning System
Eclipse (v. 11, Varian Medical Systems, Palo Alto, CA)

CT Scanner
GE LightSpeed RT (GE Medical Systems)

Measurement Devices Used
- Film – GAFCHROMIC EBT 3 Film (International Specialty Products, Wayne, NJ, USA)
- Diode – EDGE diode detector (Sun Nuclear, Melbourne, FL, USA)
- Diode Array – MapCHECK2 (Sun Nuclear, Melbourne, FL, USA)

Other Equipment Used
- Water Tank – BluePhantom2 with OmniPro software (v. 7.4b)
- Epson 10000XL Scanner
- DoseLab Pro (Mobius Medical Systems, LP)
- ImageJ (U.S. National Institutes of Health, Bethesda, MD, USA)

MATERIALS AND METHODS

Profiles

- Crossplane and inplane at dmax, 5 and 10 cm for field sizes 5, 10 and 25

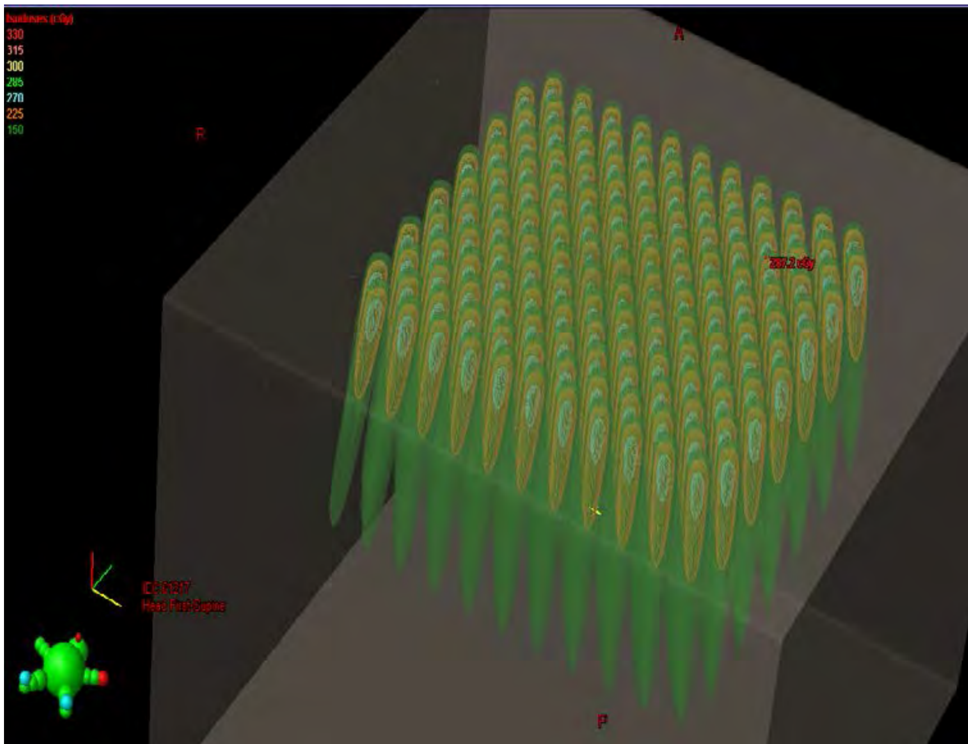
PDD

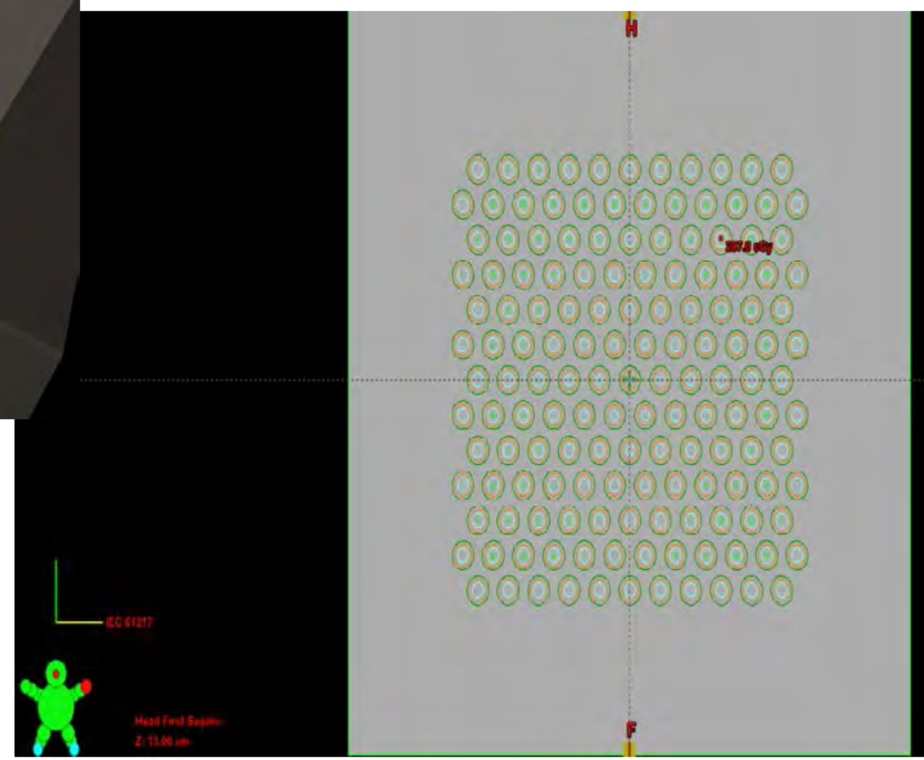
- Taken for 5, 10 and 25 cm field sizes

MLC

- Random MLC shapes and field sizes used. Film and MapCHECK2 measurements

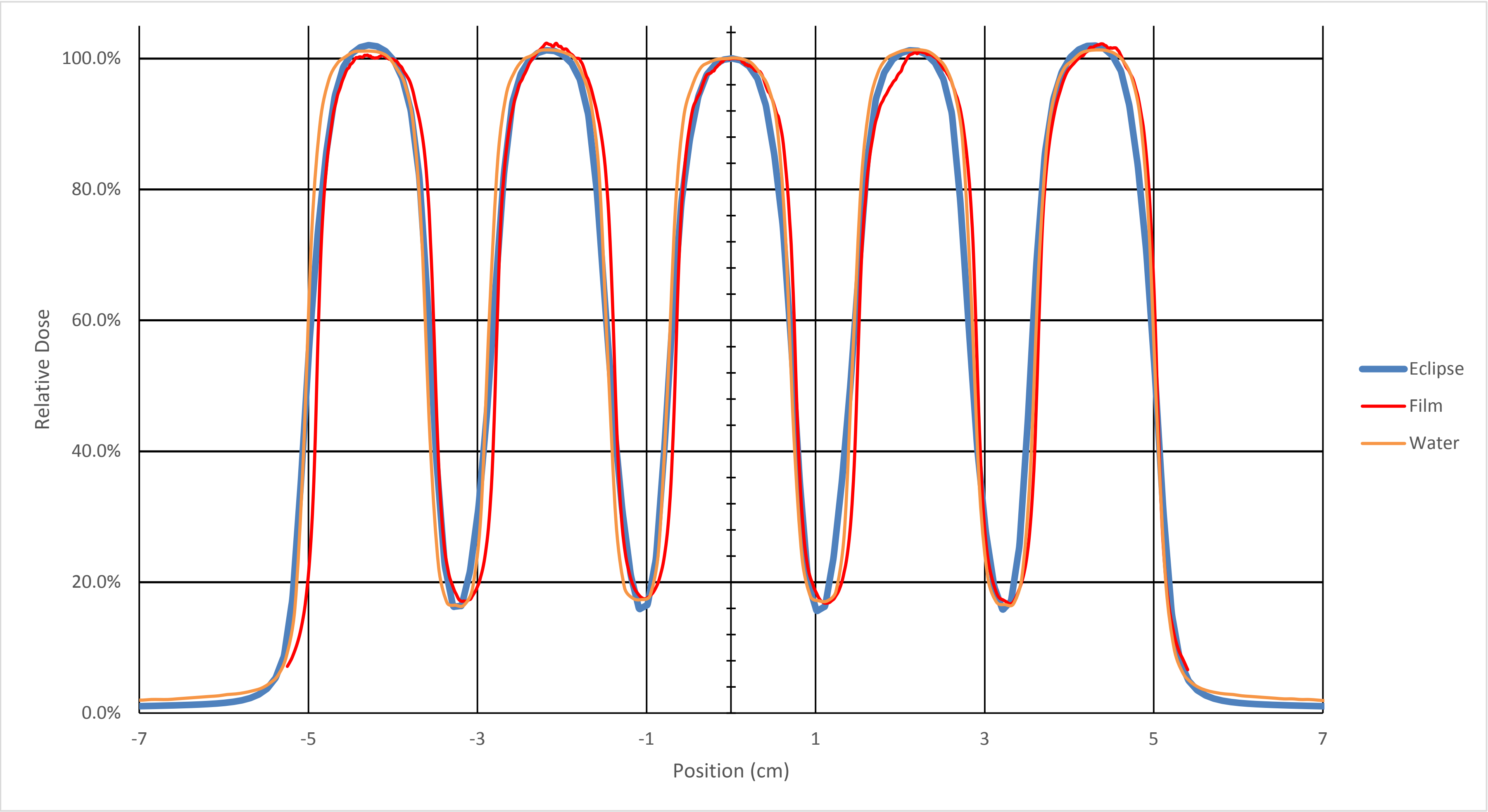
RESULTS





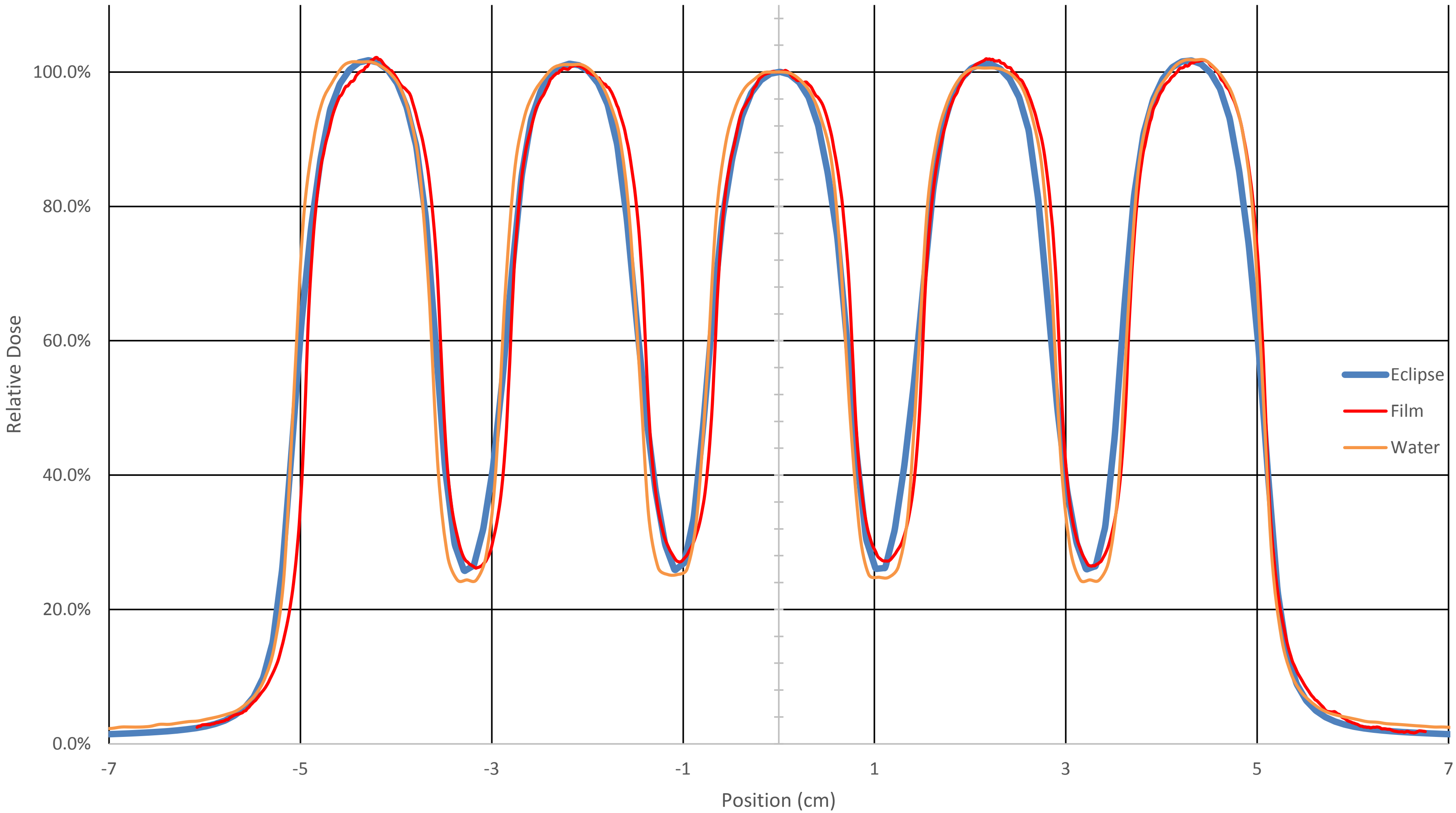
RESULTS

6 MV 10x10 Field Size at Dmax Depth



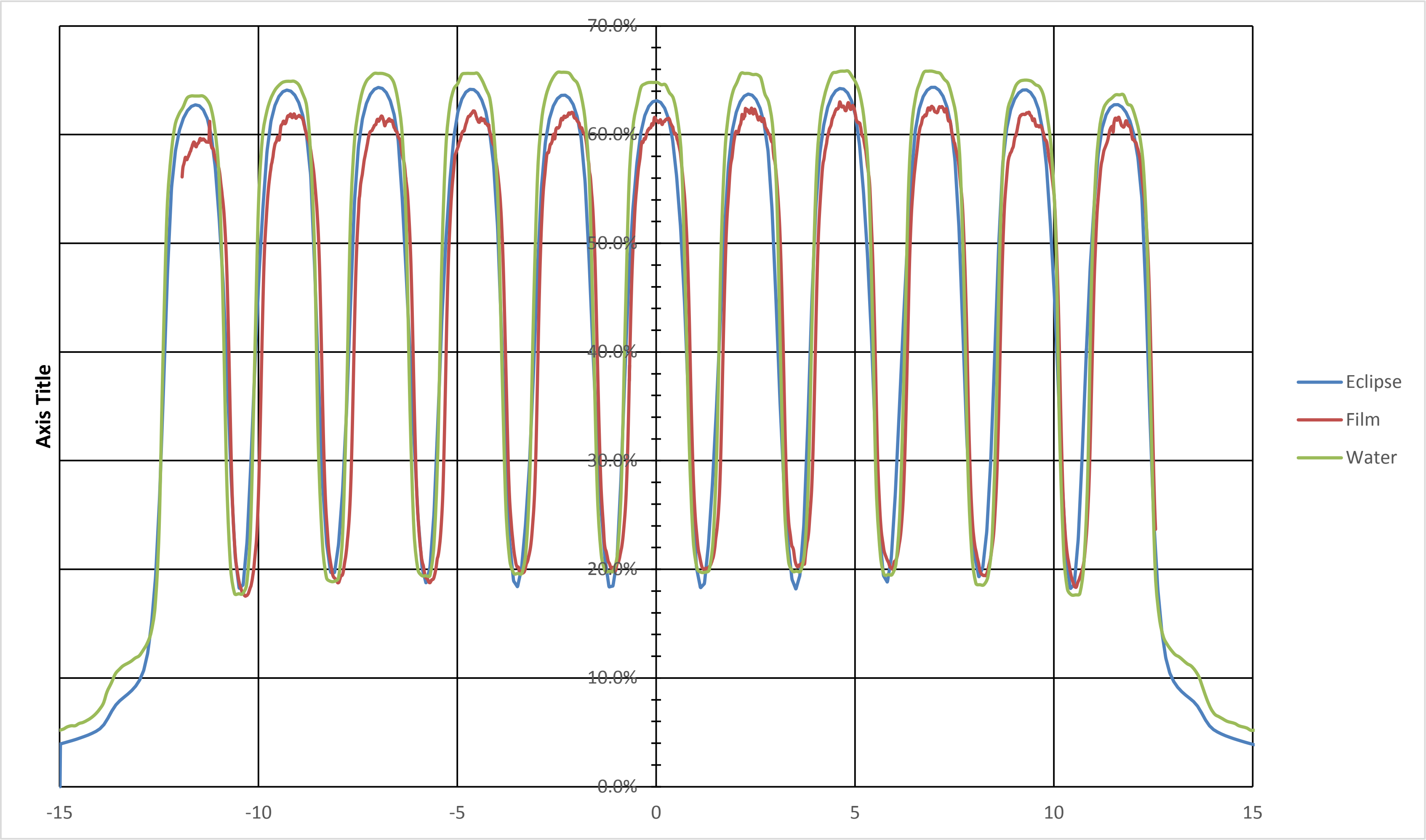
RESULTS

10 MV 10x10 Field Size at Dmax Depth



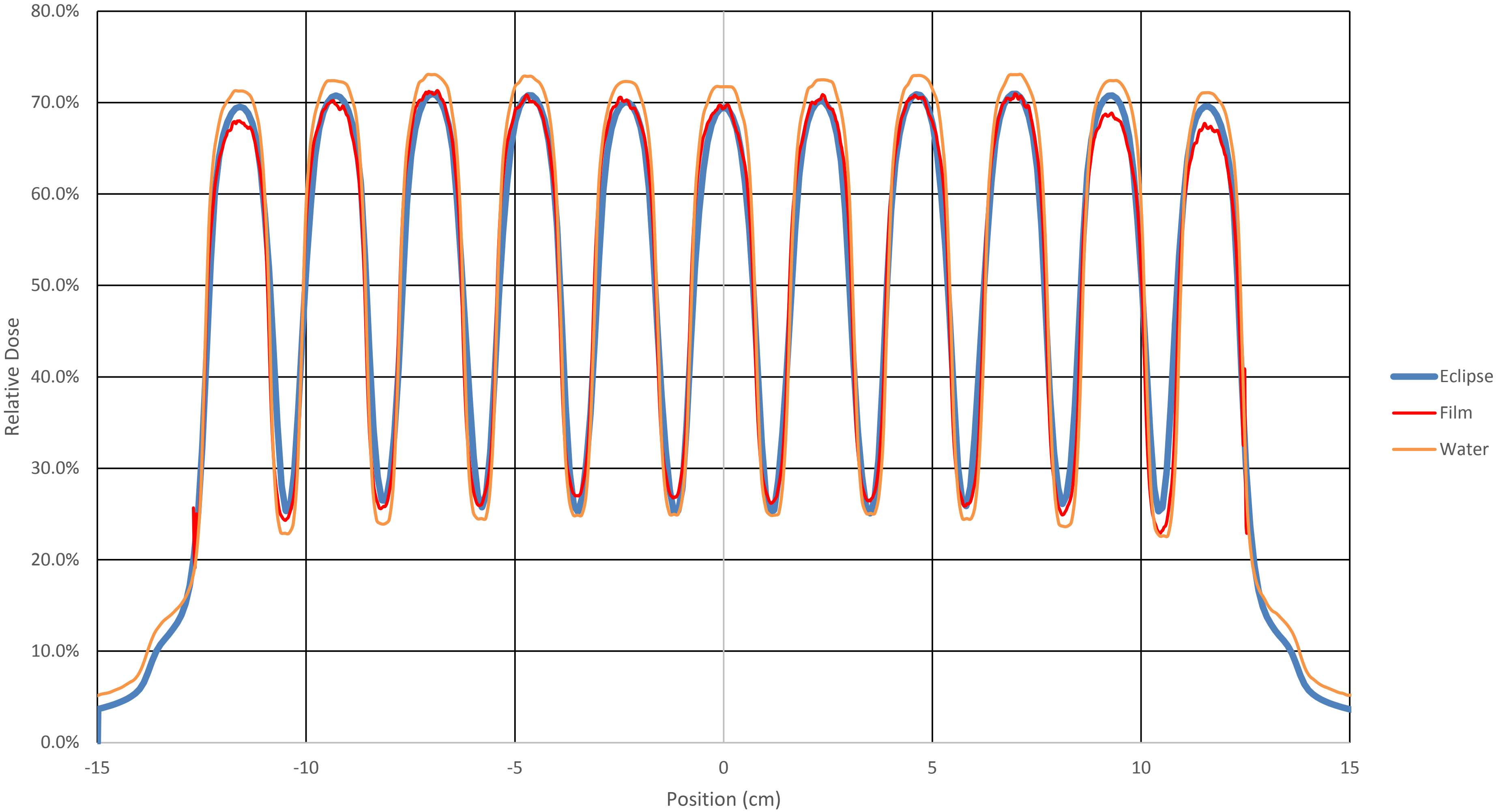
RESULTS

6 MV 25x25 Field Size at 10 cm Depth



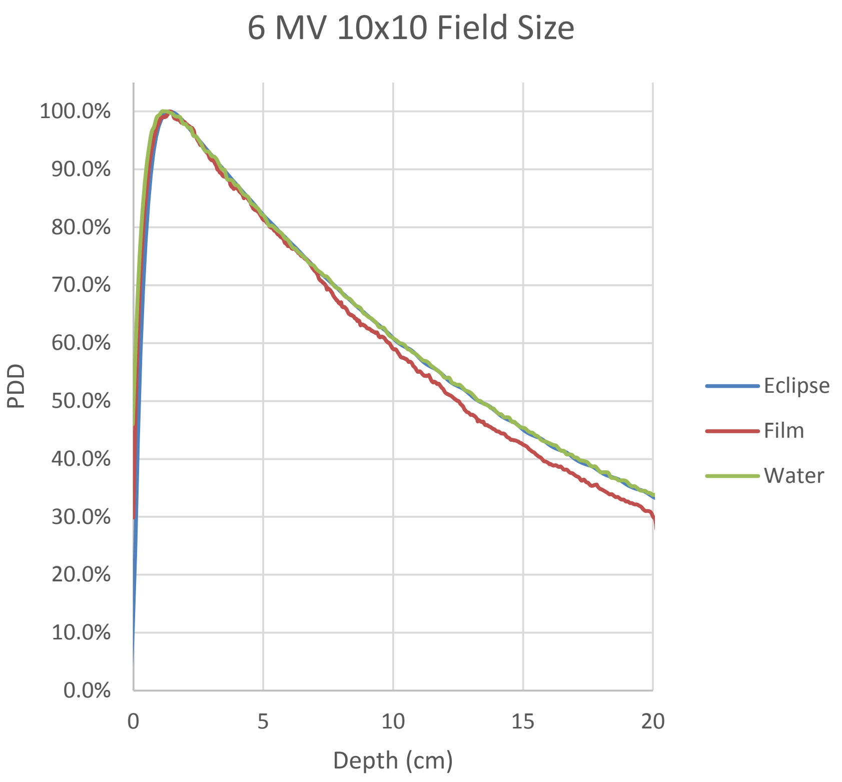
RESULTS

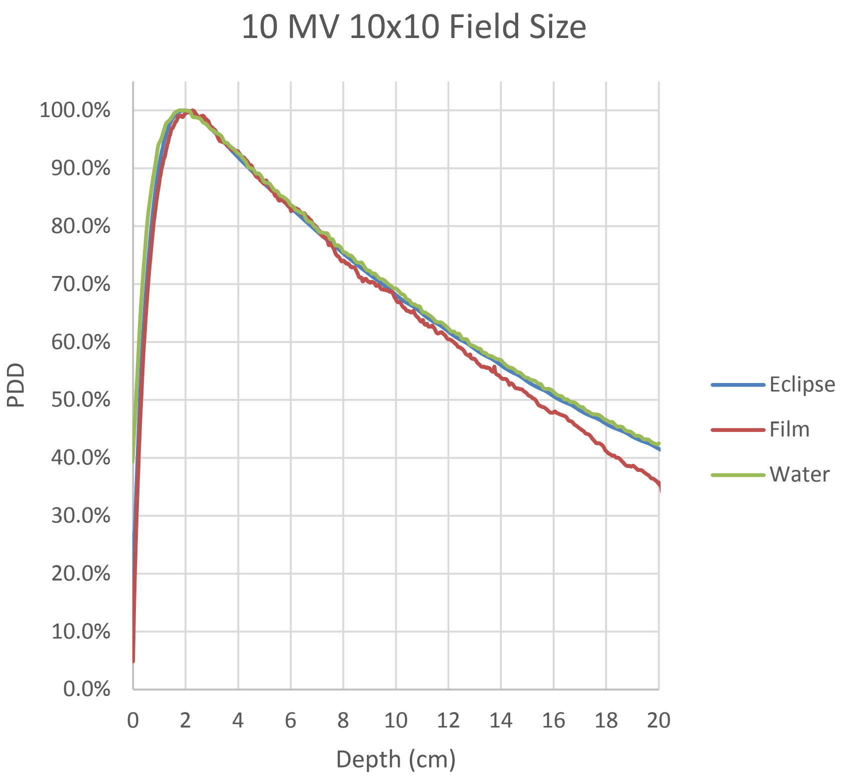
10 MV 25x25 Field Size at 10 cm Depth



RESULTS

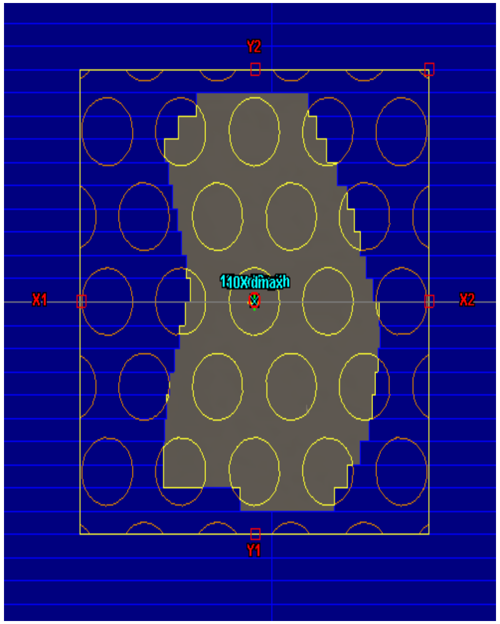
PDD Results

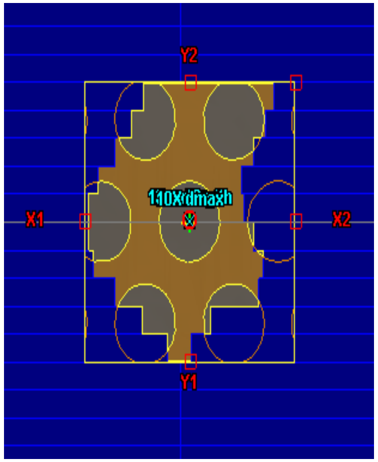


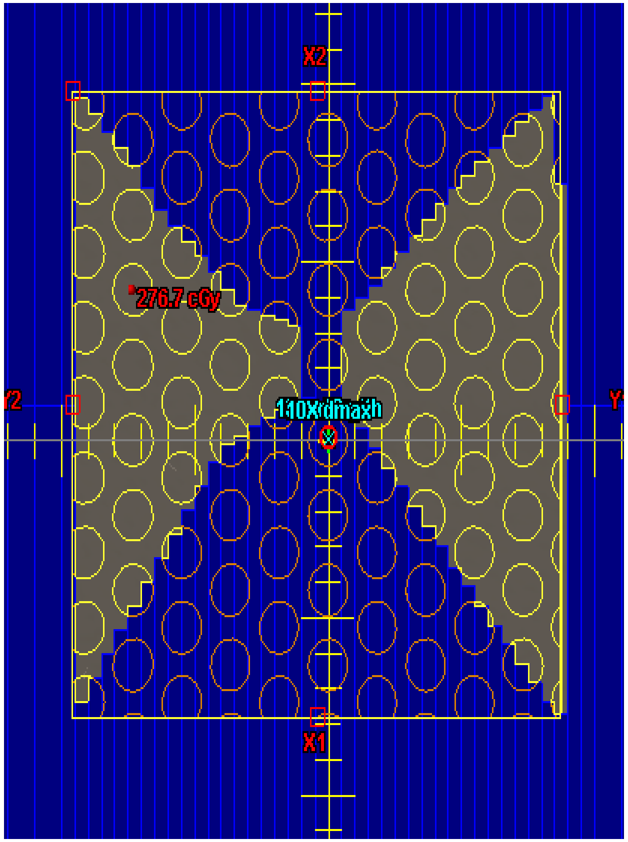


RESULTS

Random MLC Pattern Results with Film and MapCHECK2



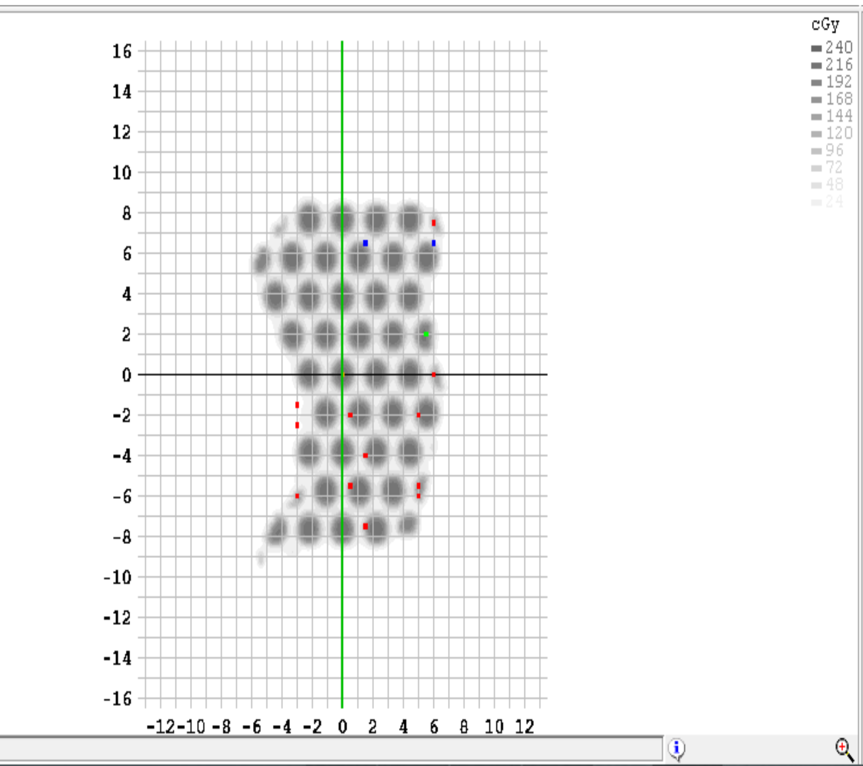


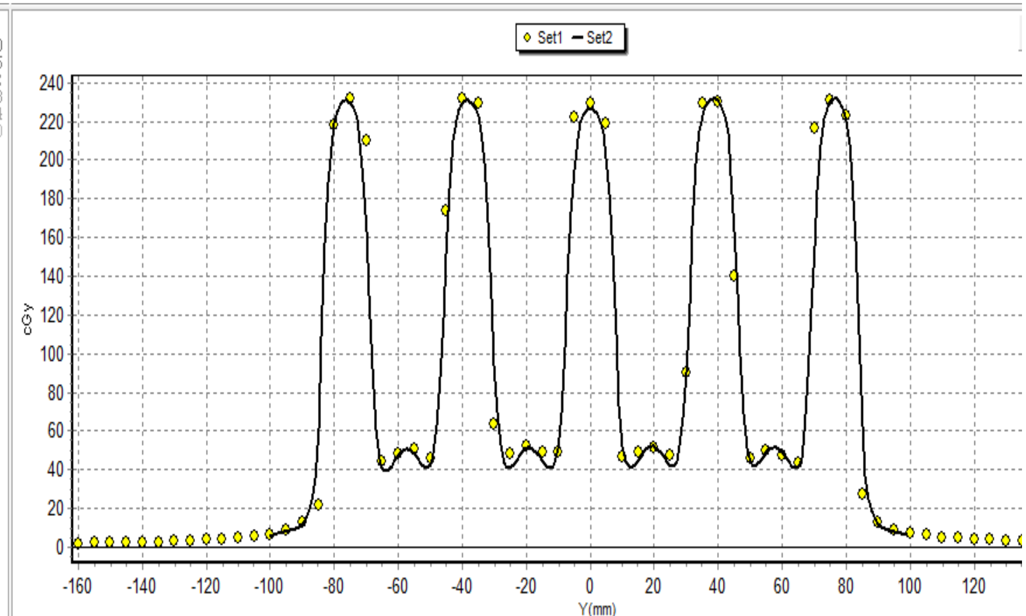


RESULTS

All film and MapCHECK2 results passed above 95% when evaluated at 5%/ 3mm Gamma Index.

6 MV MapCHECK Dose Comparison





Absolute Dose Values

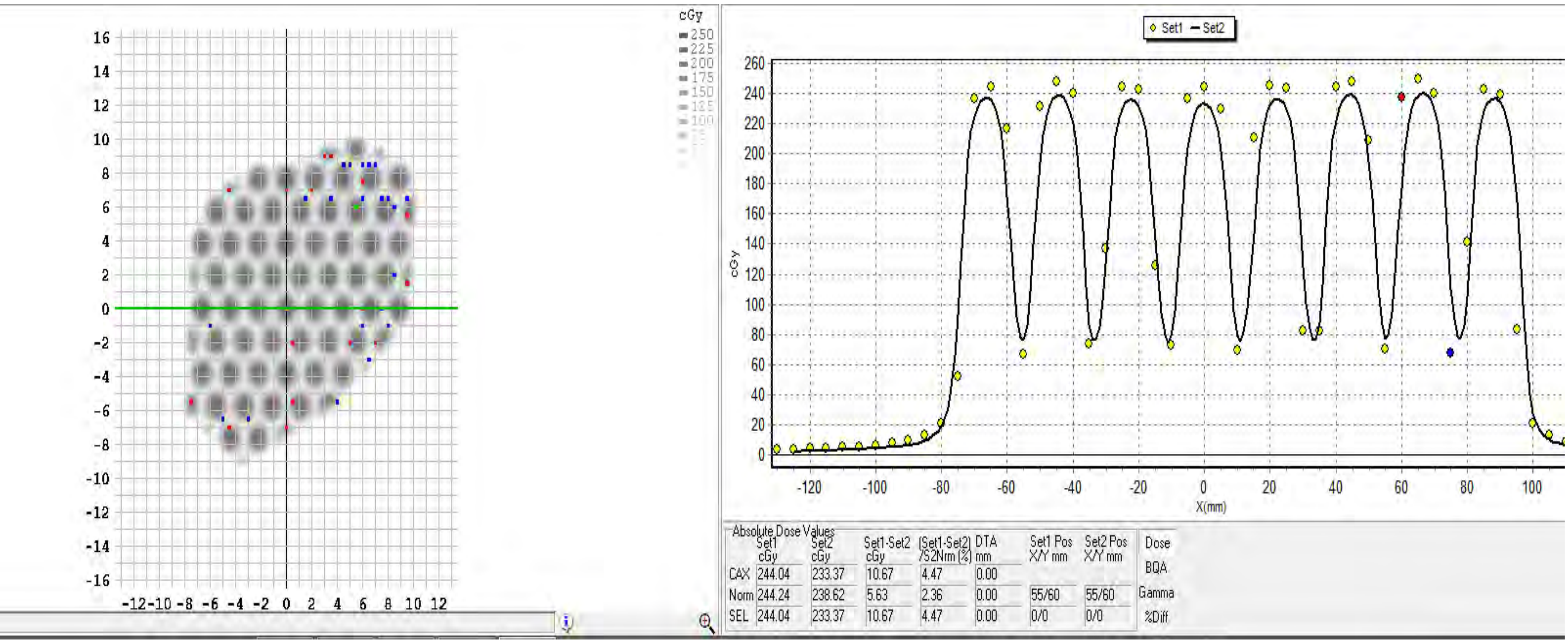
	Set1 cGy	Set2 cGy	Set1-Set2 cGy	(Set1-Set2) /S2Nrm (%)	DTA mm	Set1 Pos X/Y mm	Set2 Pos X/Y mm
CAX	229.25	226.87	2.38	1.08	0.00		
Norm	221.25	219.72	1.53	0.70	0.00	55/20	55/20
SEL	229.25	226.87	2.38	1.08	0.00	0/0	0/0

Dose
BQA
Gamma
%Diff

RESULTS

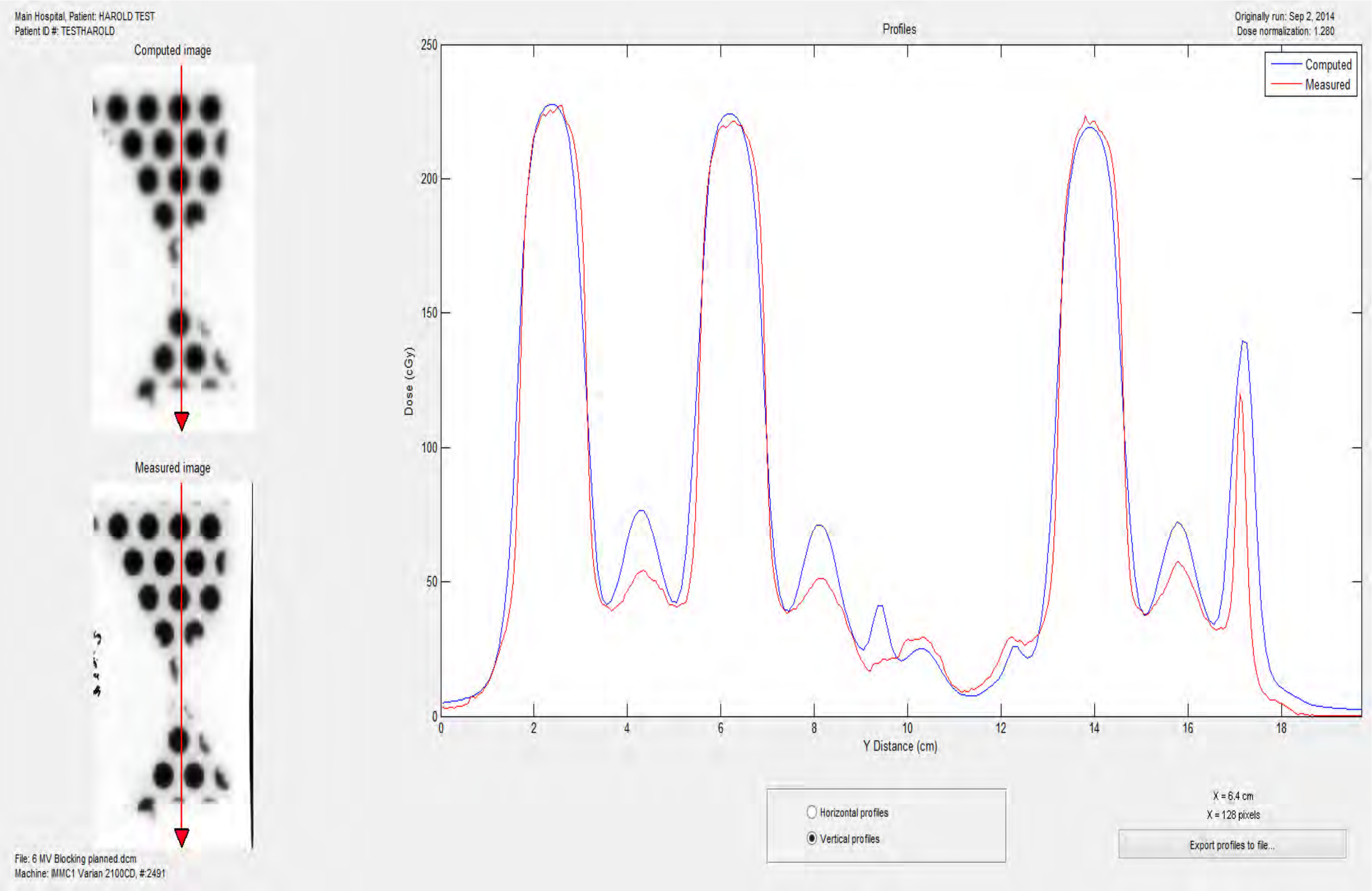
All film and MapCHECK2 results passed above 95% when evaluated at 5%/ 3mm Gamma Index.

10 MV MapCHECK Dose Comparison



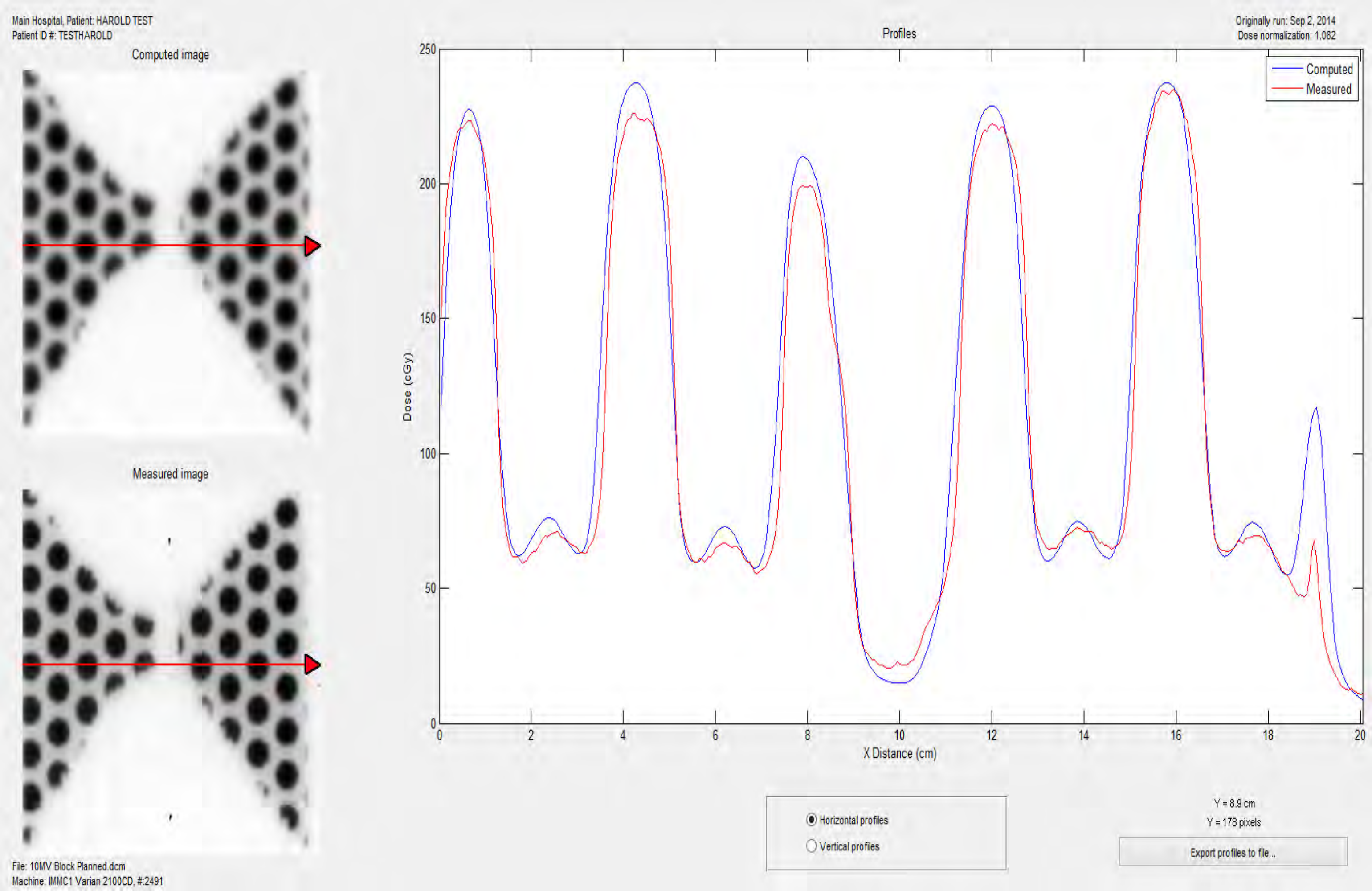
RESULTS

6 MV Film Dose Comparison



RESULTS

10 MV Film Dose Comparison



DISCUSSION

Profile Data

- Eclipse data within 5% of water and film data along CAX
- GRID Block transmission of 4% for 6 MV and 8% for 10 MV matched water and film data very well

PDD Data

- Within < 1% at dmax and 5cm for both energies for a 10x10 field. Within 1% at 10 cm depth for both energies

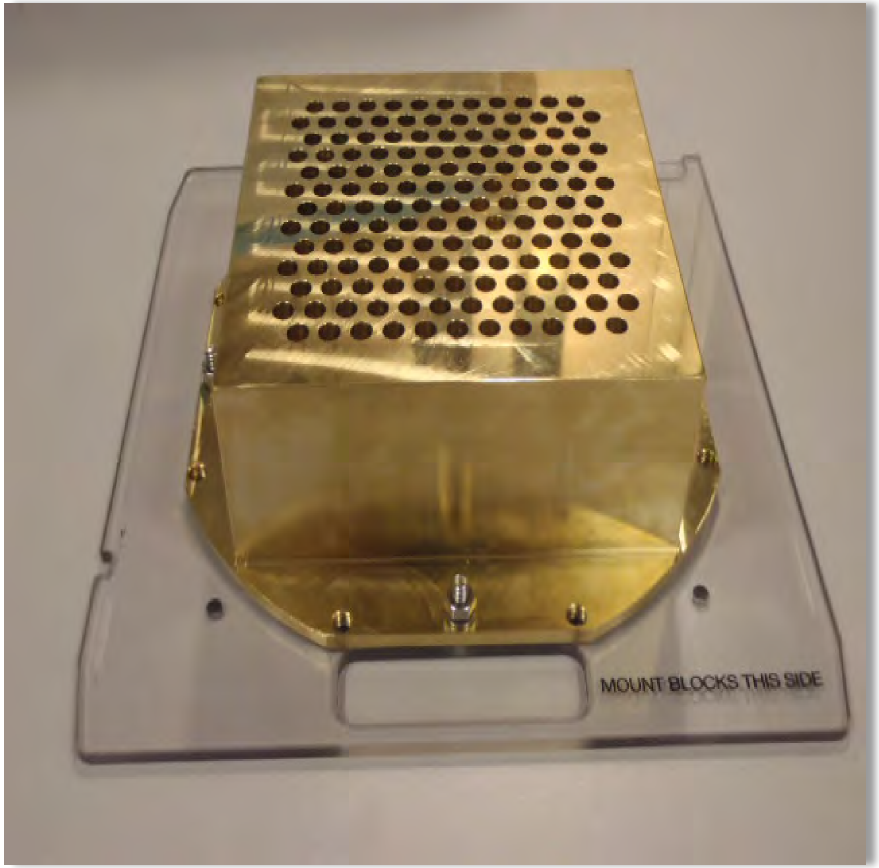
Dose Comparisons

- Many comparisons passed at 95% or better when using the gamma index comparison of 3%/ 3mm. All tests passed at 95% or better when using a gamma index comparison of 5%/ 3mm

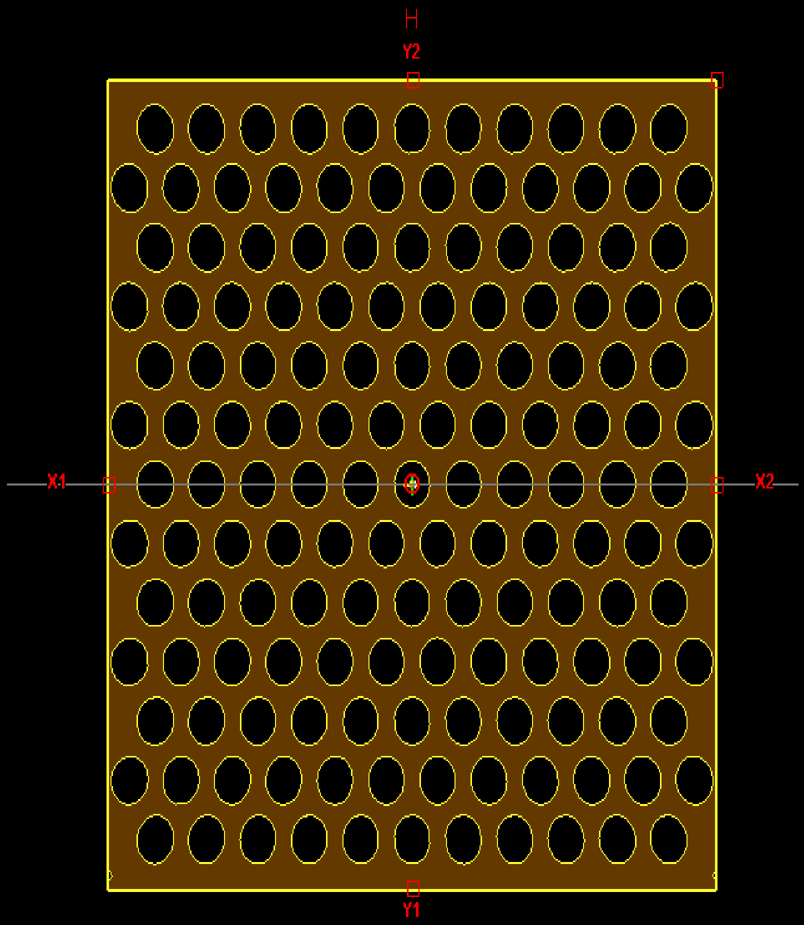
Acrylic Block

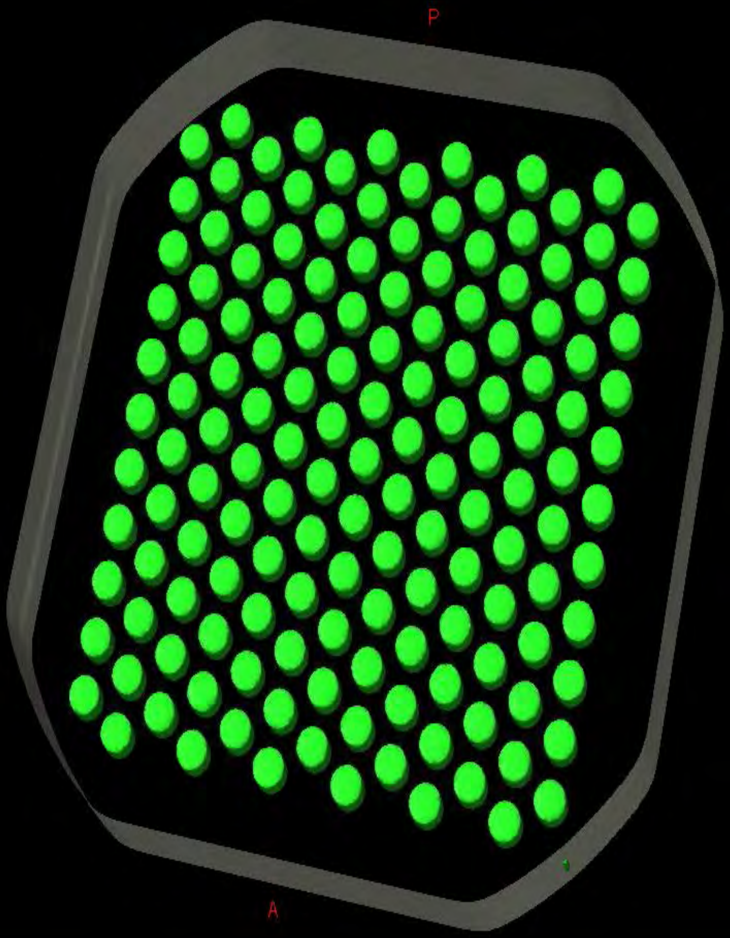
- Allows any user to create grid block in their own TPS in order to commission and validate beam parameters of the GRID
- Physicians can now view the dose distribution in the patient CT
- Hole density in target can be optimized to allow for maximum coverage of tumor.

Spatially Fractionated Radiation Therapy (GRID)

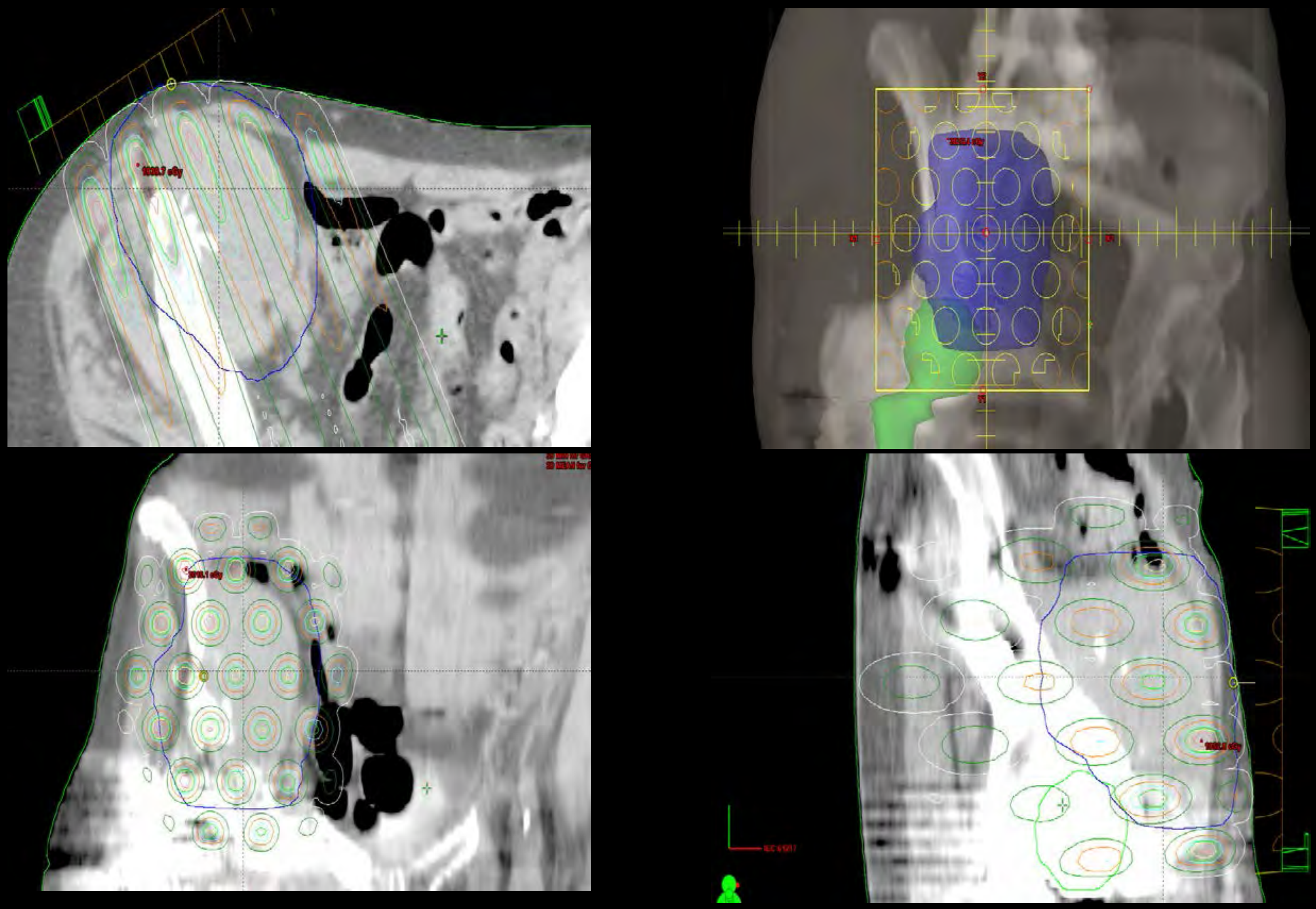


Spatially Fractionated Radiation Therapy (GRID)





Bottom Line for You

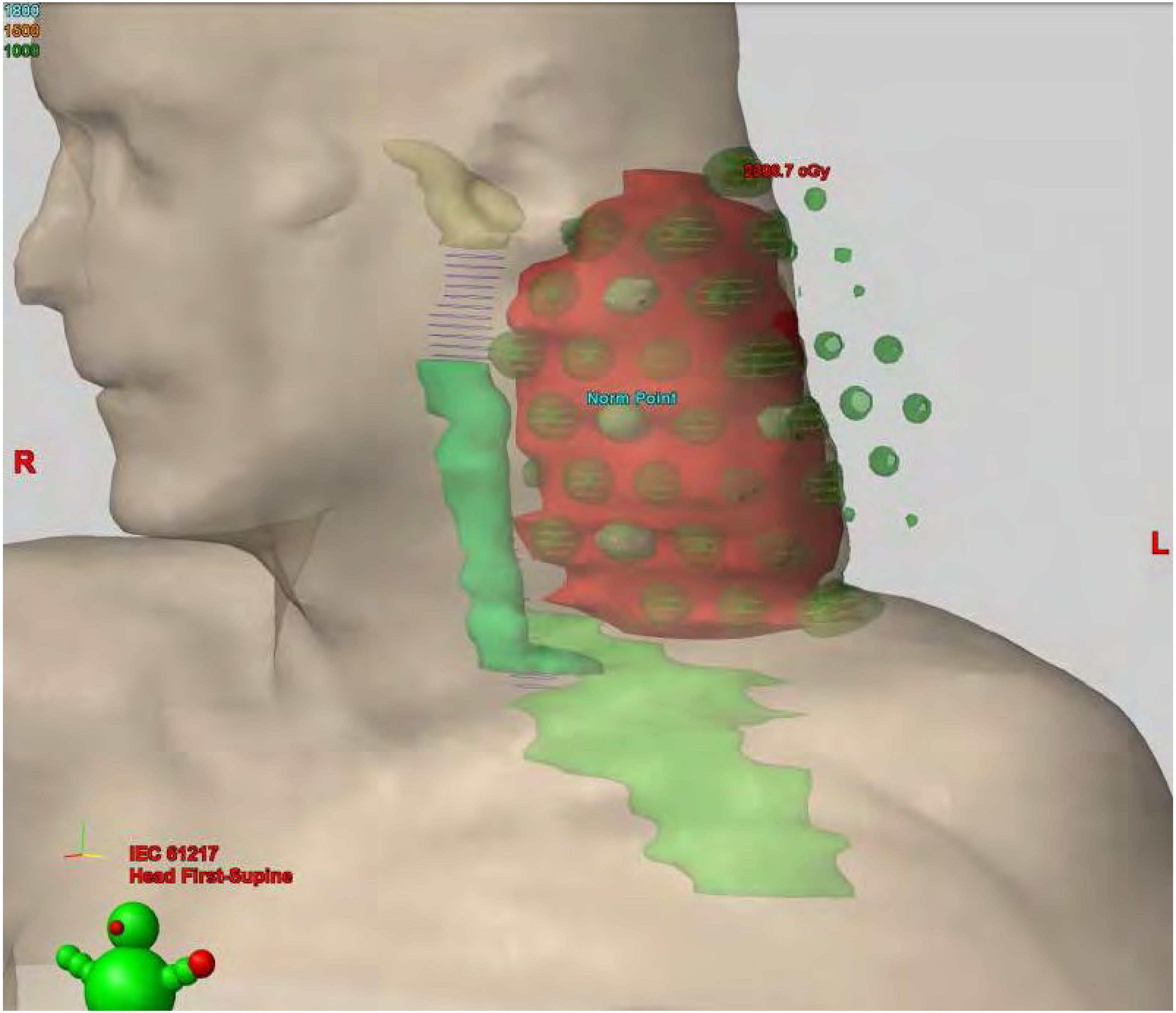


Parallel Opposed SFGRT (GRID) for Melanoma of the Neck

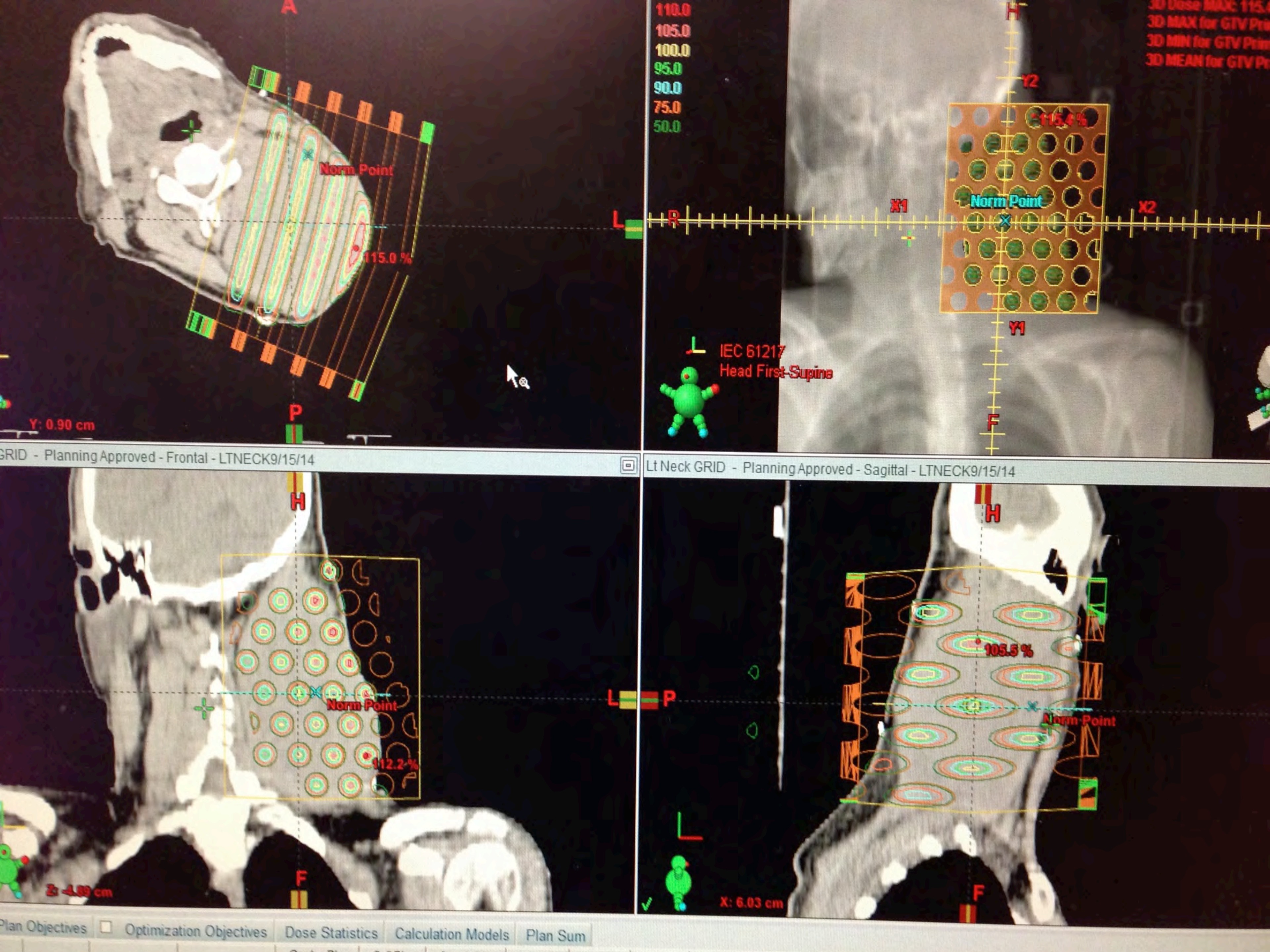
A New Era in GRID planning !!!!

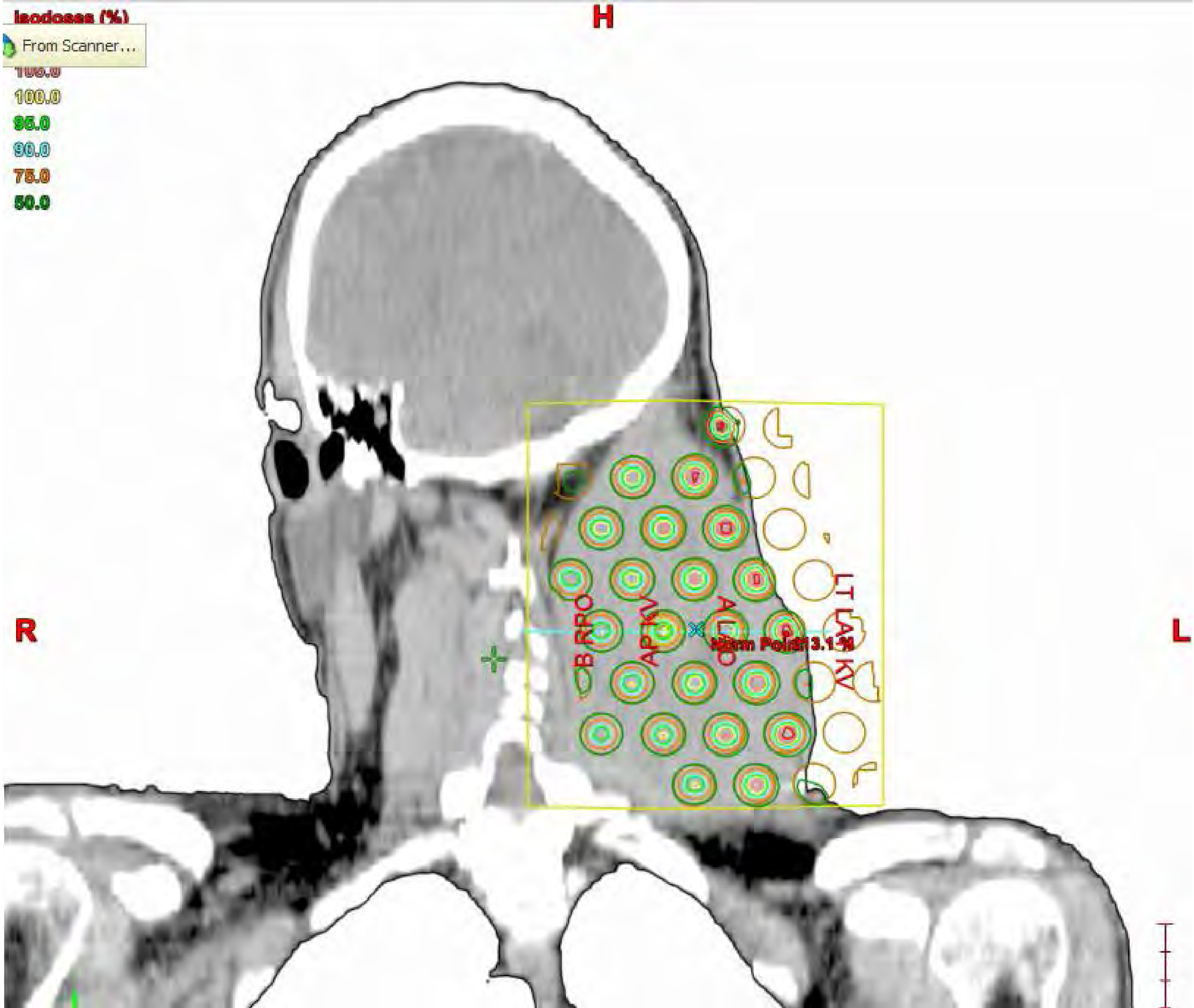
GRID

- Clinical exam 18cm (ant-post) x 15cm (sup-inf) x 8cm thick (lat to medial)
- 9/17/14: 20Gy parallel opposed GRID
- 9/18/14 to 10/15/14, got 50Gy/ 25f
- Ipilimumab x4 (June 2013 to Aug 2013)
- pembrolizumab (June 2014) with XRT

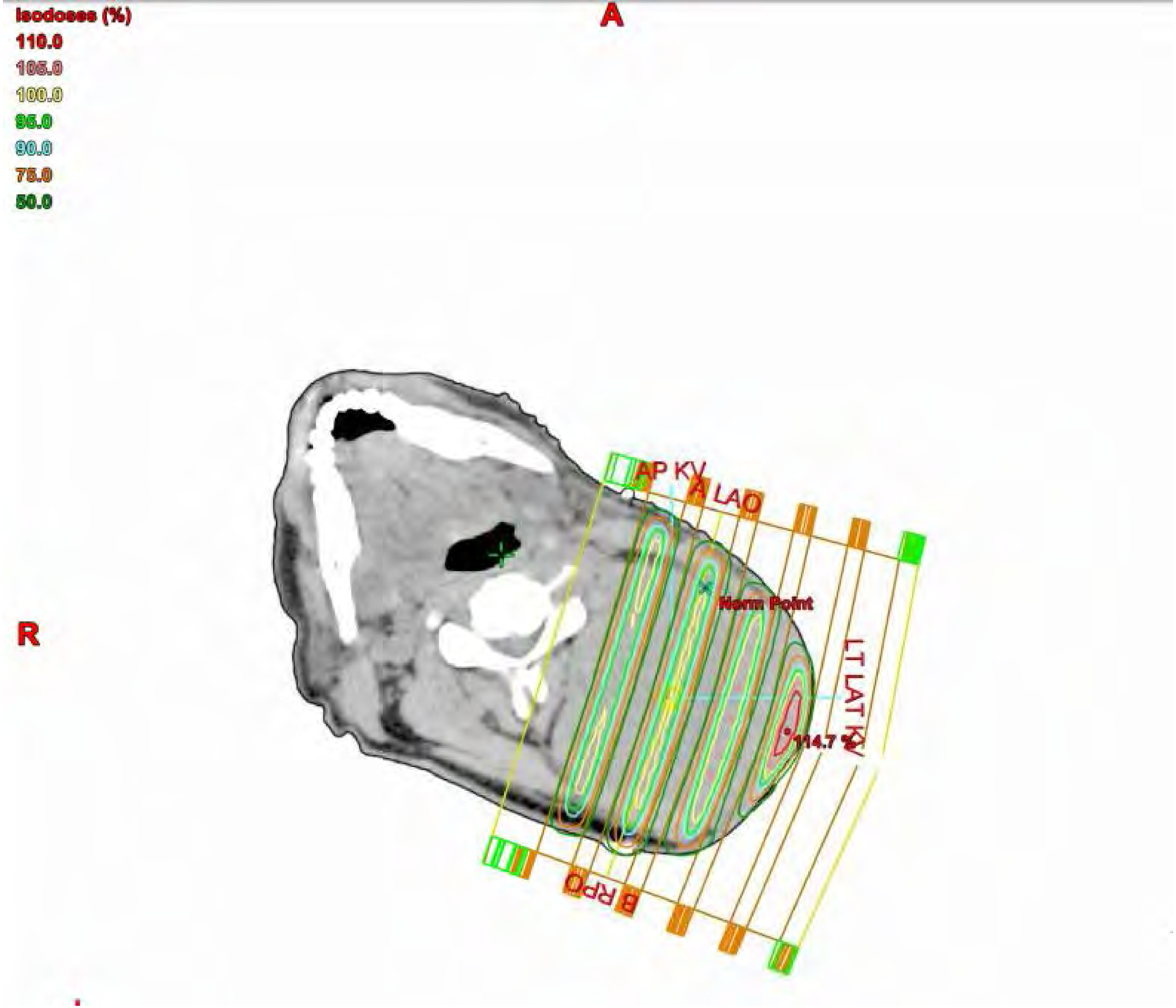


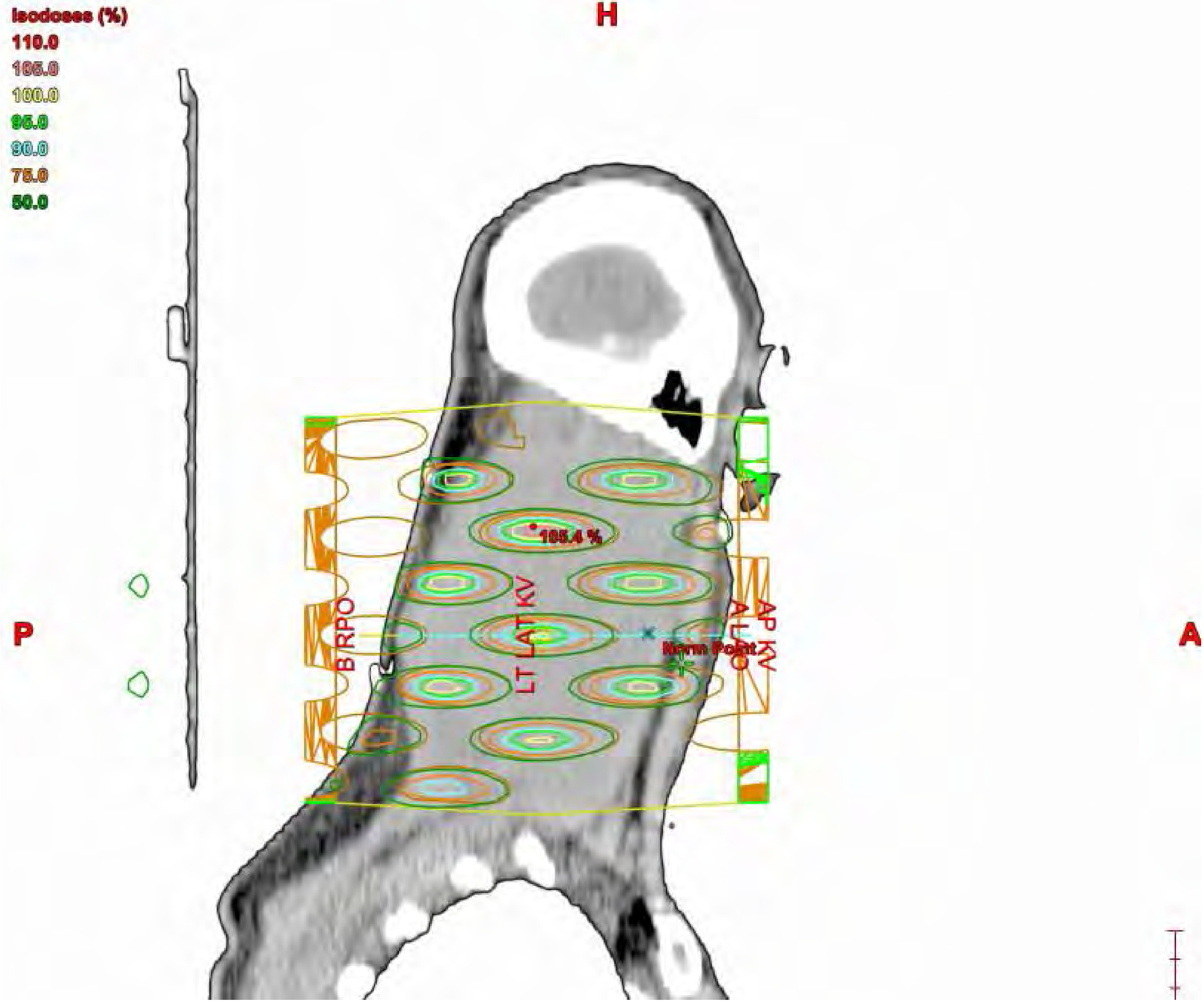
1800
1500
1000
Norm Point
R
L
IEC 61217
Head First-Supine


110.0
105.0
100.0
95.0
90.0
75.0
50.0
Norm Point
115.0 %
Y: 0.90 cm
IEC 61217
Head First-Supine
X1
X2
Y1
Y2
115.4 %
GRID - Planning Approved - Frontal - LTNECK9/15/14
Lt Neck GRID - Planning Approved - Sagittal - LTNECK9/15/14
112.2 %
105.5 %
X: 6.03 cm
Plan Objectives
Optimization Objectives
Dose Statistics
Calculation Models
Plan Sum

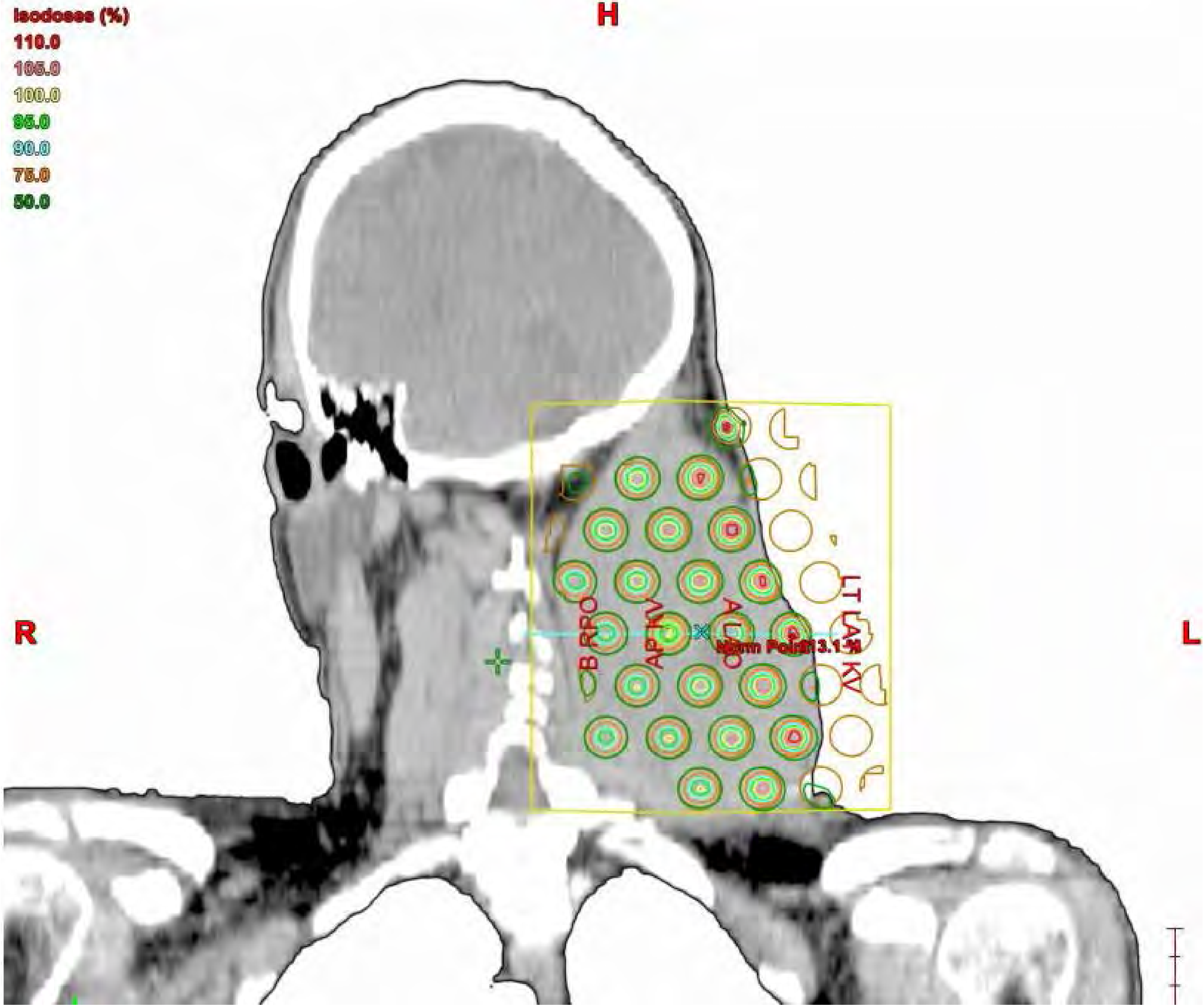


Isodoses (%)
From Scanner...
100.0
95.0
90.0
75.0
50.0
H
R
L
B RPO
AP KV
LT LAT KV

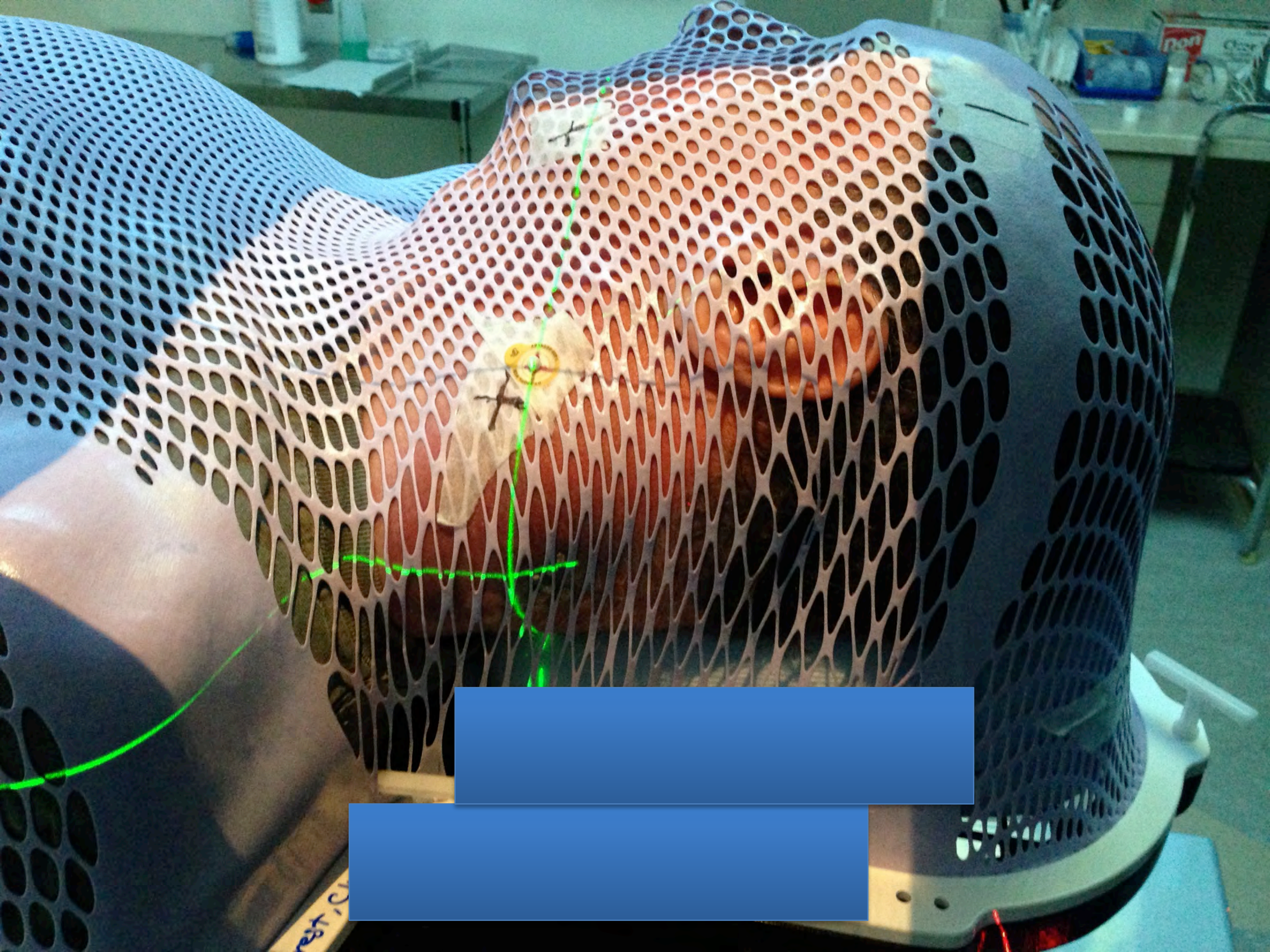

Isodoses (%)
110.0
105.0
100.0
95.0
90.0
75.0
50.0
A
R
AP KV
A LAO
Norm Point
LT LAT KV
114.7 %
B RPO

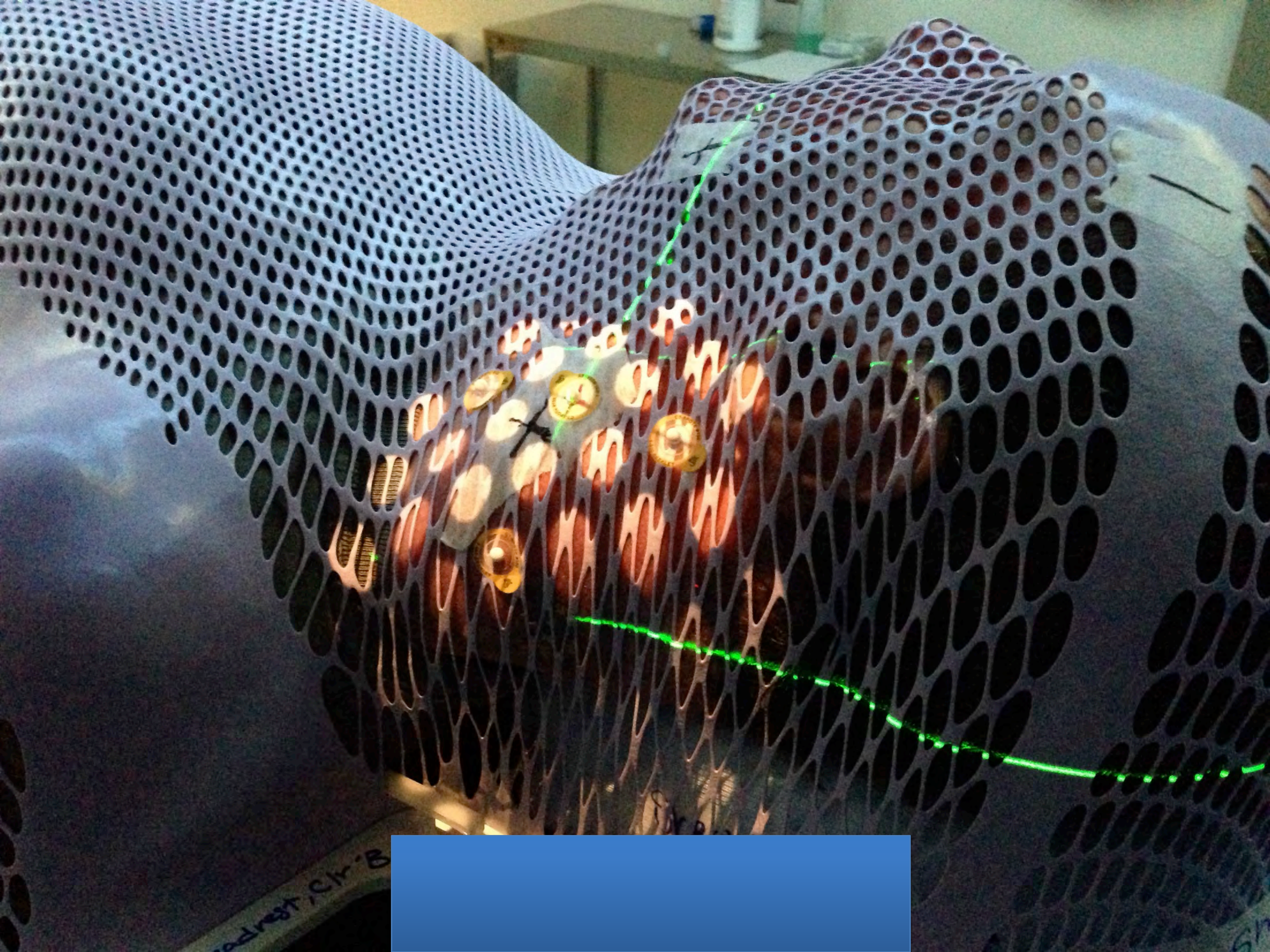


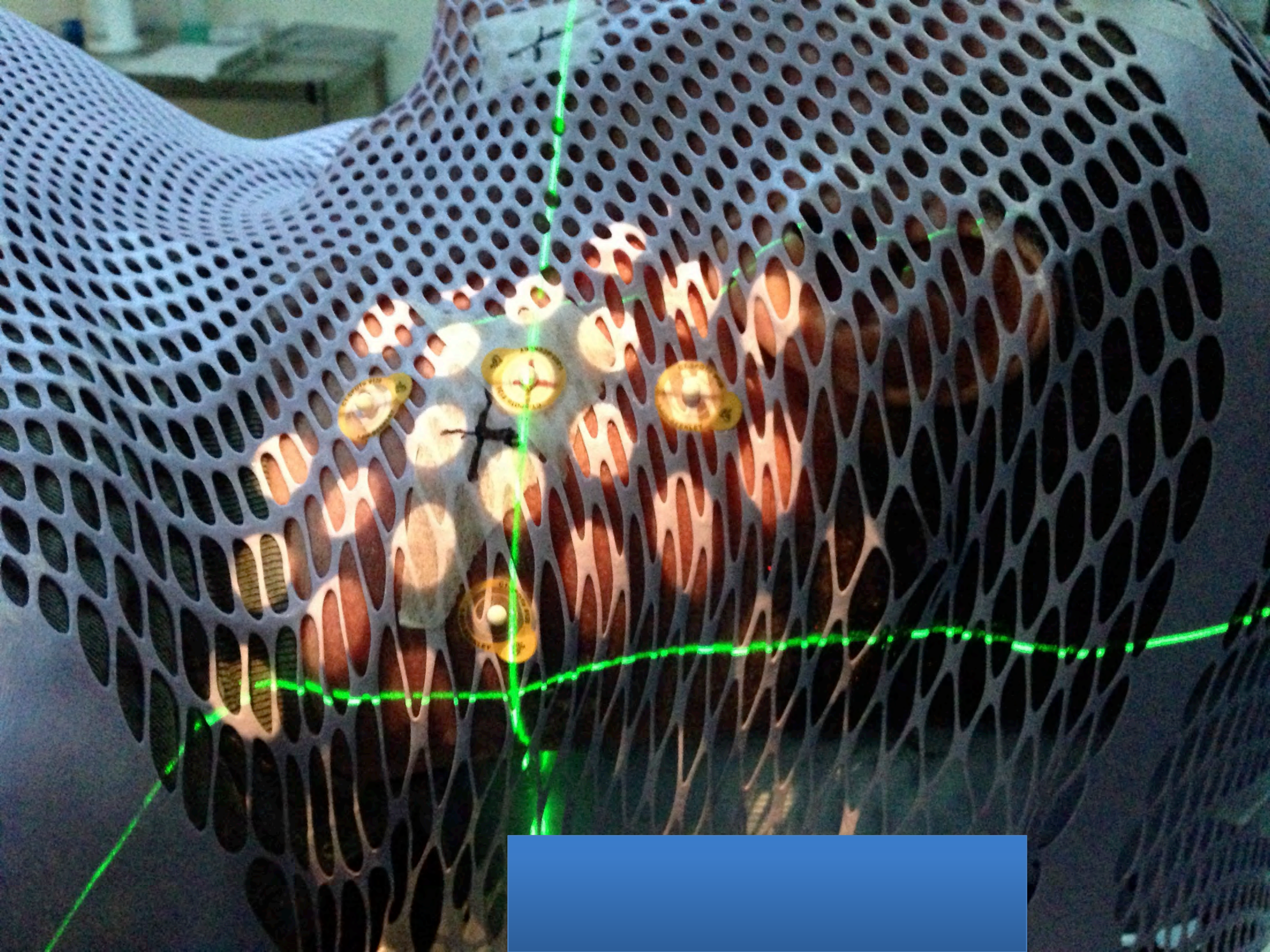
Isodoses (%)
110.0
105.0
100.0
95.0
90.0
75.0
50.0
H
P
A
B RPO
LT LAT KV
AP KV
105.4 %
Norm Point



Isodoses (%)
110.0
105.0
100.0
95.0
90.0
75.0
50.0
H
R
L
B RPO
AP KV
LT LAT KV





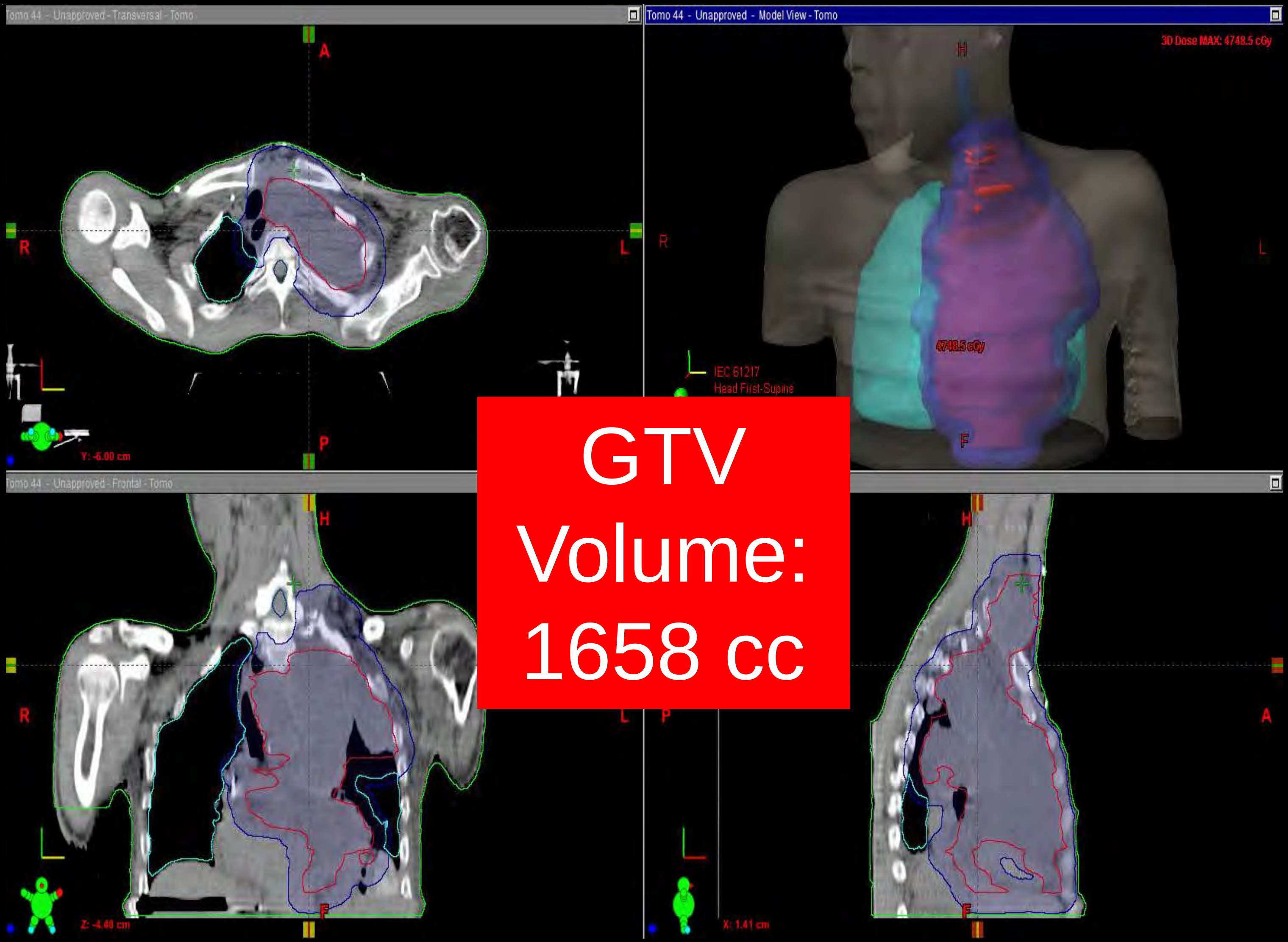


SFGRT (GRID) for Thoracic Sarcoma

Treatment Plan

- SFGRT (Spatially Fractionated GRID Radiation Therapy)
  - 20Gy x 1 fraction using parallel opposed fields
  - Start and done on 10/20/14
- Consolidation XRT of 44Gy in 22 fractions (start next day)
  - Had planned 50Gy
  - Along with ifosphamide, cycle # 3
  - Done by 11/20/14

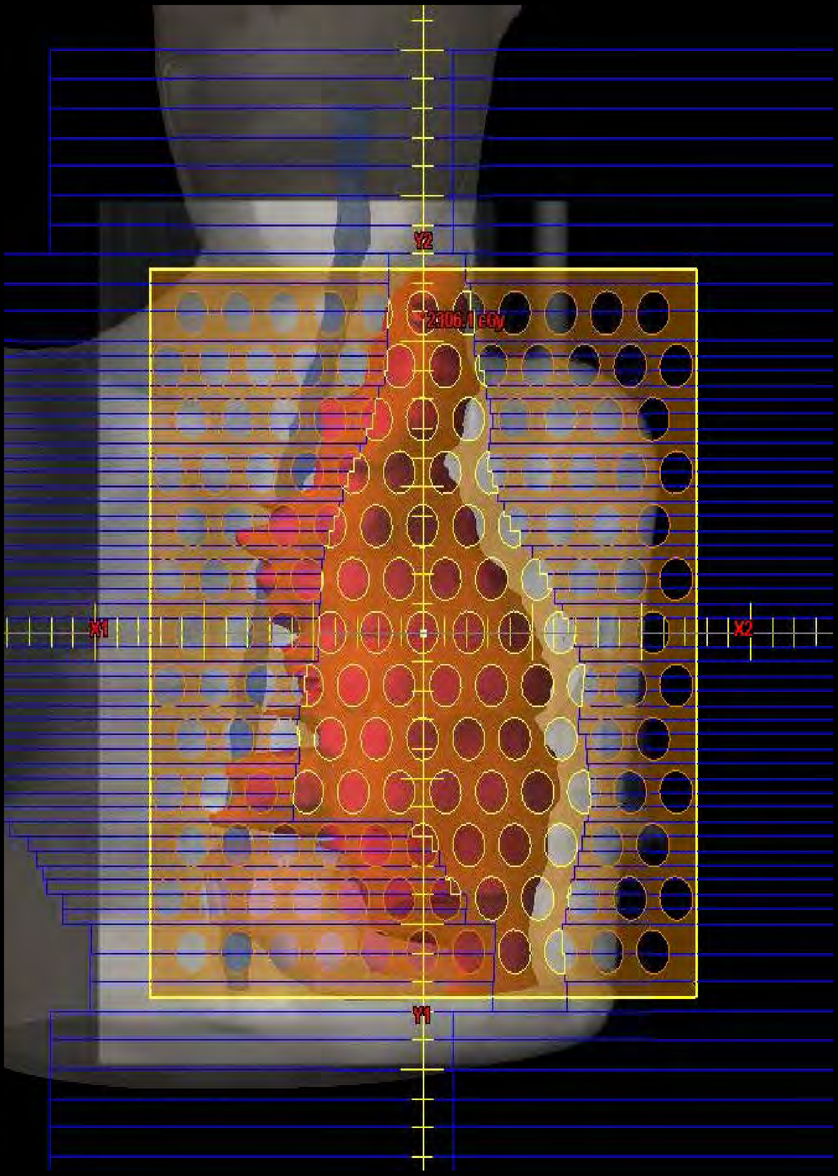
Initial CT Scan and Treatment Plan



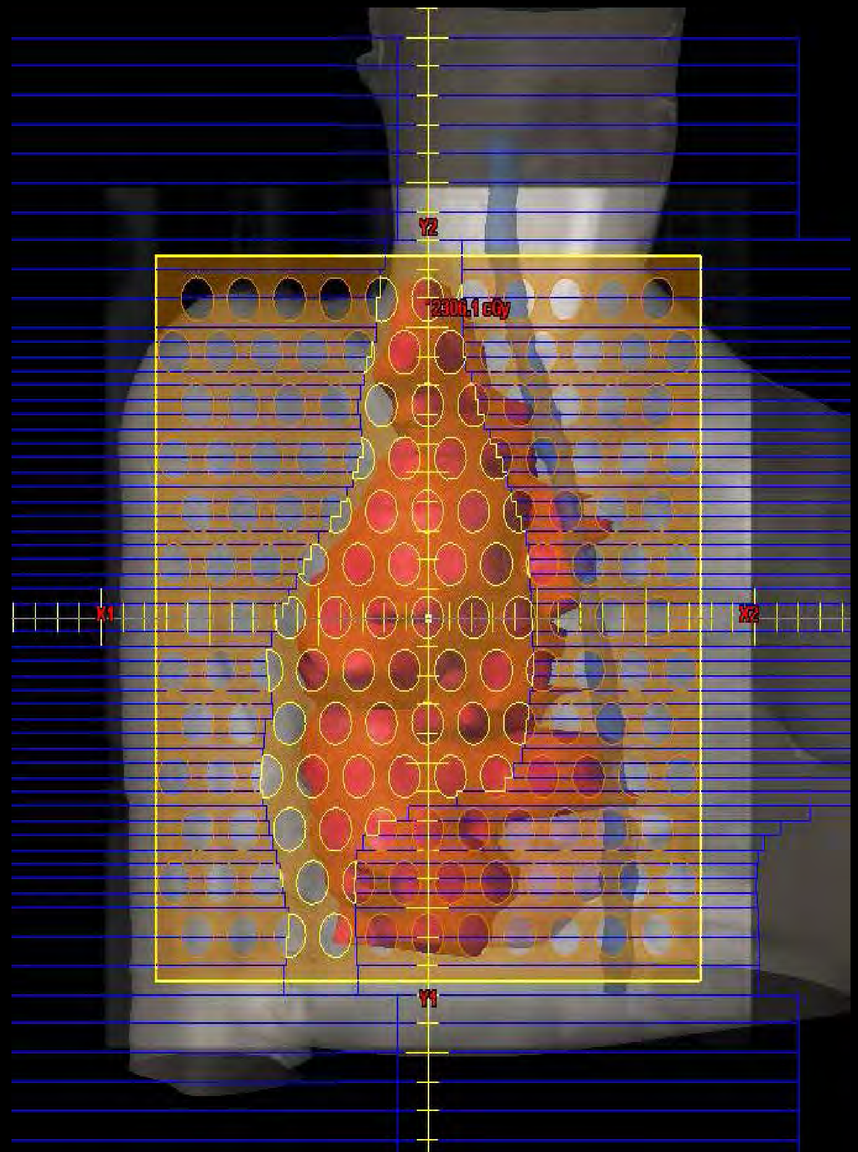
GTV Volume: 1658 cc

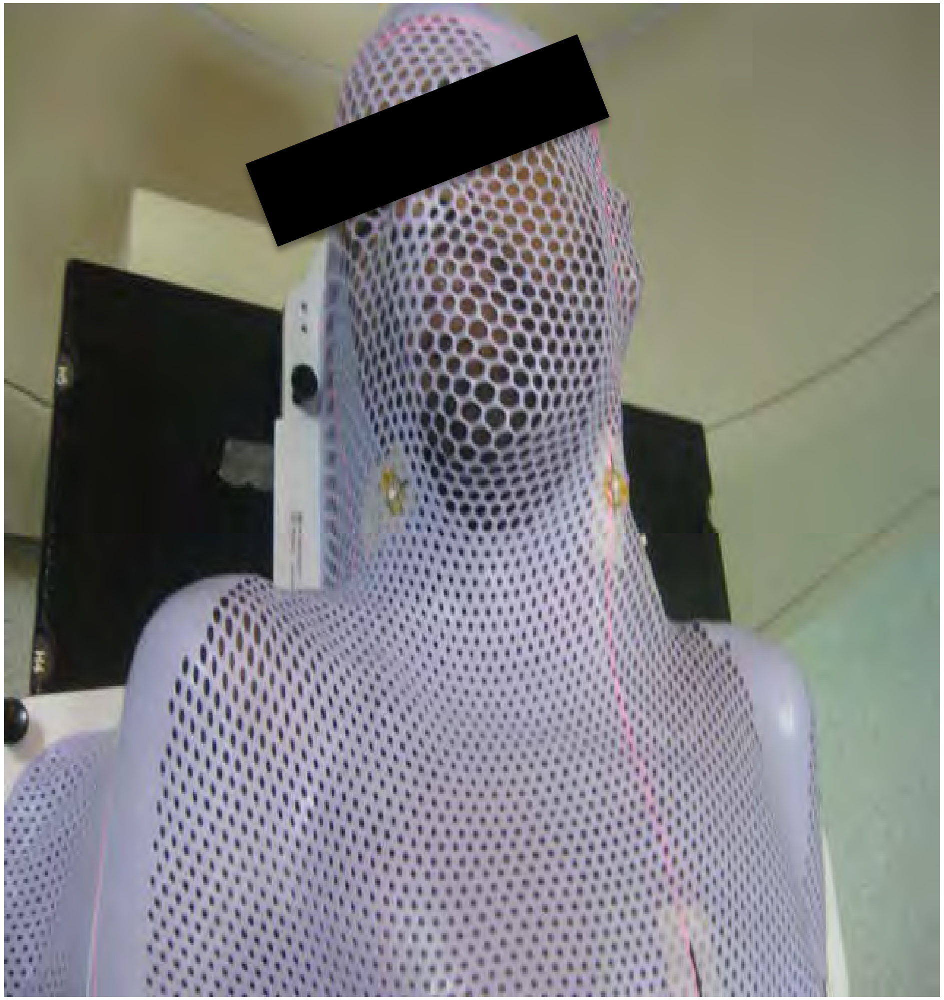
Initial CT Scan and Treatment Plan

GRID Treatment Plan - AO

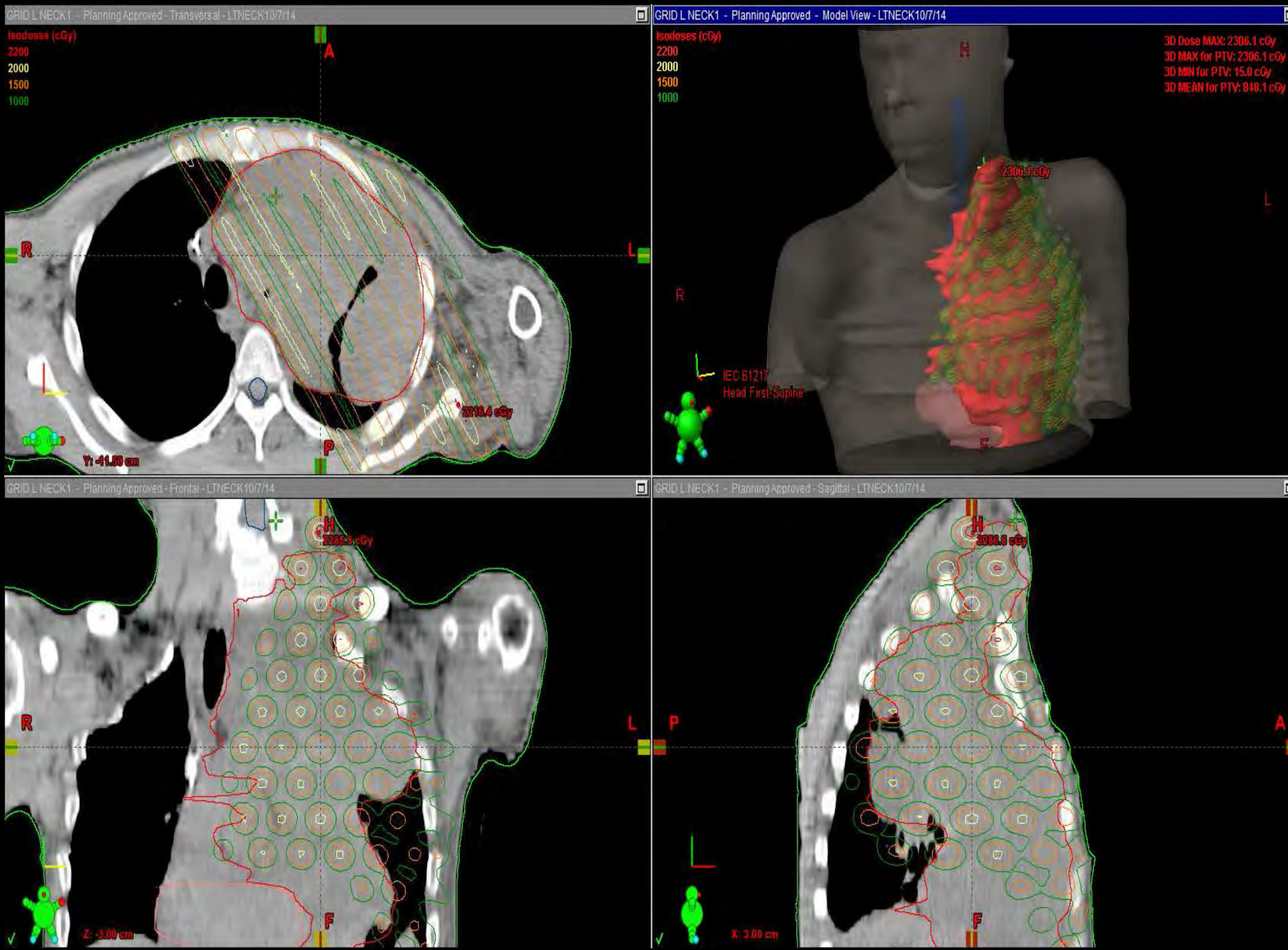


GRID Treatment Plan - PO

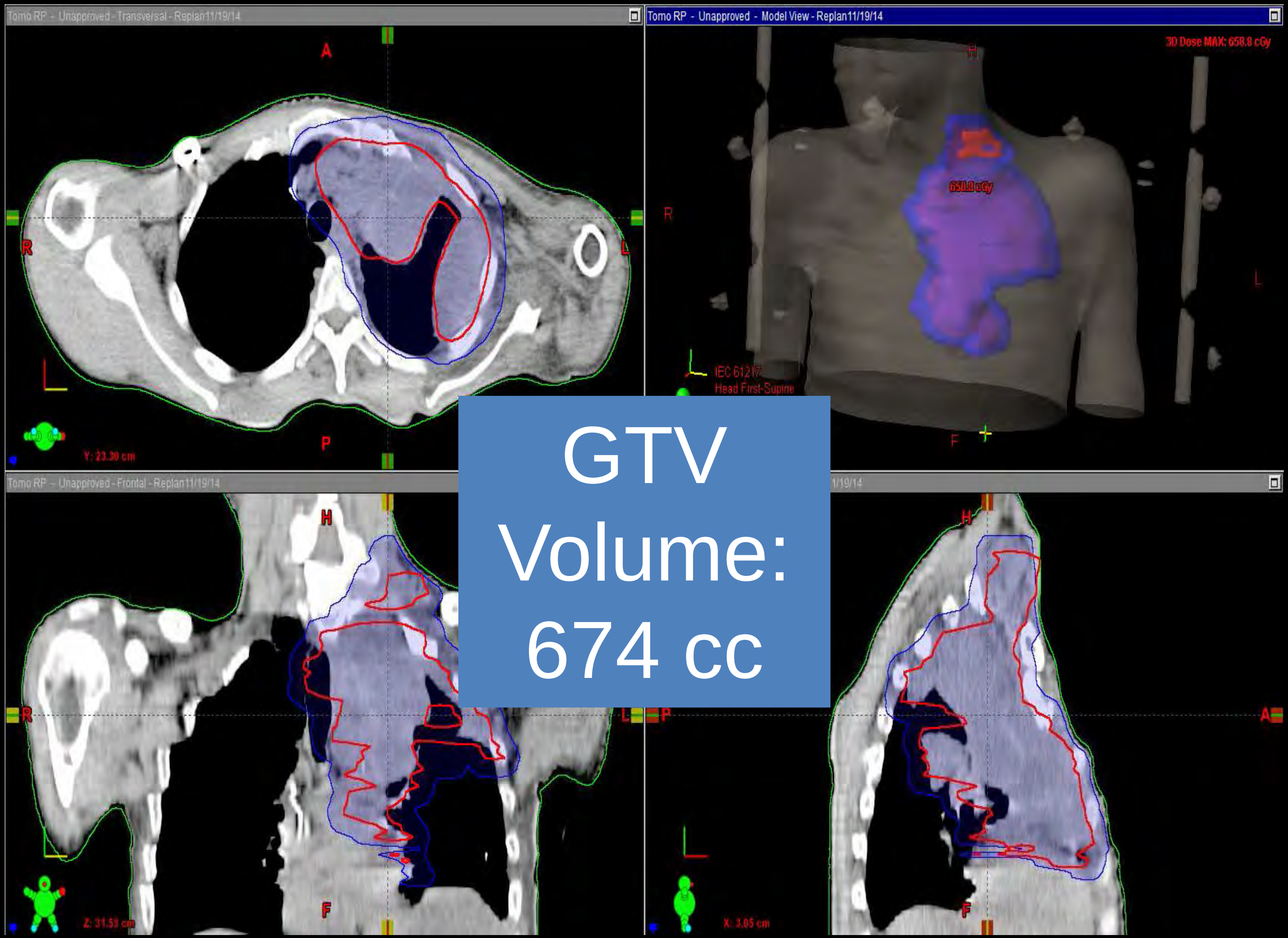




GRID Treatment Plan

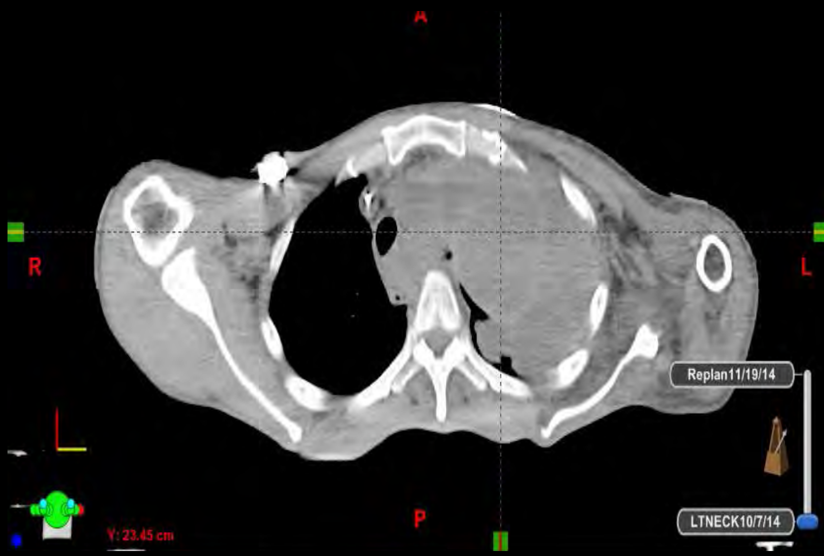


New CT Scan After 22 Fractions + GRID



Old CT vs. New CT

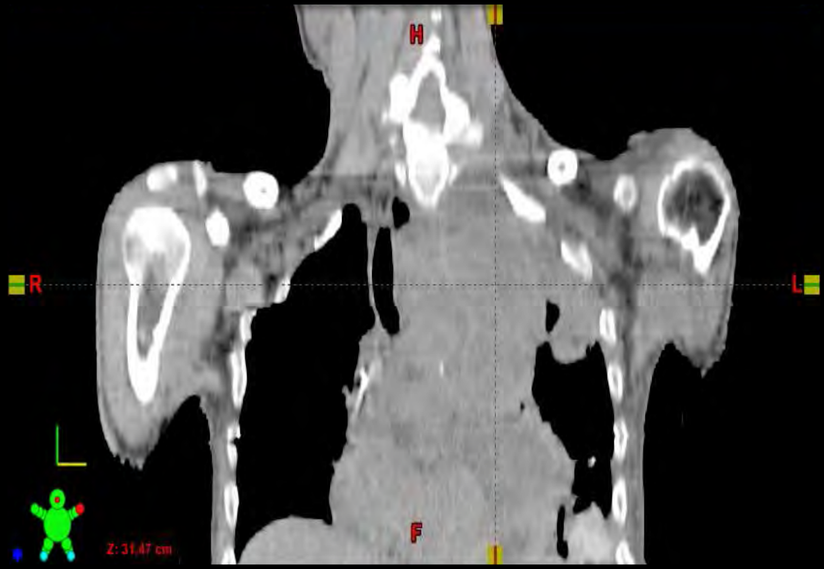
Old CT



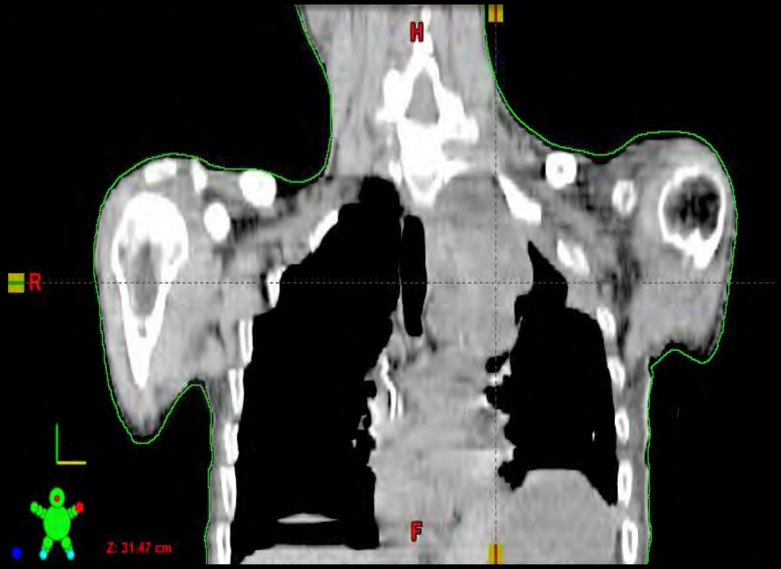
New CT

Old CT vs. New CT

Old CT

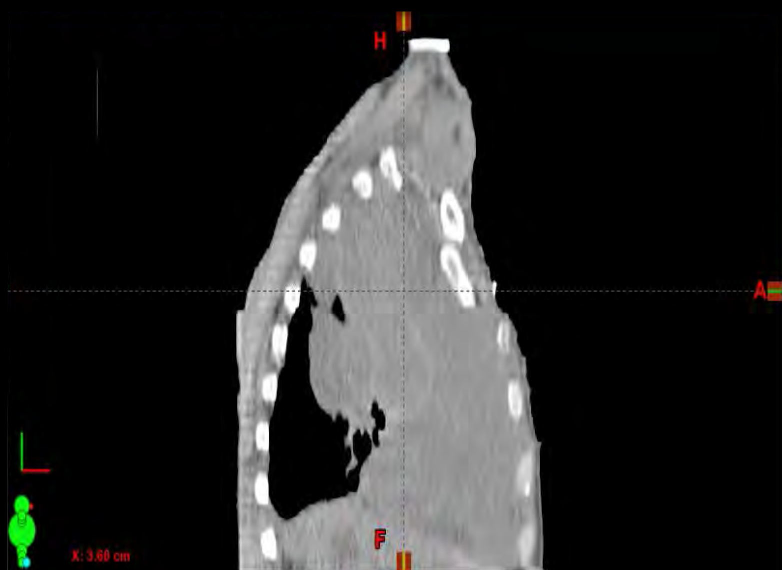


New CT

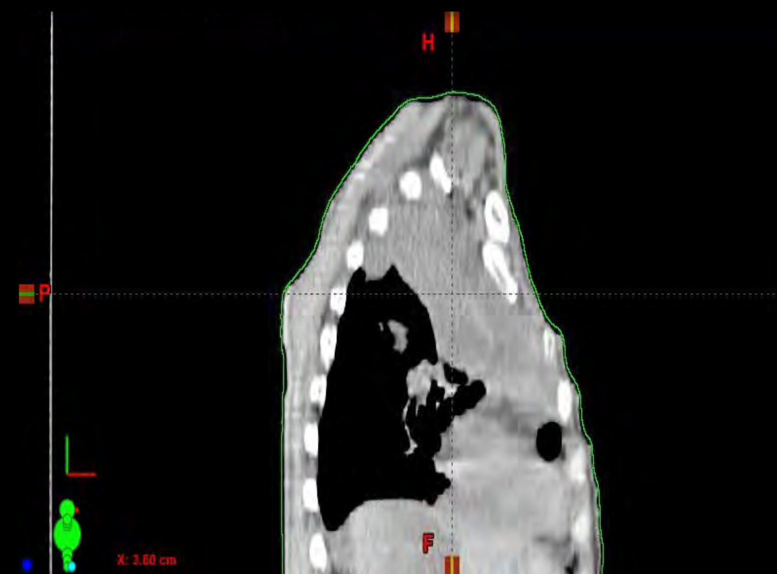


Old CT vs. New CT

Old CT



New CT



Old CT vs. New CT

Old CT Sept. 2014

New CT Dec 2014

Penile Cancer Groin Recurrence

Parallel opposed GRID

Case Presentation

- Balantis x 9 years
- Circumcision at age 51, trouble urinating due to foreskin
- Penile lesions starting in 2008, s/p bx-
- April 2014: scab lesion that was bleeding, then ulcerated lump overnight
- Bx: SCCa

Operation

- 5/21/14 radical partial penectomy with reconstruction: distal penis removed, neomeatus.
- 4.8x4.4x3.6cm, g3, keratinizing SCCa, involving corpus spongiosum and cavernosum
- Negative margins
- LVI+
- pT2Nx

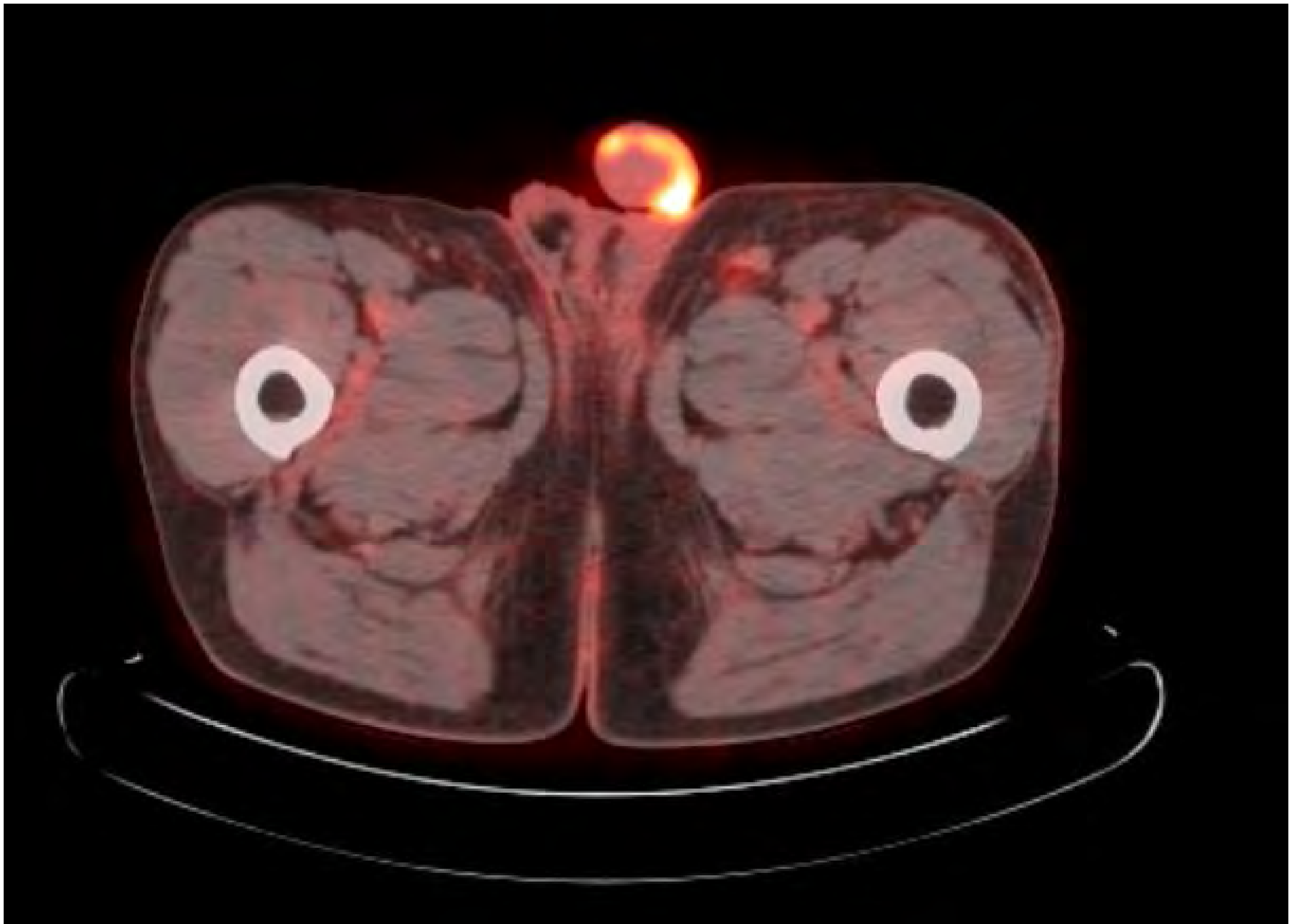
Inguinals

- June 9, 2014 CT: 2.2cm R inguinal hernia and 2.2cm L inguinal LN
- 7/2/14 L full dissection and R superficial dissection: 1/6 LNs with ECE+, 0/7 deep inferior and lateral =1/13 on Left. 0/3 on R.

Assessment:79 M with pT2N3 IV penile cancer with 1 L inguinal LN with ECE+

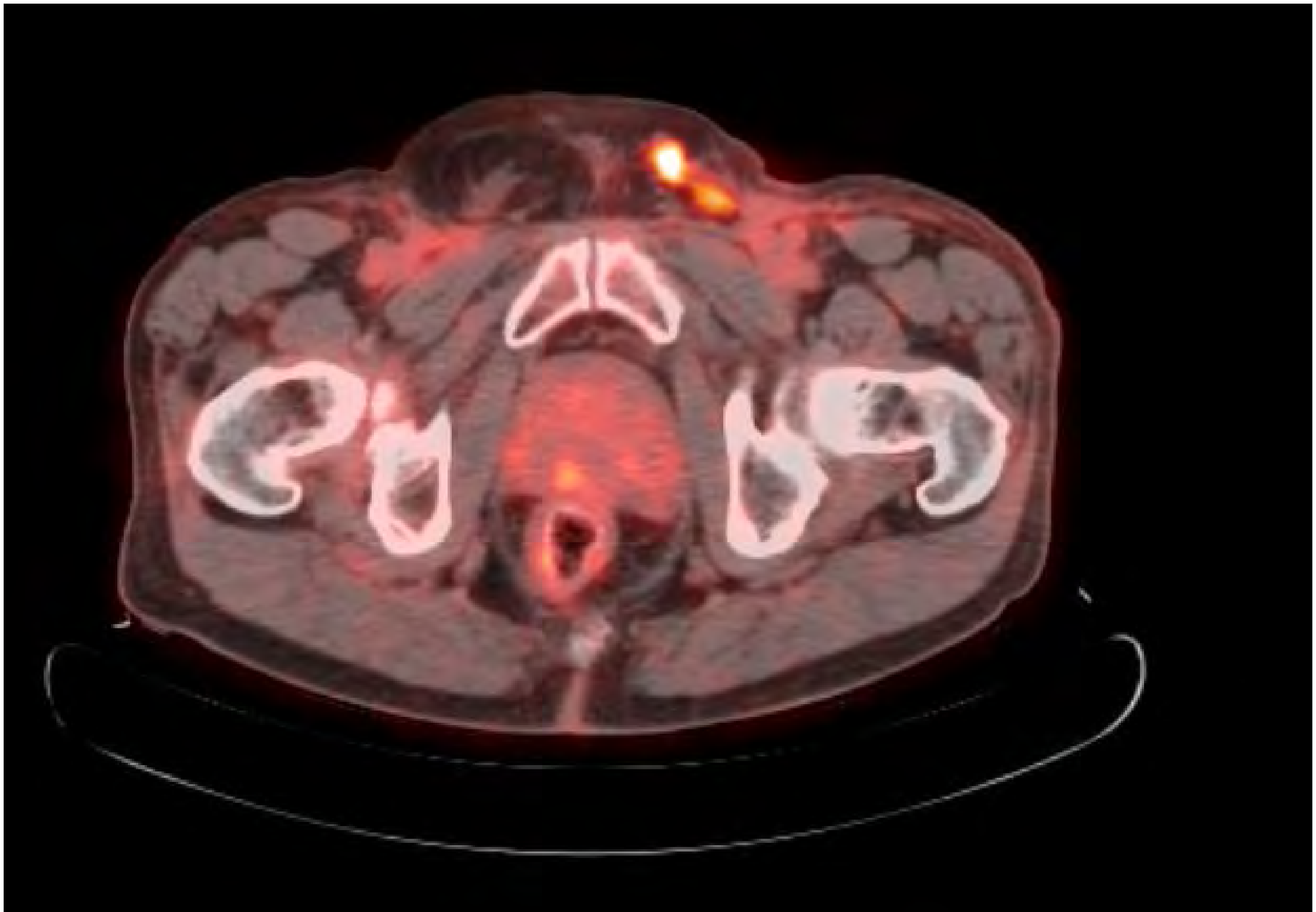
- Rad Onc consult July 2014.
- Staged as pT2N3 IV penile cancer
  - T2: corpus; N3: ECE+
- 75-80% chance of inguinal LN+ given g3, LVI+ and T2
- ECE is a poor px factor → may need pelvic LND too because he's at risk (usually for 2-3 LNs, or ECE)
- Order a PET/CT scan

PET/CT 7/22/14

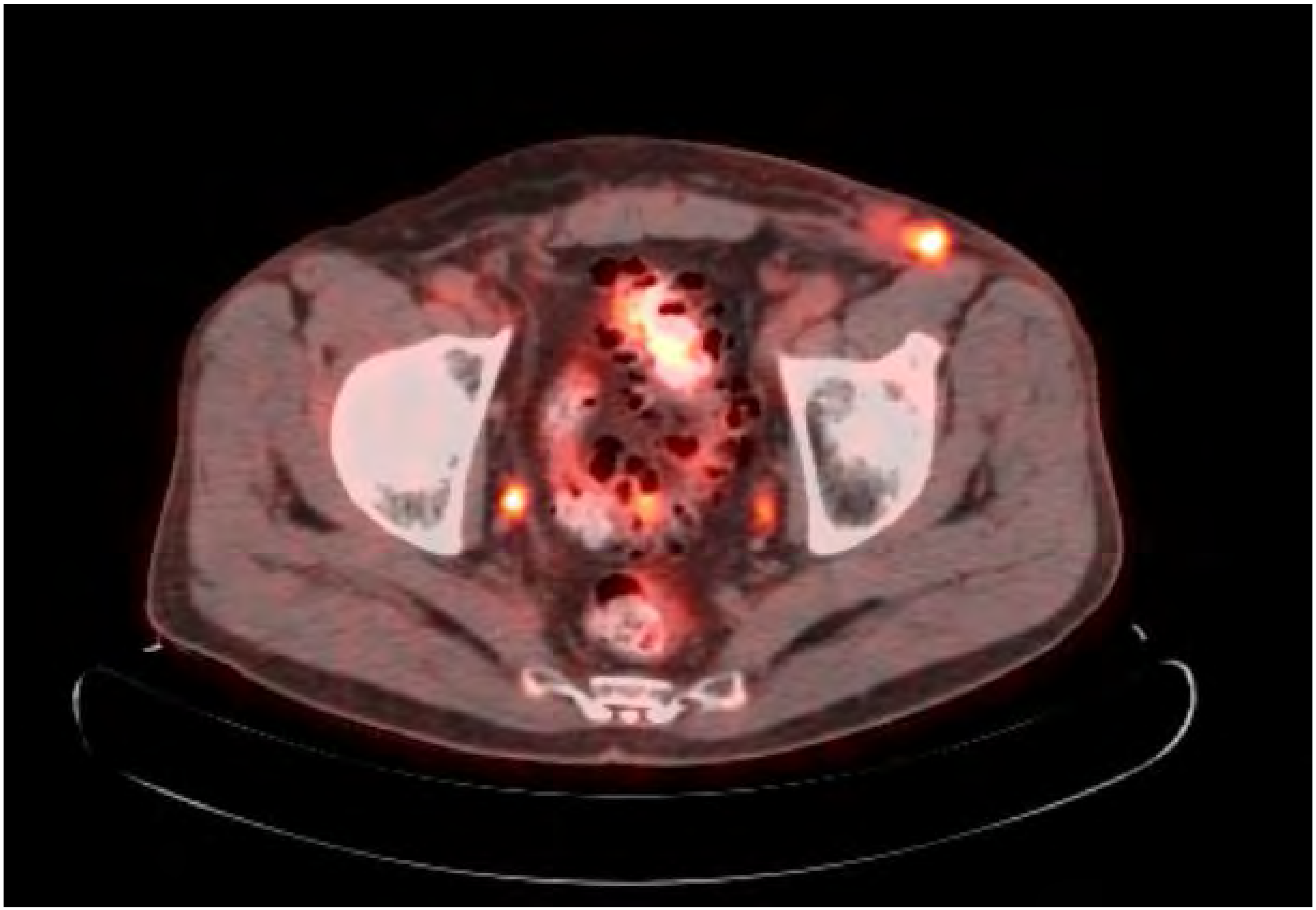


PET/CT 7/22/14

PET/CT 7/22/14



PET/CT 7/22/14



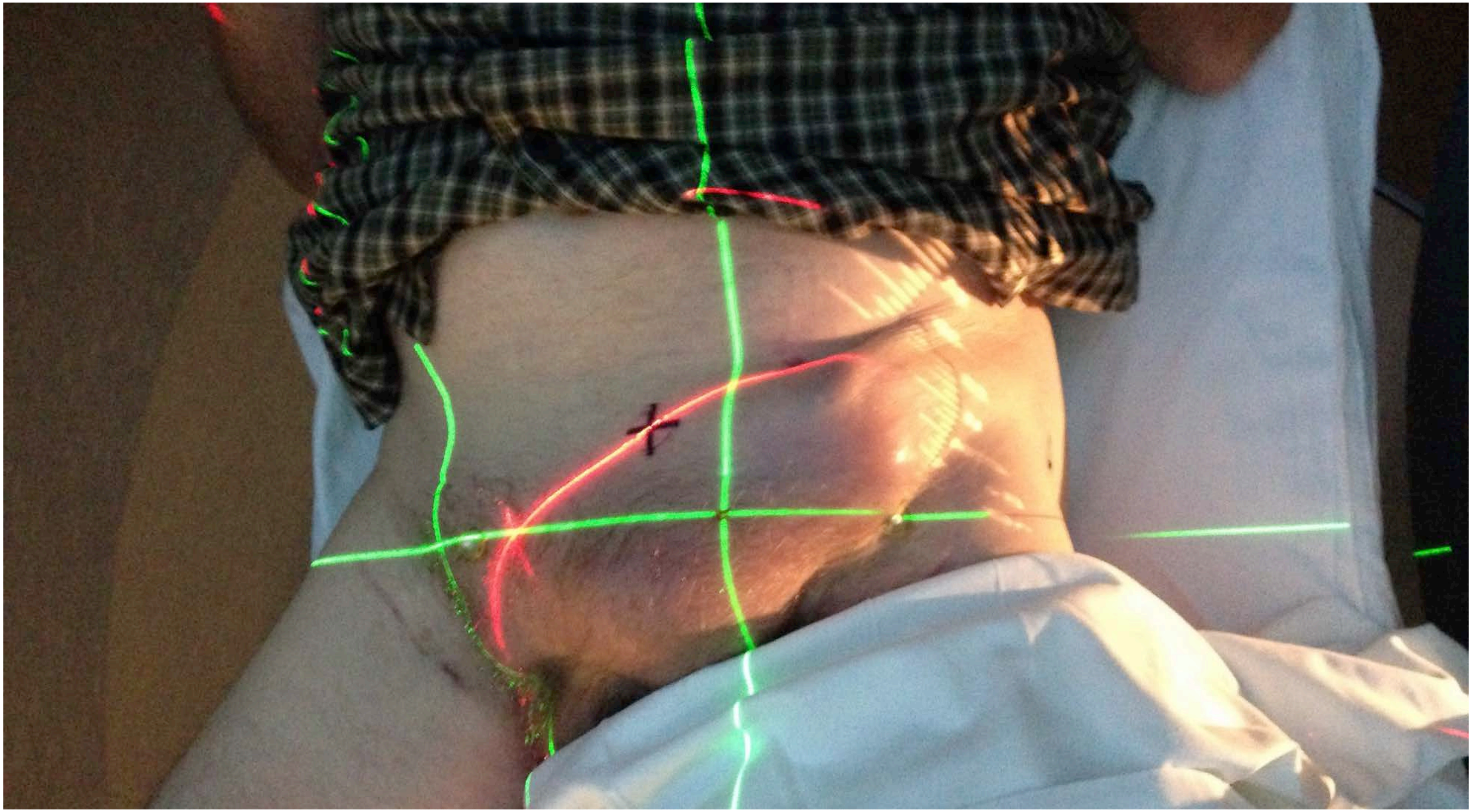
PET/CT 7/22/14

2 months later

- Patient offered platinum/taxol, but opted for short interval (2 months) scan to check on pulmonary mets.
- 9/4/14 CT chest: Pulmonary mets stable

- Unfortunately, developed 18x10cm L inguinal mass
- By 9/10/14, it was 23x14cm.
- Palliate with XRT/cisplatin.

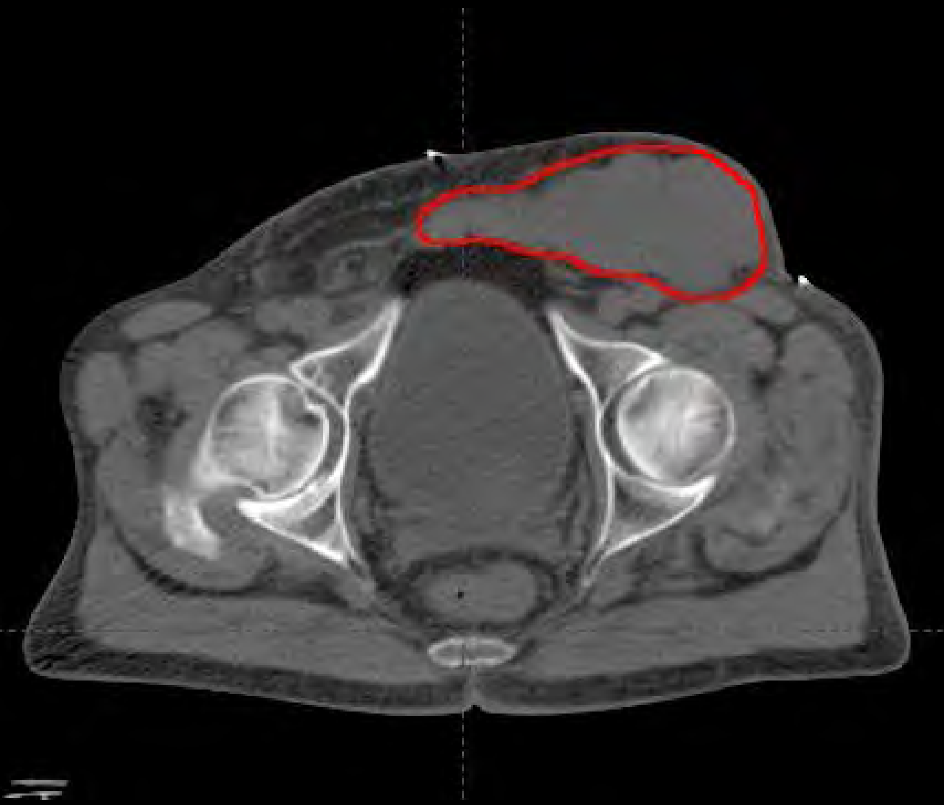
Physical Picture of Groin

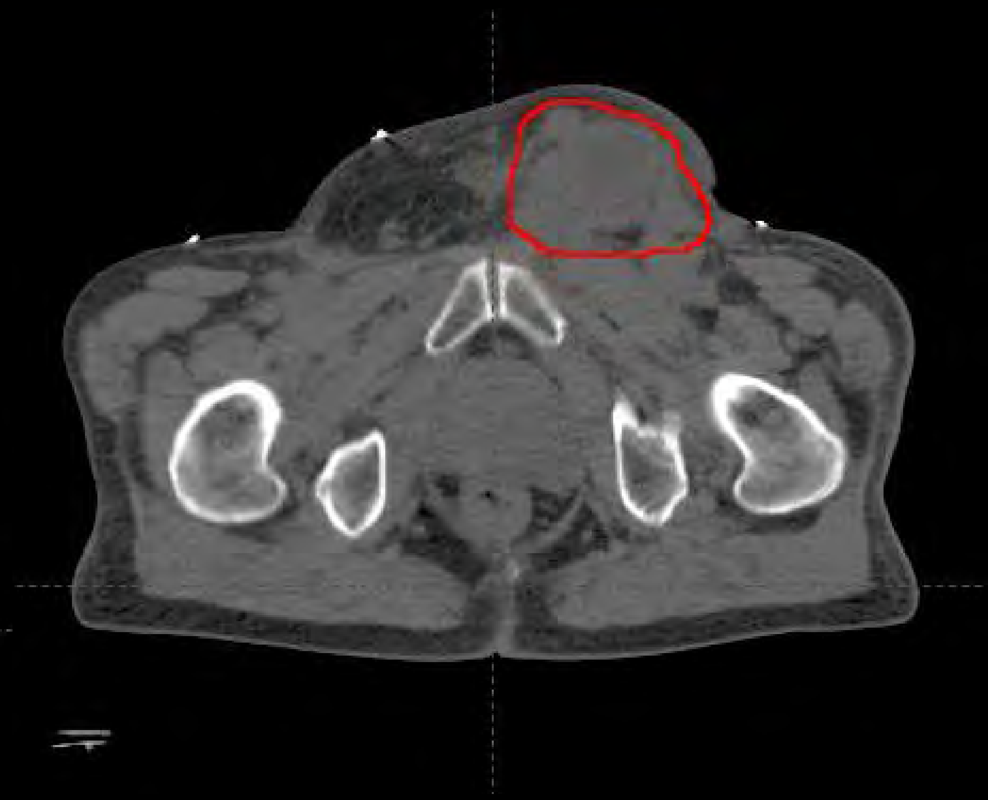


GRID video

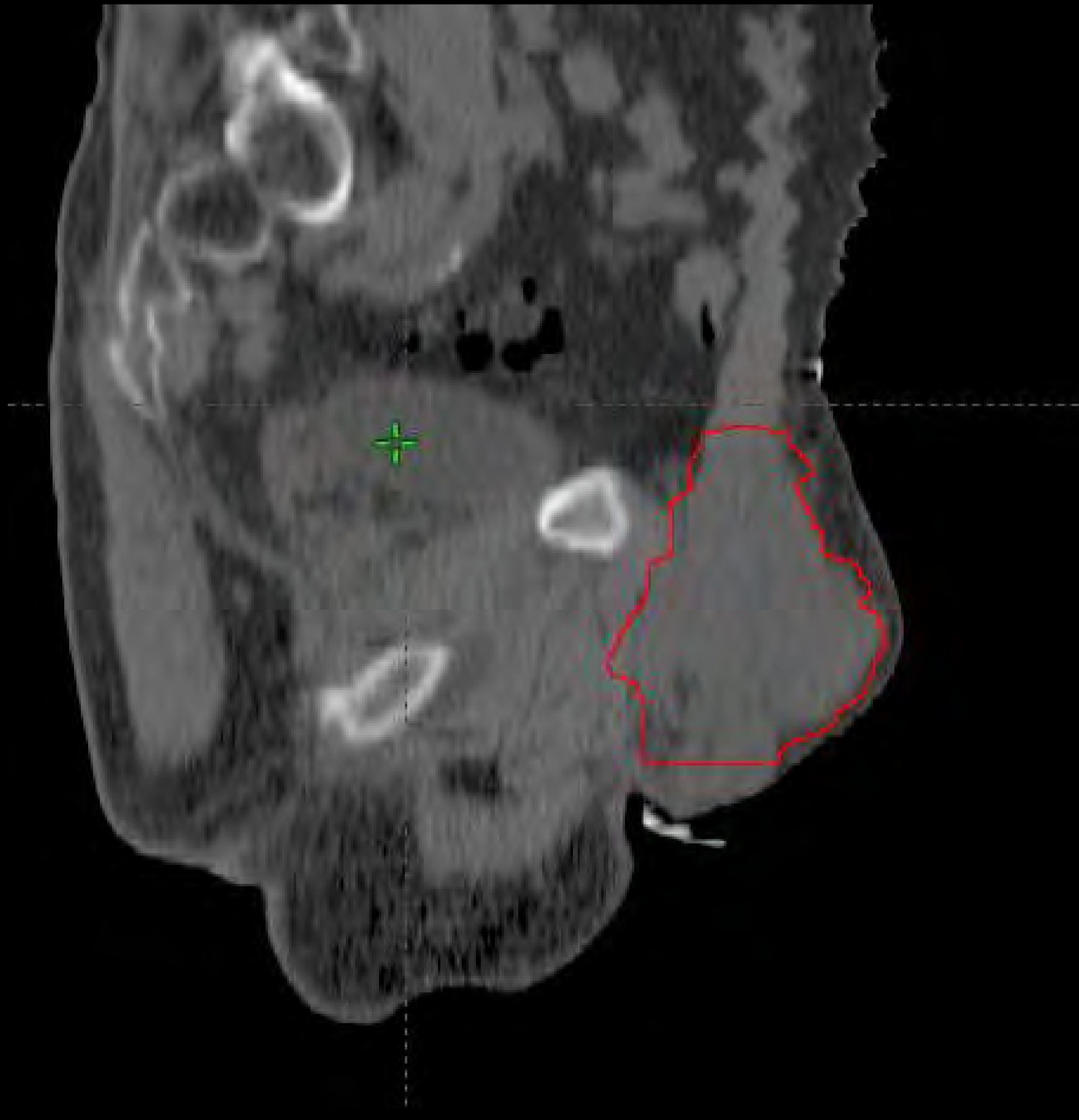
GRID

- 490.21 cm^3, or 9.8cm equiv. sphere diam.





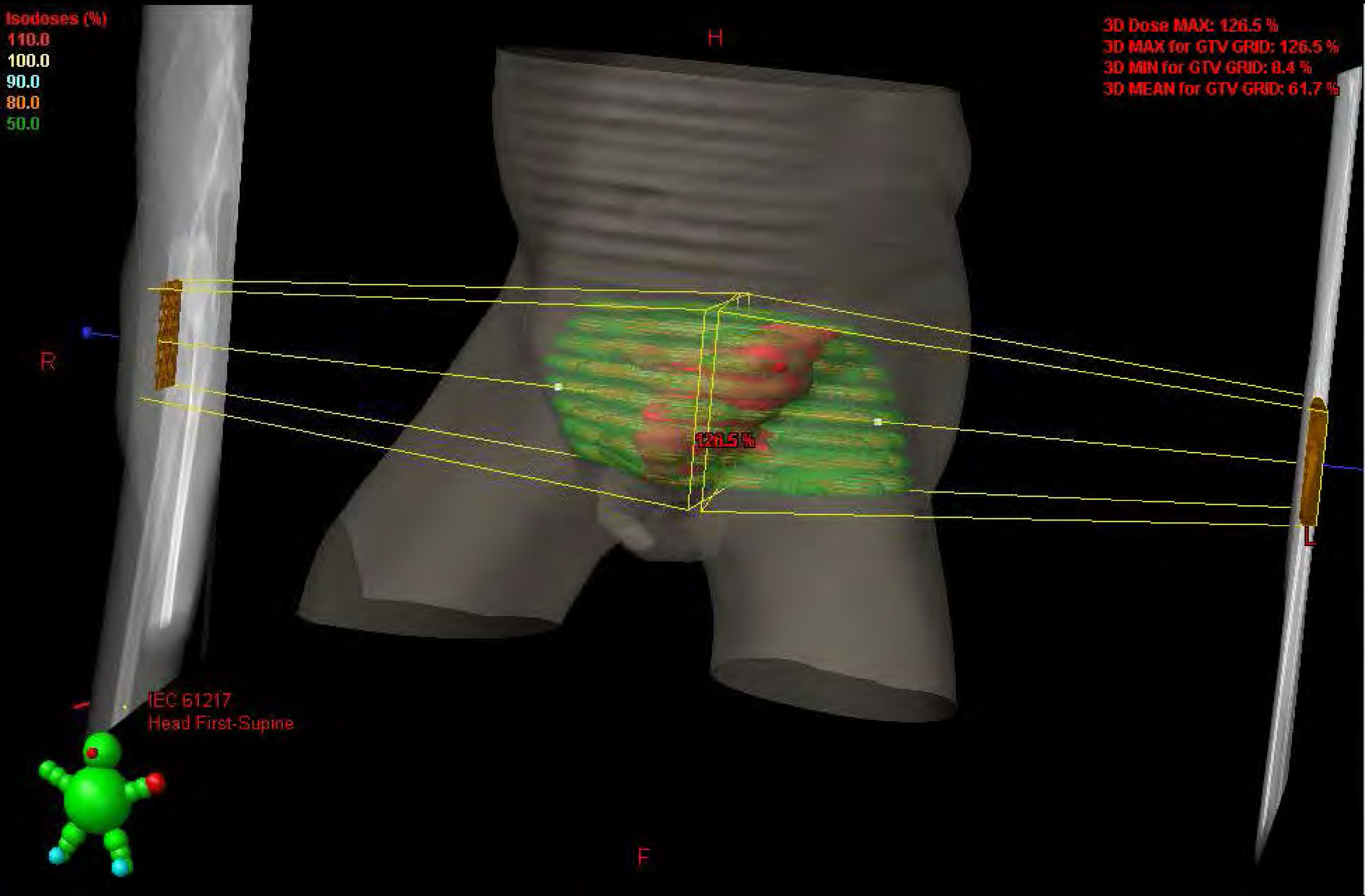
GRID Volume



GRID

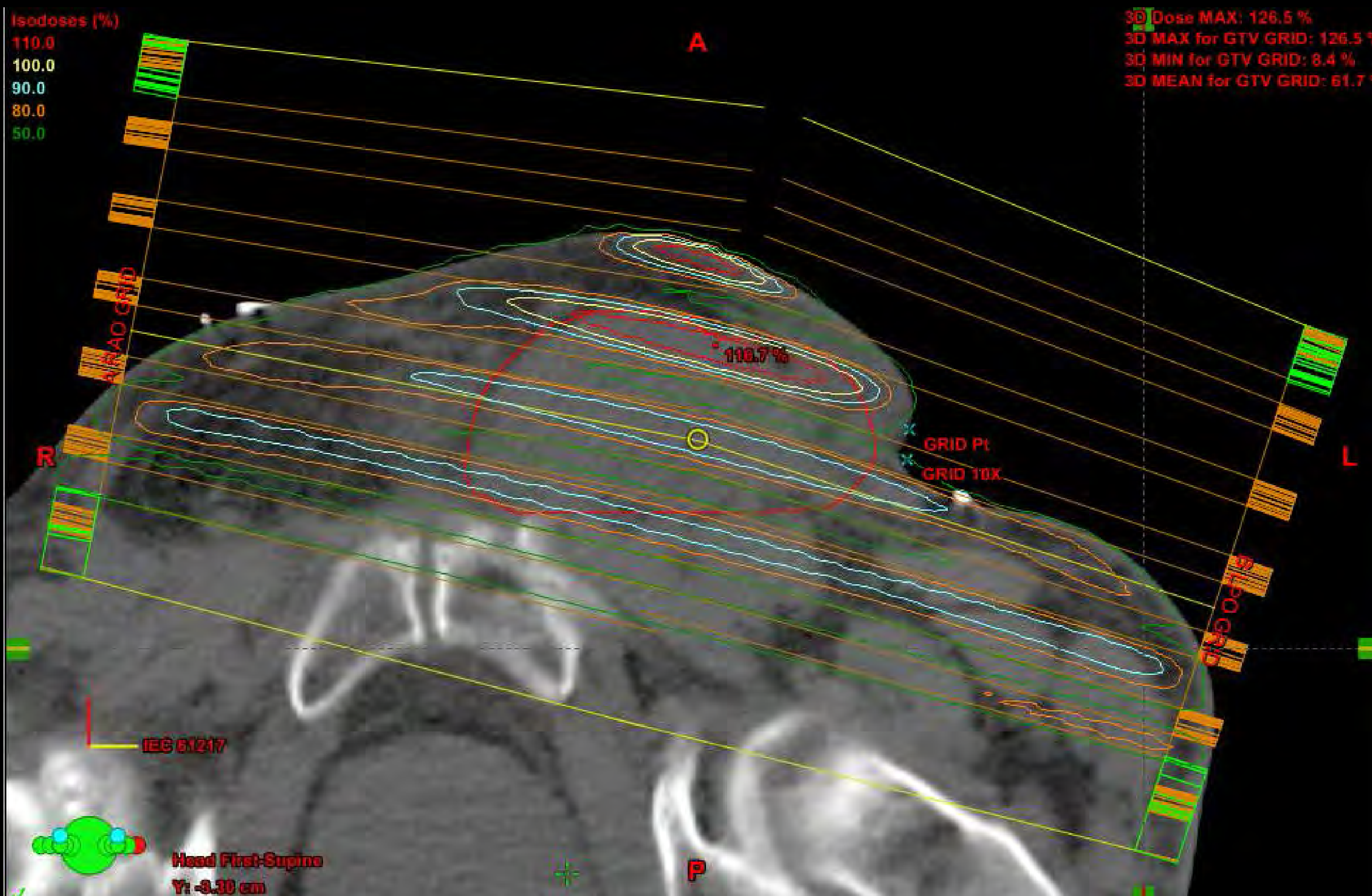

Isodoses (%)
110.0
100.0
90.0
80.0
50.0
A
3D Dose MAX: 126.5 %
3D MAX for GTV GRID: 126.5 %
3D MIN for GTV GRID: 8.4 %
3D MEAN for GTV GRID: 61.7 %
GRID Pt
GRID 10X
R
L
IEC 61217
Head First-Supine
P

GRID Fields



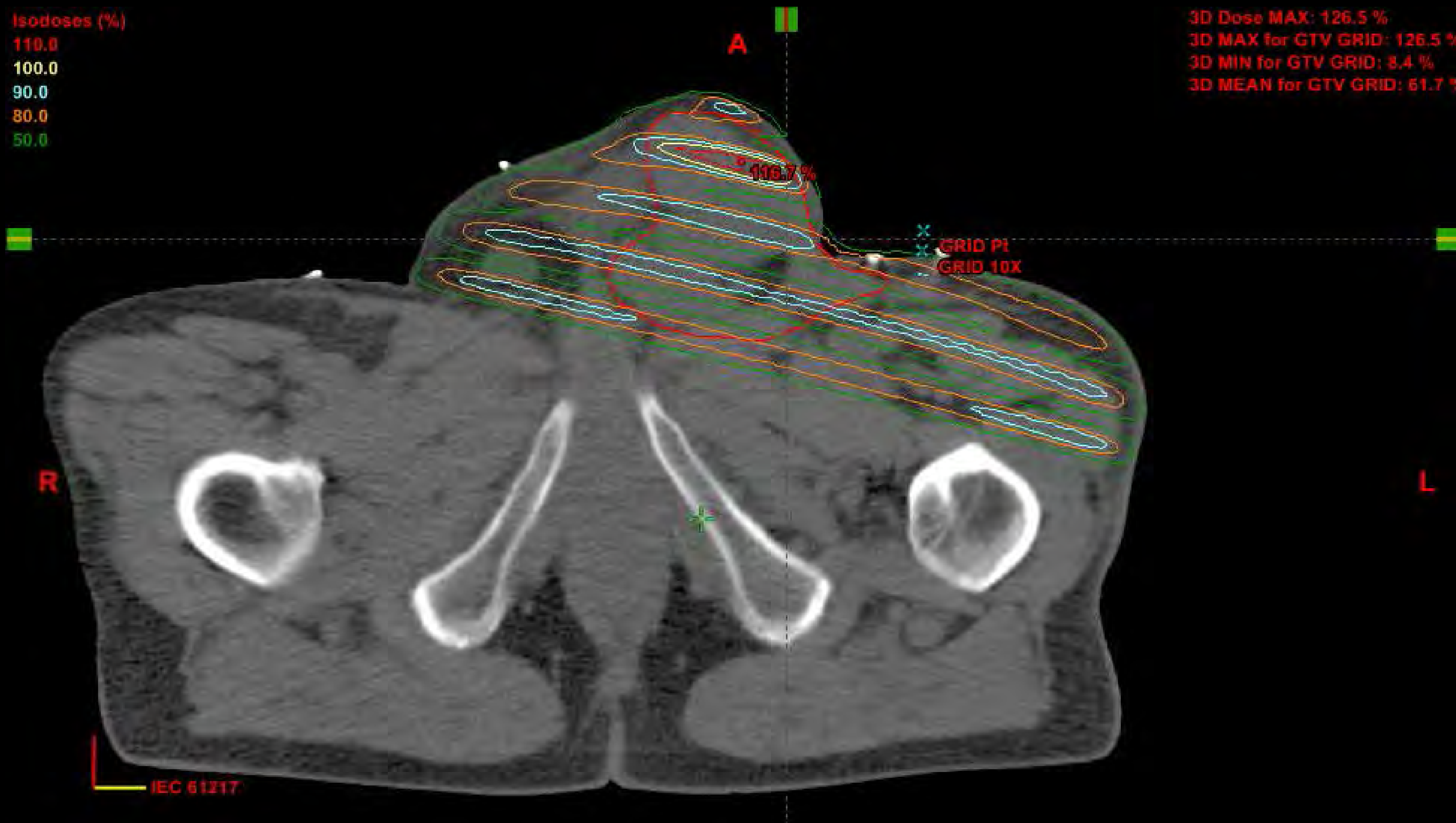
Isodoses (%)
110.0
100.0
90.0
80.0
50.0
H
R
L
F
3D Dose MAX: 126.5 %
3D MAX for GTV GRID: 126.5 %
3D MIN for GTV GRID: 8.4 %
3D MEAN for GTV GRID: 61.7 %
126.5 %
IEC 61217
Head First-Supine

GRID Fields



Isodoses (%)
110.0
100.0
90.0
80.0
50.0
A
3D Dose MAX: 126.5 %
3D MAX for GTV GRID: 126.5 %
3D MIN for GTV GRID: 8.4 %
3D MEAN for GTV GRID: 61.7 %
R
L
GRID Pt
GRID 10X
IEC 61217
Head First-Supine
P

GRID

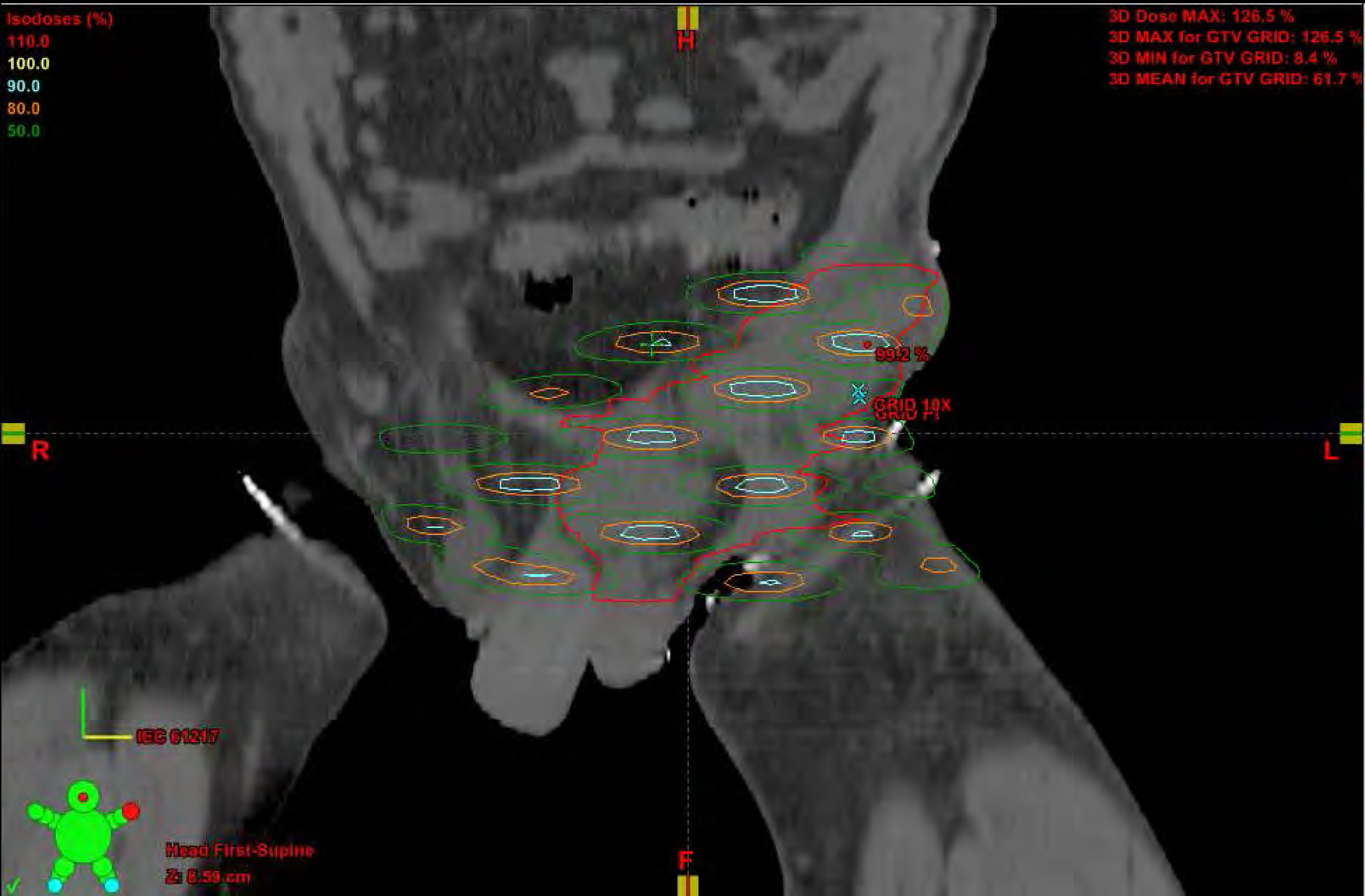


Isodoses (%)
110.0
100.0
90.0
80.0
50.0
A
3D Dose MAX: 126.5 %
3D MAX for GTV GRID: 126.5 %
3D MIN for GTV GRID: 8.4 %
3D MEAN for GTV GRID: 61.7 %
116.7 %
GRID Pt
GRID 10X
R
L
IEC 61217

GRID

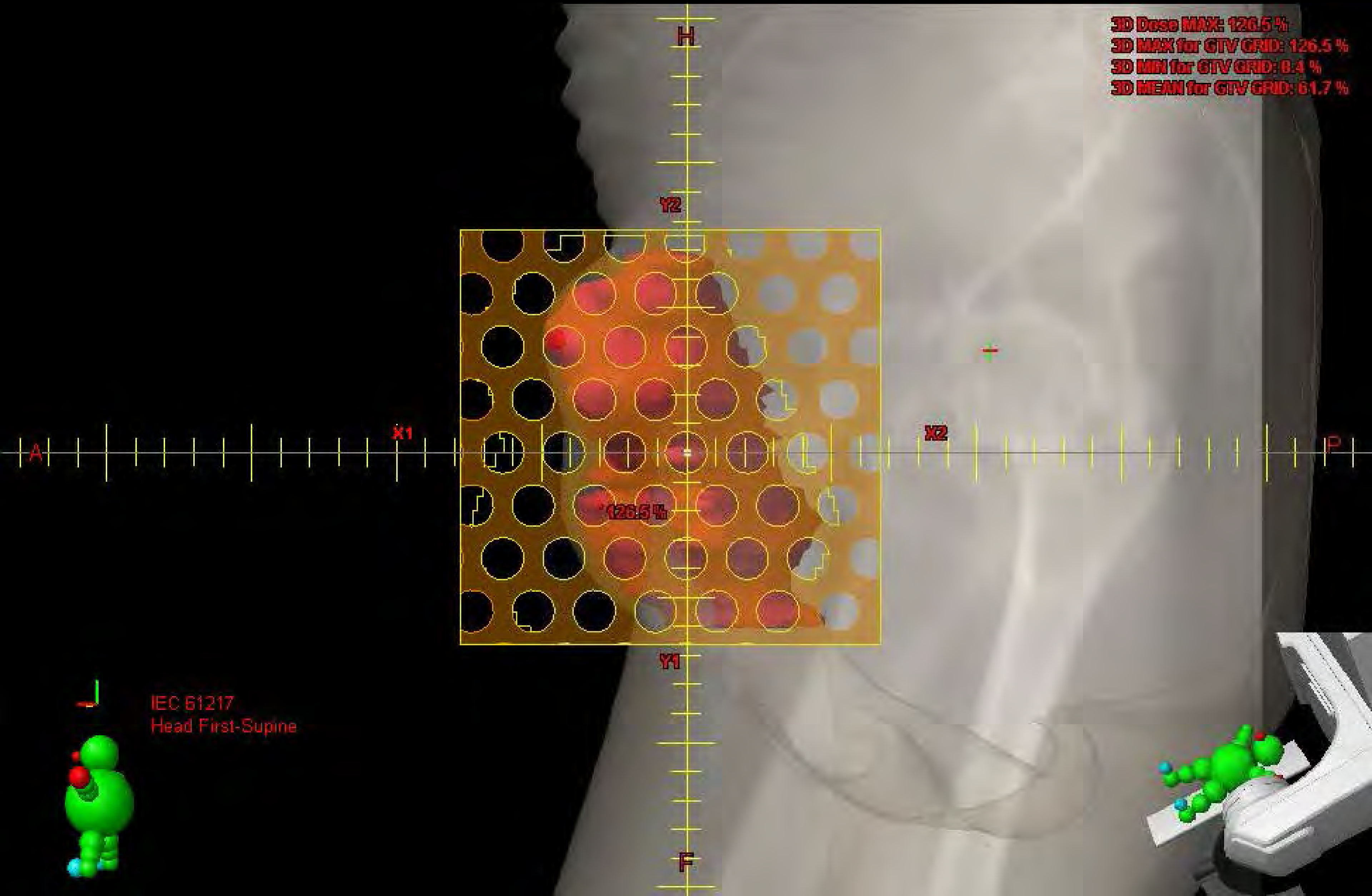
Isodoses (%)
110.0
100.0
90.0
80.0
50.0
H
3D Dose MAX: 126.5 %
3D MAX for GTV GRID: 126.5 %
3D MIN for GTV GRID: 8.4 %
3D MEAN for GTV GRID: 61.7 %
P
A
GRID 10X
GRID Pt
125.4 %
IEC 61217
Head First-Supine
X: 1.48 cm
F

GRID



Isodoses (%)
110.0
100.0
90.0
80.0
50.0
3D Dose MAX: 126.5 %
3D MAX for GTV GRID: 126.5 %
3D MIN for GTV GRID: 8.4 %
3D MEAN for GTV GRID: 61.7 %
H
R
L
F
99.2 %
GRID 10X
IEC 61217
Head First-Supine

BEV GRID

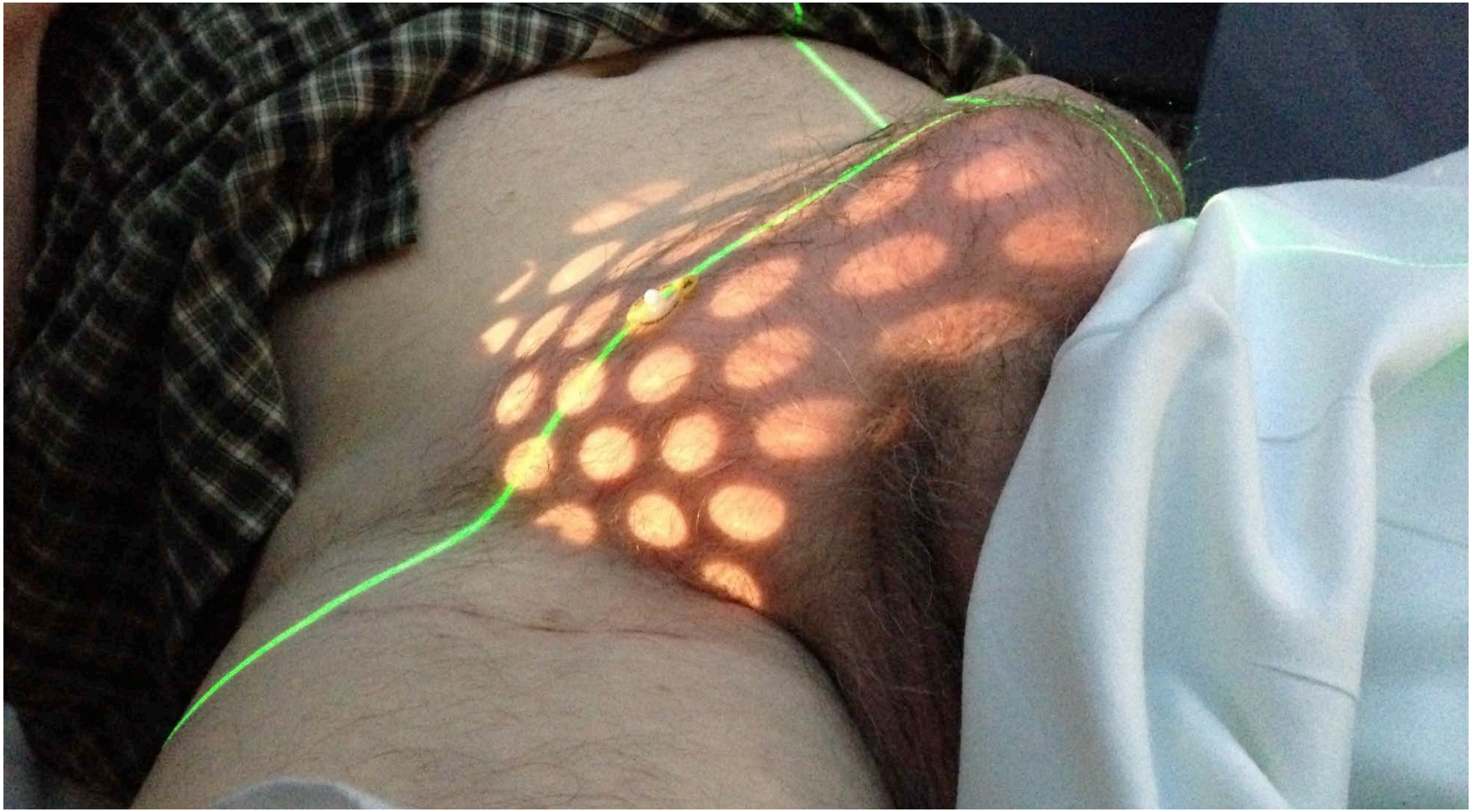


3D Dose MAX: 126.5 %
3D MAX for GTV GRID: 126.5 %
3D MIN for GTV GRID: 8.4 %
3D MEAN for GTV GRID: 61.7 %
H
Y2
X1
X2
A
P
126.5 %
Y1
F
IEC 61217
Head First-Supine

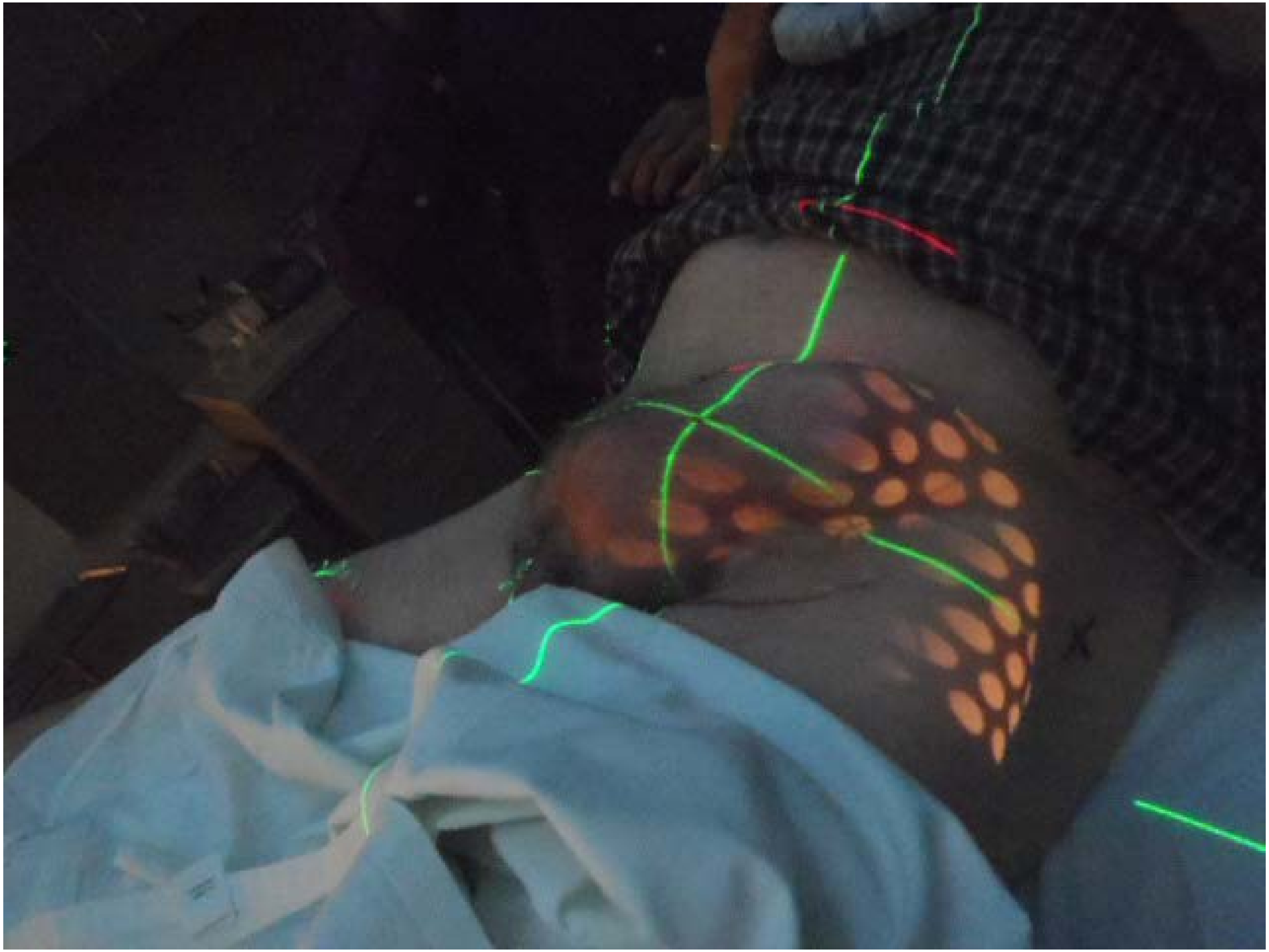
BEV GRID

Isodoses (%)
110.0
100.0
90.0
80.0
50.0
3D Dose MAX: 126.5 %
3D MAX for GTV GRID: 126.5 %
3D MIN for GTV GRID: 8.4 %
3D MEAN for GTV GRID: 61.7 %
H
Y2
X1
X2
P
A
126.5 %
Y1
IEC 61217
Head First-Supine
F

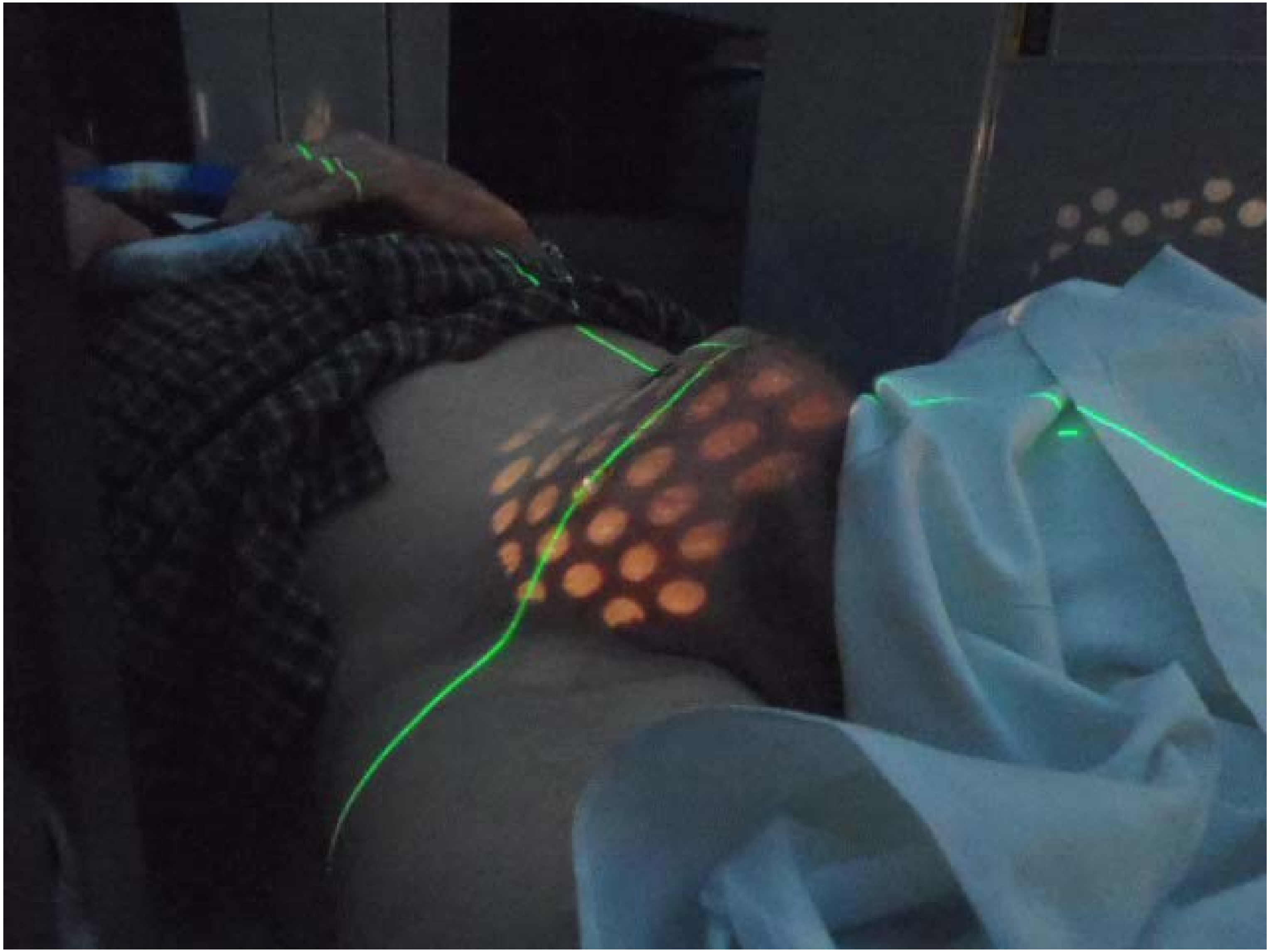
GRID



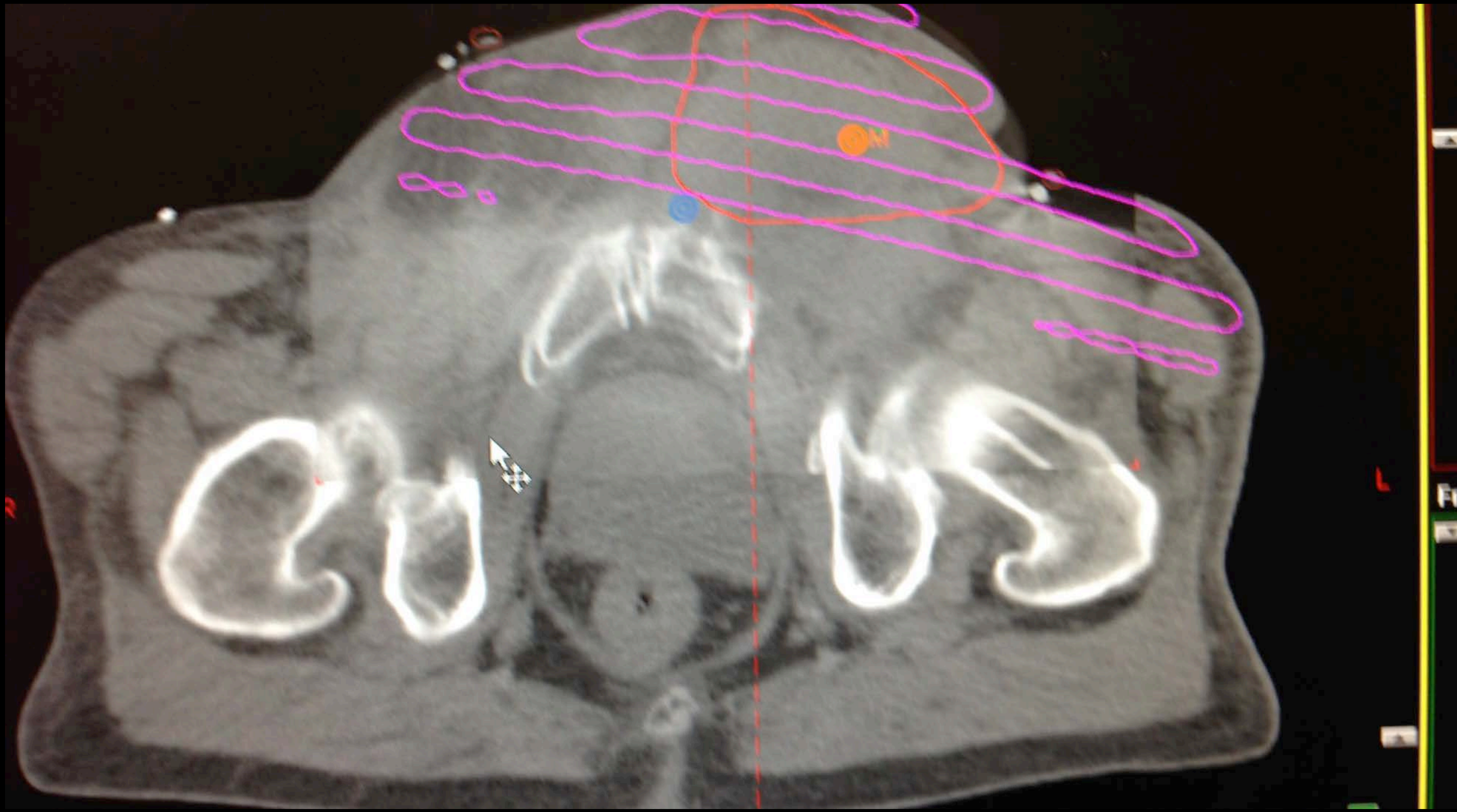
GRID



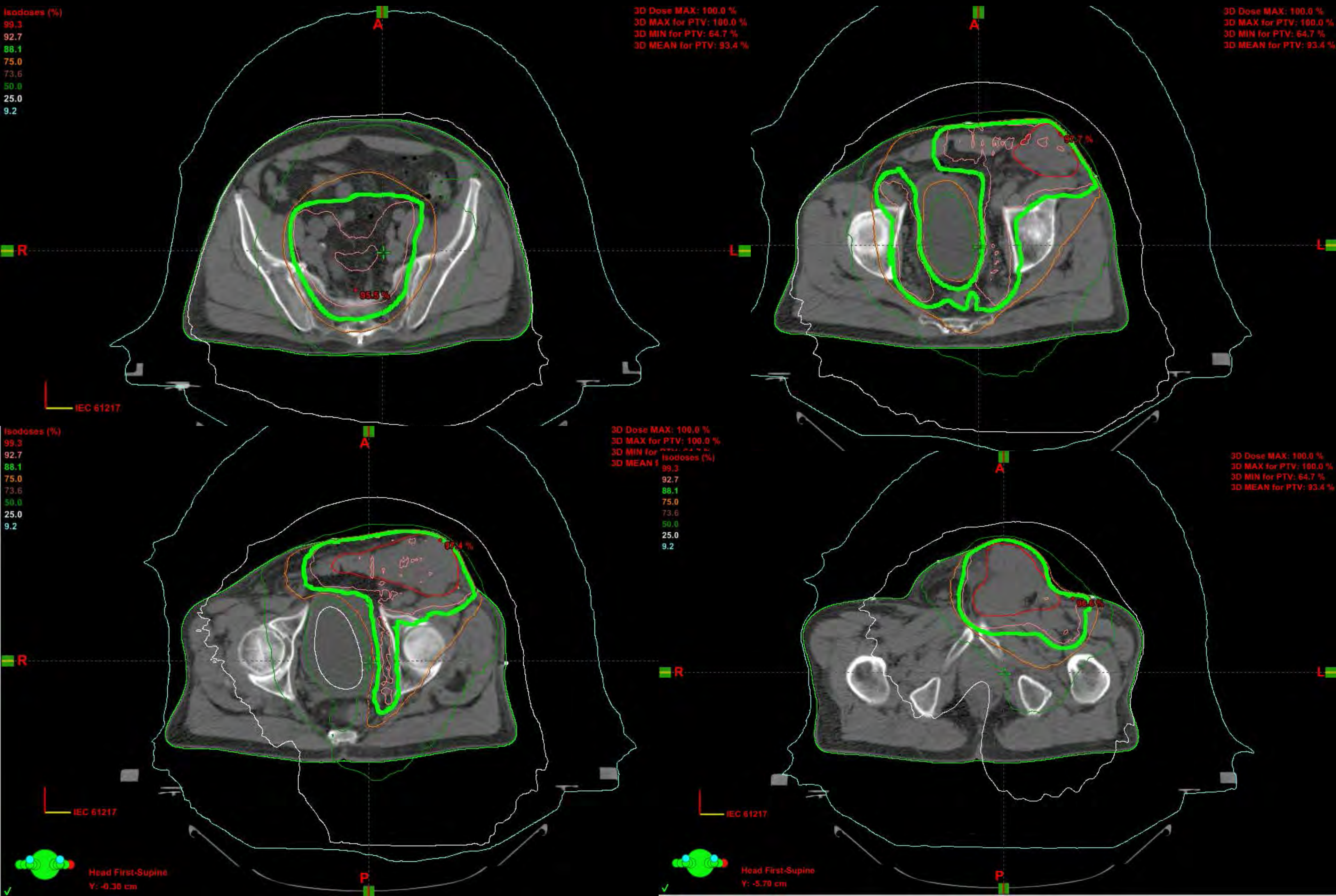
GRID



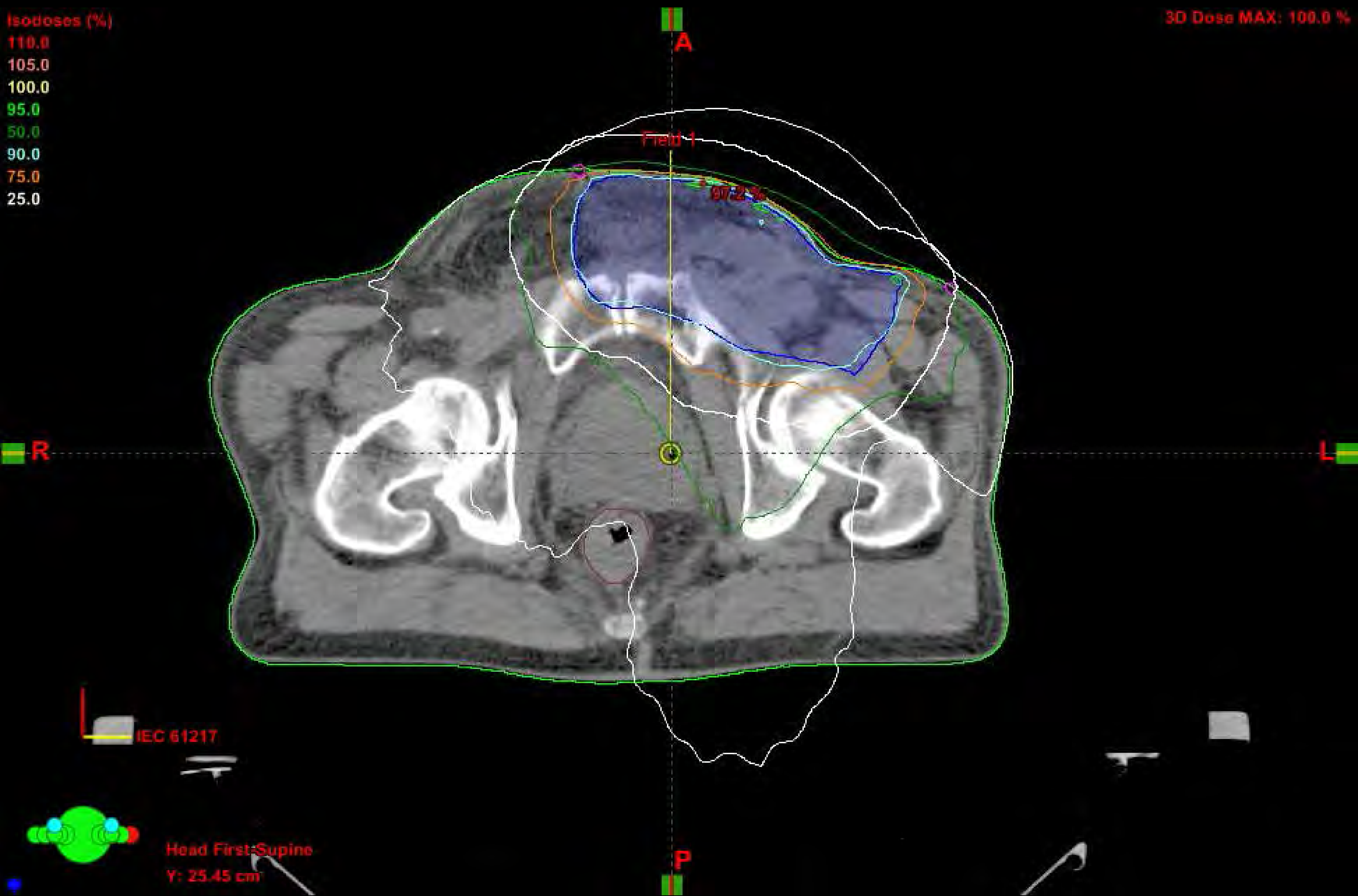
GRID



50Gy


Isodoses (%)
99.3
92.7
88.1
75.0
73.6
50.0
25.0
9.2
3D Dose MAX: 100.0 %
3D MAX for PTV: 100.0 %
3D MIN for PTV: 64.7 %
3D MEAN for PTV: 93.4 %
A
R
L
P
IEC 61217
Head First-Supine
Y: -0.30 cm
Y: -5.70 cm

16Gy boost



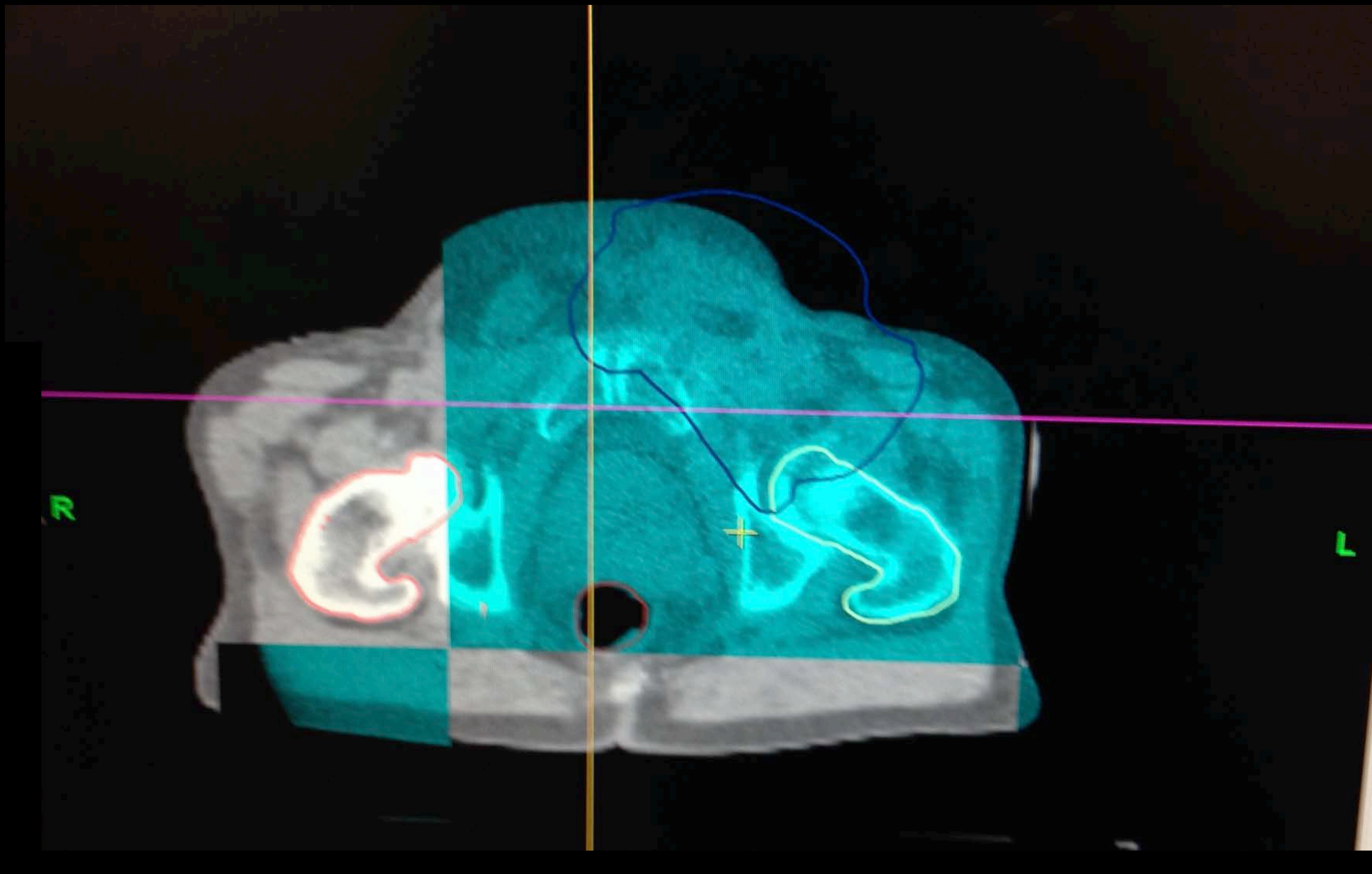
Isodoses (%)
110.0
105.0
100.0
95.0
50.0
90.0
75.0
25.0
3D Dose MAX: 100.0 %
A
Field 1
97.2 %
R
L
IEC 61217
Head First-Supine
Y: 25.45 cm
P

Radiation Treatment

- GRID – parallel opposed 20Gy x 1f on 9/16/14

- Tomotherapy 50Gy pelvis and inguinals and 16Gy boost to L groin
- XRT: 9/17/14 to 11/3/14
- Given along with cisplatin (stopped early, only 2 weekly doses due to rising Creatinine)

During Treatment 10/4/14



During Treatment 10/4/14

2 months later PE

2 months later PE

2 months later (1/31/15)

CT scan 1/31/15

CT scan 1/31/15

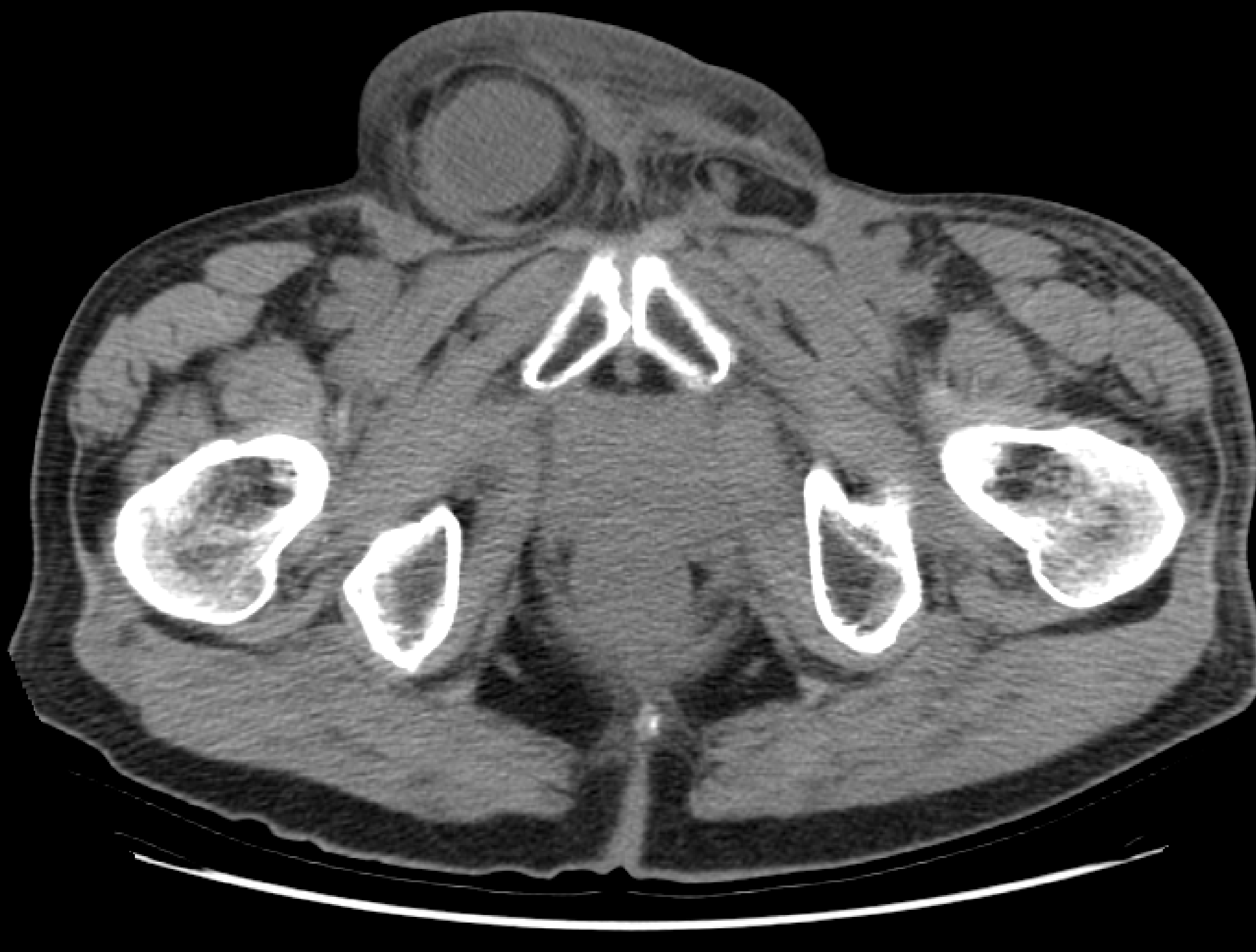
CT scan 1/31/15

CT 1/31/15

3 months later PE

3 months later PE

CT 3/3/15



Why use the brass GRID collimator?

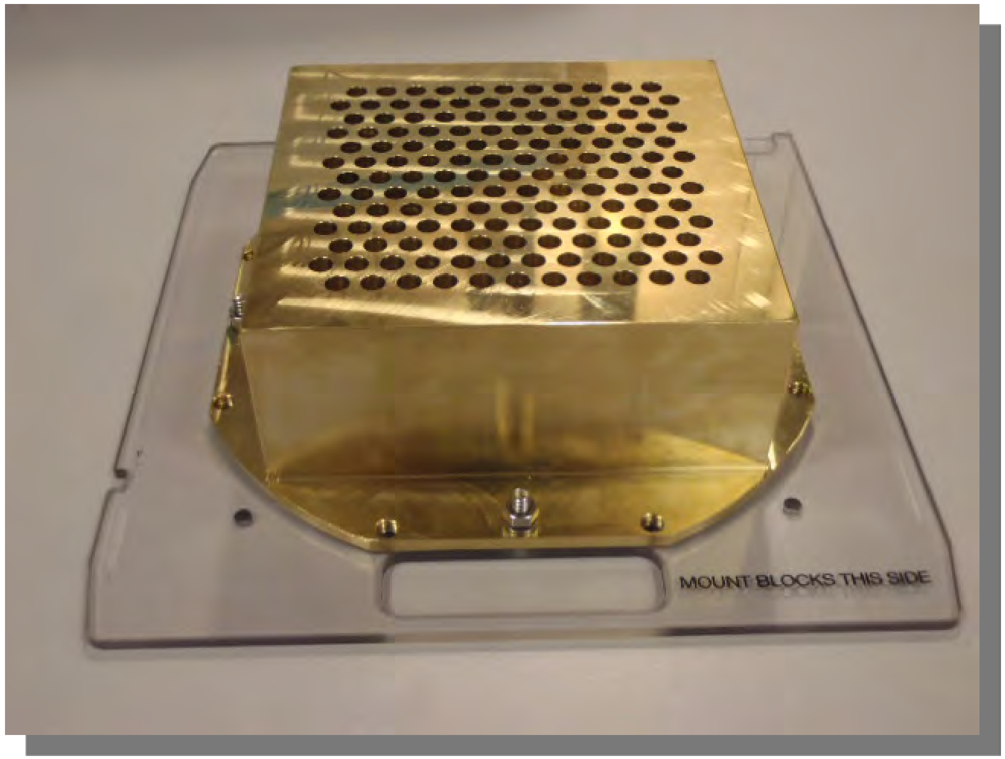
- Easier than MLC GRID:
  - Faster treat time (easier for patient, less motion blur)
  - Less Monitor Units delivered (MUs)
- Lighter than Cerrobend GRID by 14 lbs!
  - Safety issue to staff and patient

- Same valley-to-peak profile as Cerrobend GRID
- Compatible with any linear accelerator
- GRID is a one-time purchase. Can be used again and again, so very cost-effective.
- Now comes with TPS file for your system!!

Take Away Conclusions

- A possible solution when conventional treatments are not feasible or are ineffective
- Can be very effective on extremely large, bulky advanced tumors
- Published technique, >500 patients
- Delivery of higher doses (15-20Gy) in a single treatment. Consolidate with >40Gy after.

Many Thanks



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