The Use of Bolus Electron Conformal Therapy in the Clinical Setting

Presented to: The American Associatio of Medical Dosinetrists, Region 1

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Disclosure

- Sponsored by .decimal

Agenda

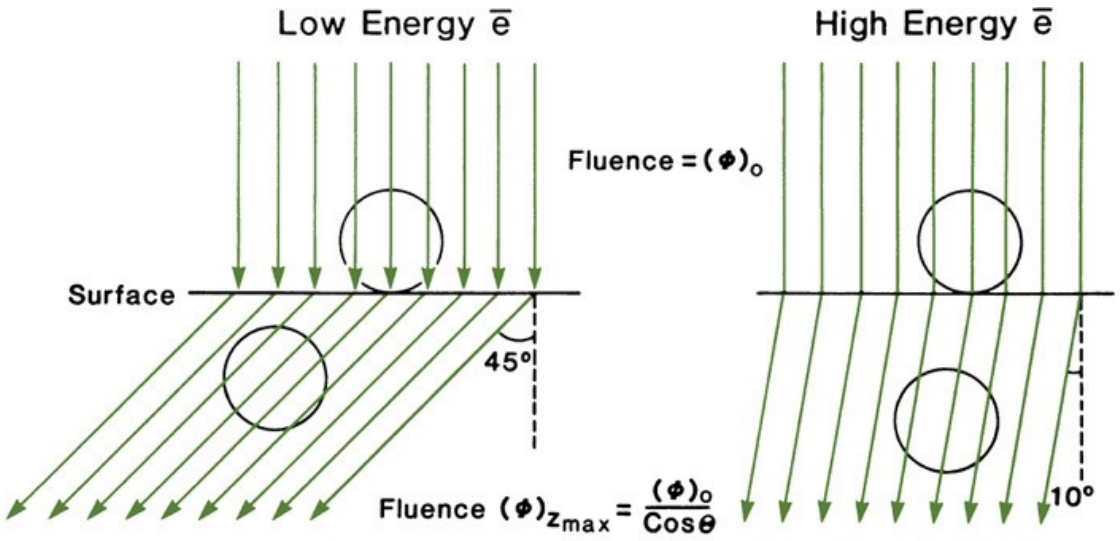
- The Basics of Electron Beam Therapy
- Why Use Bolus Electron Conformal Therapy
- Implementation
- Process Flow
- Planning Process
- Case Studies

The Basics of Electron Therapy

- Interactions
  - Inelastic collisions with atomic electrons
    - Ionization and excitation (lower atomic number media)
  - Inelastic collisions with nuclei
    - Bremsstrahlung (higher atomic number materials such as lead)
  - Elastic collisions with atomic electrons
  - Elastic collisions with nuclei

The Basics of Electron Therapy

- Surface dose
  - Lower energies scatter more easily and through larger angles



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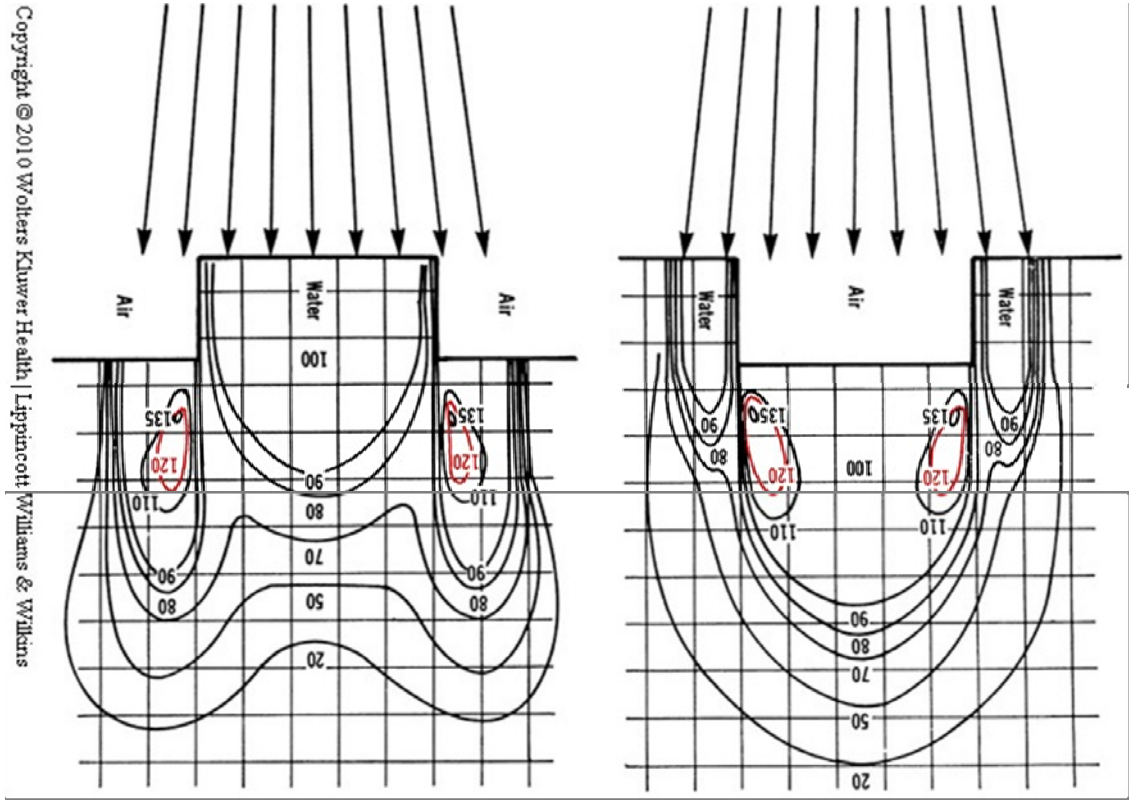
The Basics of Electron Therapy

- Central Axis Distributions, Flatness, and Curvature near field borders
  - Collimations Systems
  - Air Gaps (between cone and patient)
  - Obliquity
  - Energy
  - Field Size
  - Cone Size
  - Cutouts

The Basics of Electron Therapy

- Surface Irregularities



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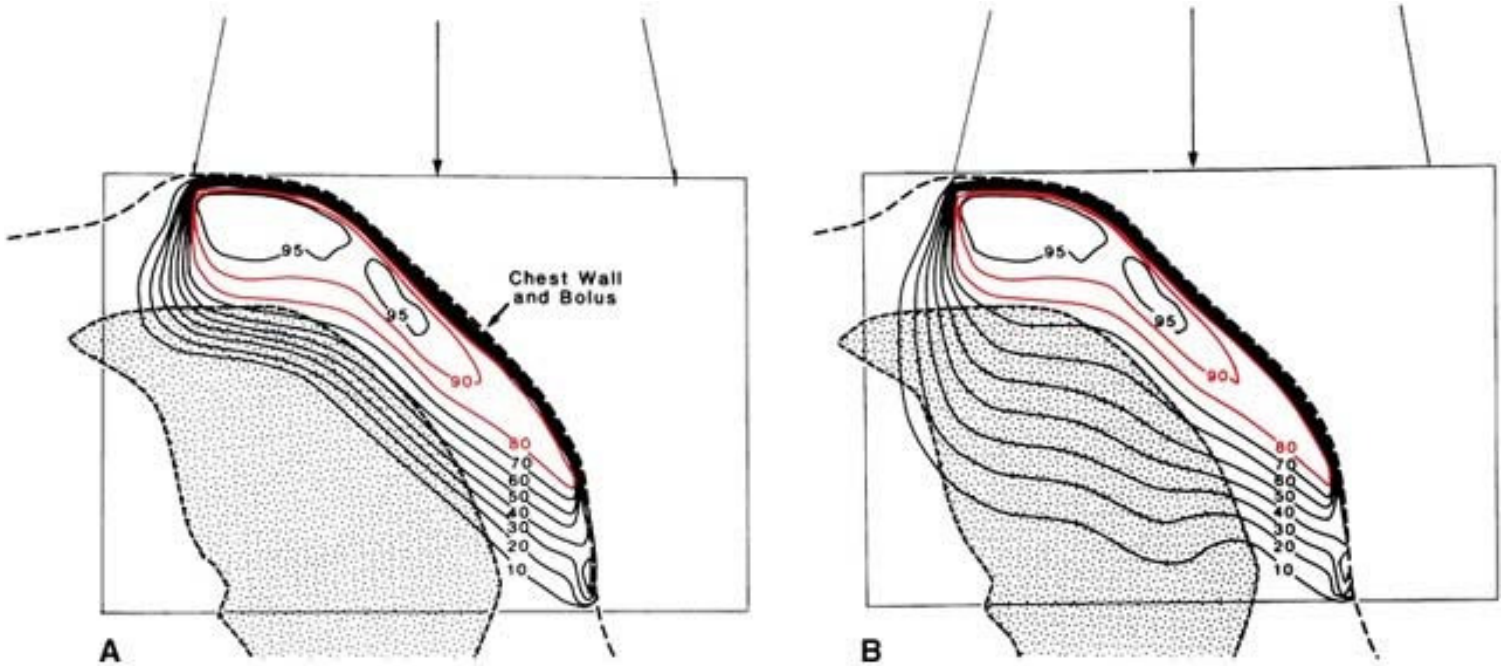
The Basics of Electron Therapy

Inhomogeneties



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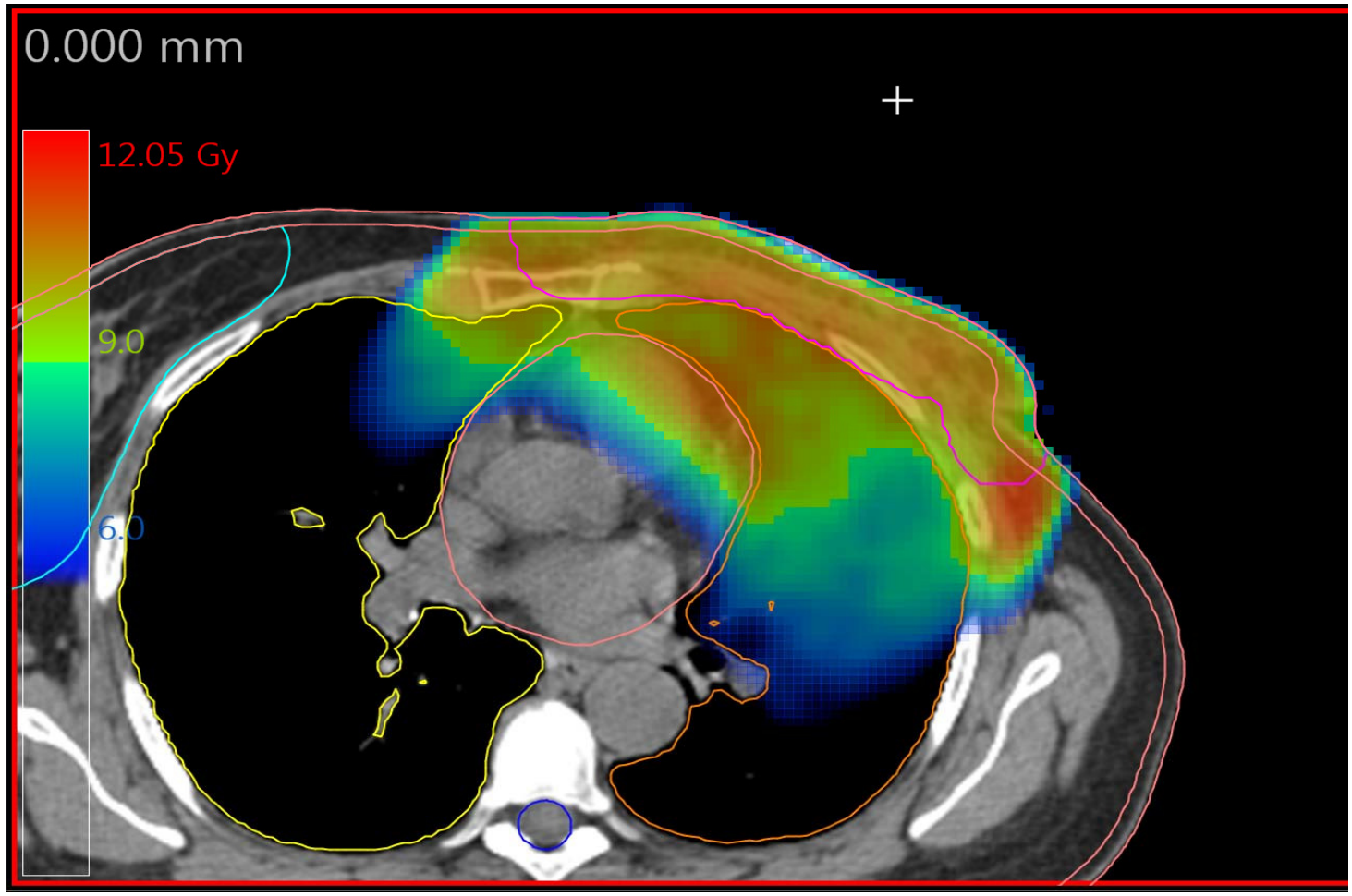
Why use BolusECT?

- Sparing underlying critical structures

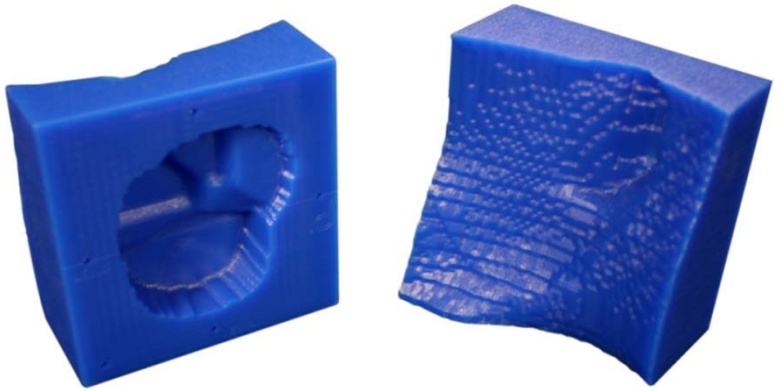


Solution

- Paraffin Wax
- Polystyrene
- Lucite (Spoilers)
- Superstuff
- Superflab
- Brass mesh
- Rice Bags
- Wet Guaze
- Water

Custom Uniform Thickness

Custom Conformal Thickness



Why use BolusECT

- What is happening in clinics today???
- Fabrication of own Electron cutouts and Bolus

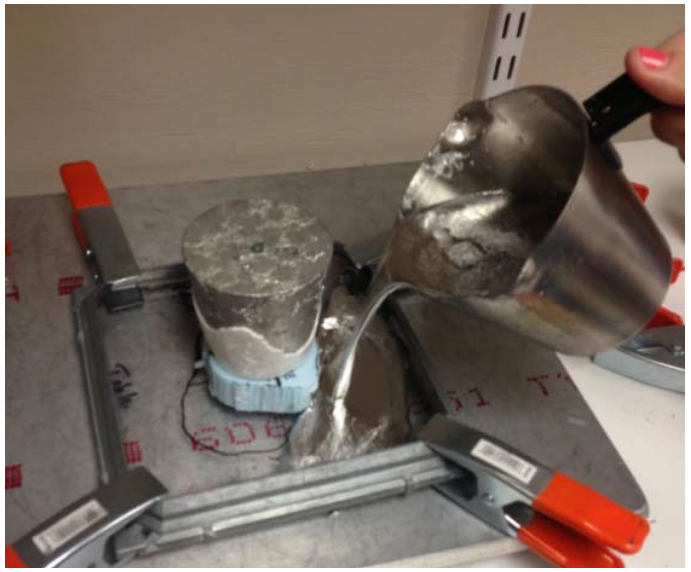
Why use BolusECT

- Clinics fabricate their own “handmade” beam modifications devices, which leads to:

  -Variability (from what was planned)

  -Imperfections in fabrication

  -Limitations in machining



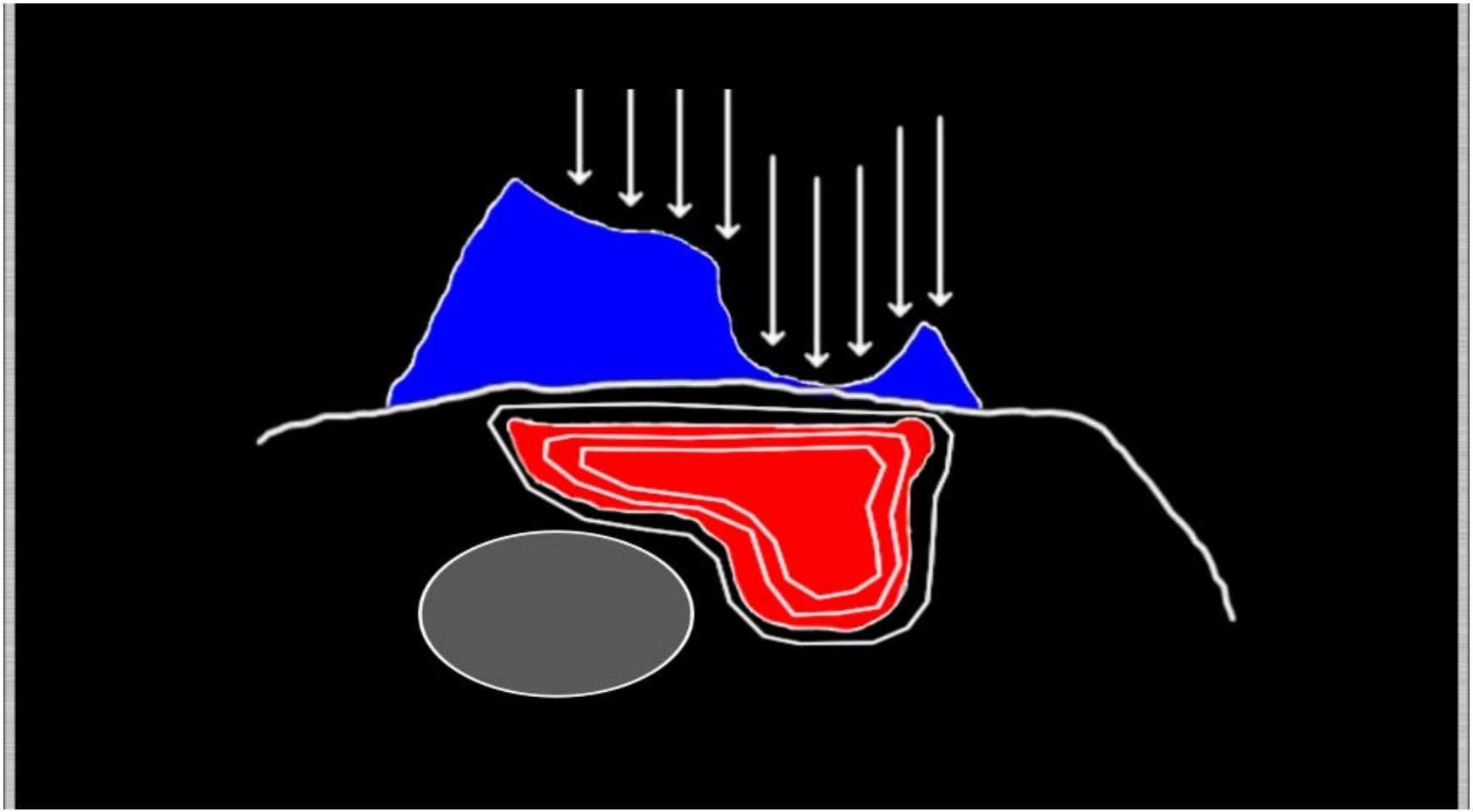
Why use BolusECT

- Issues with Bolus
  - Air Gaps
  - Rarely custom tailored to patient
  - Sanitation (often re-used on different patients…gross!)
  - Potential for error in bolus placement, and bolus selection .3cm vs .5cm vs 1cm

What is BolusECT

- A custom milled device that allows the use of a *single electron beam* with a variable thickness bolus to shape the distal prescribed isodose line to conform to and contain the PTV…

What is BolusECT?



Development

- Developed at MD Anderson in the 90's
- Well published technique
- Employs single electron field
- Allows user to conform dose
  - Typically 90% isodose line to distal surface of PTV
- Delivers minimal dose to adjacent structures
- Shorter planning / treatment times

Fabrication

.decimal factory

Fabrication

- Using the data that you generate the manufacturer is able to custom build your bolus using the latest machining techniques

Planning

- Electron Planning Issues
  - Relatively few factors that can be controlled
  - Dose Heterogeneity
  - Energy Selection
  - May cover PTV geometrically but dose distribution may be inadequate due to variable PTV depths

Implementation

- Works with your existing equipment. .decimal software is all that is needed.
- Is a specialized treatment and meant to fill a niche for very specific situations.
- Gives you another tool for tailoring treatments to individual needs.

Implementation

- Software configuration with electron data
- Provide treatment depths (Dmax, R90, R85, etc) for various energies
- Installation of software via remote upload
- Windows-based PC / Internet Access
- Software Training
- Via Webex
- Approximately one hour required

Implementation

- Afraid this technology will break your department's budget.....$$$$

Implementation

- No up front costs for the Software, implementation, training, and yes even on-going support is all provided at no cost. You only pay for the devices you use!!!!

Process Flow

Patient selection

- Physician identifies patient at time of consultation
- Physician consults with physics
- Physics consults with patient

Process Flow

Patient Education

- Skin care
- Multiple appointments needed for QA
- Additional time needed in treatment room
- Physics will be in the treatment room observing weekly (or more depending on case)
- Physician will be in the treatment room more frequently than usual

Process Flow

First Simulation (Positioning Simulation)

- Reproducible set up
- Position the patient so that the beam can be as perpendicular to the patient as possible
- Think outside box- turn patient if needed and possible
- Positioning photos acquired
- CT scan done
- MD contours tumor volume
- Information sent to dosimetry
- Patient scheduled for re-CT with BolusECT in position

Process Flow

Treatment planning

- Complex computer plan generated (no BolusECT)
- Treatment plan sent to P.D. software for BolusECT design
- BolusECT sent to .decimal for manufacture
- Information sent from P.D. software to TPS software for treatment plan with “virtual bolus” in place
- BolusECT returns from .decimal- usually 24 hours
- Analysis of BolusECT

Process Flow

Second Simulation (Device Verification)

- Patient rescanned with BolusECT in place
- Position and placement approved by MD and physics/dosimetry
- Positioning photos taken of placement of BolusECT
- BolusECT keypoints marked for matching
- Patient scheduled for first treatment

Process Flow

Final Treatment Planning

- 3D plan generated with BolusECT in place
- Any energy adjustments will be made at this time per the MD's request
- DRR generated

Process Flow

First Treatment Day

- Extra time required on first day for confirmation of electron cutout and BolusECT alignment
- Requires that MD and physics are available for first treatment
- Therapist need to allow time for any issue that may arise
- Field photos and gantry photos taken
- Image acquired for DRR comparison

Process Flow

Daily Monitoring

- Continued surveillance of placement and fit of BolusECT
- Notify MD of any contour changes or skin reactions
- Notify physics of any contour changes

Planning

- Using the CT images the physician defines the target
- Critical structures are contoured
- Create and center the treatment beam around the PTV at an SSD of 105cm
  - -Why 105cm SSD? Leave room under electron cone for bolus.

Planning

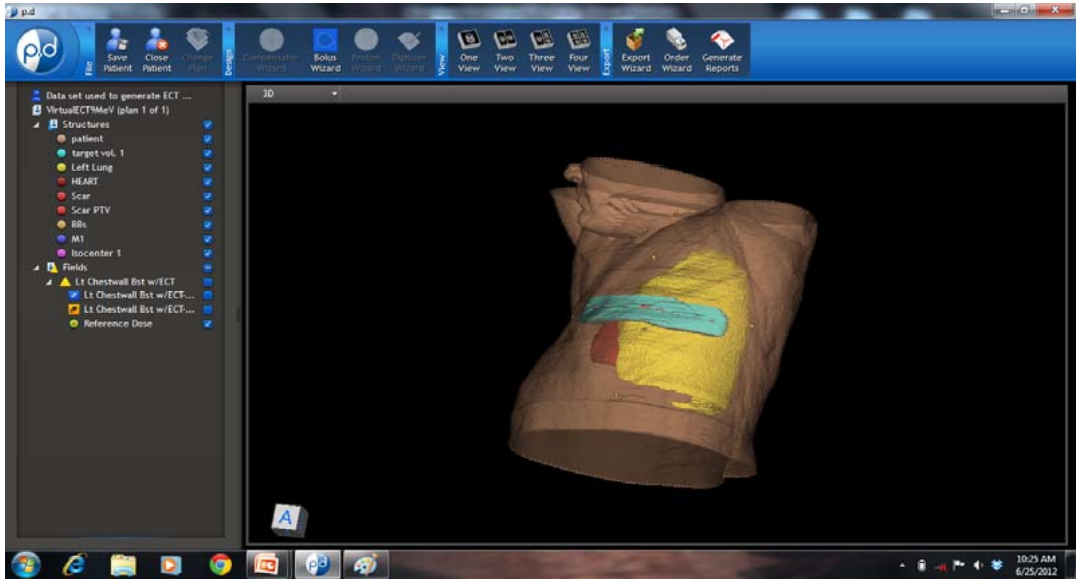
- Some planning considerations
  - Try to ensure that treatment field is perpendicular to treatment site.
  - The bolus generating software uses the external/body contour, it is important to make sure that only patient anatomy is included in this. IE Wires and other patient marking aids should be excluded.

Planning

An initial quick plan to get an idea of the energy that should be used

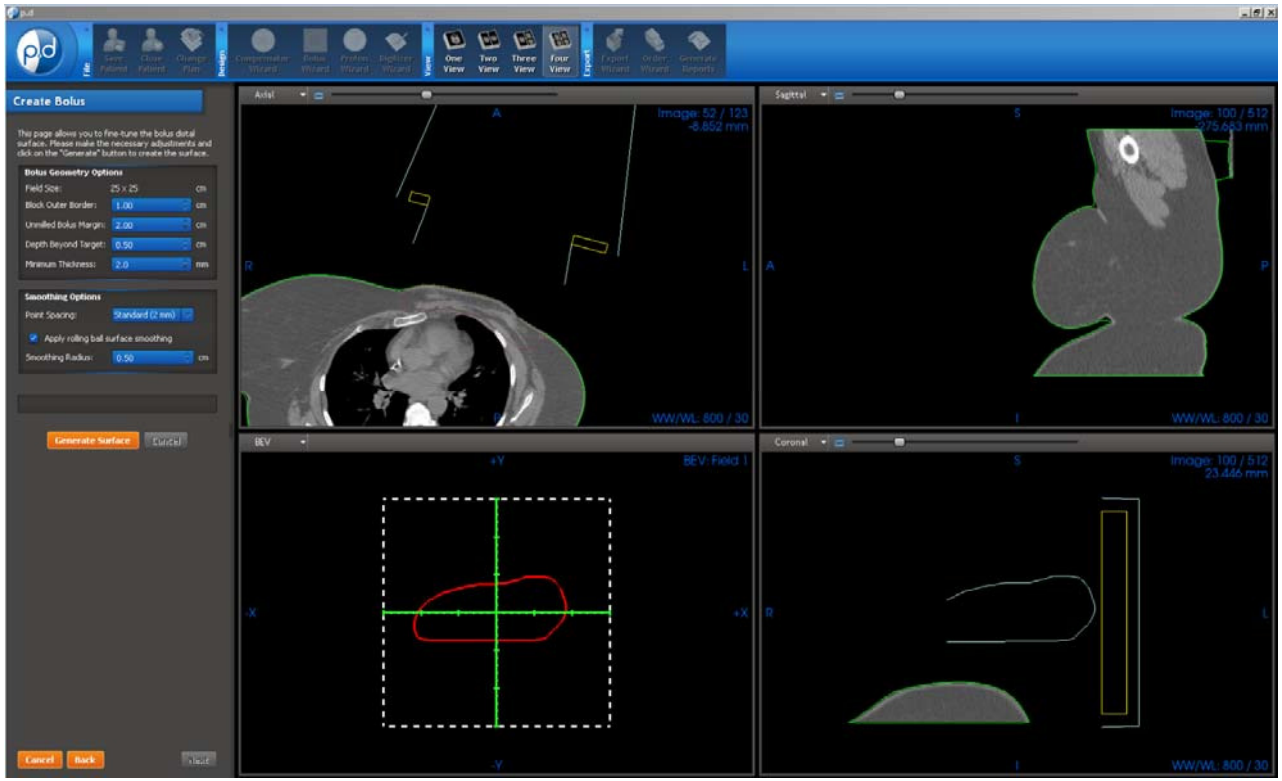
Planning

- The RT Plan, structure set, and CT images are then exported to the P.D planning software.
- Once the appropriate files are in the software, the planning process is a breeze!



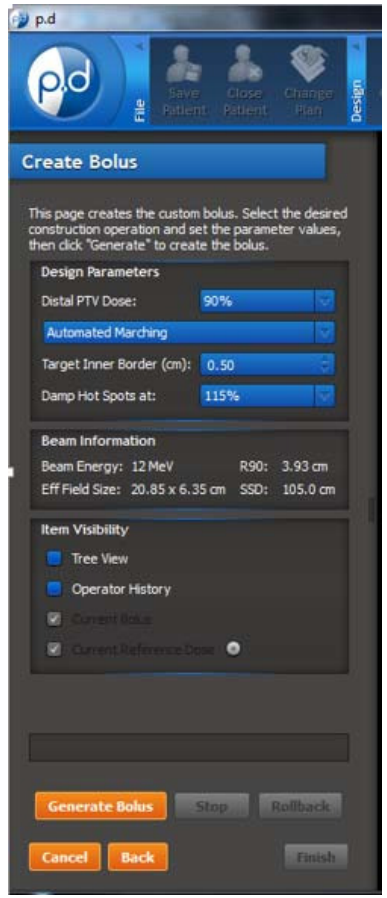
Planning

- First the software uses the External Contour to generate the initial Bolus structure.



Planning

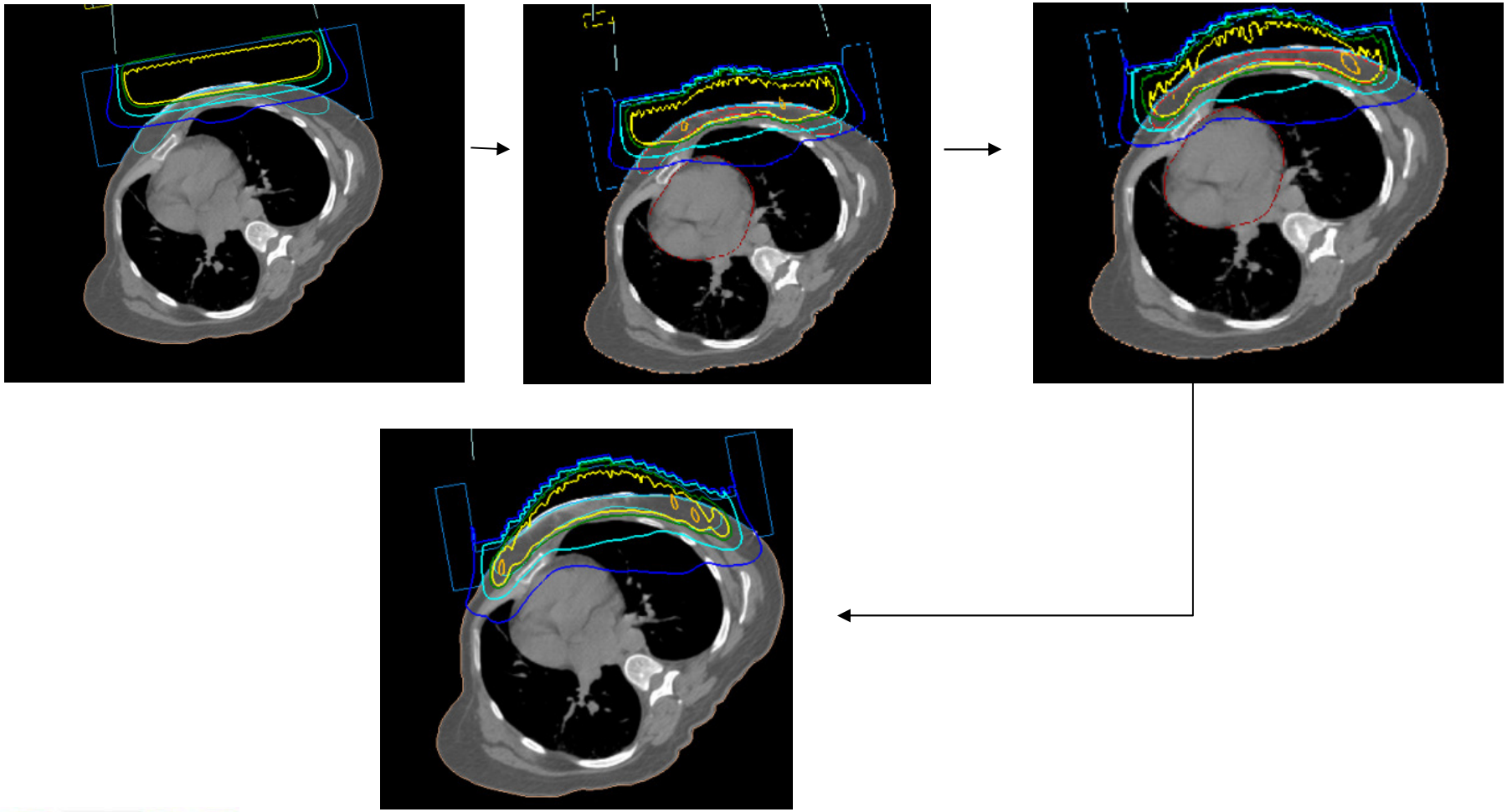
- Select: The distal PTV coverage you would like to achieve, the energy you would like to use, at what dose you would like any hotspots to be dampened, along with the margin you would like around the inner border.



Planning

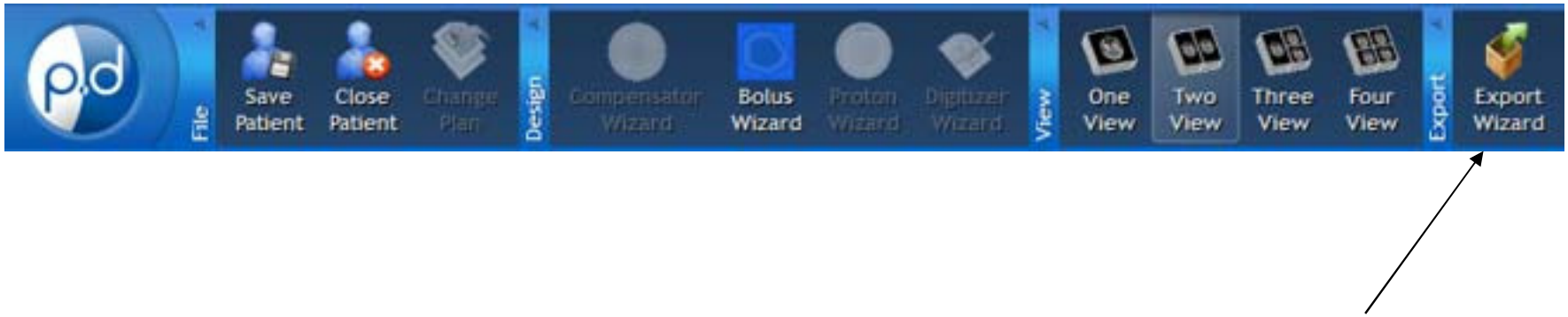
- Next click Generate bolus and watch the software work
  - The software uses an automated marching technique.
  - As the bolus is being generated, the Hogstrom redefinition pencil beam (results closely approximate the eMC) electron model approximates dose.
  - This is an iterative process that will take a few minutes.

Planning



Planning

- Once the Bolus is generated and the isodose levels look to be to a suitable level of homogeneity and conformality, the patient's structure set is sent back into your TPS.



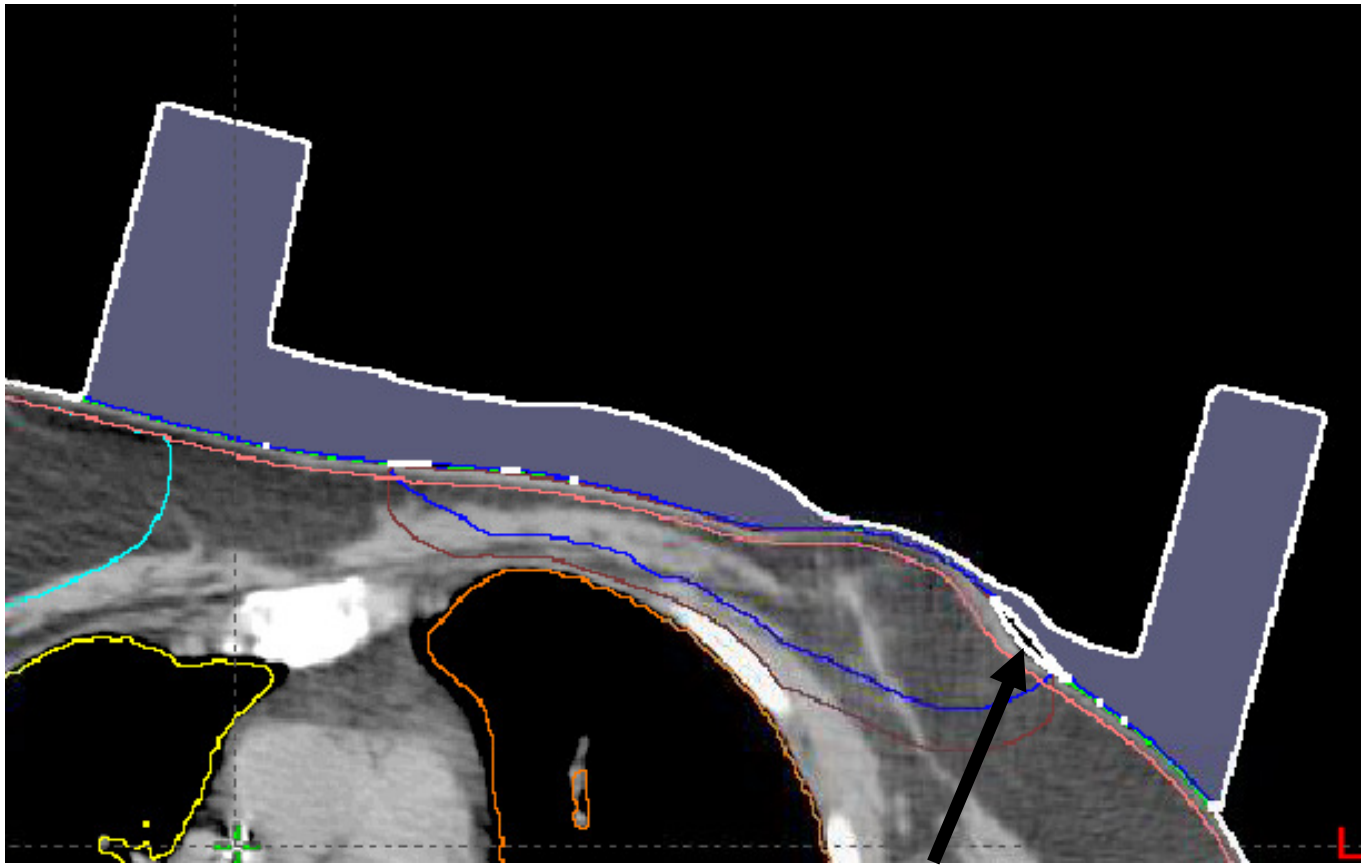
Planning

- More planning considerations

  -The .Decimal software will create a body + bolus contour called patient.

  -Any air gaps between the bolus and body in this contour should be “cleaned” before the Electron Calculation

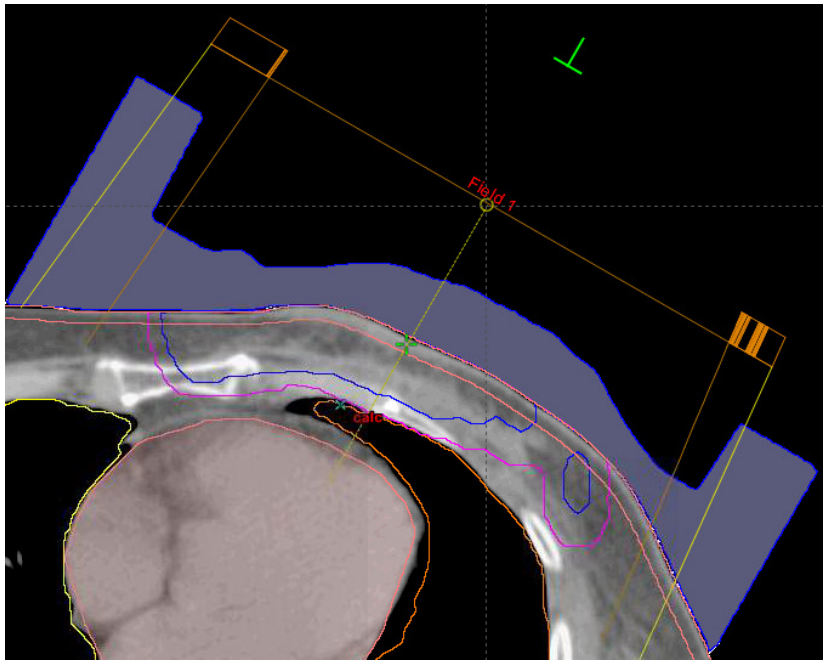
Planning



Air Gaps

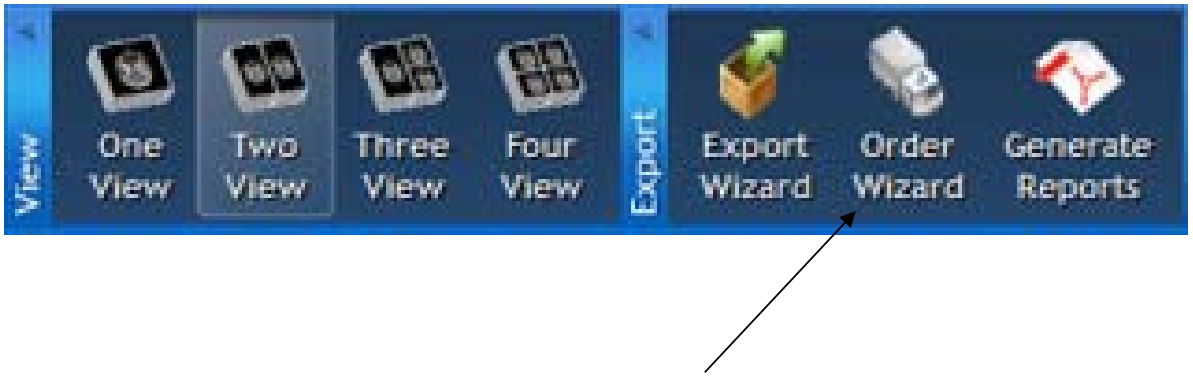
Planning

- Once in the TPS the original electron plan is calculated using the bolus structure.
  - An assigned density will come with the bolus structure



Planning

- Recalculate the plan using the original plan with the new Bolus structure
- When the plan is satisfactory the bolus is ordered using the P.D software.



Planning

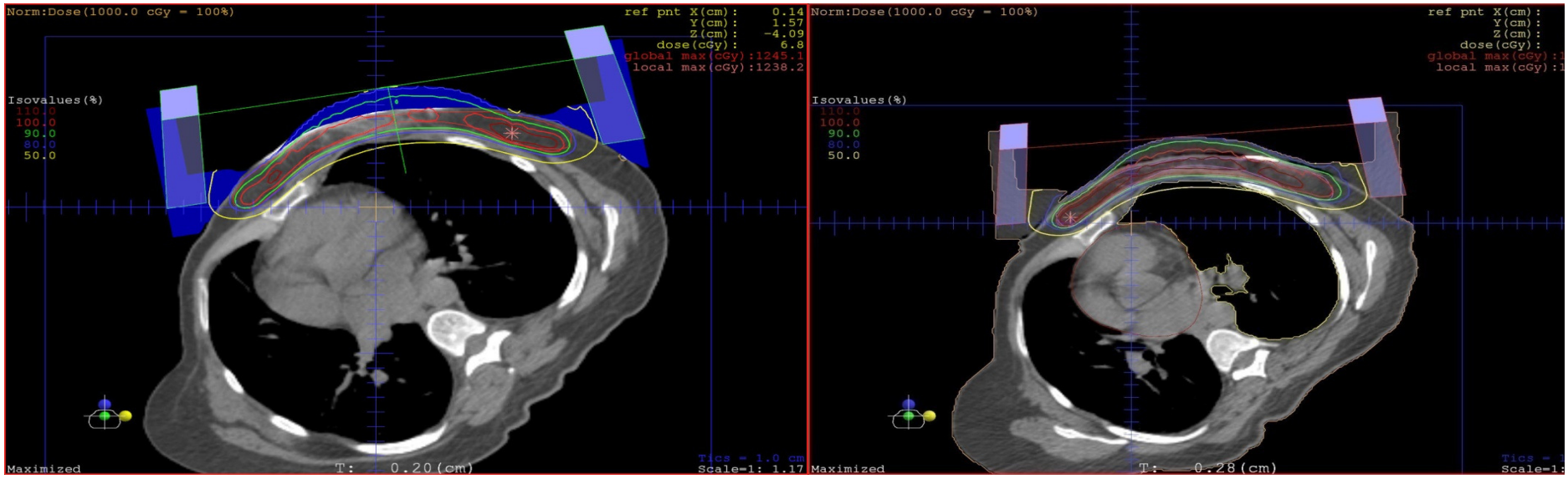
- The bolus will arrive within 24-72hrs, depending on the shipping option that you select
- When the bolus arrives the patient should be scheduled for a verification simulation
  - This is to ensure that the bolus fits
  - That the patient's setup is deliverable
  - A CT can be performed to ensure there are n major air gaps on the CT images

Planning

- Using the CT images obtained during the 2nd simulation a verification plan can now be run.

Virtual Bolus

Verified Bolus



Virtual plan and final plan match, bolus is verified and patient is ready for treatment.

Case Studies

Patient 1

52 year old female
Microscopically invasive squamous cell of perianal skin
Surgery felt to be to difficult
History of:

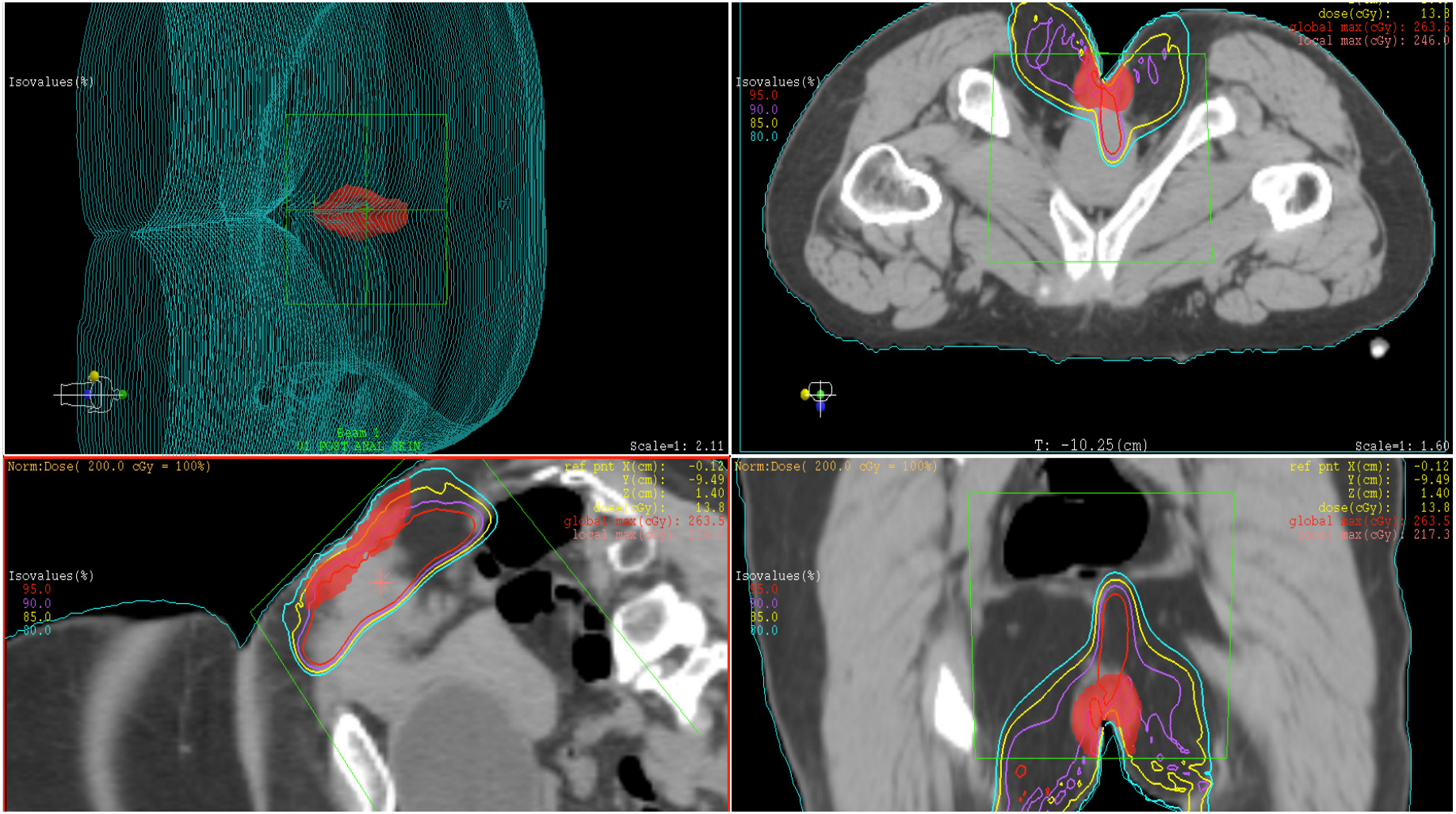
- Osteosarcoma of calcaneus
- Several instances of pleural metastases
  - Received chemo

BolusECT chosen due to:

- Lesions close to skin surface
- Sloping surface

Patient 1

Pre-Plan



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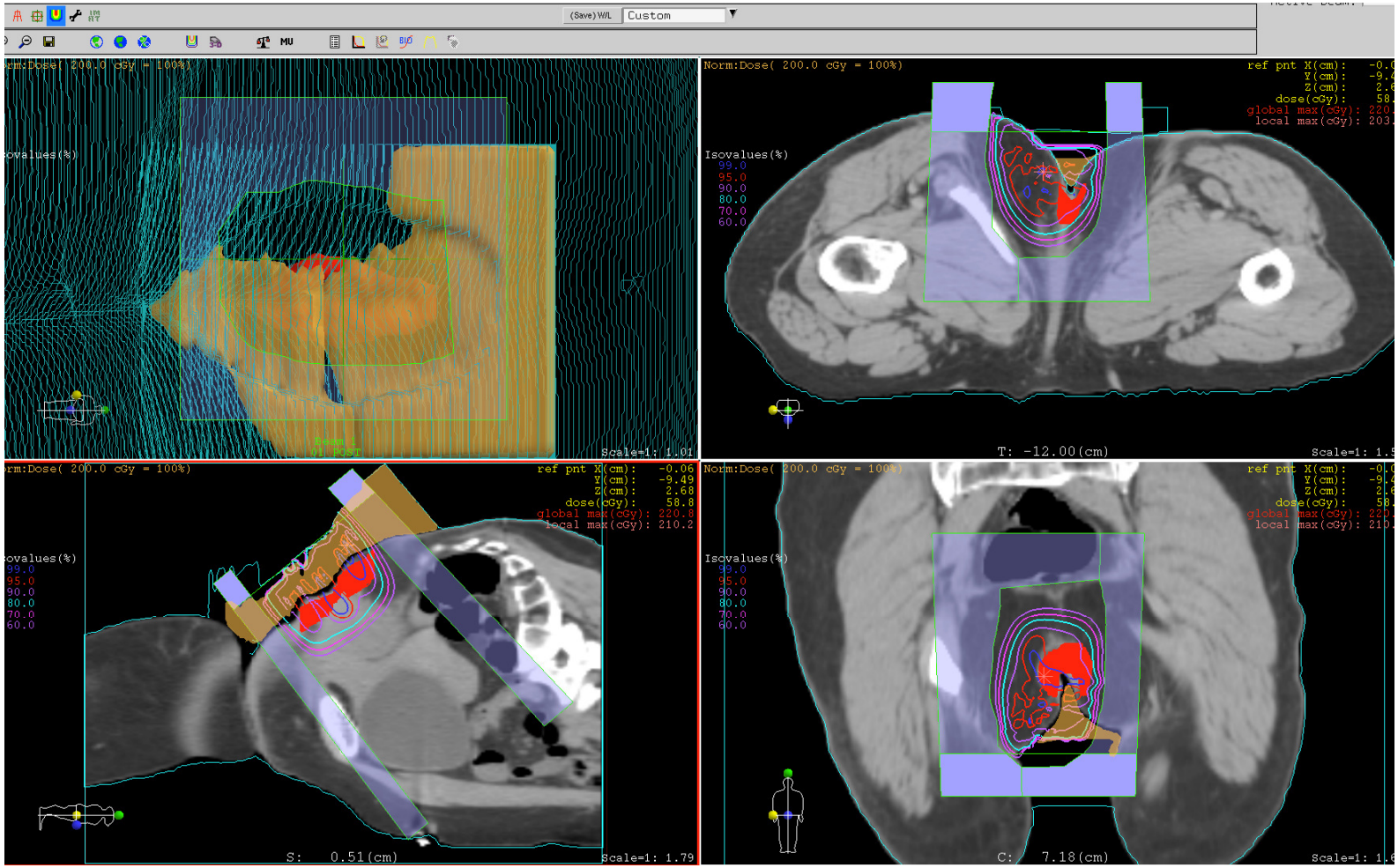
Patient 1

Virtual Plan



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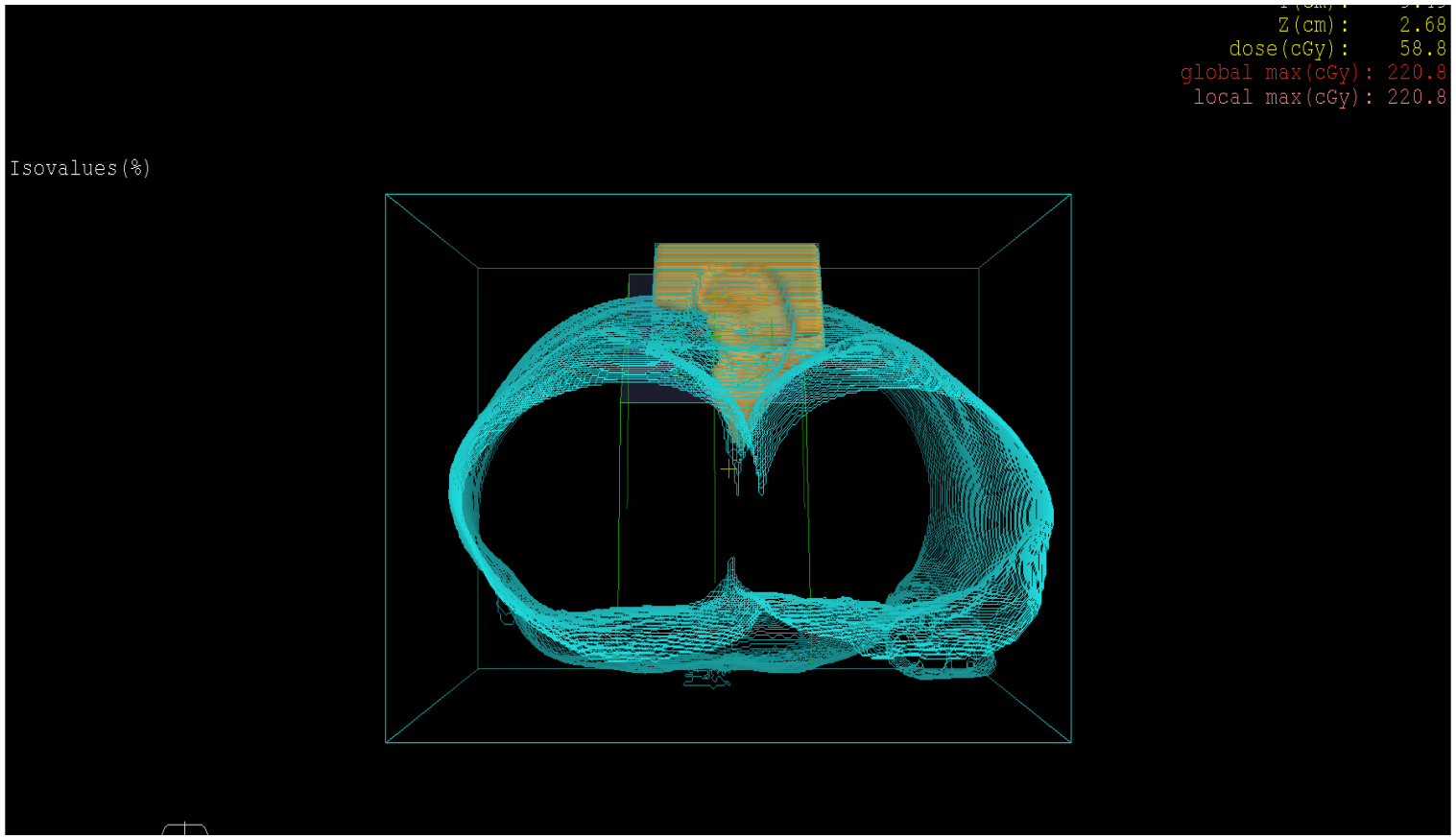
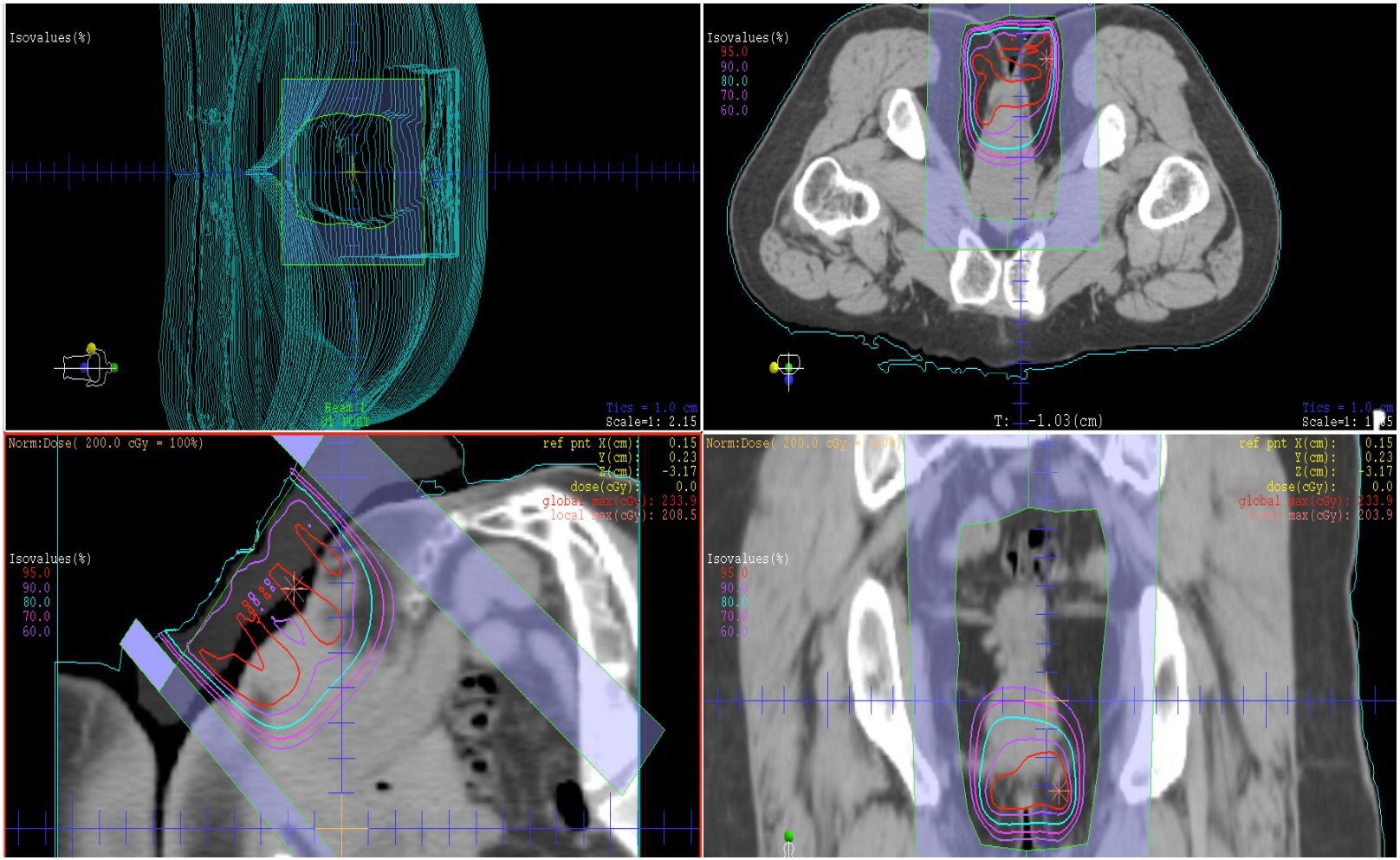
Patient 1

Virtual Plan



Patient 1

Final Plan

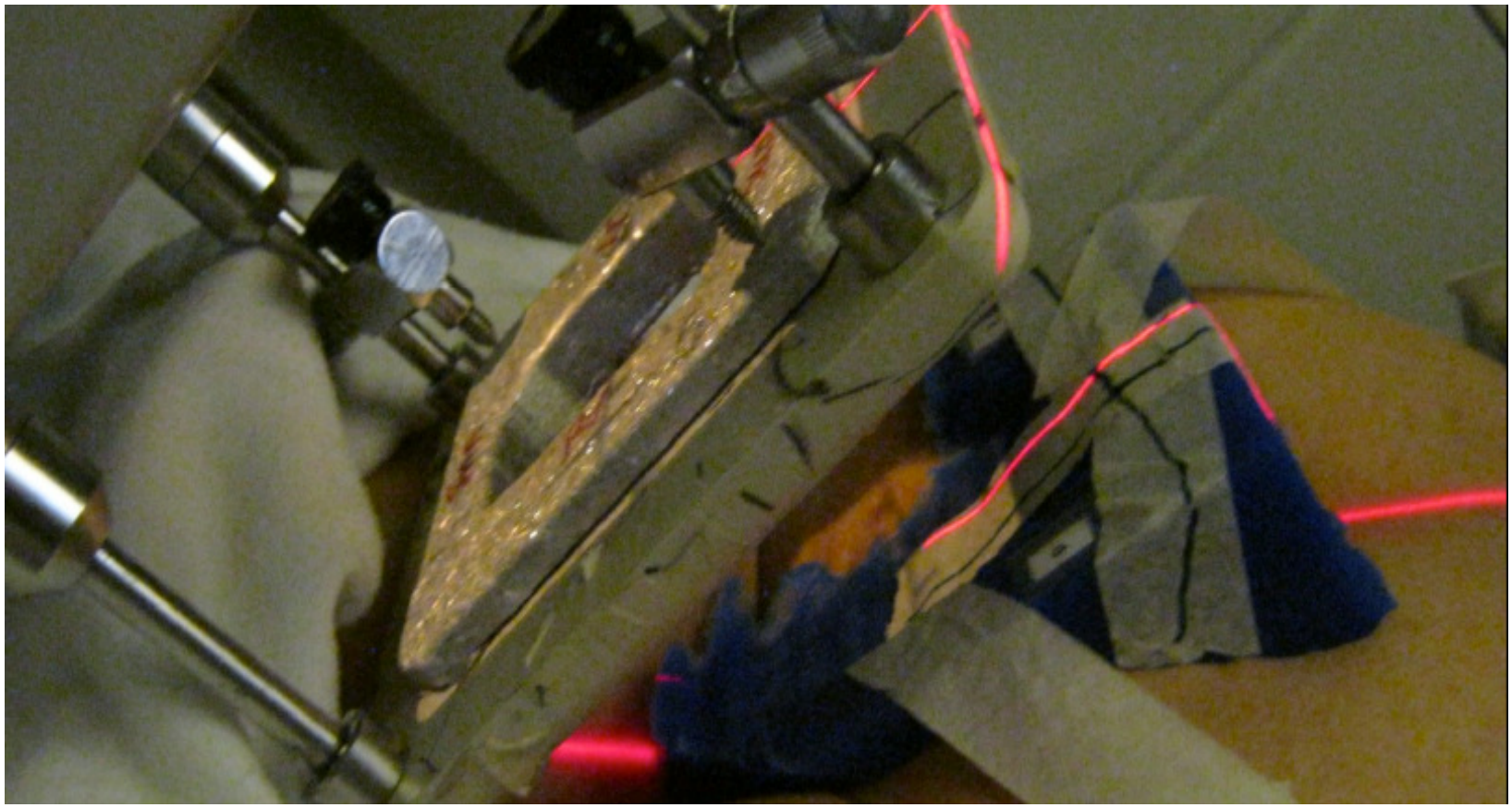


Patient 1

Patient Setup

Patient 1

Patient Setup



Patient 1

Failed to come in for initial 2 week FU

5 weeks

- Severe pain
- Oozing
- RO noted good healing except in gluteal fold
  - Felt to be a result of “rubbing”
  - Causing new growth to rub off

6 months

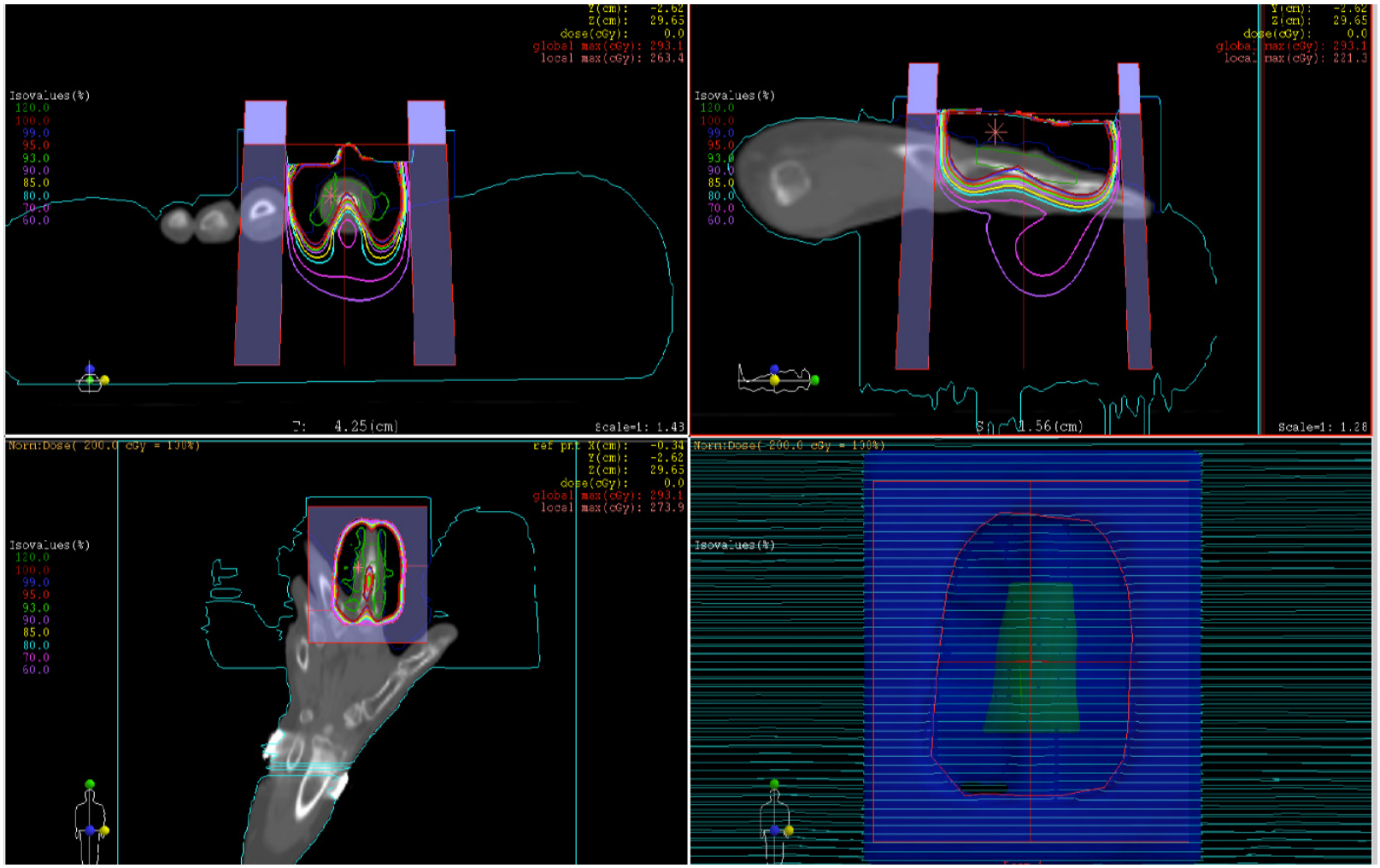
- Still minor persistent pain
- 85% of skin healed
- No evidence of persistent or recurrent disease

Patient 2

72 year old male
Several month history of enlarging lesion on lt index finger
Biopsy proven basal cell carcinoma
Surgery not an option due to possible loss of function
BolusECT chosen

- Lesion wrapped around finger
- BolusECT increase dose to surface
- Bring dose off joint/bone

Patient 2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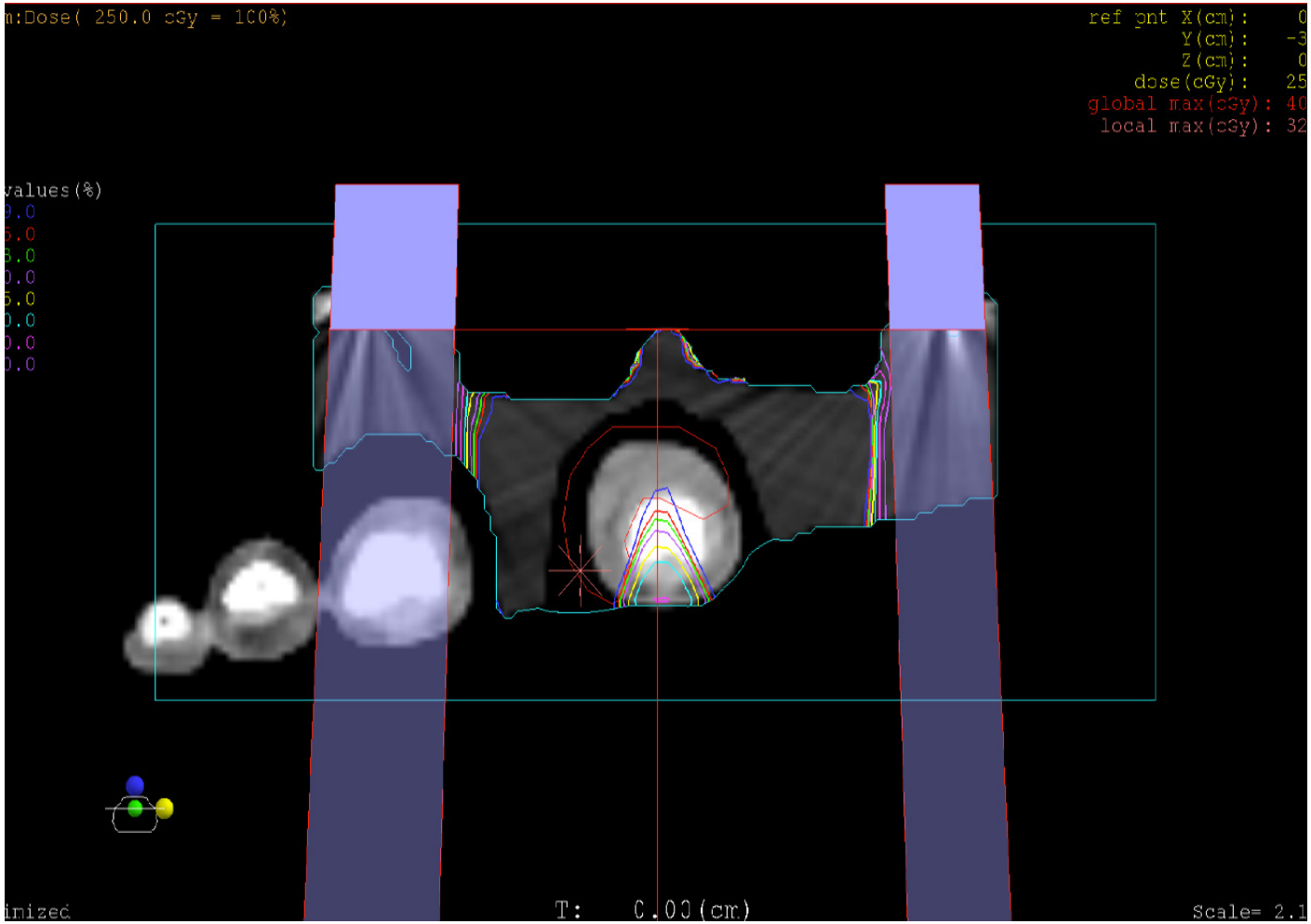
Patient 2

Final Plan



Patient 2

Patient 2

Demonstrated brisk erythema at end of treatment
Demonstrated edema in tx area
Also some mild moist desquamation
6 week FU

- Mild erythema
- Desquamation and edema resolved

3 month FU

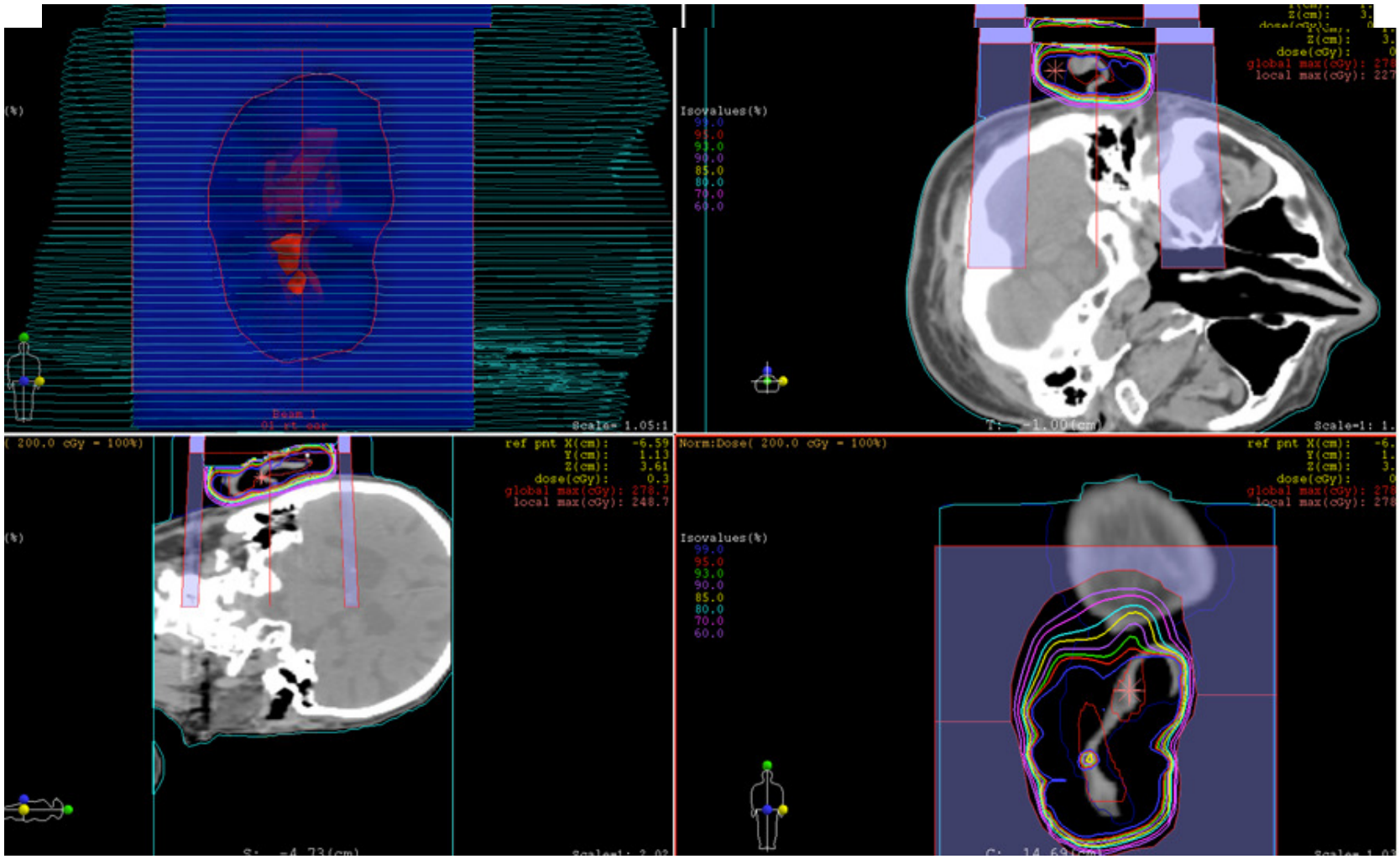
- Patient demonstrated complete healing
- Limited range of motion

Patient 3

- 92 year old male
- Recurrent basal cell lesions on left pinnae
- Traditional bolus could not conform to patient surface like BolusECT
- BolusECT provide more homogenous dose distribution due to irregular surface

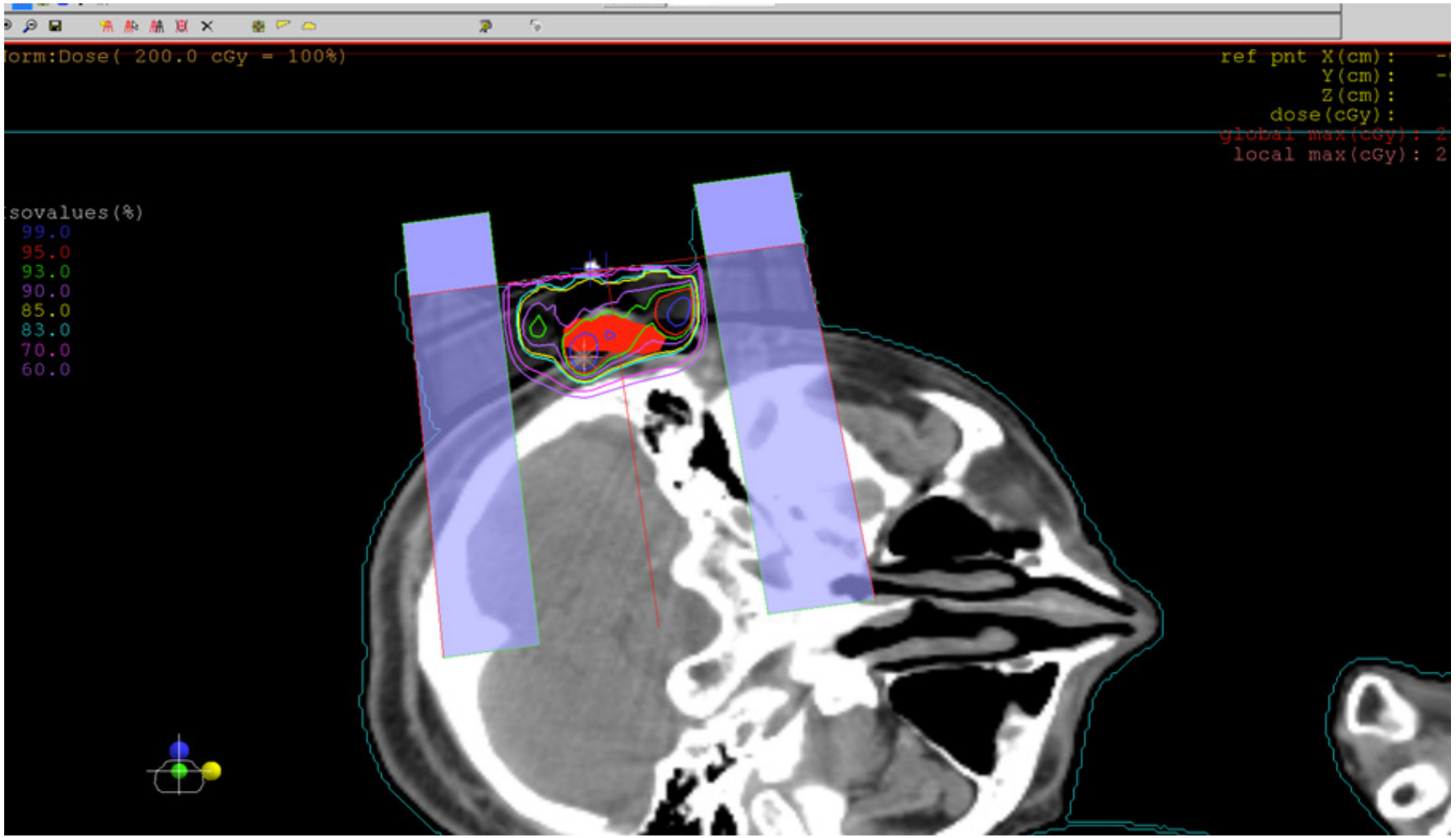
Patient 3

Virtual Plan



Patient 3

Final Plan



Patient 3

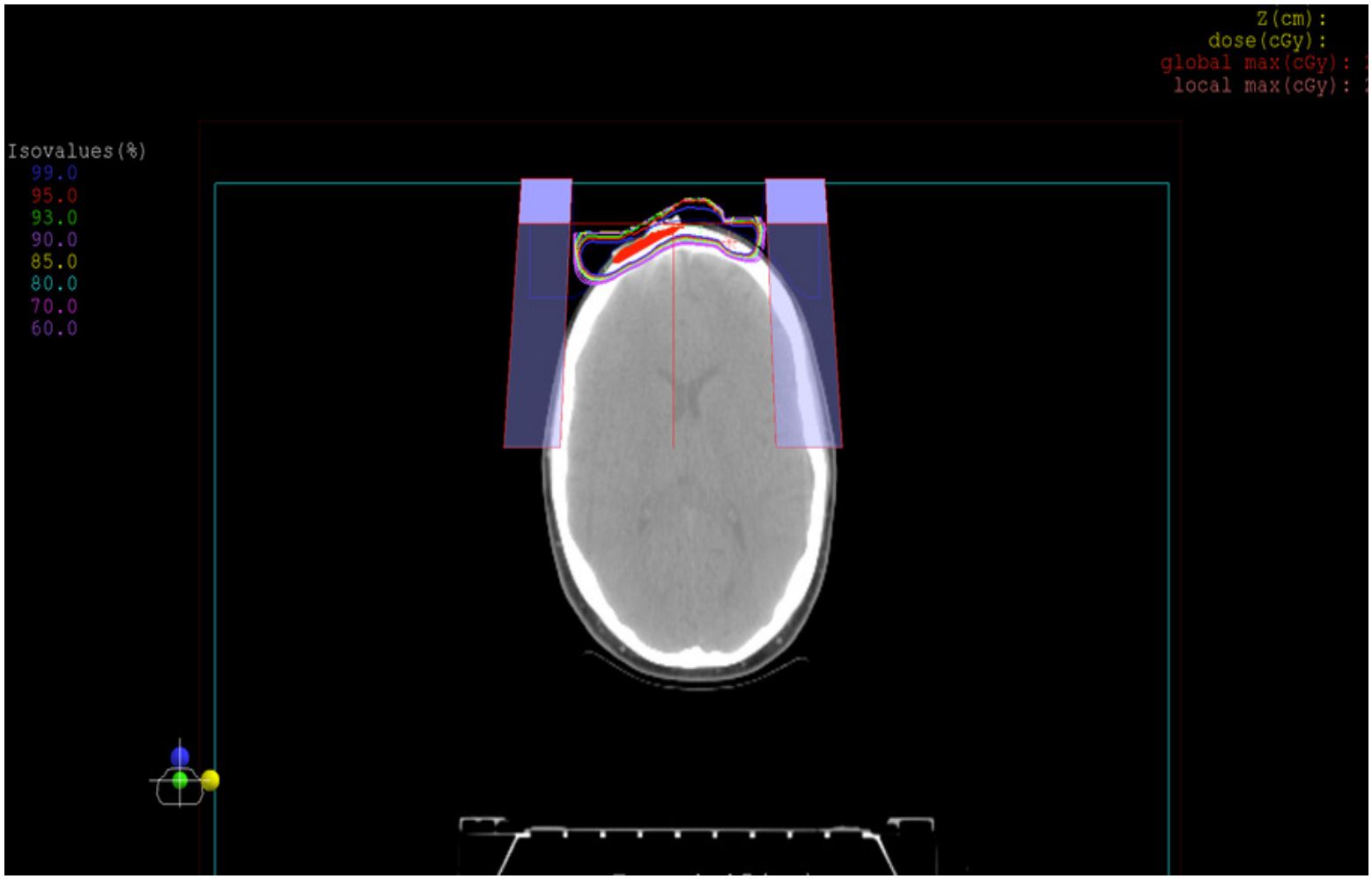
- Demonstrated brisk erythema at end of treatment
- At 6 week FU completely healed

Patient 4

- 33 year old female
- Multiple recurrent basal cell lesion on the forehead
- BolusECT chosen due to sloping surface
- With BolusECT all lesions could be treated in one field instead of multiple matching fields

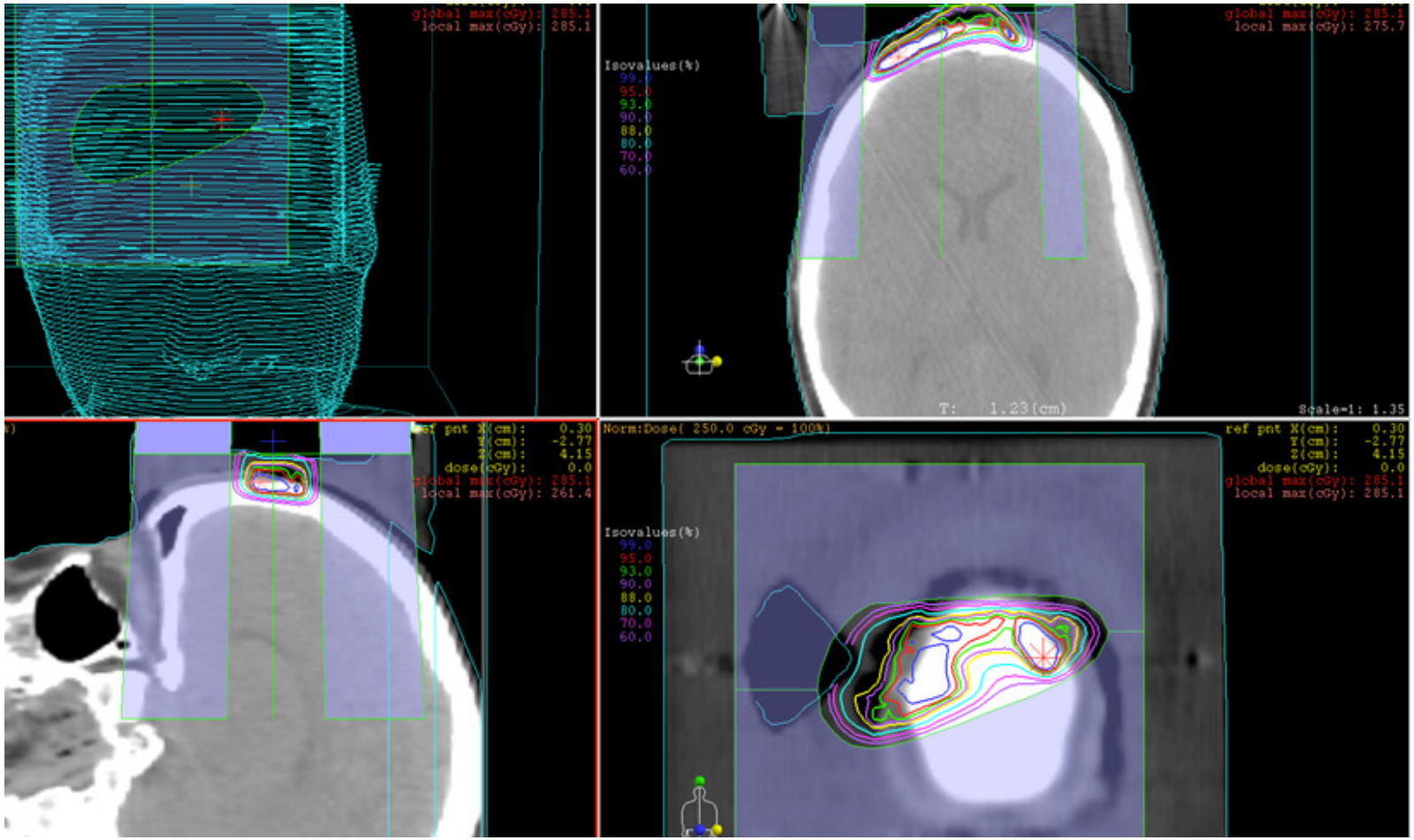
Patient 4

Virtual Plan

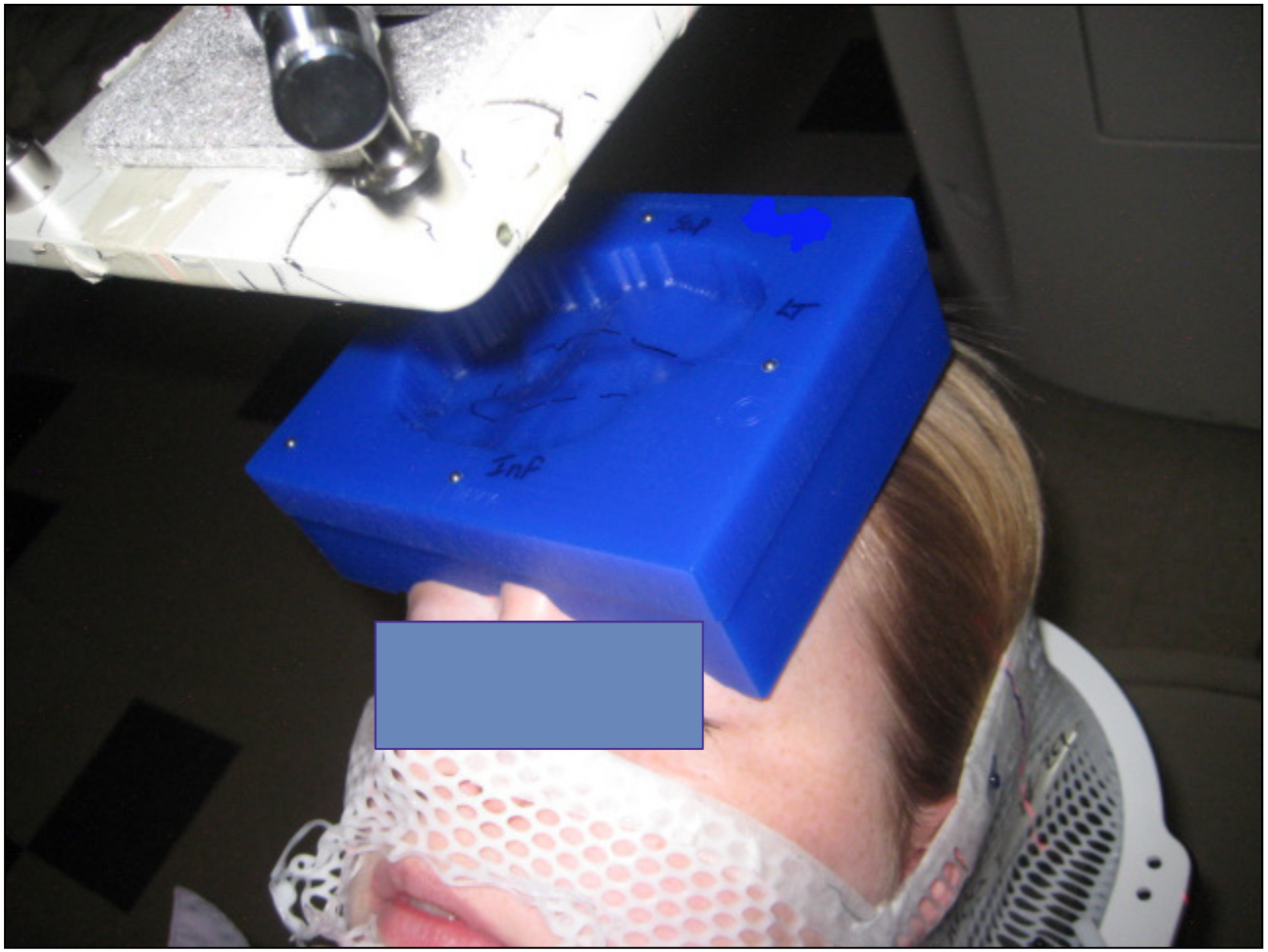


Patient 4

Final Plan



Patient 4



Patient 4

Brisk erythema and edema at end of treatment
Demonstrated significant tumor response
2 week follow up

- Continued erythema
- Scabbing over tumor area

6 week follow up

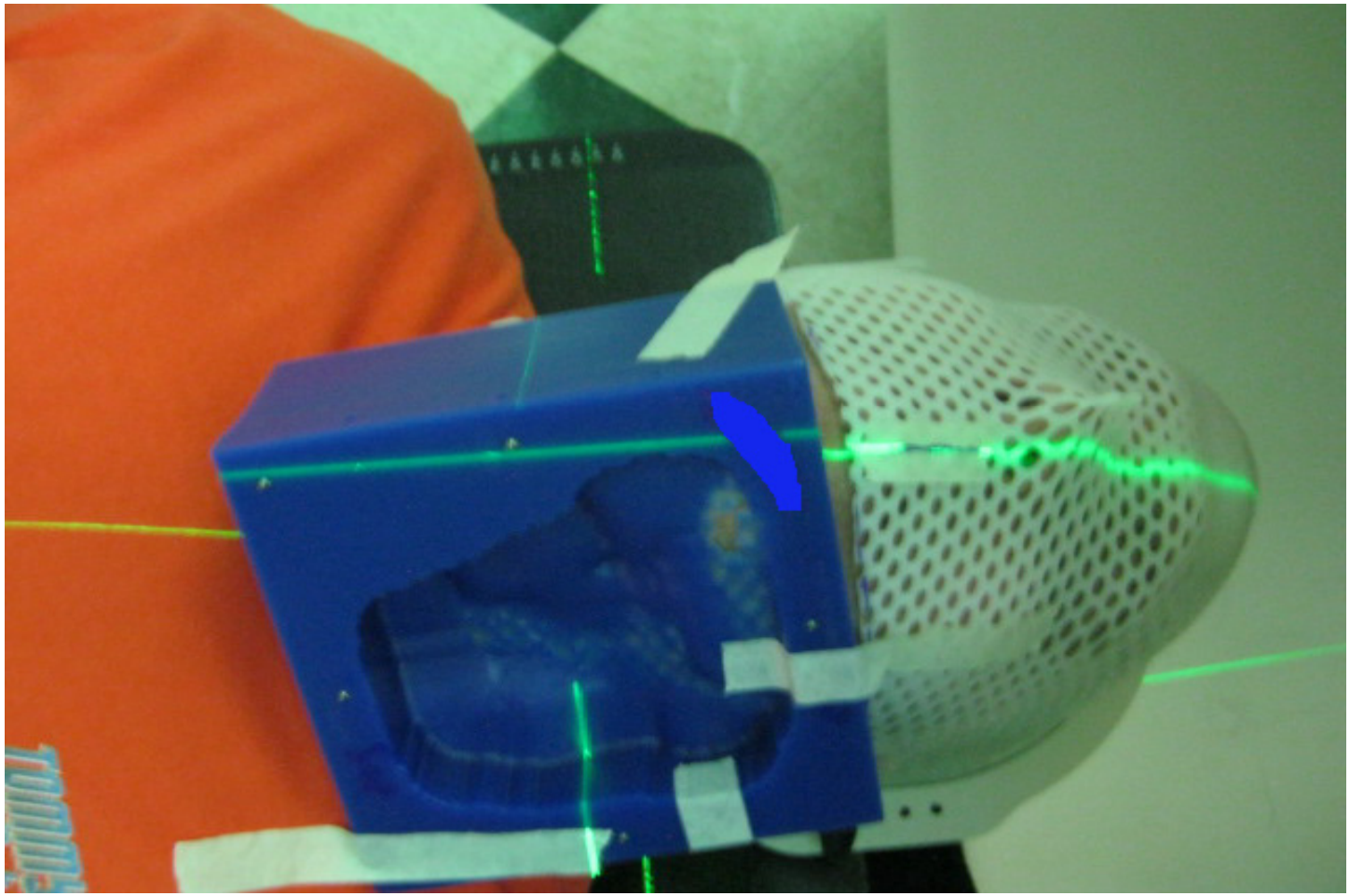
- Slight erythema
- Scabbing resolved

Other Areas Treated

- Eye
- Head and Neck
- Thigh
- Chest Wall
- Nose

Eye

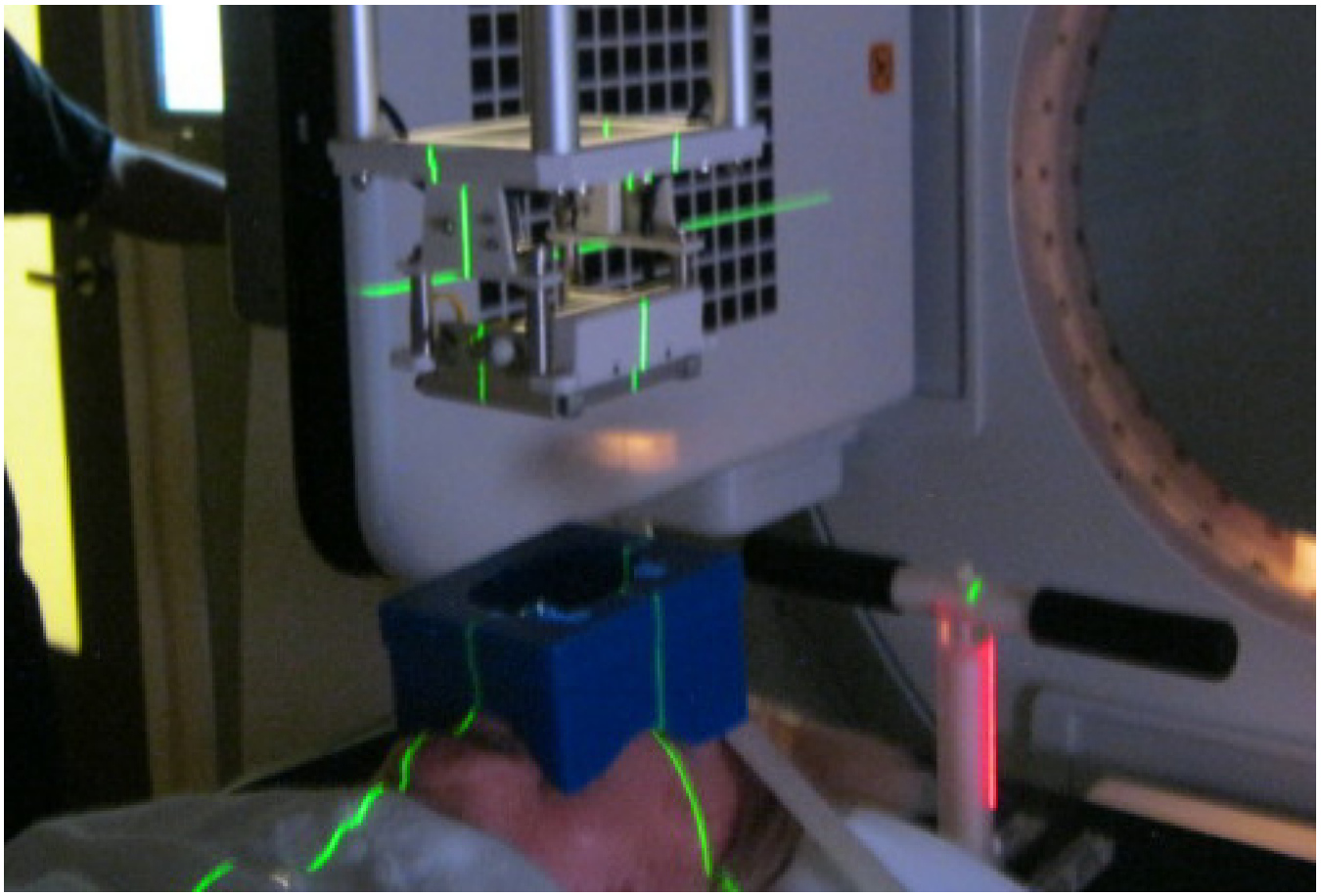
Head & Neck



Thigh

Chest wall

Nose



Summary

PI initiative through Cancer Committee

Critical Considerations

- Patient selection
- Physician and staff training
- Patient positioning
- No up front capital investment

Clinical Observations

- Substantially reduced short term morbidity and recovery
- High patient acceptance
- Focal draw for referring physicians

Questions?

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Thanks

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John Lowden, MS

Adam Moore, CMD

Thank You!

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