

# Advanced Technology Consortium (ATC) Credentialing Procedures for 3D Conformal Therapy Protocols 3D CRT Benchmark\*

## Purpose:

To evaluate an institution's 3D treatment planning process and the institution's ability to provide the documentation required to participate in 3D collaborative protocols. Note: This is not an evaluation of IMRT planning, and IMRT is not to be used.

## Definition:

The following five components are believed to constitute 3D conformal radiation therapy:

1. definition of relevant patient anatomy in three dimensions, typically performed with computerized tomography (CT)
2. definition of both clinical target(s) and normal tissues, using ICRU 50/62 terminology
3. dose calculations and analysis in three dimensions, including the use of dose-volume histograms
4. an attempt to optimize patient set-up accuracy by immobilization or any other process
5. conformal treatment planning (by using blocks, multiple fields, or non coplanar fields) to maximize dose to the defined target and minimize dose to defined normal tissues

## Data Submission Requirements:

1. Complete a treatment plan as described in Section
2. Submit all treatment planning data listed in Section

If you have any questions, please contact:

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or

Dosimetry  
Phone: 713-745-8989  
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Please return completed forms and supporting documents to:

Dosimetry  
IROC Houston QA Center  
8060 EL RIO St.  
Houston, TX 77054  
Fax: (713) 794-1364

\*Modified by the IROC Houston in 2003 from the original QARC version. Either version is accepted by both QARC and RPC. The RPC will inform NCCTG and QARC of institution's that pass this benchmark.

## **Section 1: Description of 3D CRT Benchmark**

The following benchmark is a sample case used to evaluate the treatment planning process at your institution, i.e., data acquisition, dose calculation and monitor unit calculations. The aim is to demonstrate your capability to participate fully in 3D CRT protocols. You will not be expected to complete separate benchmarks for different 3D CRT protocols, unless required by a specific protocol.

Use of heterogeneity corrections is not allowed for this benchmark case to be consistent with current protocols.

The following example uses a CT scan of a head. The benchmark case is not restricted to this anatomical site. The institution may choose to use a different anatomical site for their 3D CRT plan. Appropriate normal tissues for the chosen site must be contoured.

### 1. CT scan of head

- A. Use CT scans of one of your recent patients, in a supine position. The scan must include the entire head, from the top of the head through the base of the skull, including the full extent of the temporal lobes.
- B. The maximum slice thickness shall be 5 mm (taken contiguously); 3 mm or smaller slice thickness is preferred, from at least the top of the orbits through the base of the skull.

### 2. Target Volume (Figure I)

- A. Delineate the clinical target volume (CTV) as the inferior right temporal lobe extending superiorly to the level of the sella tursica. The posterior boundary of the CTV shall be the external auditory meatus and the petrous ridge.
- B. The planning target volume (PTV) shall be 3 mm larger in all dimensions than the CTV.

### 3. Normal Tissues (Figure I)

The following normal tissues will be delineated on the CT scans:

- skin (or surface)
- right globe
- right optic nerve
- left globe
- left optic nerve
- pituitary
- brain stem (from the top of the posterior clinoids to the foramen magnum)

### 4. Treatment

The treatment plan shall consist of two or more fields, of which at least one must not lie in the plane of the CT images (Figure II shows an example of a right lateral and a vertex field).

Beam energy: 4 MV or greater

Beam Portals: Design the portals from beam's-eye views (BEVs) (see examples in Figures III & IV); indicate the margin used and whether cerrobend blocking or multi-leaf collimator is used.

## 5. Dose Prescription

The prescription dose of 6000 cGy in 30 fractions is the minimum dose received by 98% of the PTV. The maximum dose received by a volume of 2% of the PTV should not exceed the prescription dose by more than 7%. No more than 2% of the PTV and none of the CTV may receive less than 6000 cGy. The minimum PTV dose (encompassing  $\geq 98\%$  of the PTV) is 6000 cGy.

## 6. Monitor Unit (MU) Calculation

Use the forms and calculation methods of your department and calculate the MU needed to deliver 200 cGy to the prescription isodose line.

## 7. Dose-Volume Histograms (DVH)

### A. DVH Requirements:

The sampling element must be at least as fine as the dose grid (i.e.  $\leq 3$  mm).

The dose shall be binned in increments of no greater than 10 cGy.

Dose shall be displayed in absolute dose (cGy).

The volume shall be displayed in percent volume (%), if available. If not available, be sure to also provide the volume of each structure.

Histograms shall be displayed as cumulative.

### B. Calculate dose-volume histograms for the PTV and the CTV.

Indicate the volume for each (% or  $\text{cm}^3$ ) that receives the prescription dose, and 107% of the prescription dose.

### C. Calculate dose-volume histograms for all normal tissues that were contoured.

## **Section 2: Data to be Submitted**

The following data are to be submitted by original hardcopy in color to the RPC. If you have the capability, also submit data electronically to the Resource Center for Emerging Technologies (RCET)<sup>1</sup> or Image-guided Therapy Center (ITC)<sup>2</sup>. Please make sure that target volumes, normal tissues, and isodose contours are readily identifiable.

1. All axial CT images on which the target volume or any normal tissues (other than skin) are delineated. (See Figure I).
2. Reconstructed coronal slice through isocenter showing beams, target volumes and normal tissues. (See Figure II).
3. BEVs for all fields showing collimators, beam aperture, PTV, right globe, right optic nerve, pituitary and brain stem. (See Figures III and IV).
4. Axial and sagittal CT image at isocenter with PTV and isodose contours superimposed. Show at least the 6420, 6000, 5800, 5500, 5000, and 3000 cGy contours. (See Figure V).
5. Axial CT slice at the level of the right optic nerve with the PTV, optic nerve and brain stem delineated and isodose contours superimposed. Show at least the 6420, 6000, 5800, 5500, 5000, and 3000 cGy contours. (See Figure VI).
6. Lateral and AP DRRs with PTV superimposed. (Include a linear scale.) (See Figures VII and VIII).
7. Dose-volume histograms for the PTV, the CTV, and all contoured normal tissues. (See Figures IX and X).
8. A printout of beam specifications, including at a minimum, the beam energy, gantry, couch, and collimator positions, field sizes, aperture names, wedge specifications, and depth of isocenter (or SSD).
9. MU calculations.
10. The 3D CRT Dosimetry Summary Form.

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<sup>1</sup> <http://rcet.health.ufl.edu/>

<sup>2</sup> <http://itc.wustl.edu/>

**QUALITY ASSURANCE REVIEW CENTER / RADIOLOGICAL PHYSICS CENTER  
3D CRT DOSIMETRY SUMMARY**

INSTITUTION NAME \_\_\_\_\_

PHYSICIST/DOSIMETRIST \_\_\_\_\_

PHONE \_\_\_\_\_

EMAIL \_\_\_\_\_

RADIATION ONCOLOGIST \_\_\_\_\_

PHONE (if different) \_\_\_\_\_

EMAIL \_\_\_\_\_

**DOSE PRESCRIPTION**

Dose per Fraction to Prescription Isodose	
Intended Number of Fractions	
Intended Dose to Prescription Point	

Maximum Dose per Fraction in the Planning Target Volume	
Minimum Dose per Fraction in the Planning Target Volume	
Minimum Dose per Fraction in the Clinical Target Volume	

Treatment Machine	
Treatment Planning System (manufacturer/model/version)	

**TREATMENT TECHNIQUE**

	FIELD I	FIELD II	FIELD III	FIELD IV
FIELD NAME (ANT, POST, RT LAT, etc.)				
ENERGY, MODALITY (e.g. 6X, 6e)				
SSD				
GANTRY / COLLIMATOR / COUCH ANGLE	/ /	/ /	/ /	/ /
COLLIMATOR SETTING (W x L or if using independent jaws X <sub>1</sub> , X <sub>2</sub> , Y <sub>1</sub> , Y <sub>2</sub> )				
EQUIVALENT SQUARE AT SAD / SSD				
TMR, TAR, % DEPTH DOSE, etc. (type/value)				
DEPTH OF PRESCRIPTION POINT				
ATTENUATORS: Blocks or Multi-leaf collimators (MLC) (tray factor if applicable)				
Wedge (angle/factor)				
<input type="checkbox"/> Physical <input type="checkbox"/> Internal <input type="checkbox"/> Enhanced Dynamic <input type="checkbox"/> Virtual				
Compensator (factor, material, thickness) / Bolus (depth)				
DOSE PER FRACTION				
MONITOR UNITS PER FRACTION				

For this benchmark case:

CT slice thickness: \_\_\_\_\_ Margin of aperture

from target volume: \_\_\_\_\_ cm

Grid size used on axial

slices for dose calc: \_\_\_\_\_ mm DVH

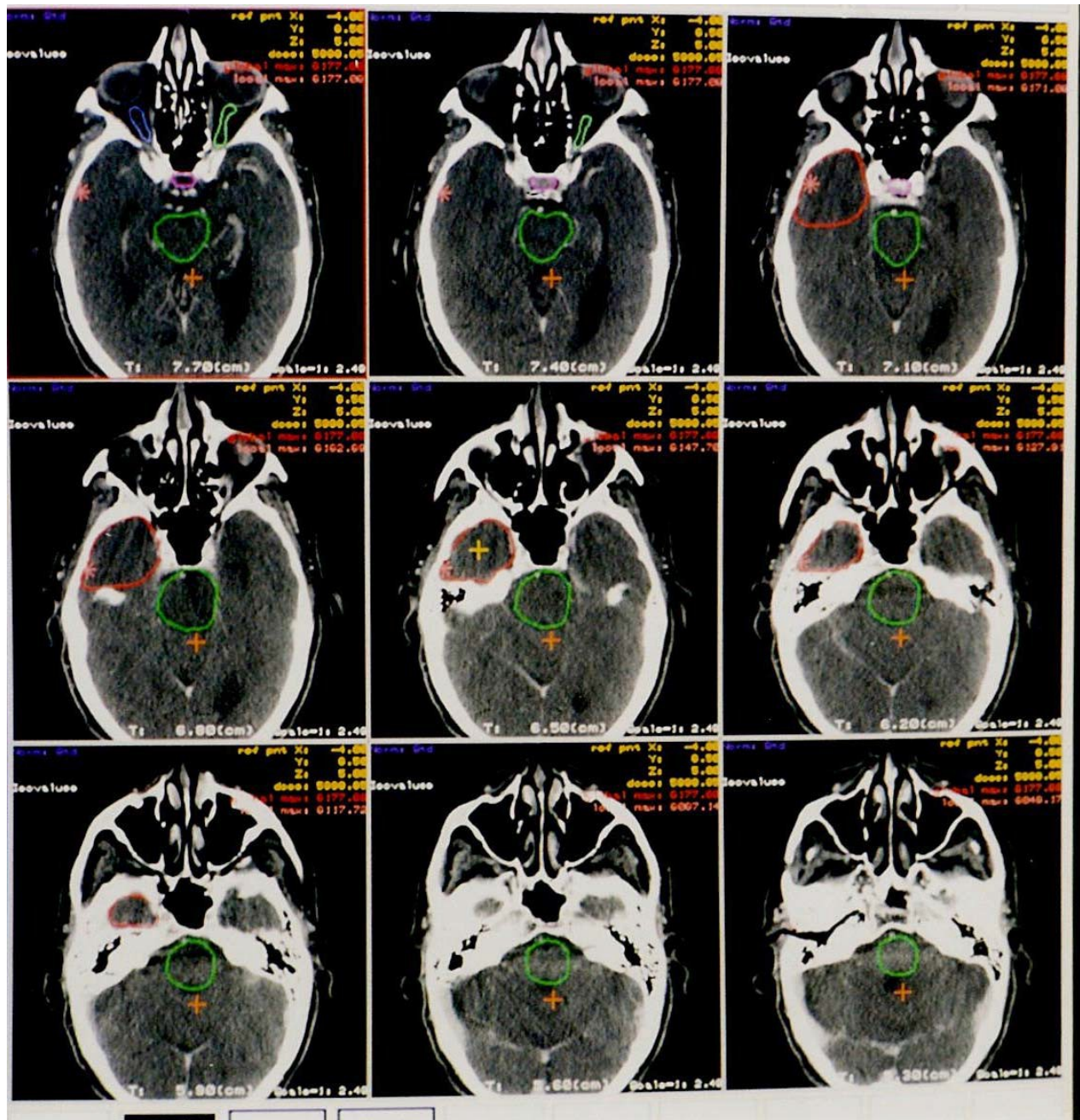
Site      Volume (cc)

PTV      Target      Volume \_\_\_\_

NT1      R      Optic      Nerve \_\_\_\_

NT2      R Globe      \_\_\_\_\_

NT3      Pituitary      \_\_\_\_\_



CTV = Red      Optic Nerves = Blue & Green      Pituitary = Pink      Brainstem = Green

Figure I: All axial CT images on which the CTV or any normal tissues (other than skin) are delineated.

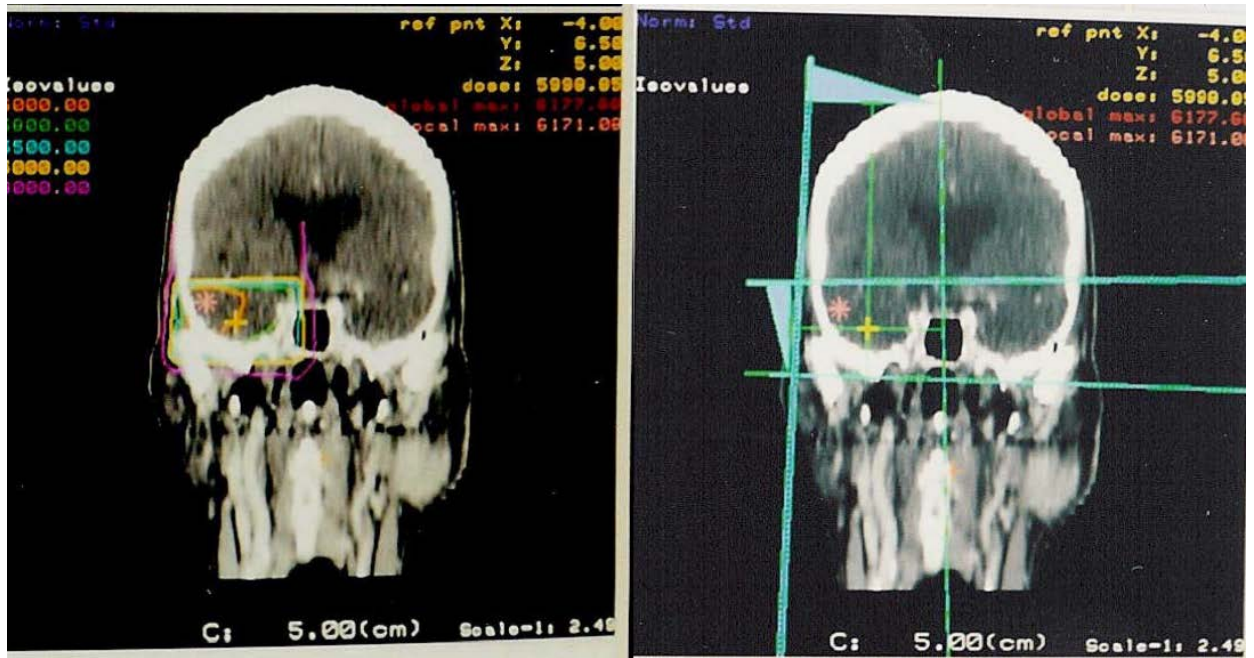


Figure II: Reconstructed coronal slice through isocenter showing lateral and vertex beams, CTV (red outline) and normal tissues.

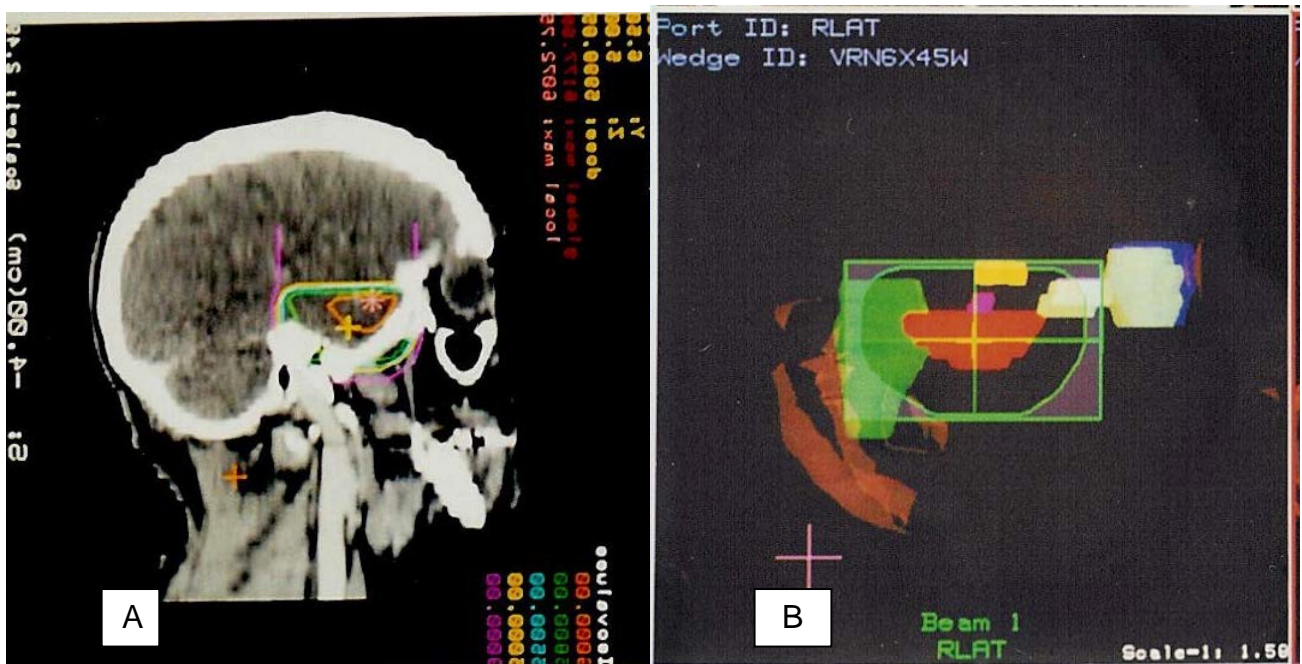


Figure III:

A. Reconstructed sagittal slice through isocenter with isodose contours superimposed. Show at least the 6420, 6000, 5800, 5500, 5000, and 3000 cGy contours.

B. BEV of right lateral portal showing collimators, beam aperture, PTV, right globe, right optic nerve, pituitary and brain stem.



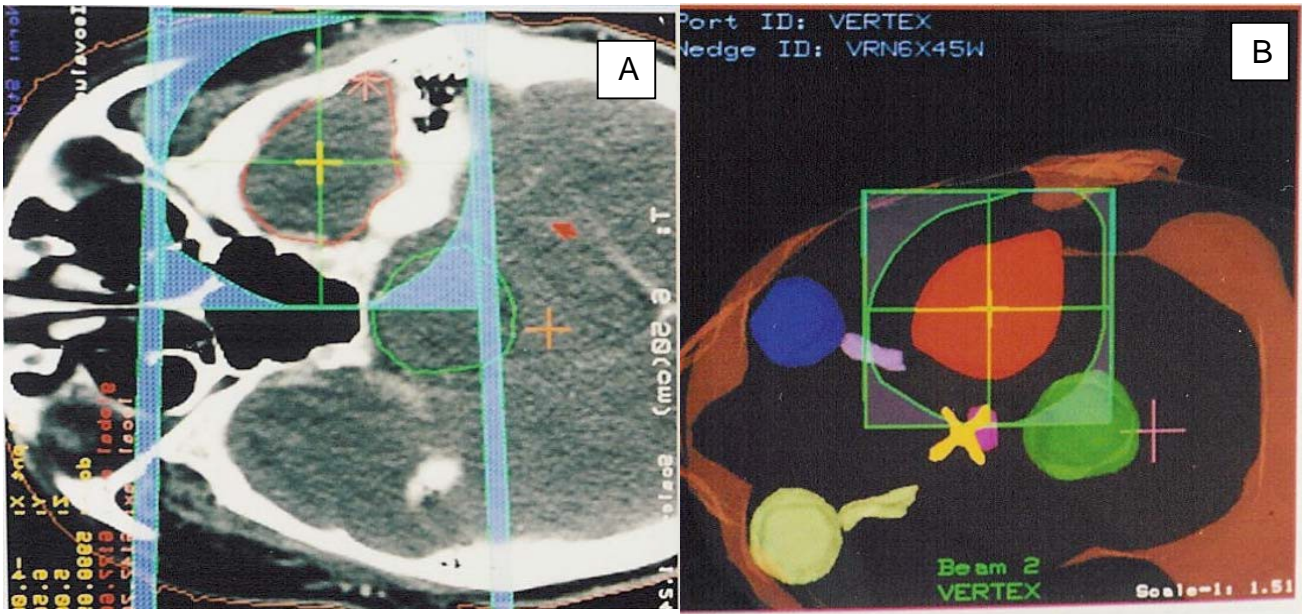


Figure IV

A Reconstructed sagittal slice through isocenter with isodose contours superimposed. Show at least the 6420, 6000, 5800, 5500, 5000, and 3000 cGy contours

B. BEV of vertex portal showing collimators, beam aperture, PTV, and all normal tissues except skin.

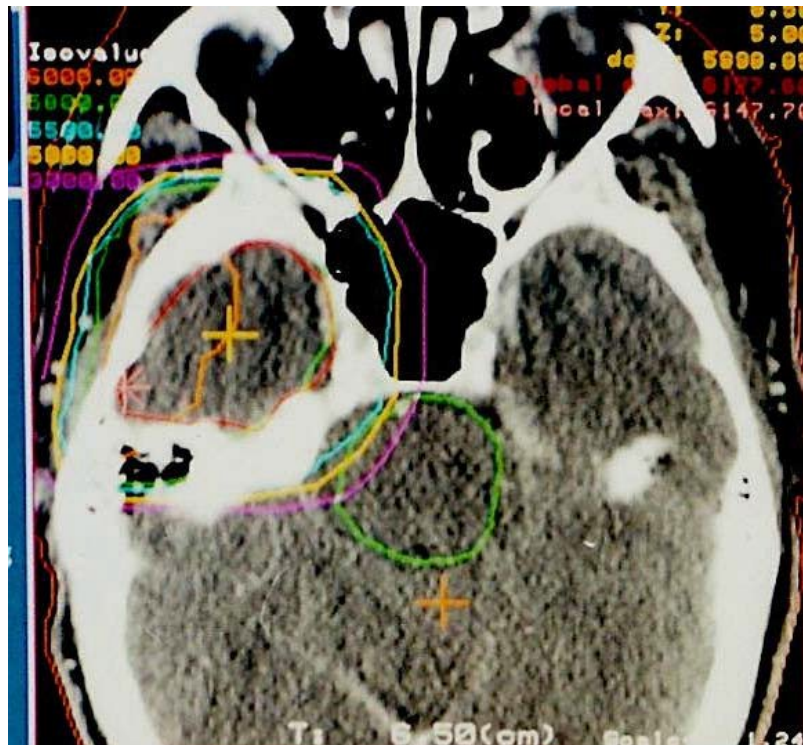


Figure V: Axial CT slice at isocenter with CTV and isodose contours superimposed. Show at least the 6420, 6000, 5800, 5500, 5000, and 3000 cGy contours.

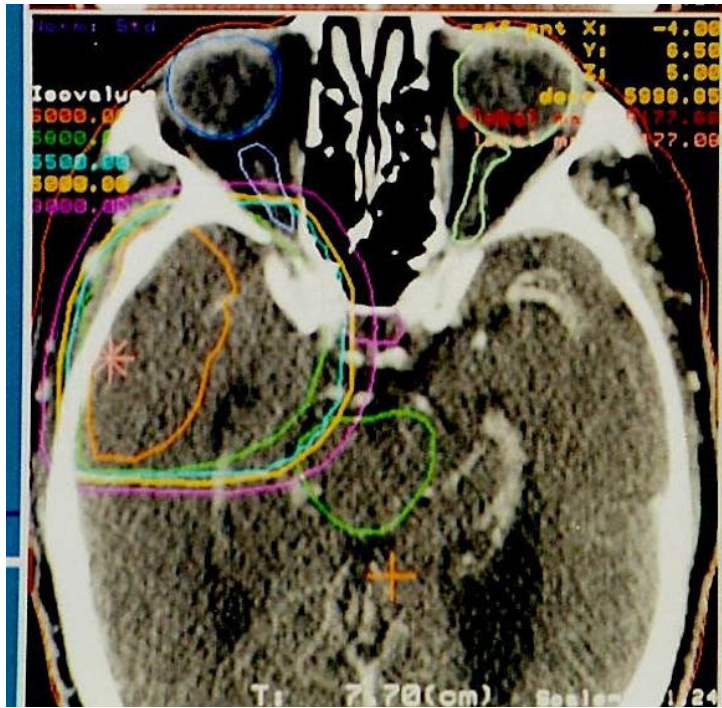


Figure VI: Axial CT slice at the level of the right optic nerve with the pituitary, globes, optic nerves and brain stem delineated and isodose contours superimposed. Show at least the 6420, 6000, 5800, 5500, 5000, and 3000 cGy contours.

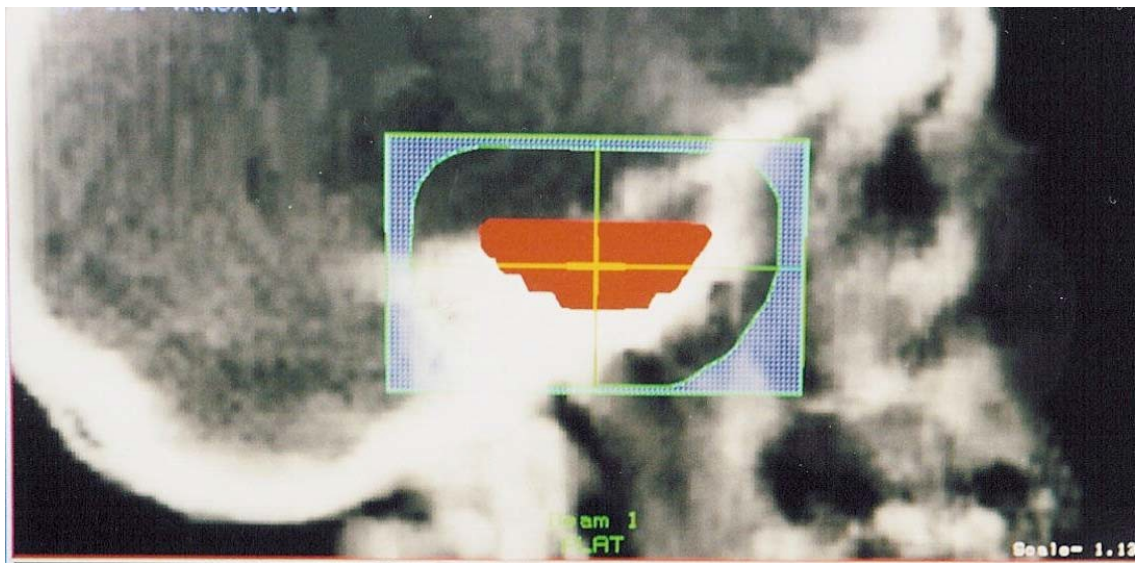


Figure VII: Right lateral DRR with PTV and beam aperture superimposed. (Include a linear scale.)



Figure VIII: AP DRR (include a linear scale.)

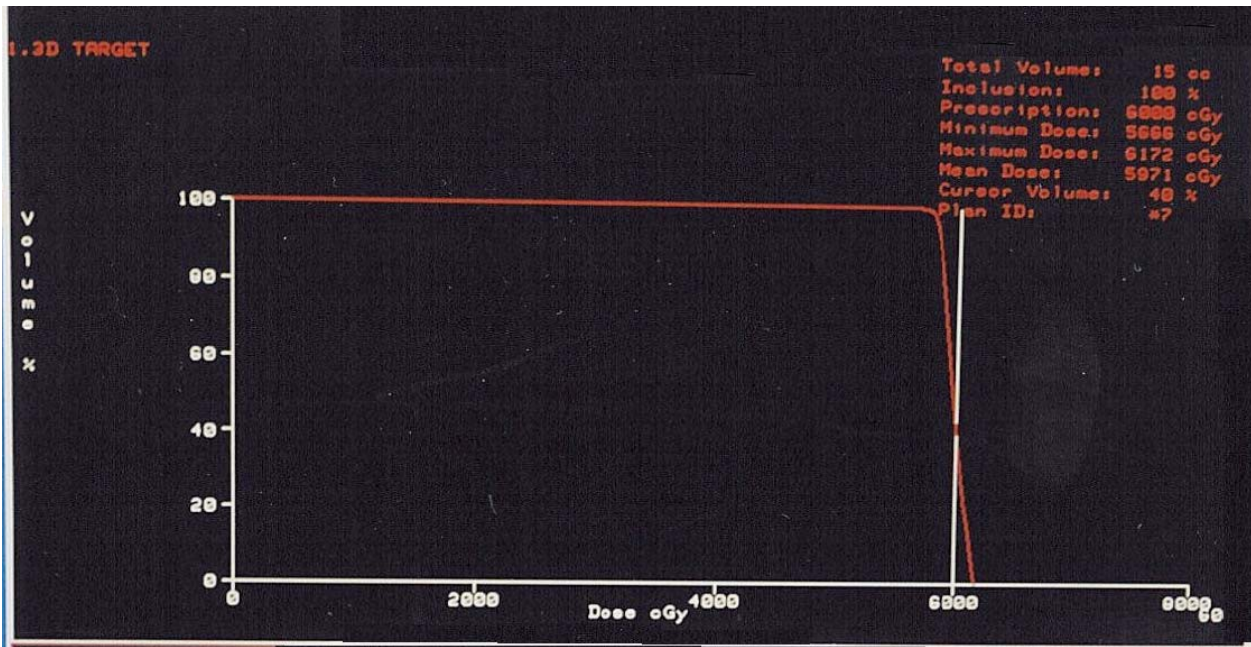


Figure IX: Dose-volume histogram for the planning target volume. Note that this DVH does not satisfy the dose prescription defined in Section 5.

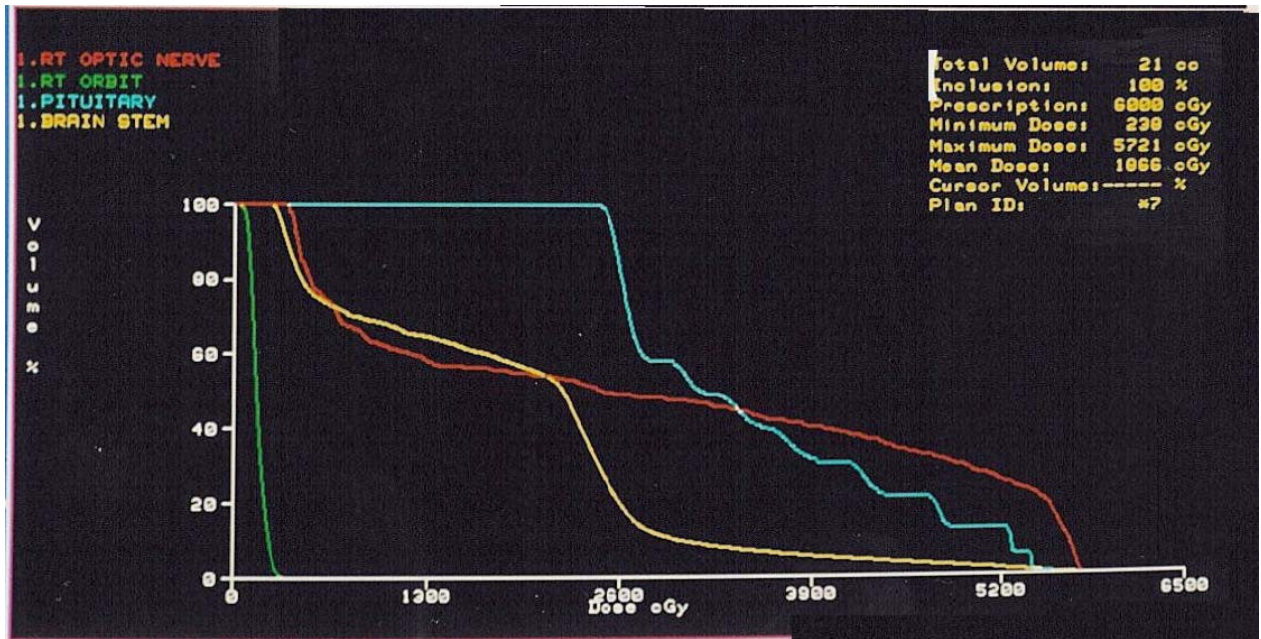


Figure X: Dose-volume histogram for the right optic nerve, right globe, pituitary, and brain stem.