MASSACHUSETTS
GENERAL HOSPITAL

RADIATION ONCOLOGY

National
Alliance for
Medical Image
Computing

DBP3: Head and Neck Cancer

Gregory C. Sharp, PhD

Department of Radiation Oncology
Massachusetts General Hospital

NA-MIC CMRO Meeting
May 05, 2011

Advertisement

- 3D Slicer user group meeting at AAPM/COMP
- Tuesday, Aug 2, 2011

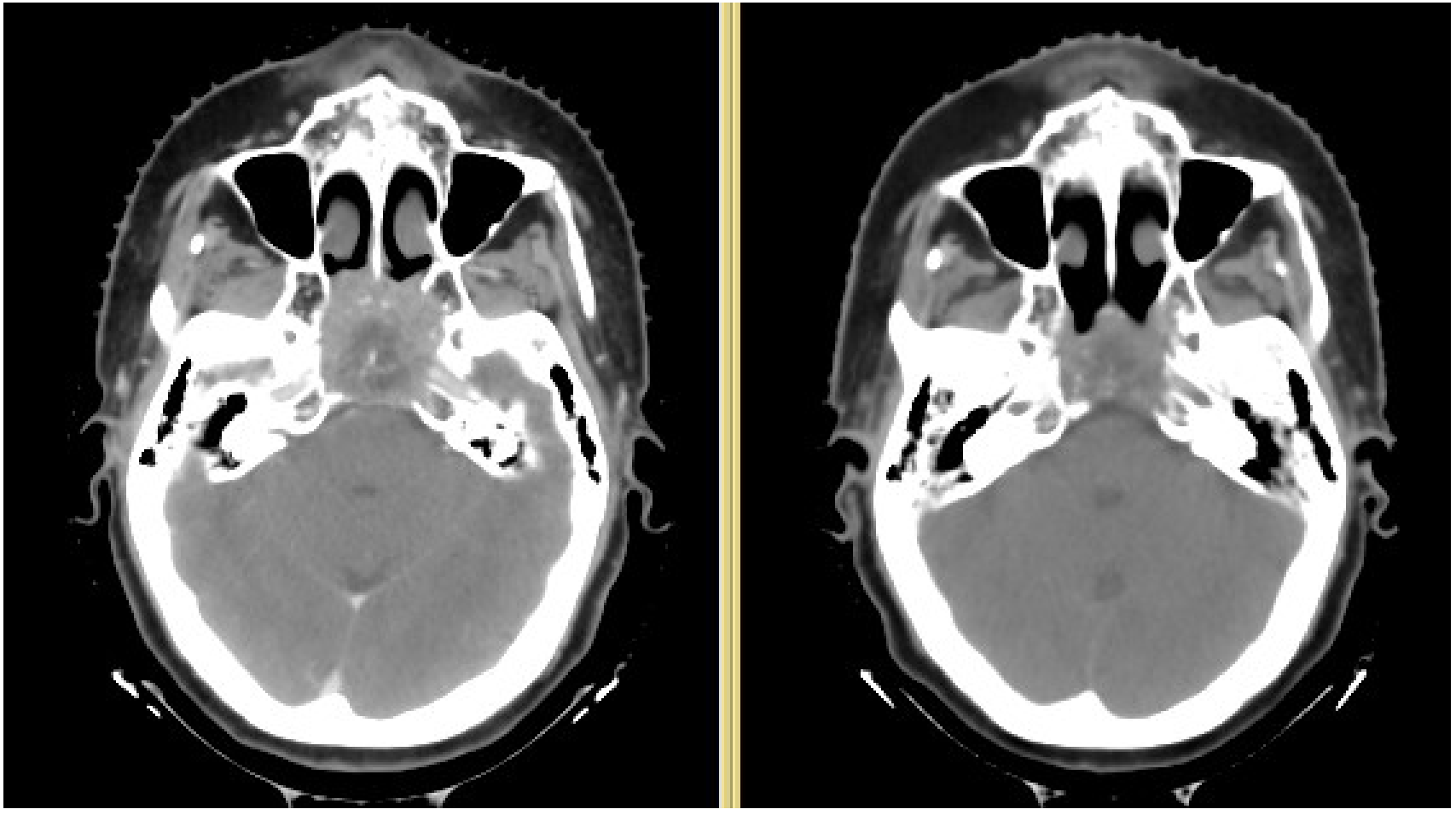
Specific Aims

1. Develop an open computational workflow for adaptive radiotherapy. We will develop a practical workflow for adaptive therapy planning that enables the registration of successive CT scans, segmentation of the tumor and the critical structures in CT, mapping of prior radiation plans onto new images, and planning of additional radiation therapy. We hypothesize that a flexible framework or workflow will enable an adaptive plan to be generated, reviewed, and ready for use within hours of acquisition.

2. Validate the accuracy of image analysis algorithms for radiotherapy. We will investigate and quantify the accuracy of automatic image registration and segmentation algorithms to establish spatial correspondences across consecutive CT scans and to delineate structures for radiation planning. We will adapt and compare the algorithms within NA-MIC Kit, and work with the Computer Science Core to develop novel segmentation and registration methods tailored to adaptive radiotherapy planning.

3. Evaluate the dosimetric gain of adaptive radiotherapy. Using CT images acquired from patients before treatment and at the mid-point during treatment, we will perform dosimetric comparisons of traditional radiotherapy and adaptive radiotherapy. We hypothesize that adaptive radiotherapy will result in a clinical gain in the probability of tumor control and/or a reduction in complication rate, as predicted by radiation dose-response models.

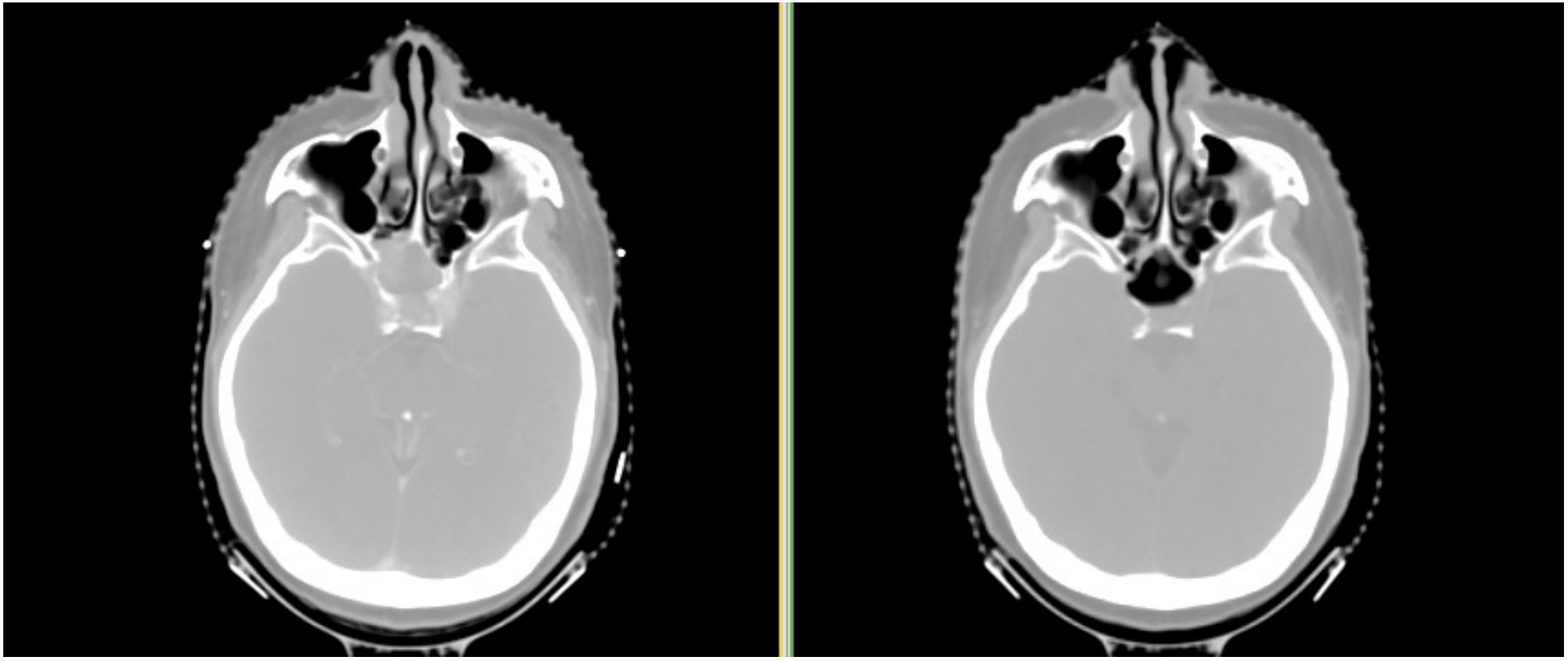
Anatomic Change



Pre-treatment

Mid-treatment

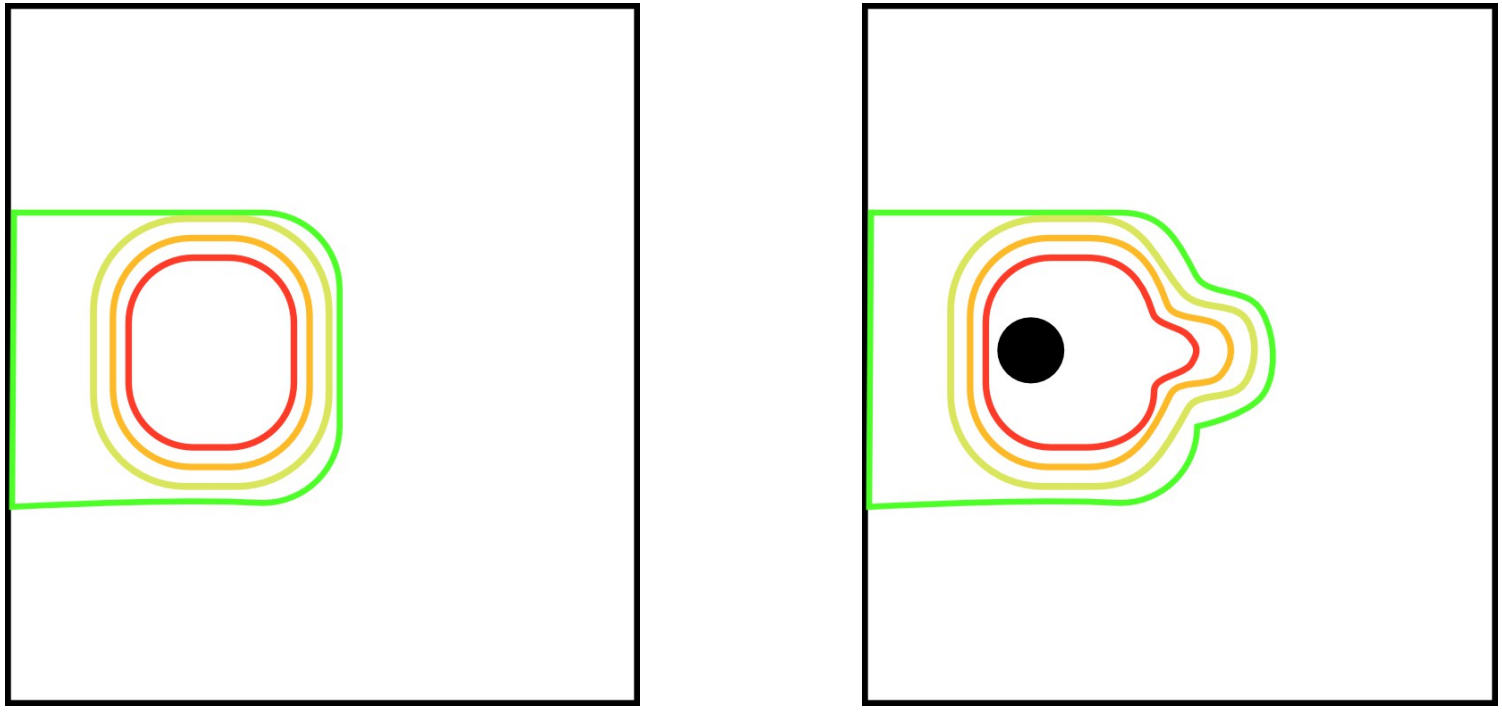
Anatomic Change



Pre-treatment

Mid-treatment

Implications of Anatomic Change



Algorithms

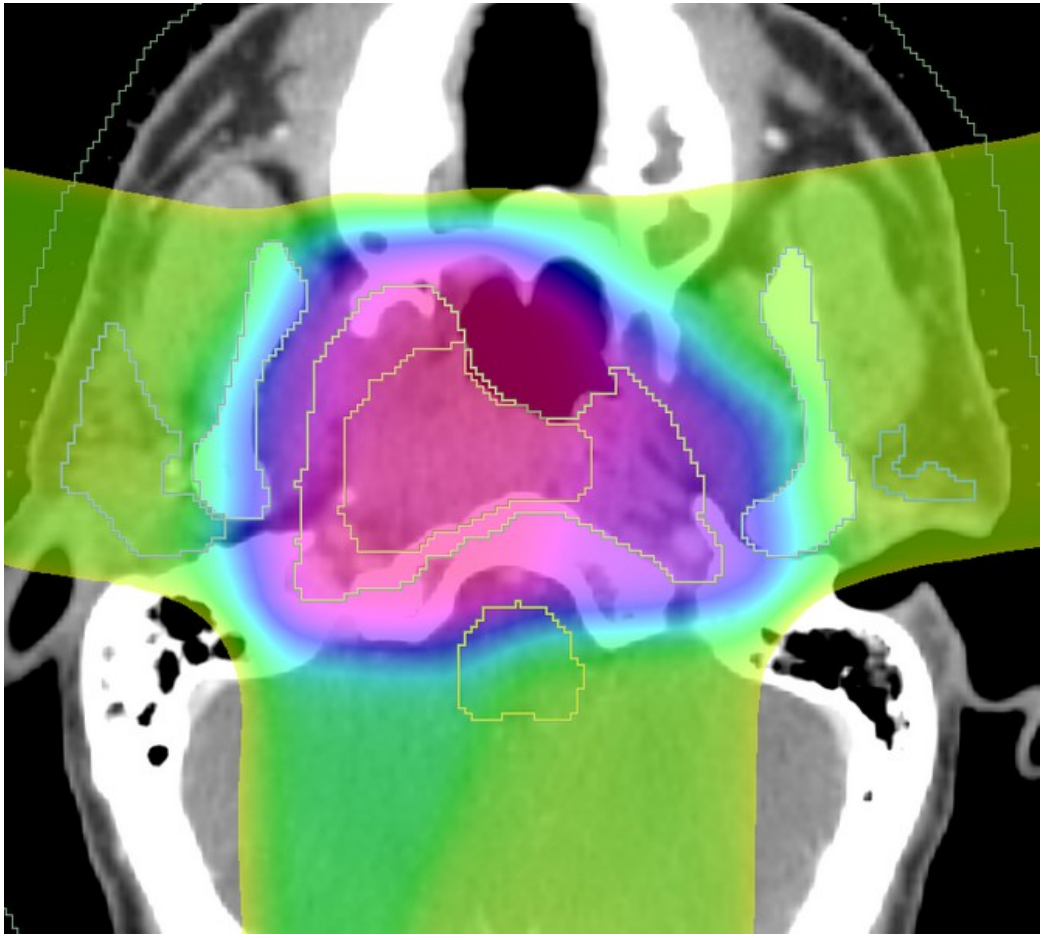
- Polina Golland, Amelia Arbisser (MIT)
  - Atlas-based segmentation
- Allen Tannenbaum, Ivan Kolesov (GT)
  - Shape-based segmentation

Engineering Plan

- Support for adaptive radiotherapy in NA-MIC
- Four goals
  - DICOM-RT interchange
  - Structure and dose warping
  - Interactive deformable registration
  - Plan review

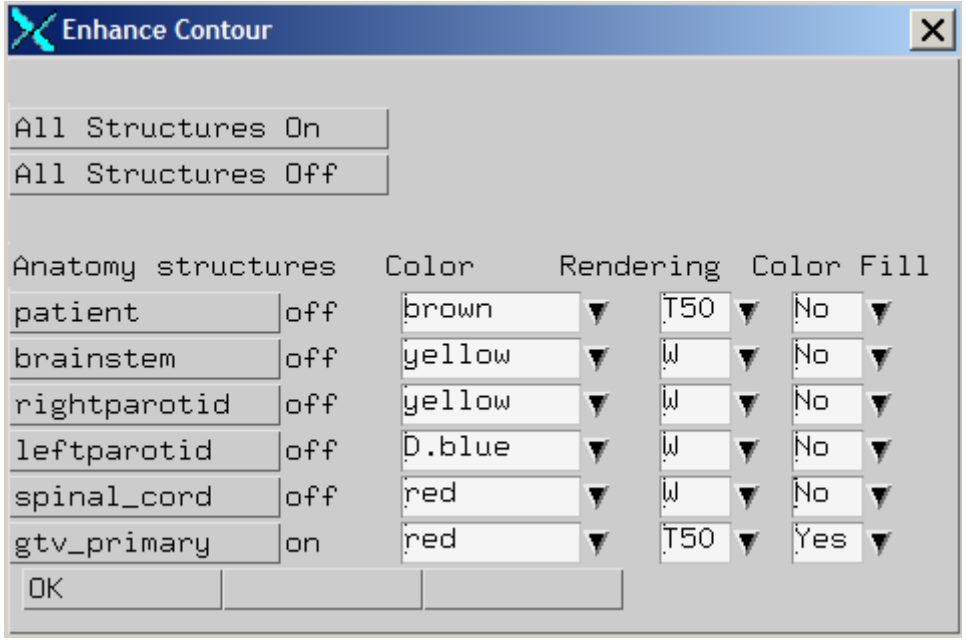
DICOM-RT Interchange

- RT Dose
  - Dose in Gray
- RT Structure Sets
  - Polyline contours of organs of interest
- RT Plan
  - Beam arrangements



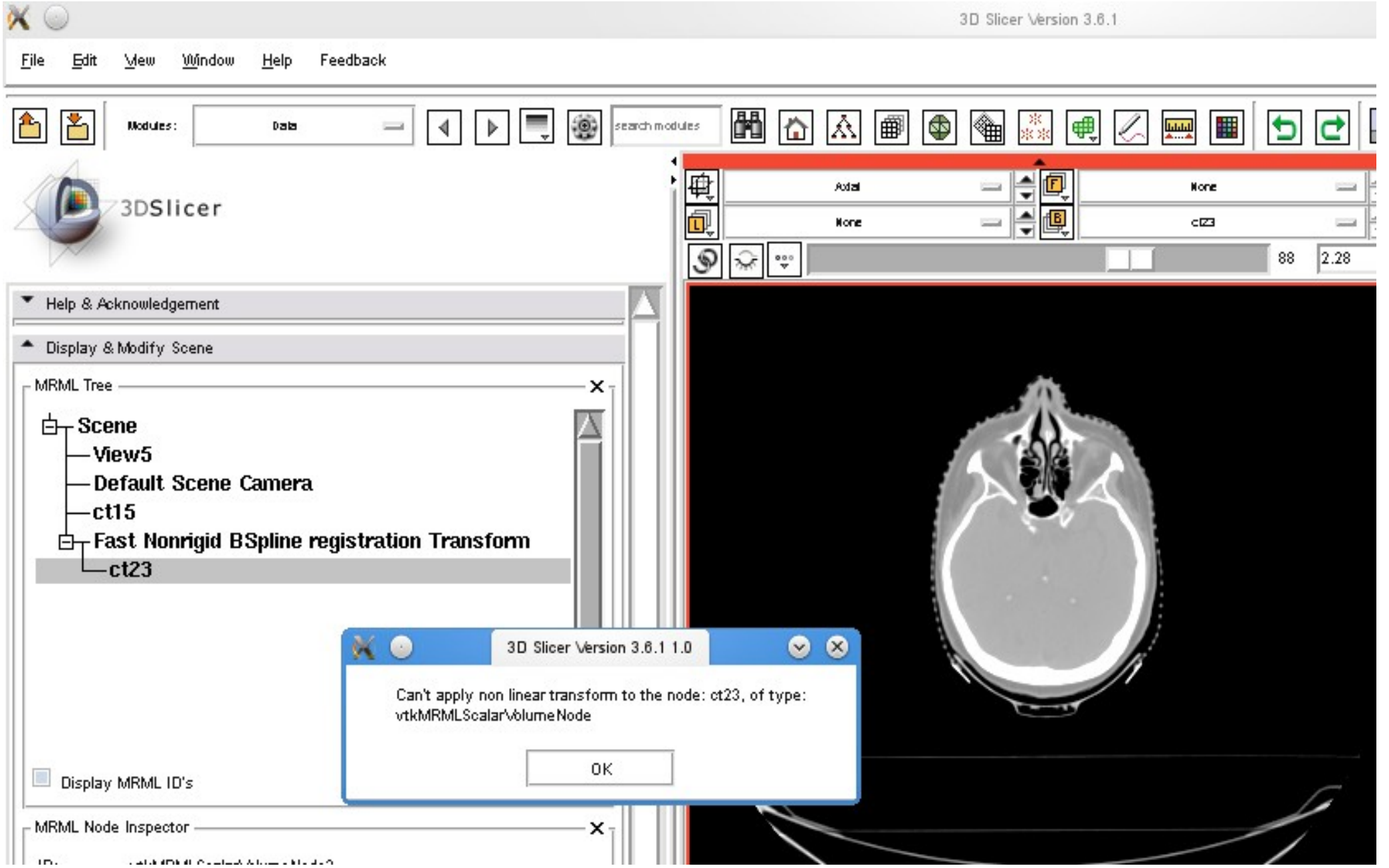
Structure Set Manipulation

- Overlapping structures
- Individual control of visibility, style
- Names and colors grouped with structures



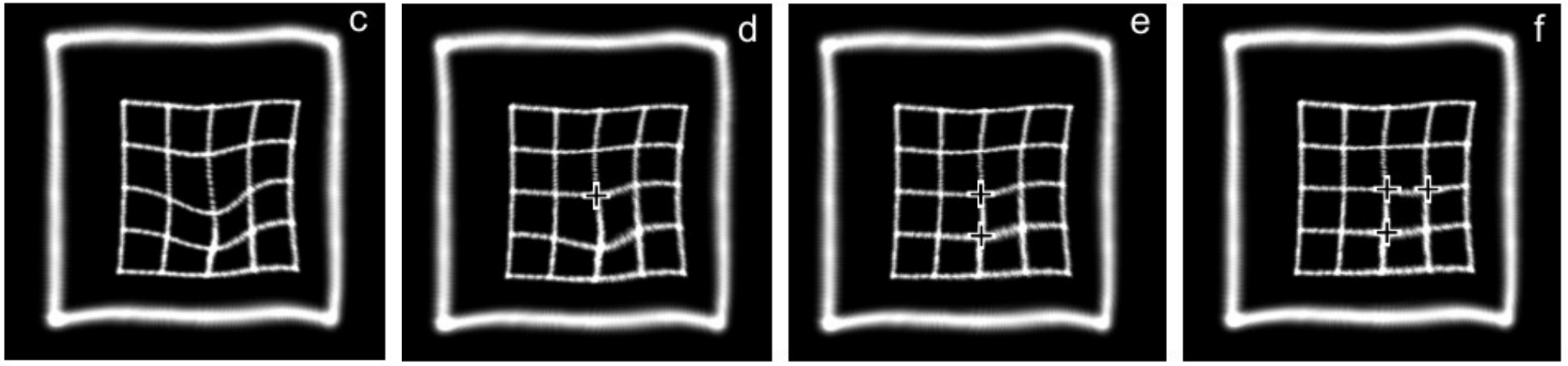
Structure and Dose Warping

- Evaluate registration algorithms for CT
- Workflow for structure and dose warping


3D Slicer Version 3.6.1
File
Edit
View
Window
Help
Feedback
Modules:
Data
search modules
3DSlicer
Help & Acknowledgement
Display & Modify Scene
MRML Tree
Scene
View5
Default Scene Camera
ct15
Fast Nonrigid BSpline registration Transform
ct23
Display MRML ID's
MRML Node Inspector
Axial
None
None
ct23
88
2.28
3D Slicer Version 3.6.1 1.0
Can't apply non linear transform to the node: ct23, of type: vtkMRMLScalarVolumeNode
OK

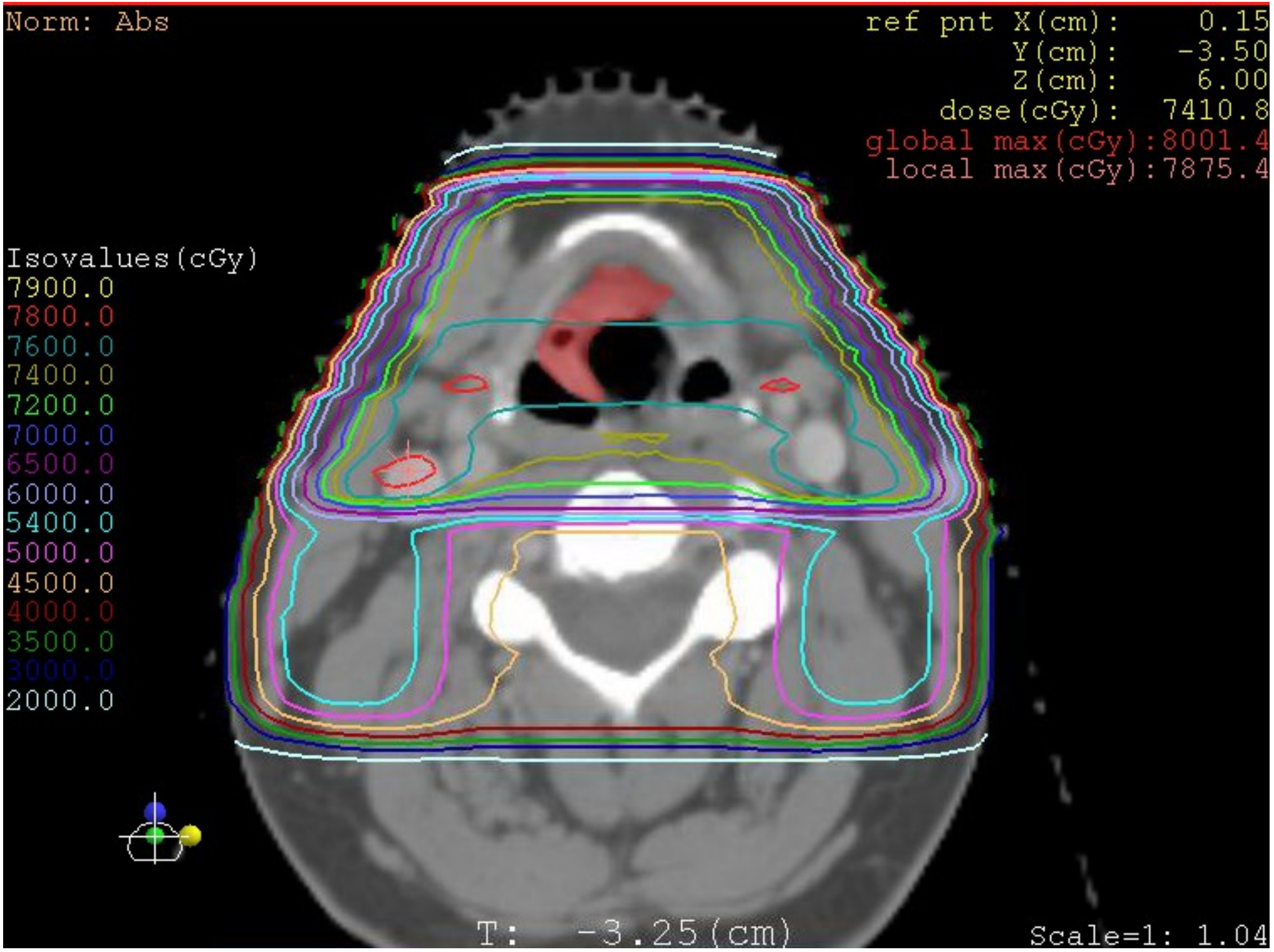
Interactive Deformable Registration

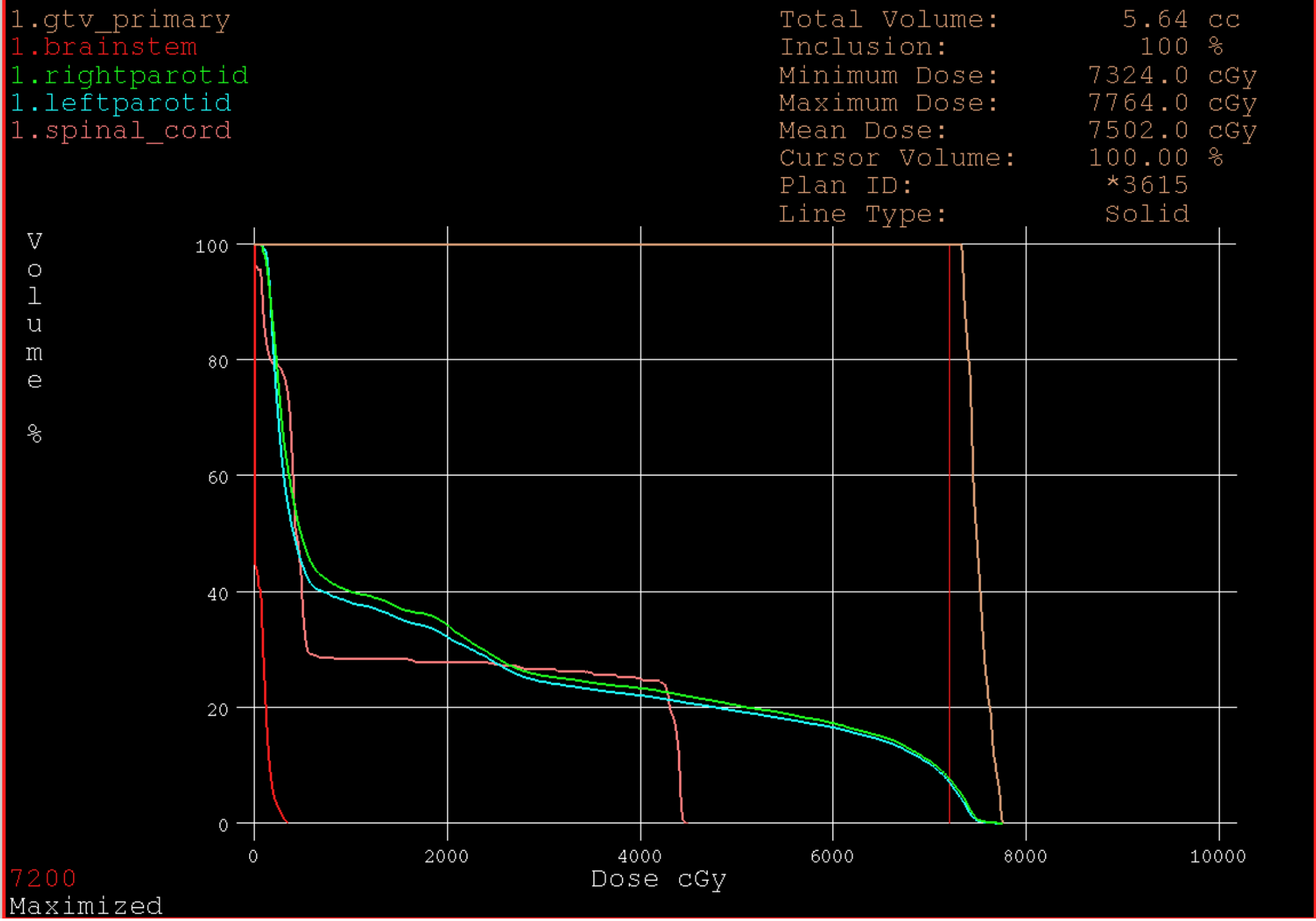
- Landmark-based method
- Make local corrections to registration results



Plan Review

- Isodose display
- Dose volume histograms (DVH)
- Dose comparison tools


Norm: Abs
ref pnt X(cm): 0.15
Y(cm): -3.50
Z(cm): 6.00
dose(cGy): 7410.8
global max(cGy):8001.4
local max(cGy):7875.4
Isovalues(cGy)
7900.0
7800.0
7600.0
7400.0
7200.0
7000.0
6500.0
6000.0
5400.0
5000.0
4500.0
4000.0
3500.0
3000.0
2000.0
T: -3.25(cm)
Scale=1: 1.04


1.gtv_primary
1.brainstem
1.rightparotid
1.leftparotid
1.spinal_cord
Total Volume: 5.64 cc
Inclusion: 100 %
Minimum Dose: 7324.0 cGy
Maximum Dose: 7764.0 cGy
Mean Dose: 7502.0 cGy
Cursor Volume: 100.00 %
Plan ID: *3615
Line Type: Solid
Volume %
100
80
60
40
20
0
0
2000
4000
6000
8000
10000
Dose cGy
7200
Maximized