NA-MIC
National Alliance for Medical Image Computing
http://www.na-mic.org

SlicerRT Extension

Csaba Pinter[1], Andras Lasso[1], Kevin Wang[2]

[1]Laboratory for Percutaneous Surgery, Queen's University, Canada
[2]University Health Network, Toronto, ON, Canada

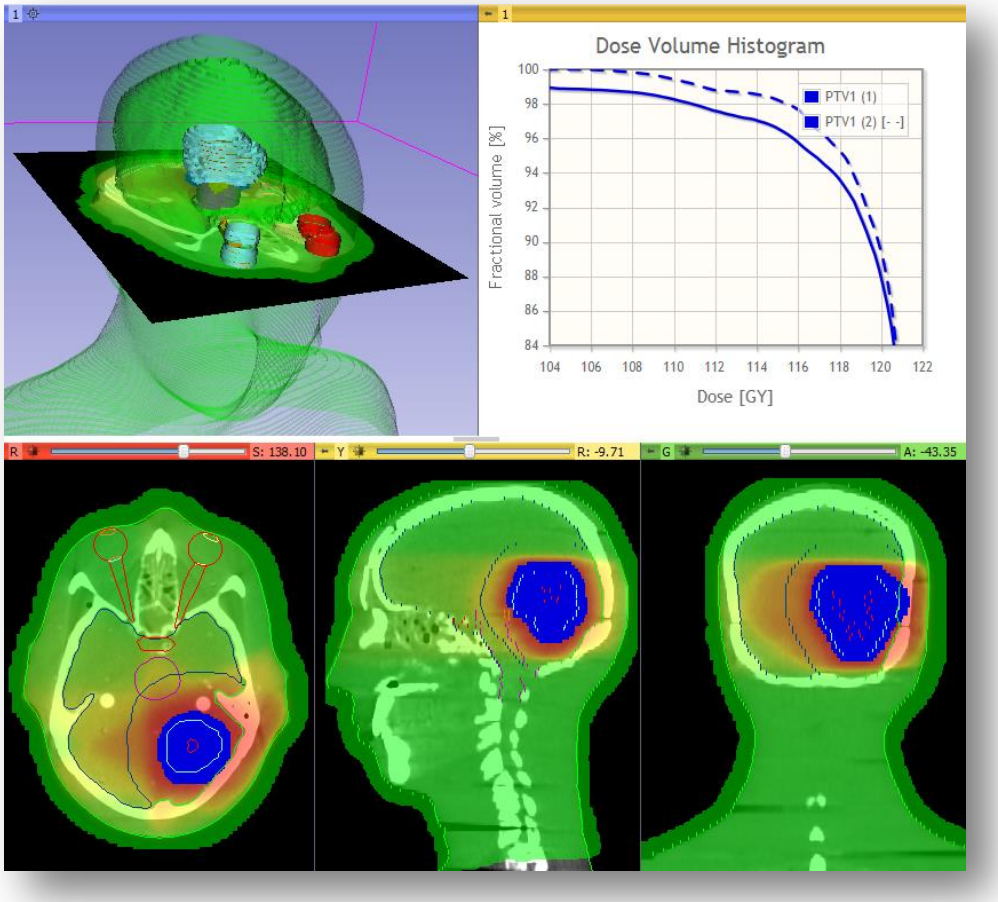
pinter@cs.queensu.ca

NA-MIC Tutorial Contest: Summer 2013

Learning Objective

This tutorial demonstrates how to perform a radiation therapy research workflow using the SlicerRT extension:

Evaluation of the isocenter shifting adaptation method



Pre-requisite

- Pre-requisite tutorial:
  - **Data Loading and Visualization**
  - Sonia Pujol, Ph.D.
  - http://www.slicer.org/slicerWiki/images/c/c7/DataLoadingAndVisualizationSlicer4.1_SoniaPujol.pdf

Material

This tutorial requires the installation of the most recent Slicer nightly release and the tutorial dataset. They are available at the following locations:

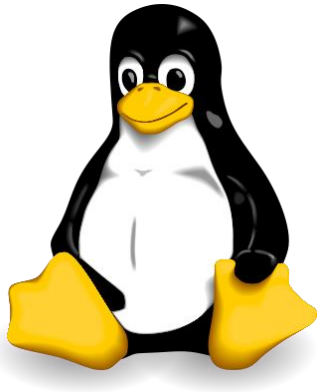
Slicer download page

http://www.slicer.org/pages/Downloads/

Tutorial dataset: SlicerRtTutorial_Namic2013June
http://slicer.kitware.com/midas3/download/folder/1345/SlicerRtTutorial_Namic2013June.zip

Platforms

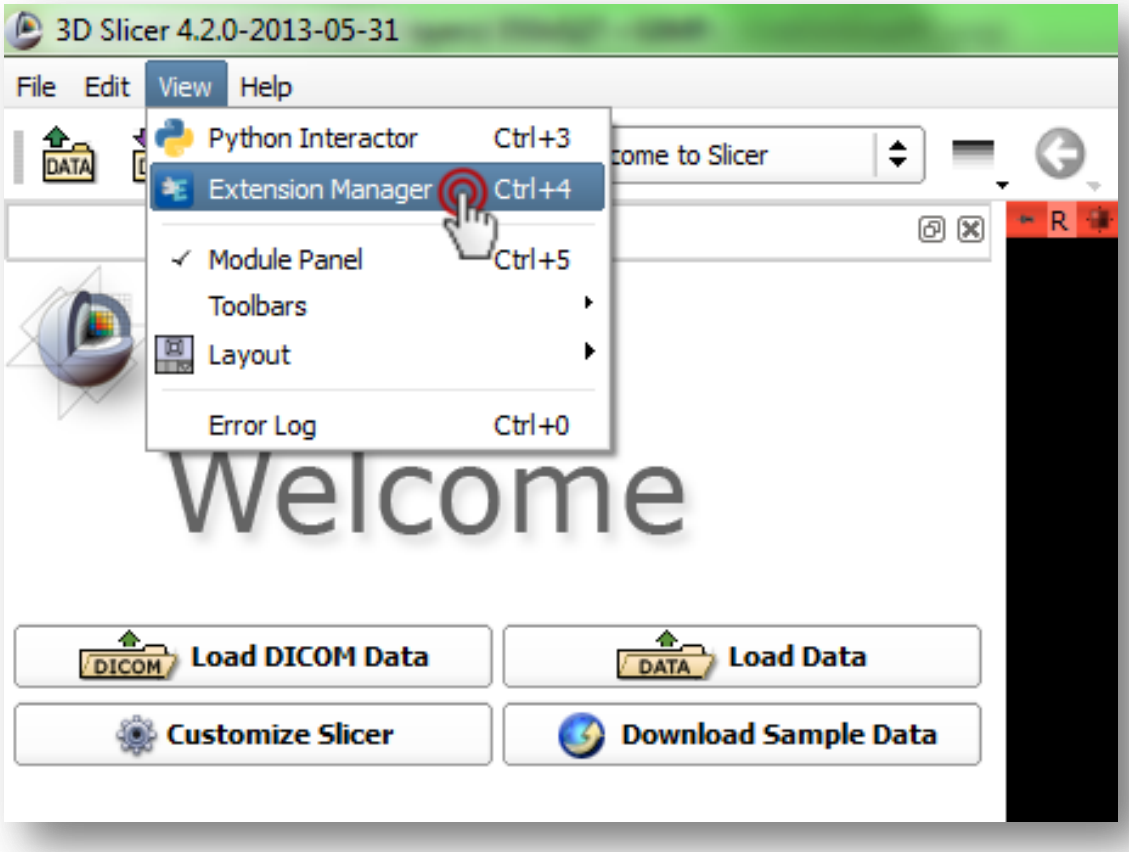
- All major desktop platforms are supported



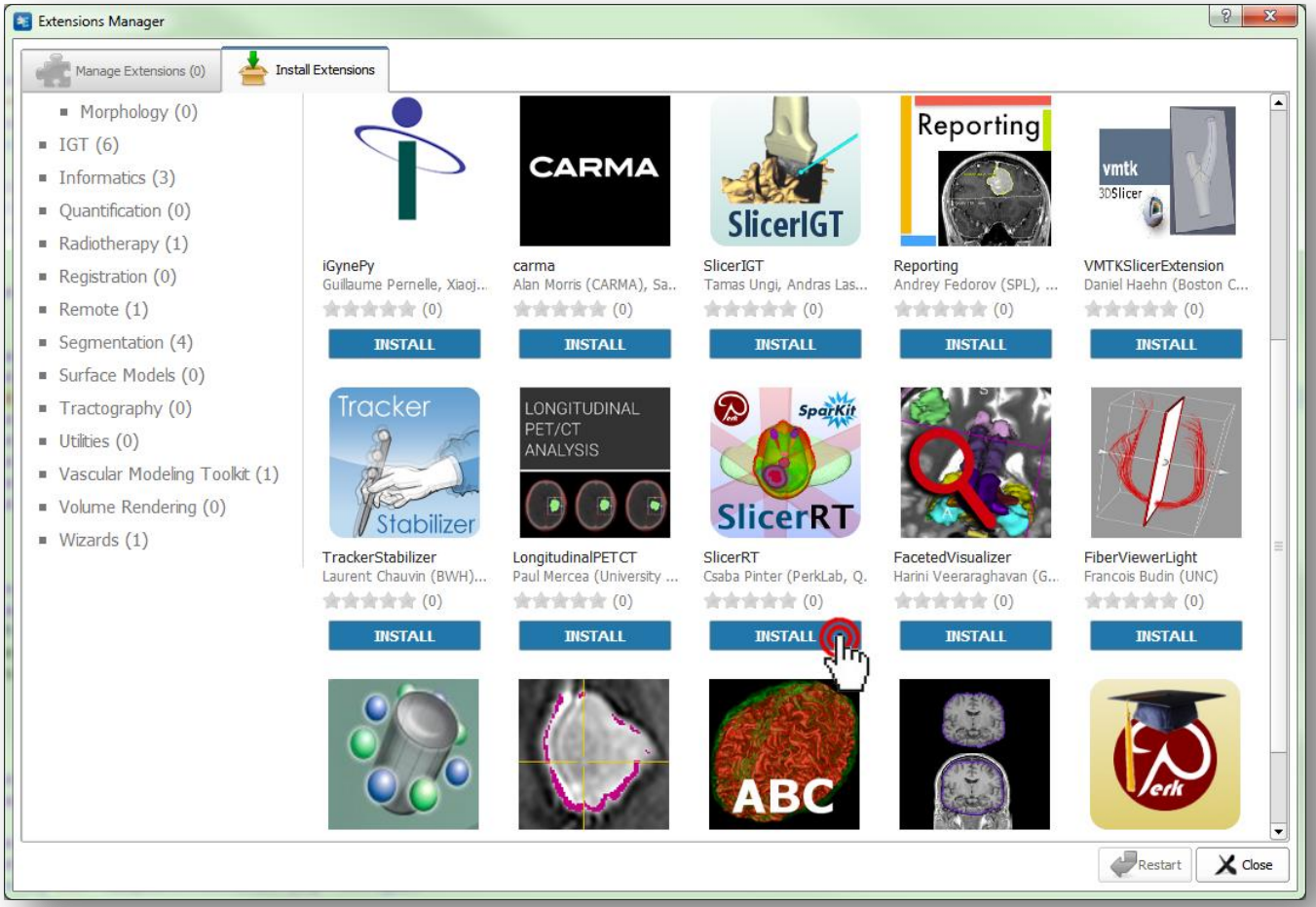
Overview

1. Install SlicerRT extension
2. Load data from DICOM and nrrd
3. Create isodose lines and surfaces
4. Perform rigid registration on CT images
5. Resample day 2 dose volume
6. Compare dose distributions
7. Accumulate dose distributions
8. Compute dose volume histogram

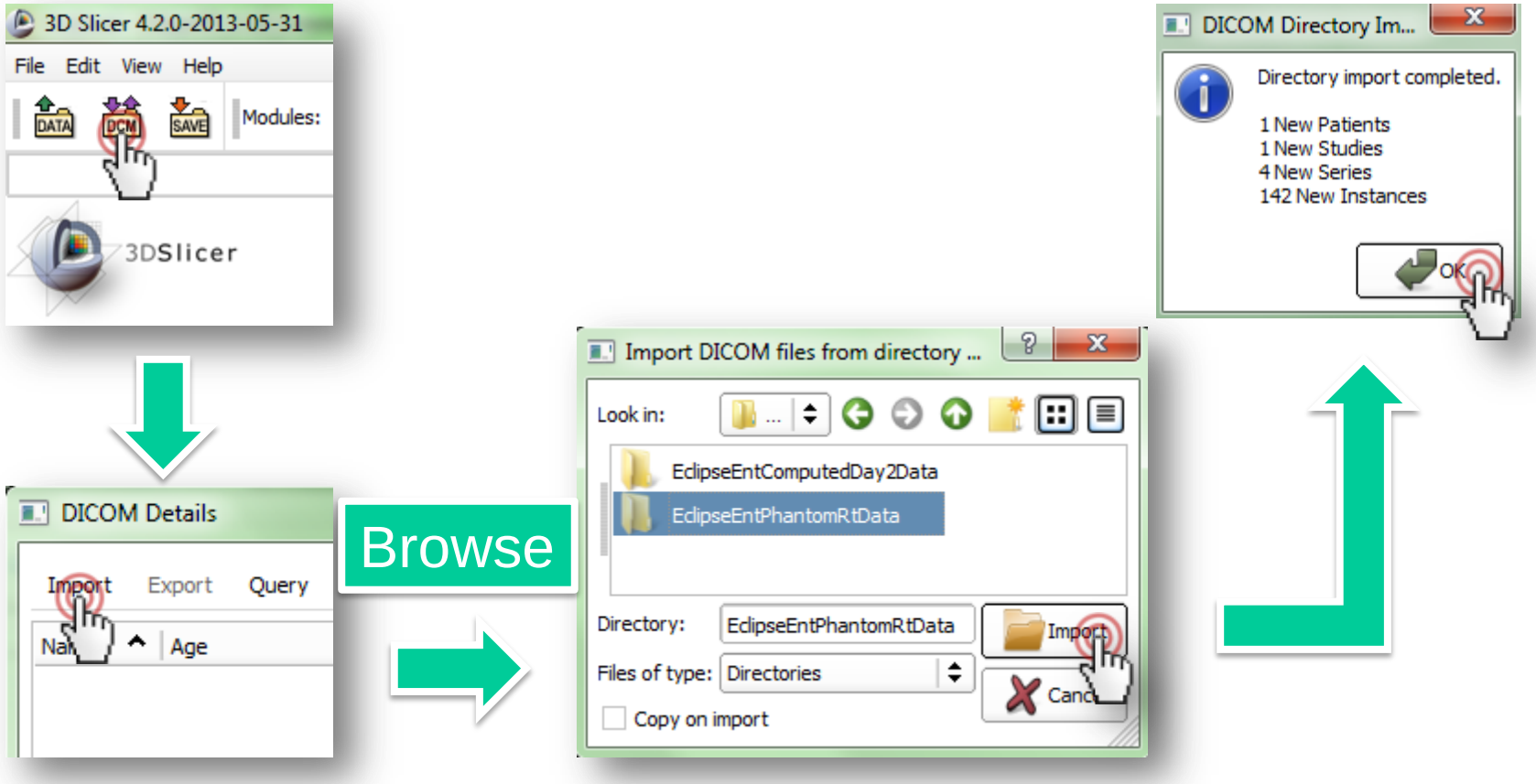
1/1. Install SlicerRT extension



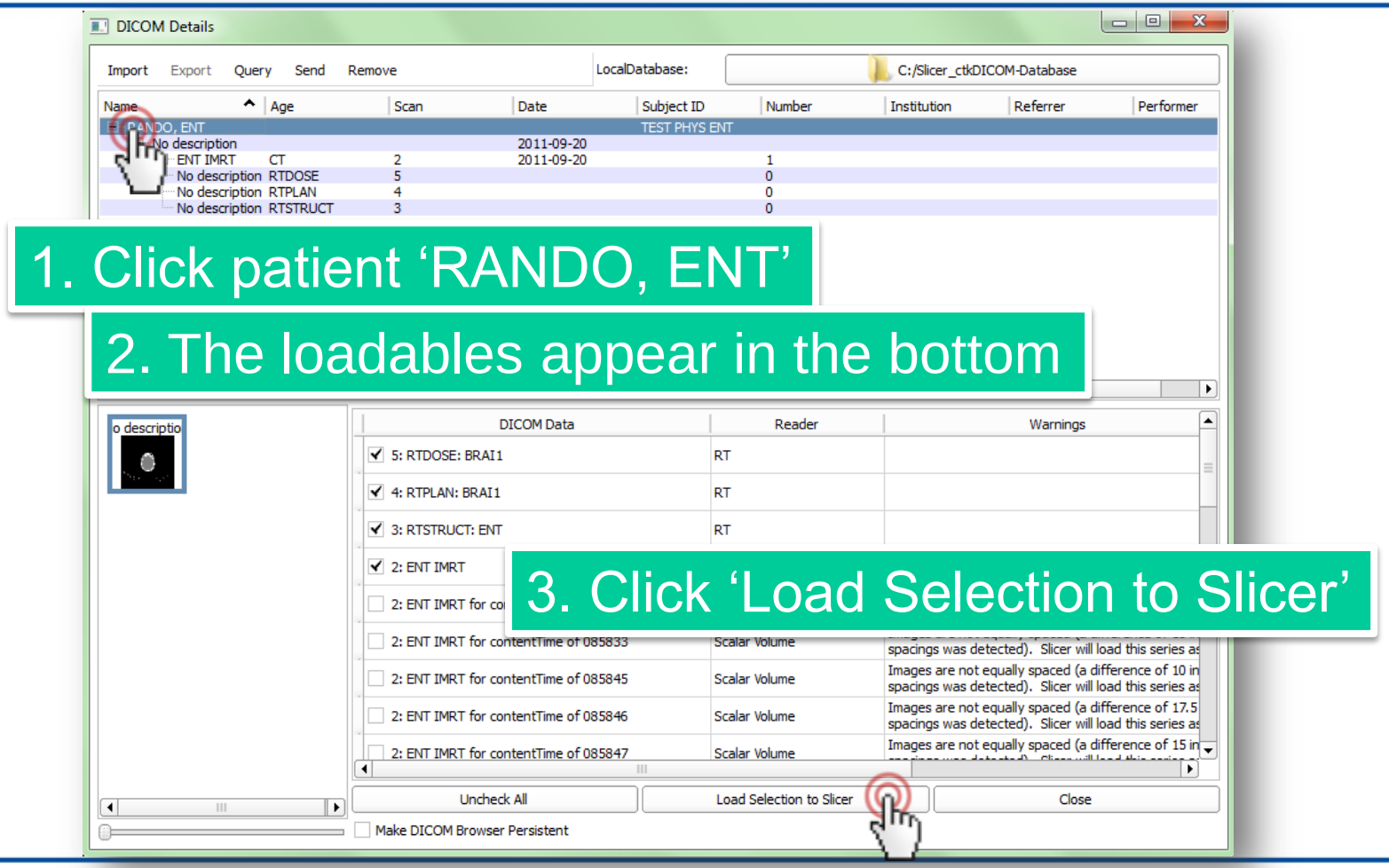
1/2. Install SlicerRT extension



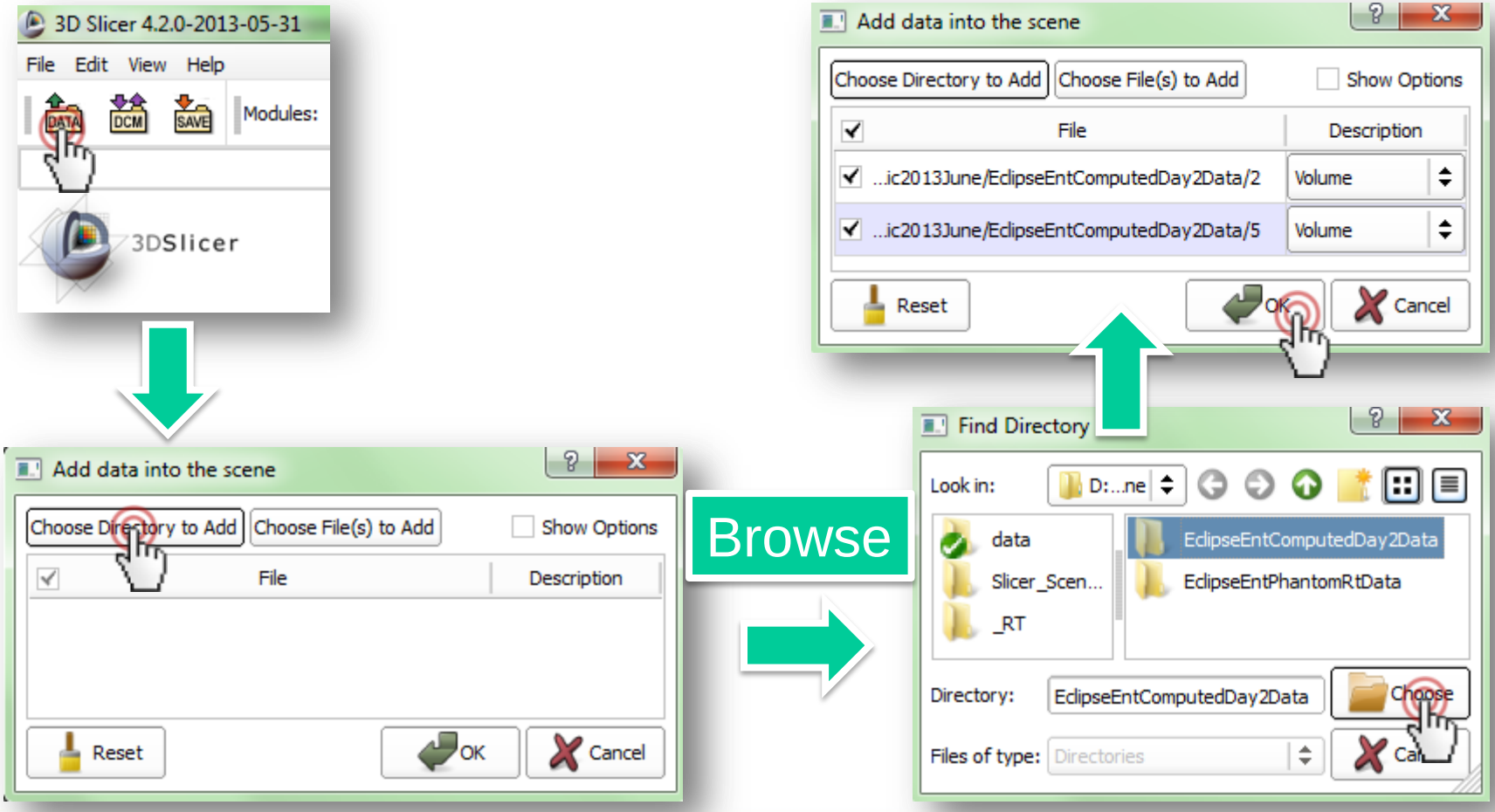
2/1. Import planning data



2/2. Load planning data

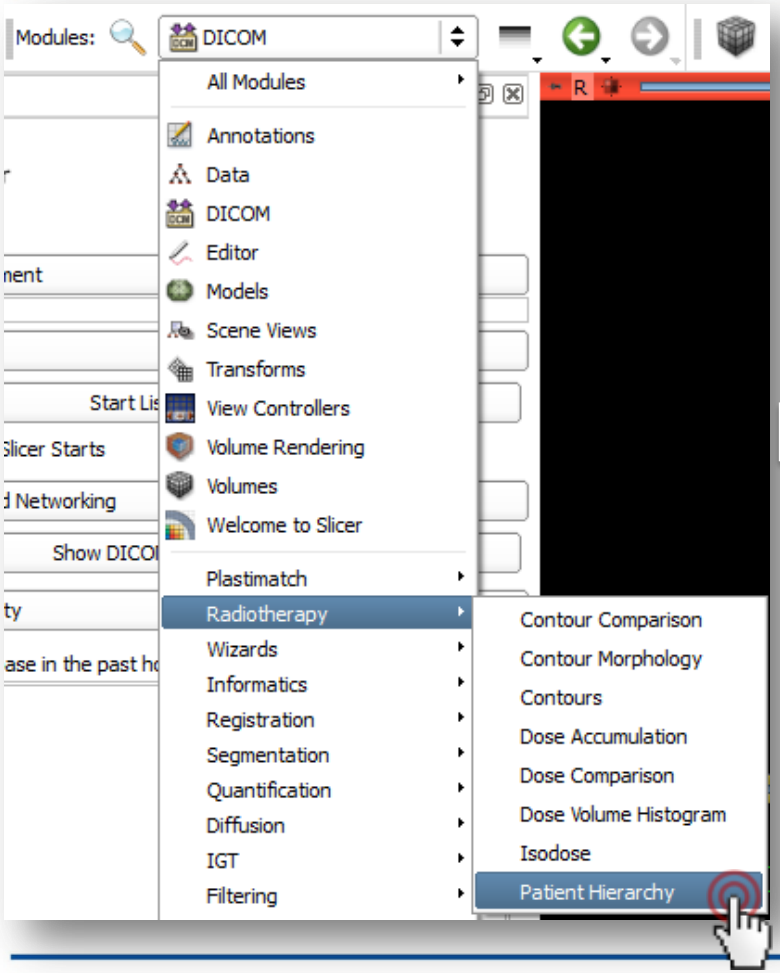


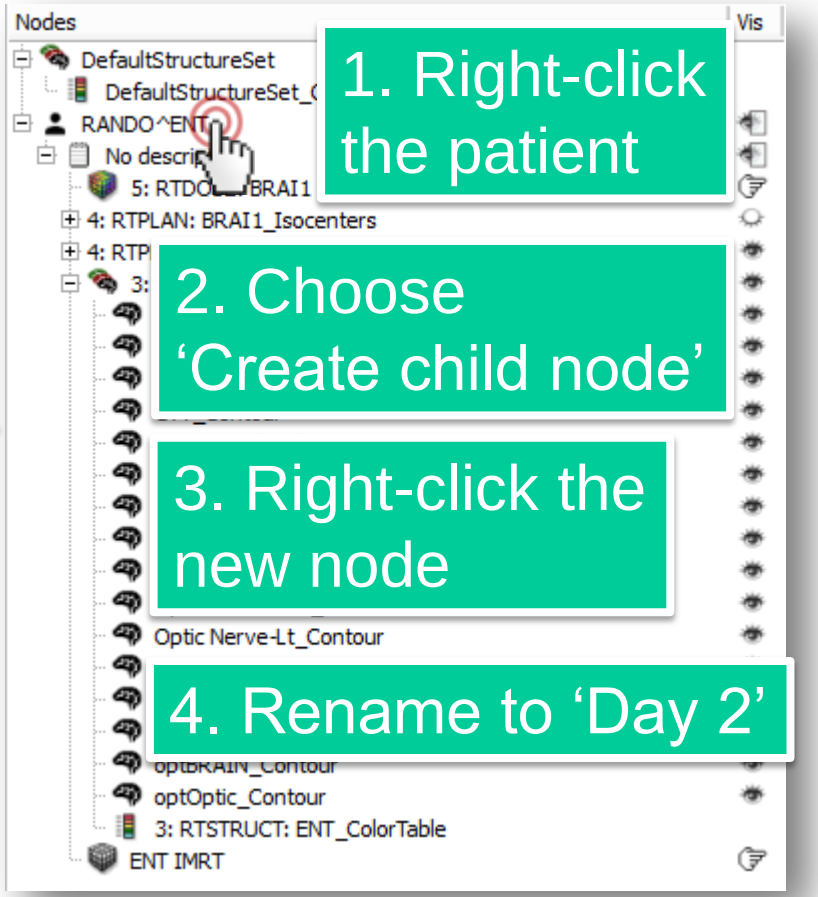
2/3. Load day 2 data



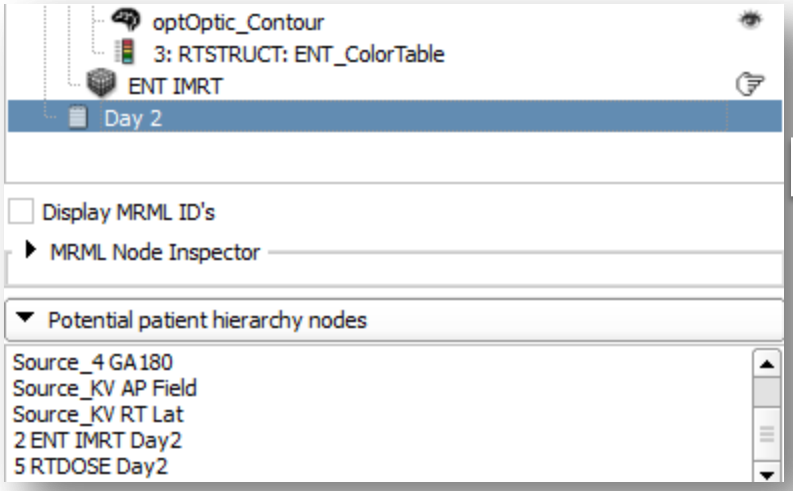
National Alliance for Medical Image Computing
http://www.na-mic.org

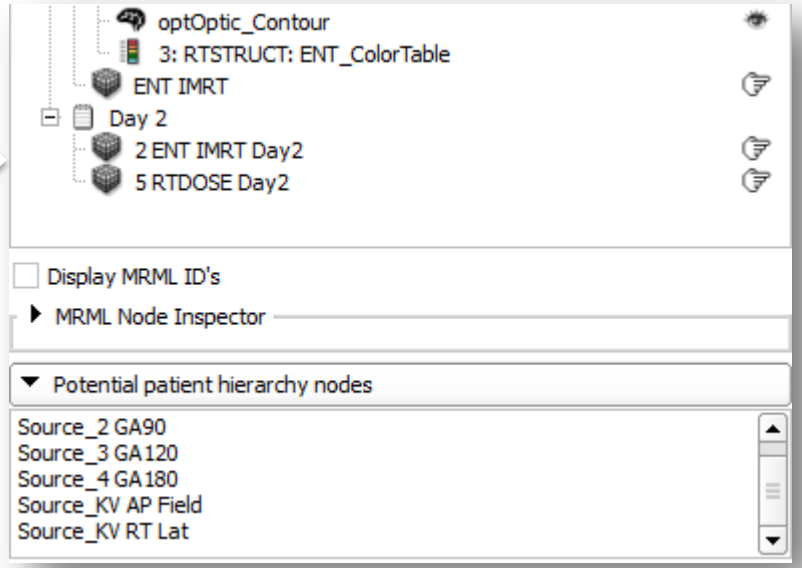
2/4. Add day 2 non-DICOM data to patient hierarchy





2/5. Add day 2 non-DICOM data to patient hierarchy

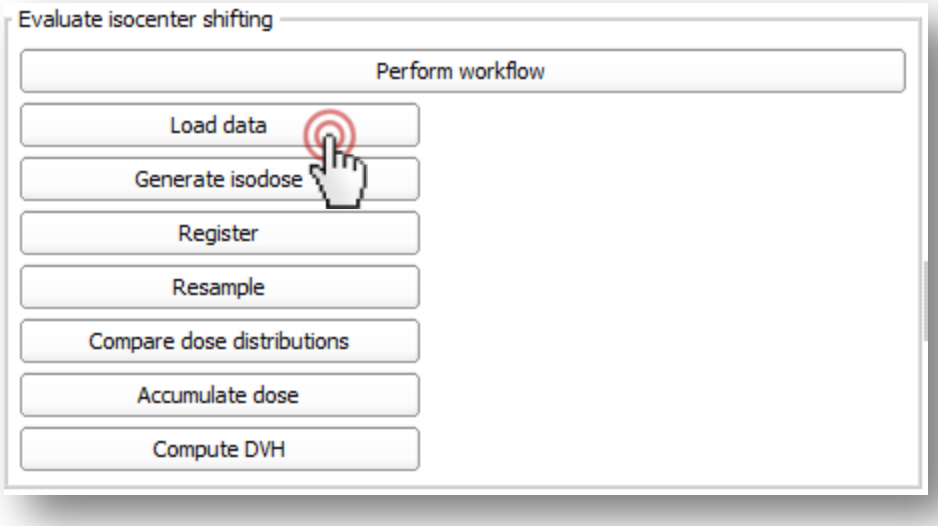




1. Drag&drop ‘ENT IMRT Day2’ on the study ‘Day 2’

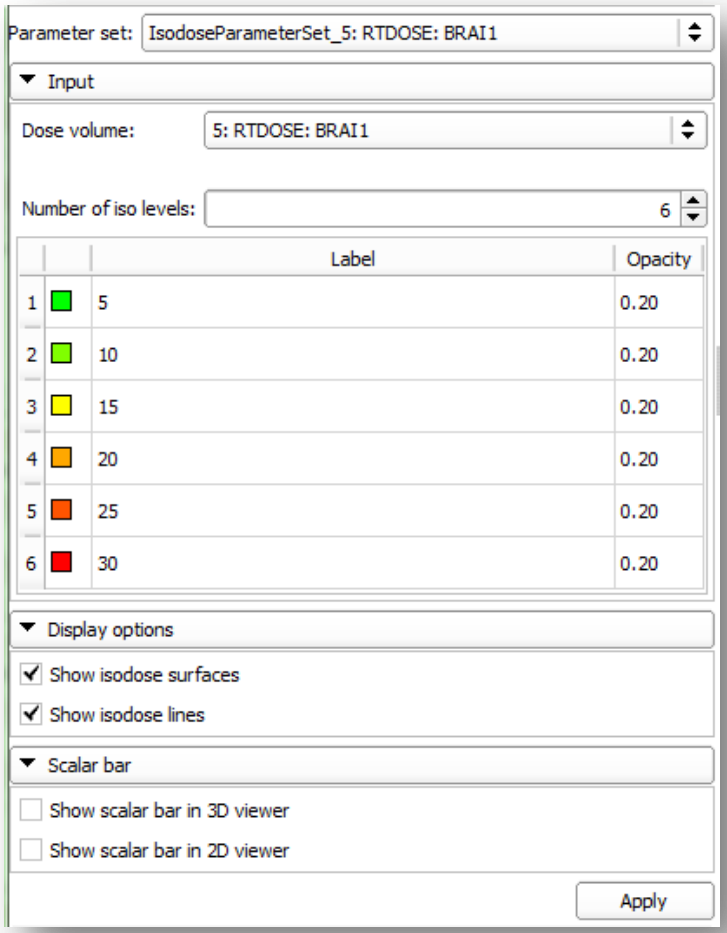
2. Do the same with ‘5 RTDOSE Day2’

Note: Automatic loading



Test data can be automatically downloaded, imported and loaded using the self test module:
Testing / SlicerRT Tests / SlicerRT NA-MIC Tutorial 2013June Self Test

3/1. Create isodose lines



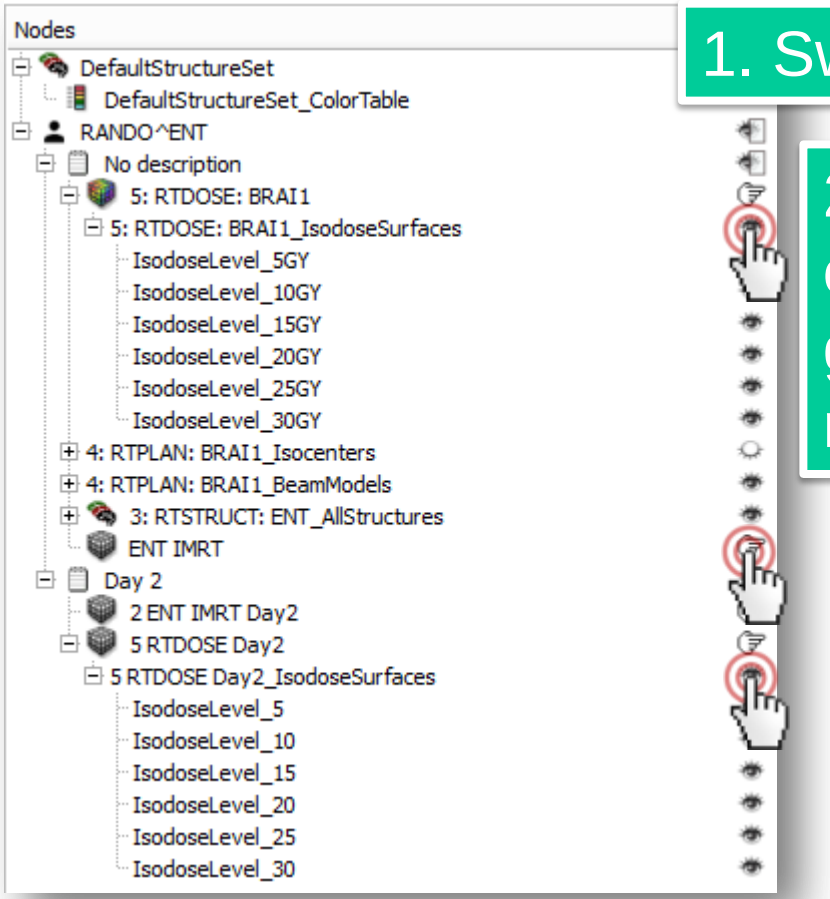
1. Choose Radiotherapy / Isodose module

2. Click Apply

3. Choose ‘5 RTDOSE Day2’ volume as Dose volume

4. Click Apply

3/2. Visualize isodose lines

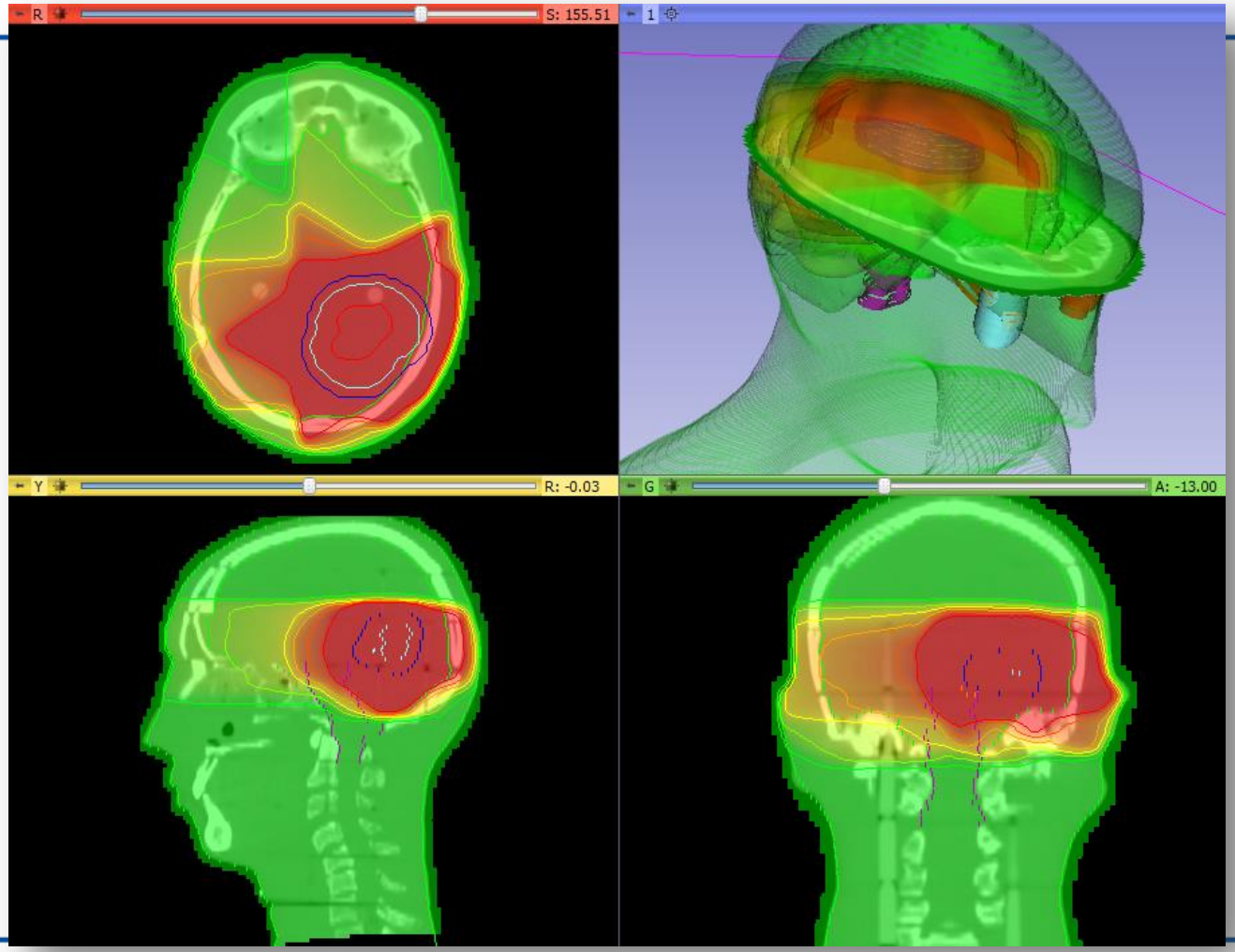


1. Switch back to Patient Hierarchy

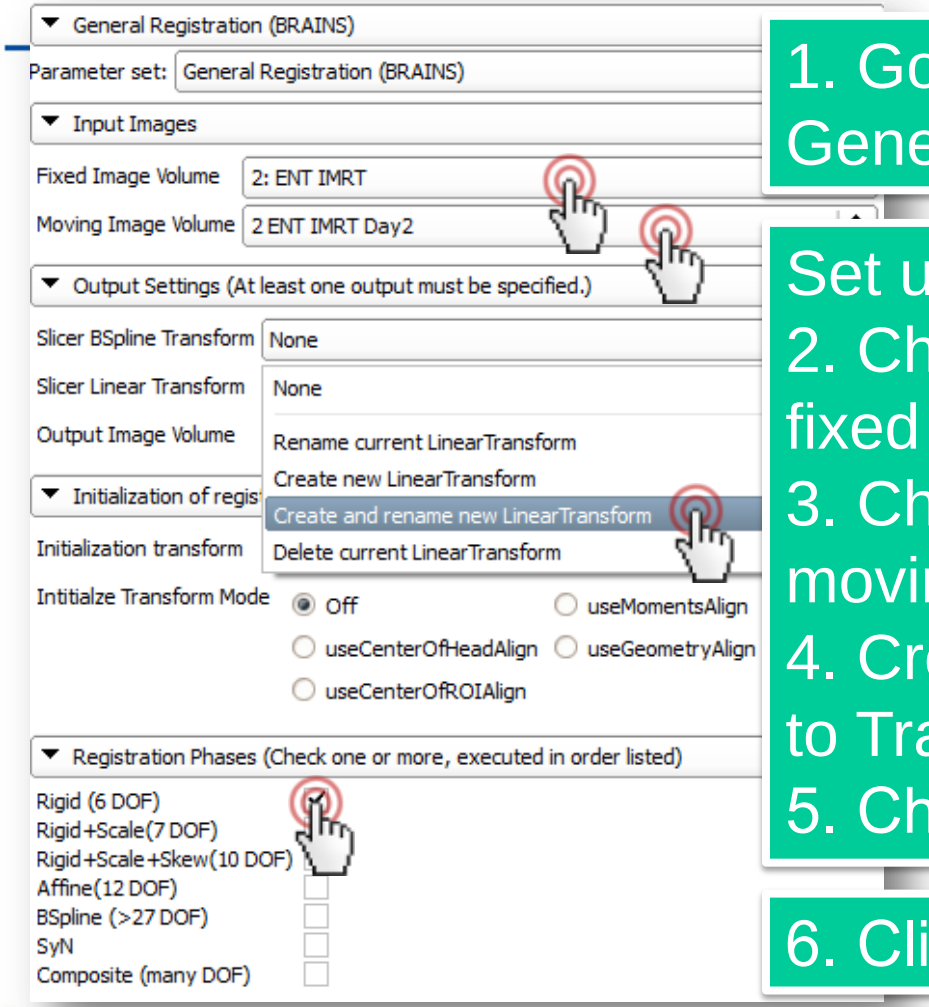
2. Turn on and off visualization of isodose line and surface groups by clicking the eye icon next to the parent node

3. Display volumes in the 2D viewers by clicking the hand icon next to the volumes

3/3. Relevant data showed



4. Register CT volumes



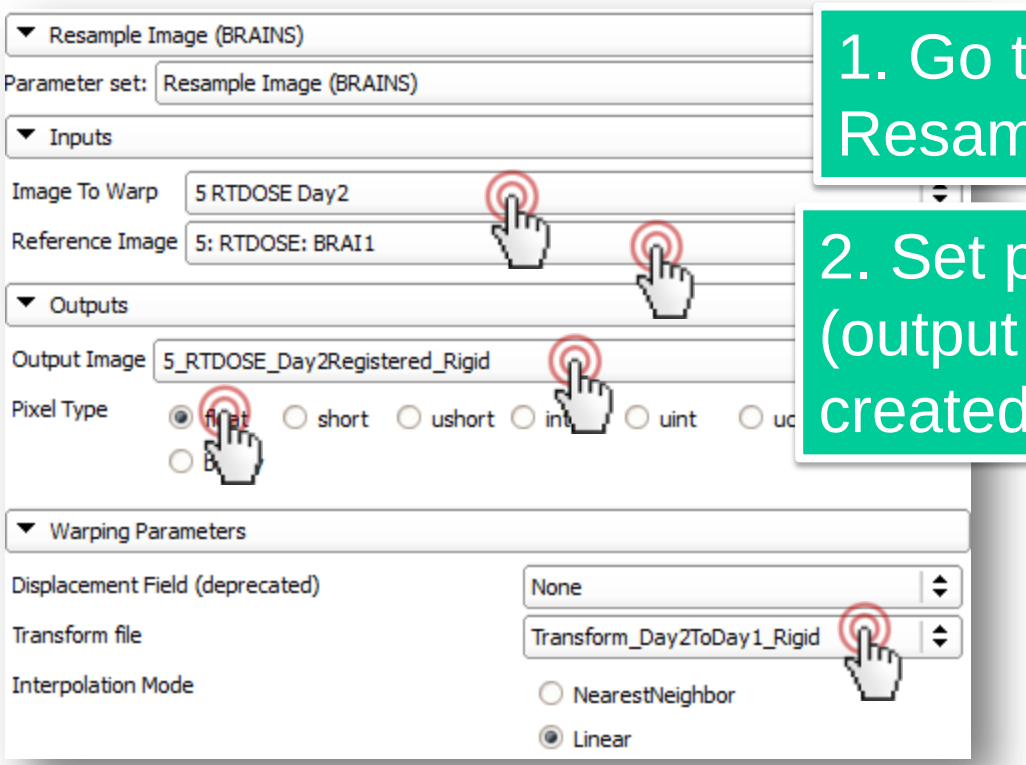
1. Go to module Registration / General Registration (BRAINS)

Set up parameters as shown:

2. Choose planning CT as fixed image
3. Choose day 2 CT as moving image
4. Create transform and rename it to Transform_Day2ToDay1_Rigid
5. Choose ‘Rigid (6 DOF)

6. Click ‘Apply’

5. Resample day 2 dose

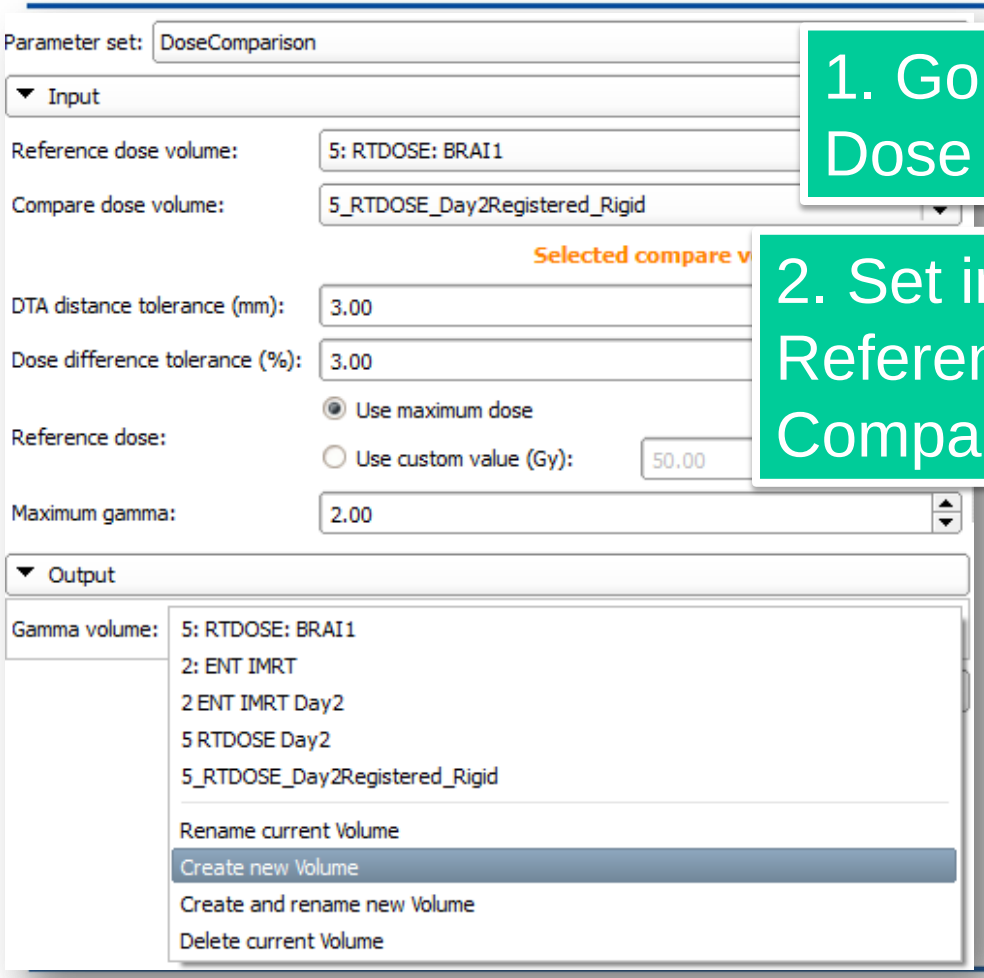


1. Go to module Registration / Resample Image (BRAINS)

2. Set parameters as indicated (output image needs to be created and renamed)

3. Click ‘Apply’

6/1. Compare dose volumes



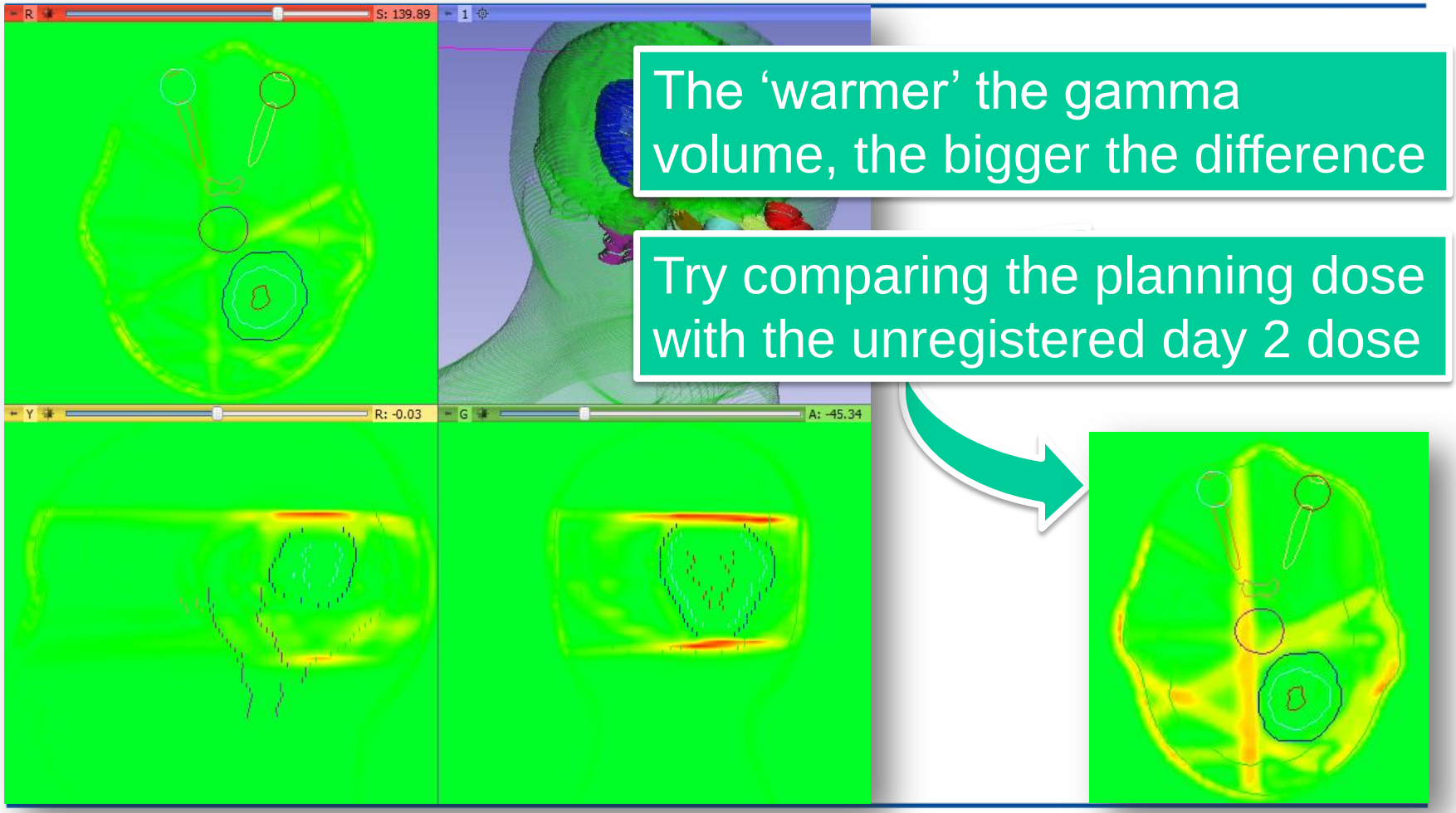
1. Go to module Radiotherapy / Dose Comparison

2. Set inpit volumes:
Reference: Planning dose
Compare: Registered day 2 dose

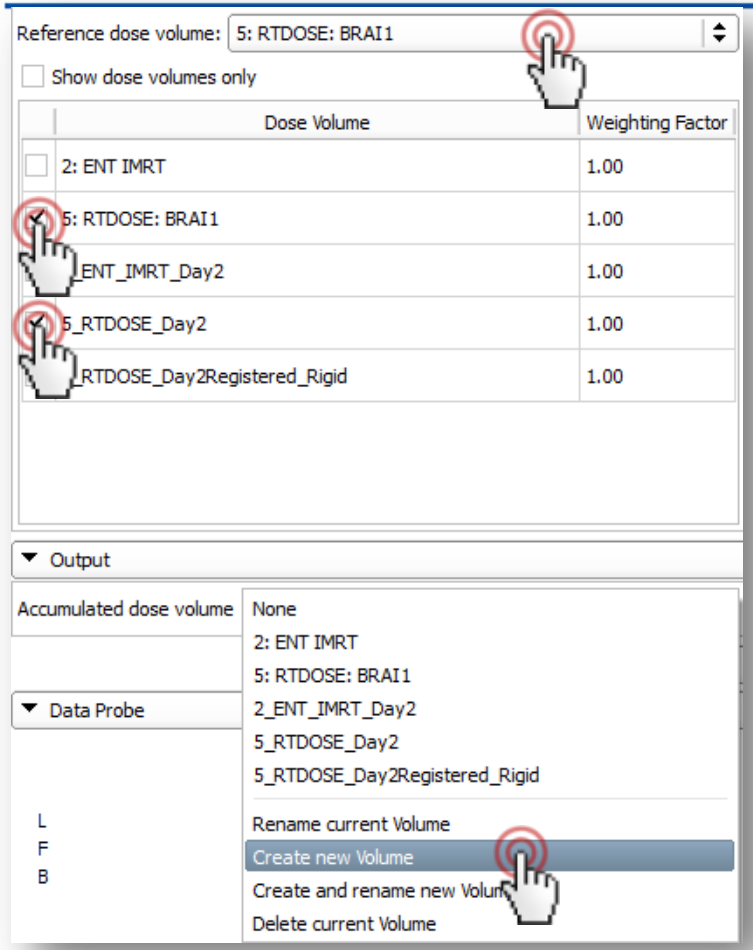
3. Create output
(no rename necessary)

4. Click ‘Apply’

6/2. Verify registration

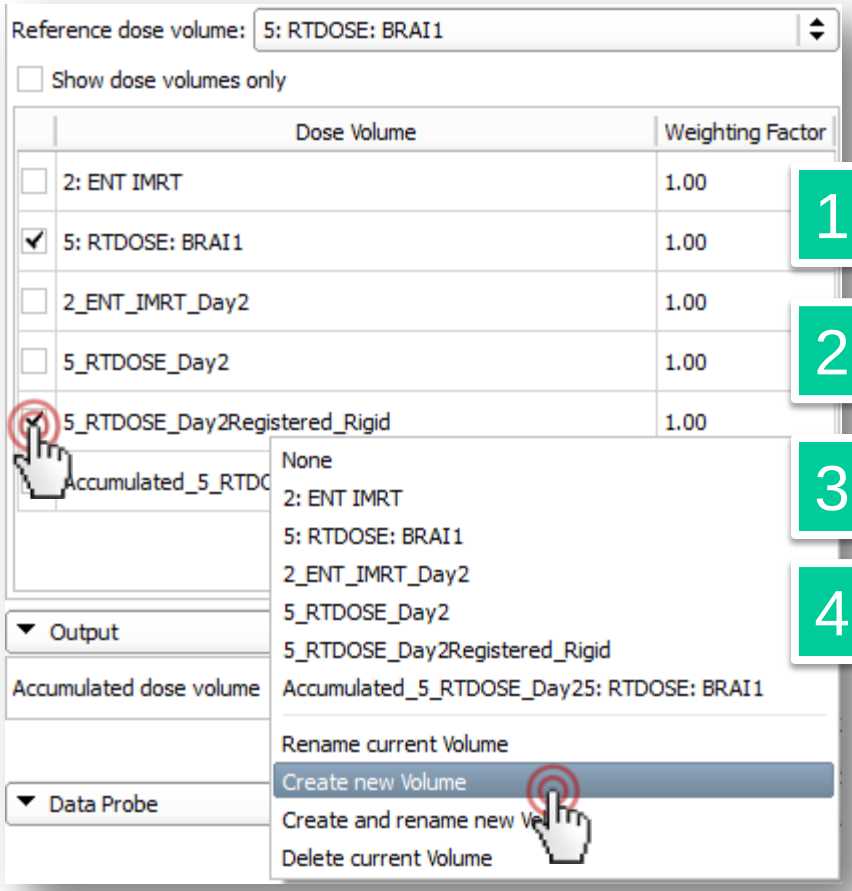


7/1. Accumulate doses unregistered = no adaptation



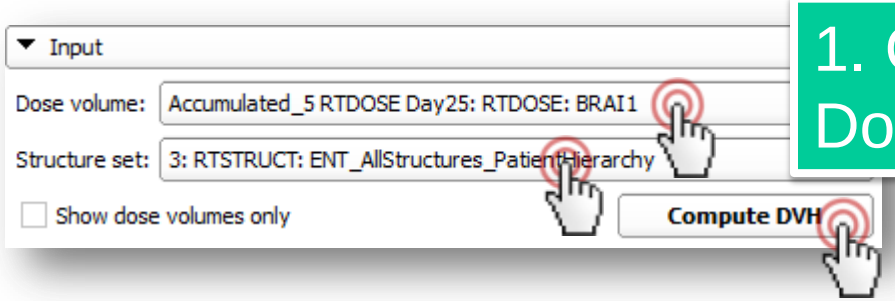
1. Go to module Radiotherapy / Dose Accumulation
2. Uncheck ‘Show dose volumes only’ (dose attributes are not yet automatically added to the nodes)
3. Choose reference, then planning and day 2 dose volumes
4. Create output volume
5. Click ‘Apply’

7/2. Accumulate doses registered = isocenter shift



1. Uncheck day 2 dose volume
2. Select registered day 2 dose
3. Create output volume
4. Click ‘Apply’

8/1. Compute dose volume histogram for unregistered



1. Go to module Radiotherapy / Dose Volume Histogram

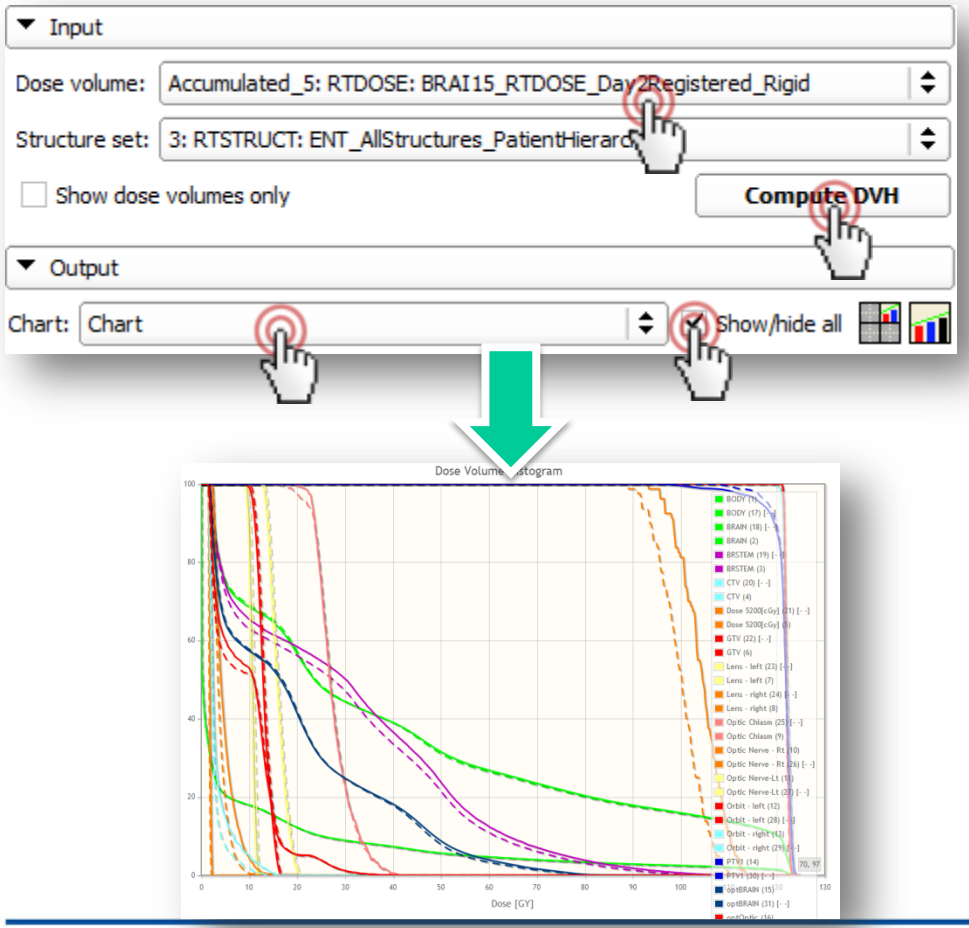
2. Choose unregistered accumulated dose

3. Uncheck ‘Show dose volumes only’

4. Choose
‘3: RTSTRUCT: ENT_AllStructures_PatientHierarchy’

5. Click ‘Compute DVH’

8/2. Compute dose volume histogram for registered



1. Choose registered accumulated dose

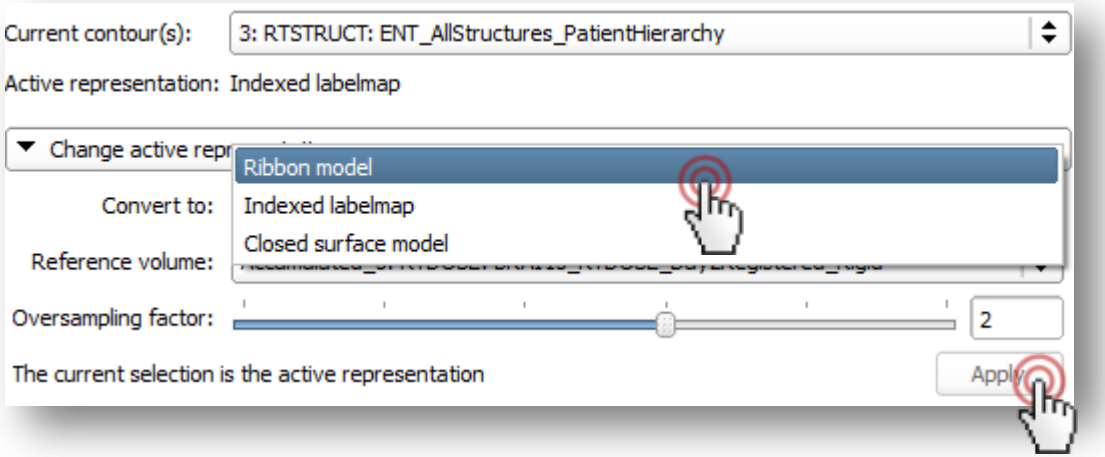
2. Click ‘Compute DVH’

3. Create chart

4. Click ‘Show/hide all’

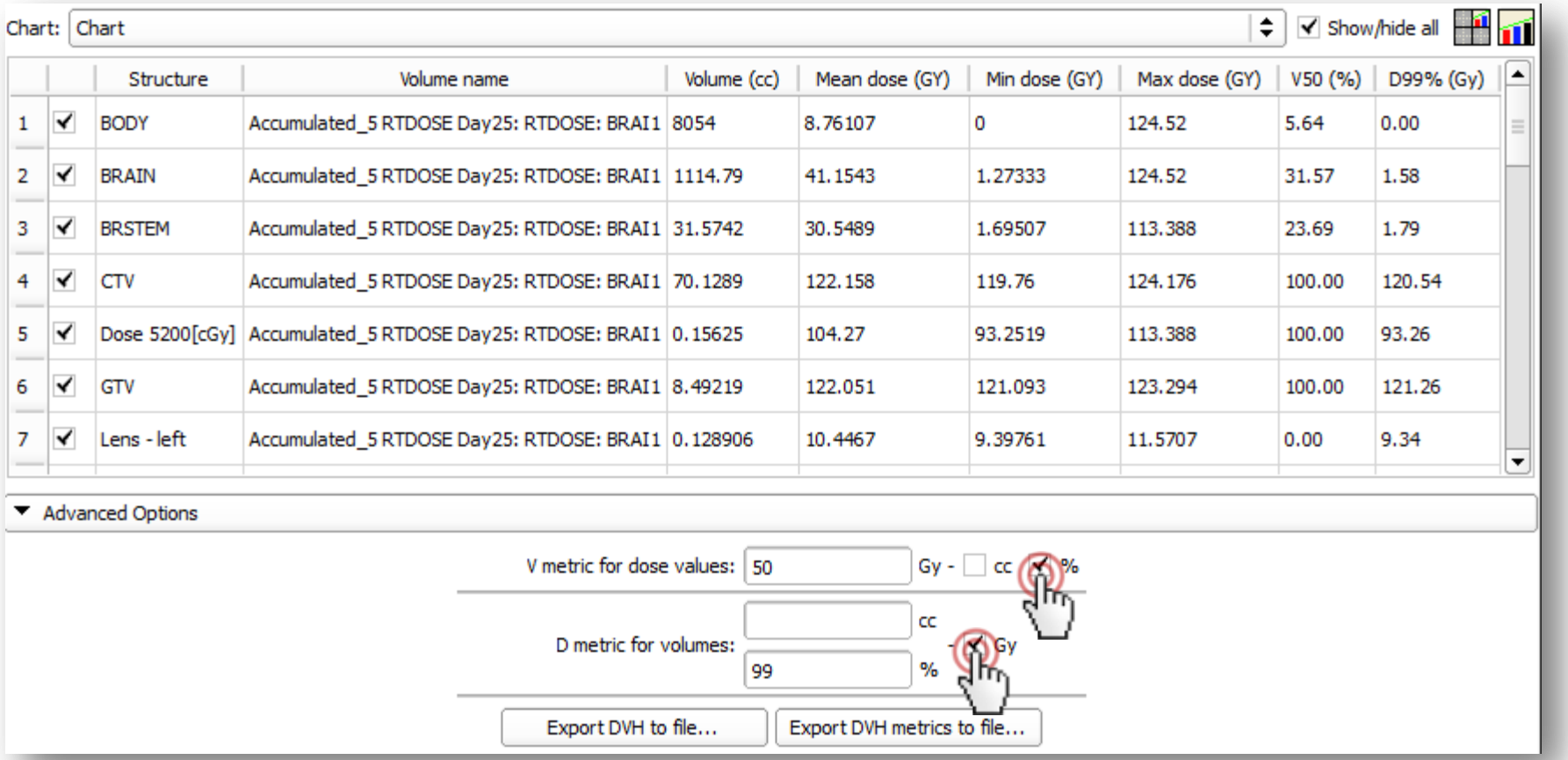
5. DVH curves appear

Note: Structures have been rasterized



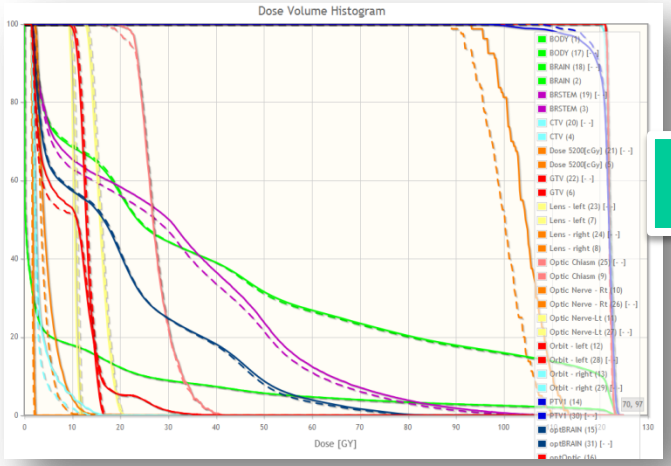
Structures are automatically rasterized during DVH computation. In this state, they can be seen as labelmaps over the volumes in the 2D viewers. To show the models again, convert back in the Radiotherapy / Contours module.

8/3. Quantify improvement

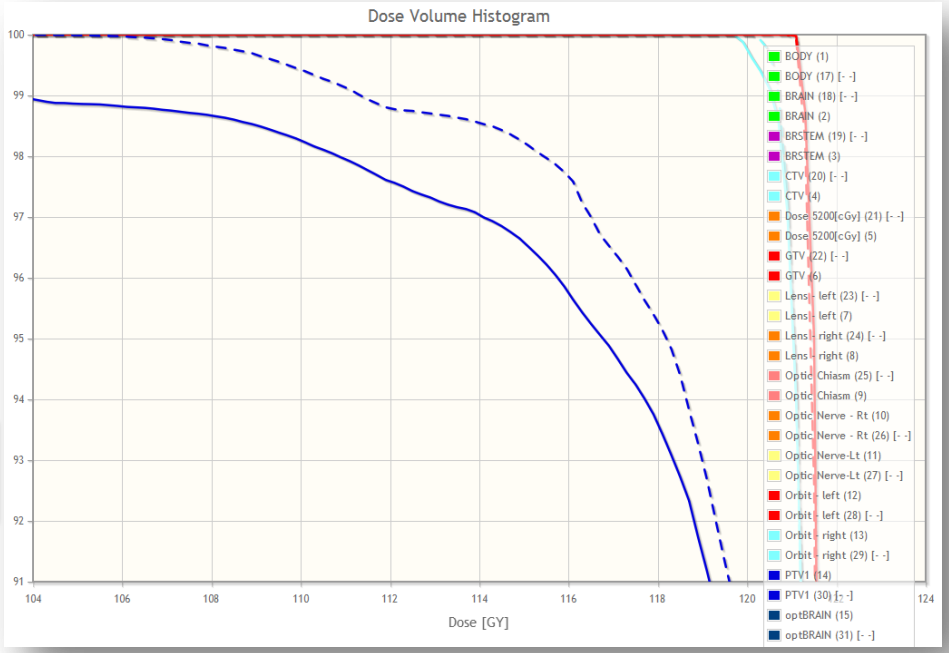


		Structure	Volume name	Volume (cc)	Mean dose (GY)	Min dose (GY)	Max dose (GY)	V50 (%)	D99% (Gy)
1	✓	BODY	Accumulated_5 RTDOSE Day25: RTDOSE: BRAI1	8054	8.76107	0	124.52	5.64	0.00
2	✓	BRAIN	Accumulated_5 RTDOSE Day25: RTDOSE: BRAI1	1114.79	41.1543	1.27333	124.52	31.57	1.58
3	✓	BRSTEM	Accumulated_5 RTDOSE Day25: RTDOSE: BRAI1	31.5742	30.5489	1.69507	113.388	23.69	1.79
4	✓	CTV	Accumulated_5 RTDOSE Day25: RTDOSE: BRAI1	70.1289	122.158	119.76	124.176	100.00	120.54
5	✓	Dose 5200[cGy]	Accumulated_5 RTDOSE Day25: RTDOSE: BRAI1	0.15625	104.27	93.2519	113.388	100.00	93.26
6	✓	GTV	Accumulated_5 RTDOSE Day25: RTDOSE: BRAI1	8.49219	122.051	121.093	123.294	100.00	121.26
7	✓	Lens - left	Accumulated_5 RTDOSE Day25: RTDOSE: BRAI1	0.128906	10.4467	9.39761	11.5707	0.00	9.34

8/4. Visualize improvement



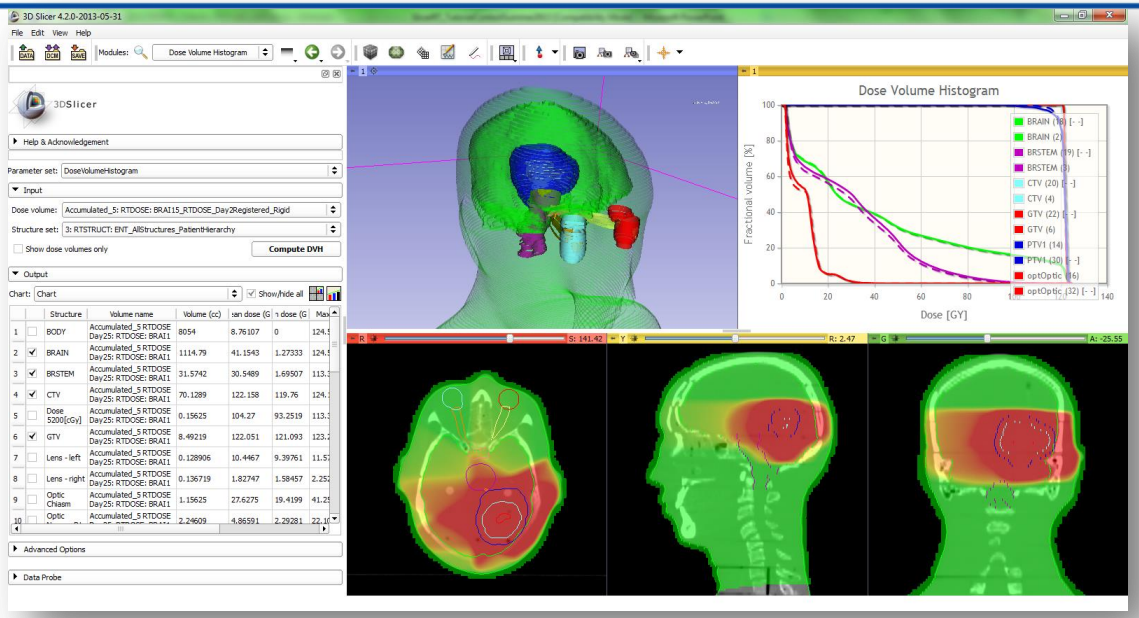
Zoom



Conclusion

Creating and performing radiation therapy research workflows are easy using the BRAINS registration tools along with the numerous SlicerRT modules

Reference and webpage



- Overview paper: Csaba Pinter, Andras Lasso, An Wang, David Jaffray, and Gabor Fichtinger, “SlicerRT: Radiation therapy research toolkit for 3D Slicer”, Med. Phys. 39 (10), October 2012
- Project homepage: http://www.SlicerRT.org/

Acknowledgments

National Alliance for Medical Image Computing

NIH U54EB005149

Cancer Care Ontario

SparKit

(Software Platform and Adaptive Radiotherapy Kit)