Tutorial:

Isocenter shifting image-guidance in SlicerRT

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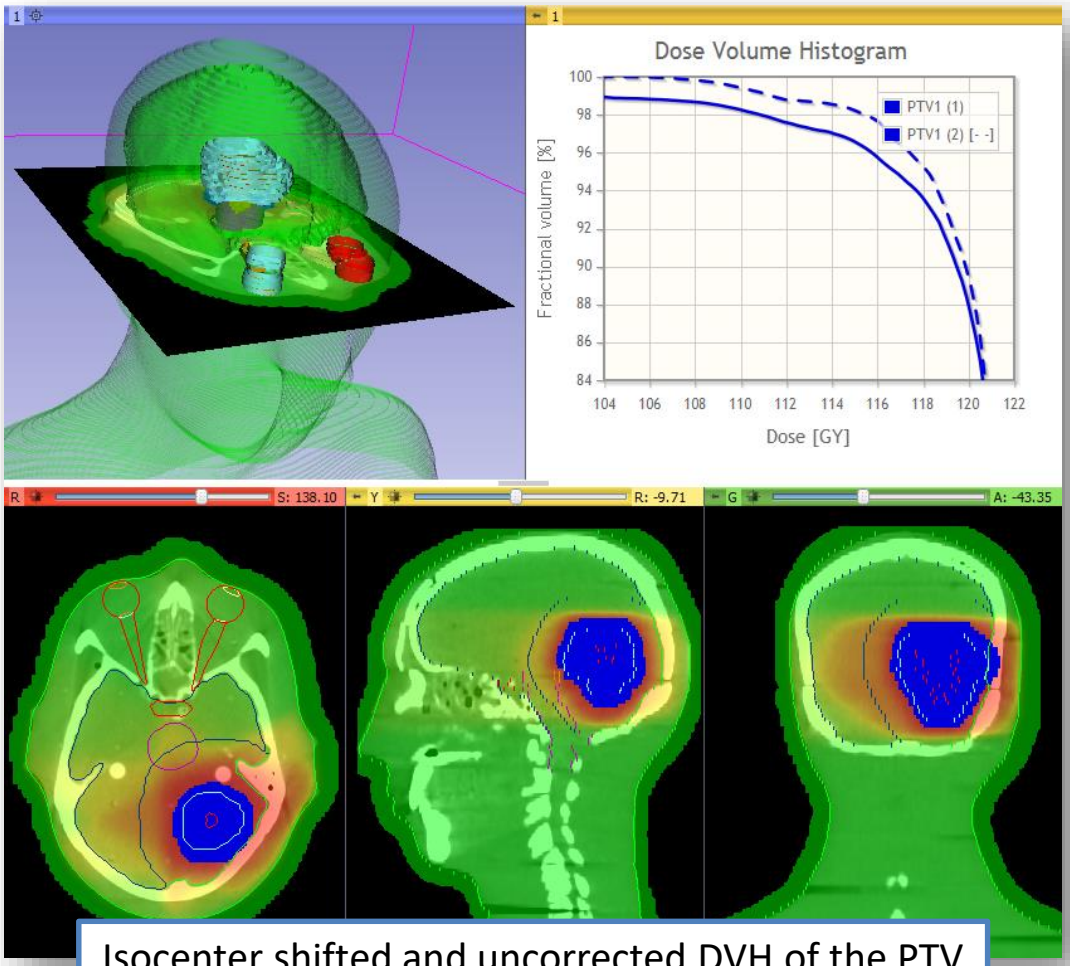
Learning objective

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

Isocenter shifting image-guidance



Isocenter shifted and uncorrected DVH of the PTV

Material

- Dataset available on the Slicer Training page:

  https://www.slicer.org/wiki/Documentation/Nightly/Training#Slicer4_Radiation_Therapy_Tutorial

- Supported platforms:

   Windows,  Mac OSX,  Linux

  – 32-bit is not supported!

Overview

1. Install SlicerRT extension
2. Load data from DICOM and nrrd files
3. Perform rigid registration on CT images
4. Transform day 2 dose volume
5. Accumulate dose distributions
6. Compute dose volume histogram

+1. Create isodose lines and surfaces

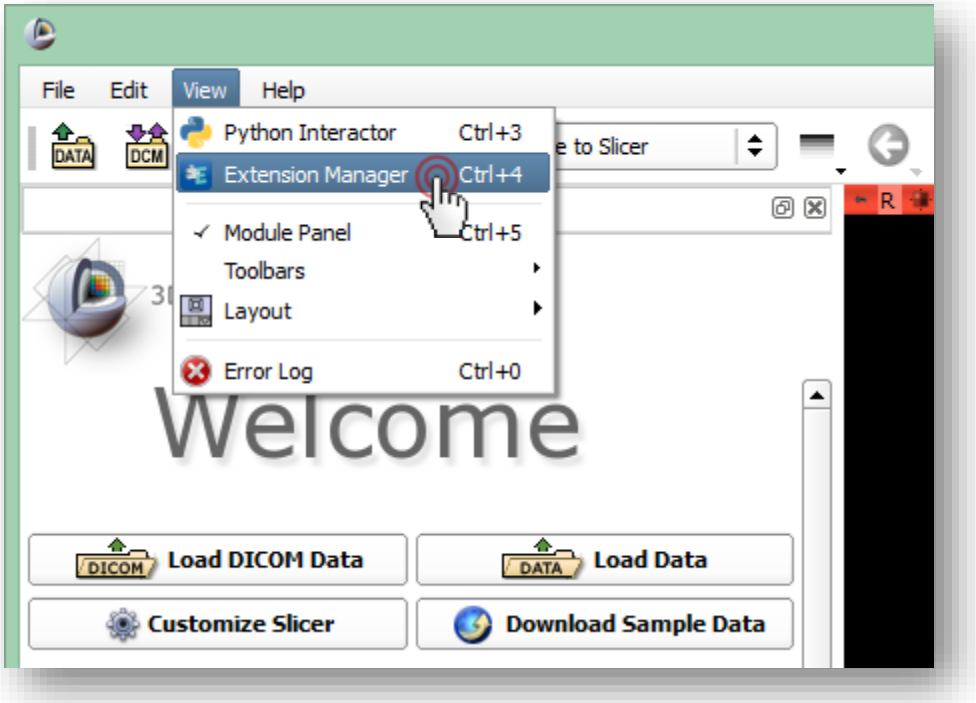
+2. Compare dose distributions using gamma

1/1. Install 3D Slicer

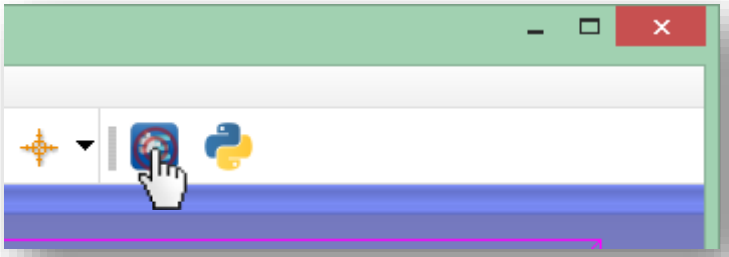
- Download latest 3D Slicer from http://download.slicer.org

- Follow the usual steps to install an application
  - Different for each operating system

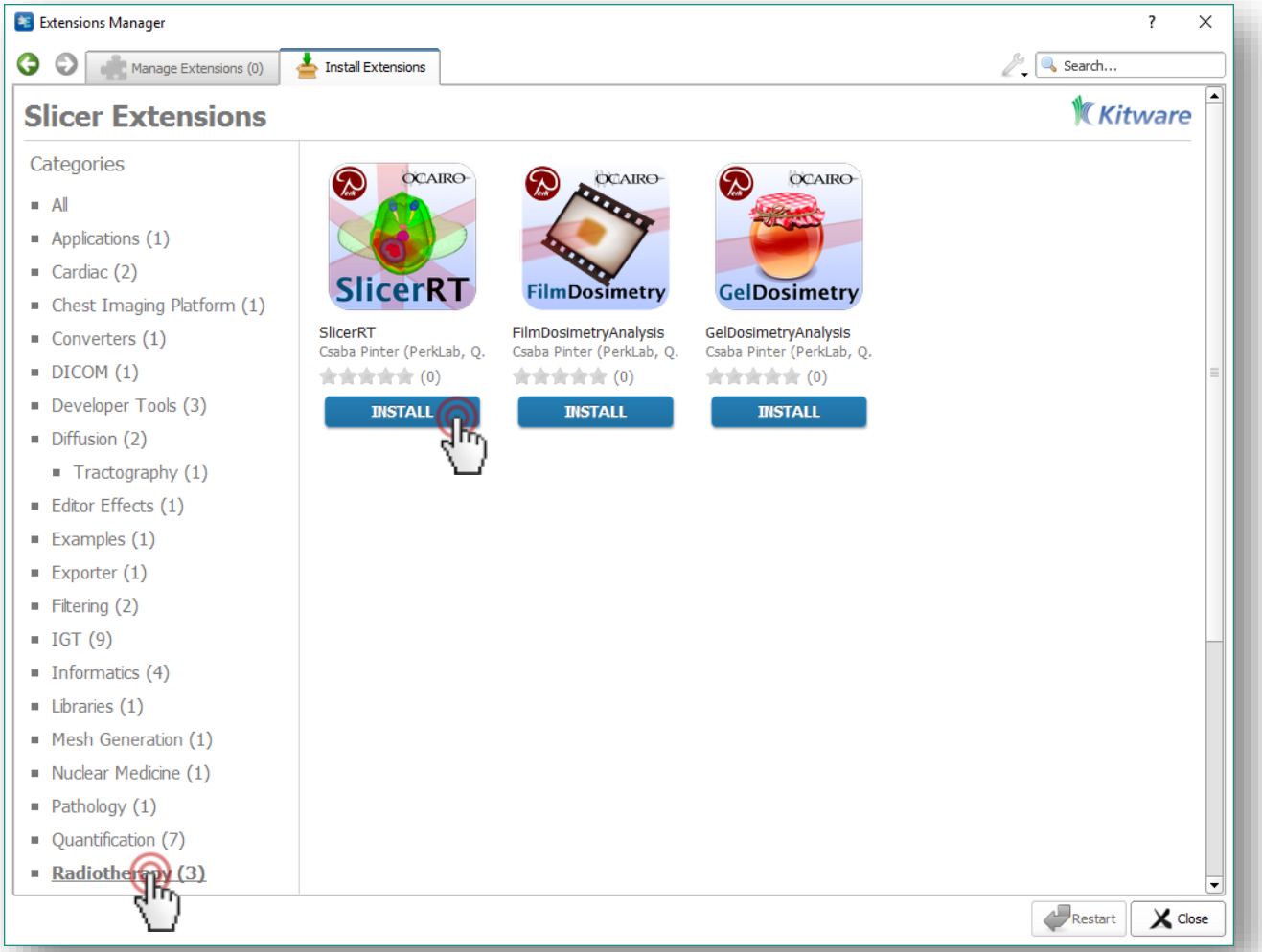
1/2. Install SlicerRT extension



or



1/3. Install SlicerRT extension



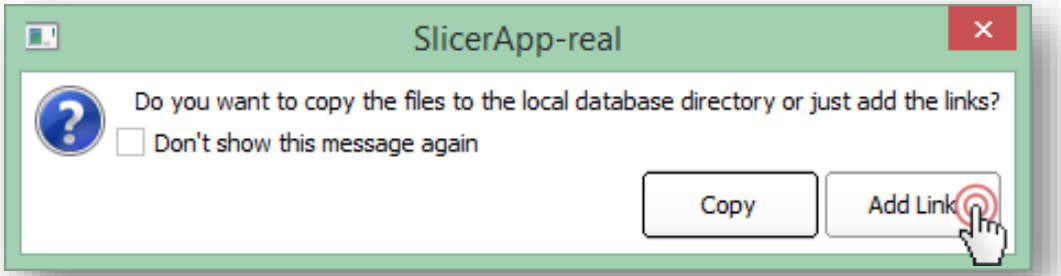
2/1. Unpack tutorial datasets

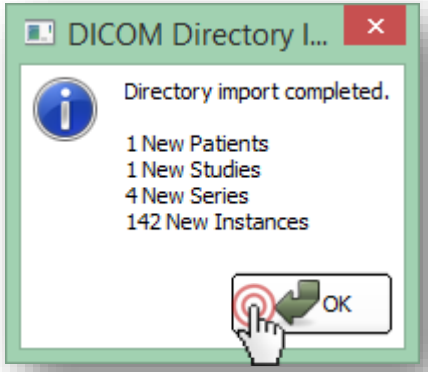
- Find the dataset you downloaded named *SlicerRT_WorldCongress_TutorialIGRT_Dataset.zip*
- Unpack it to a local folder of your choice
  - Different for each operating system

2/2. Import planning DICOM data

Drag&drop folder named *EclipseEntPhantomRtData* onto Slicer

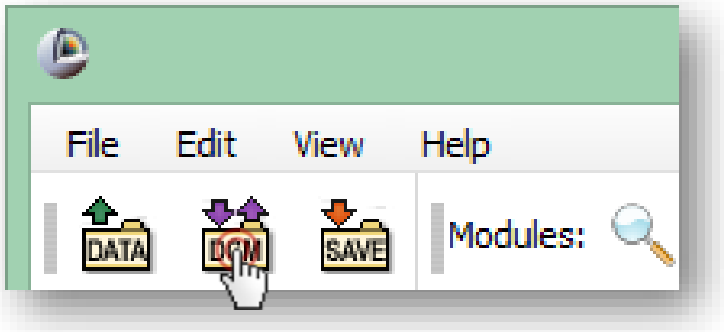
You'll be prompted for database folder here



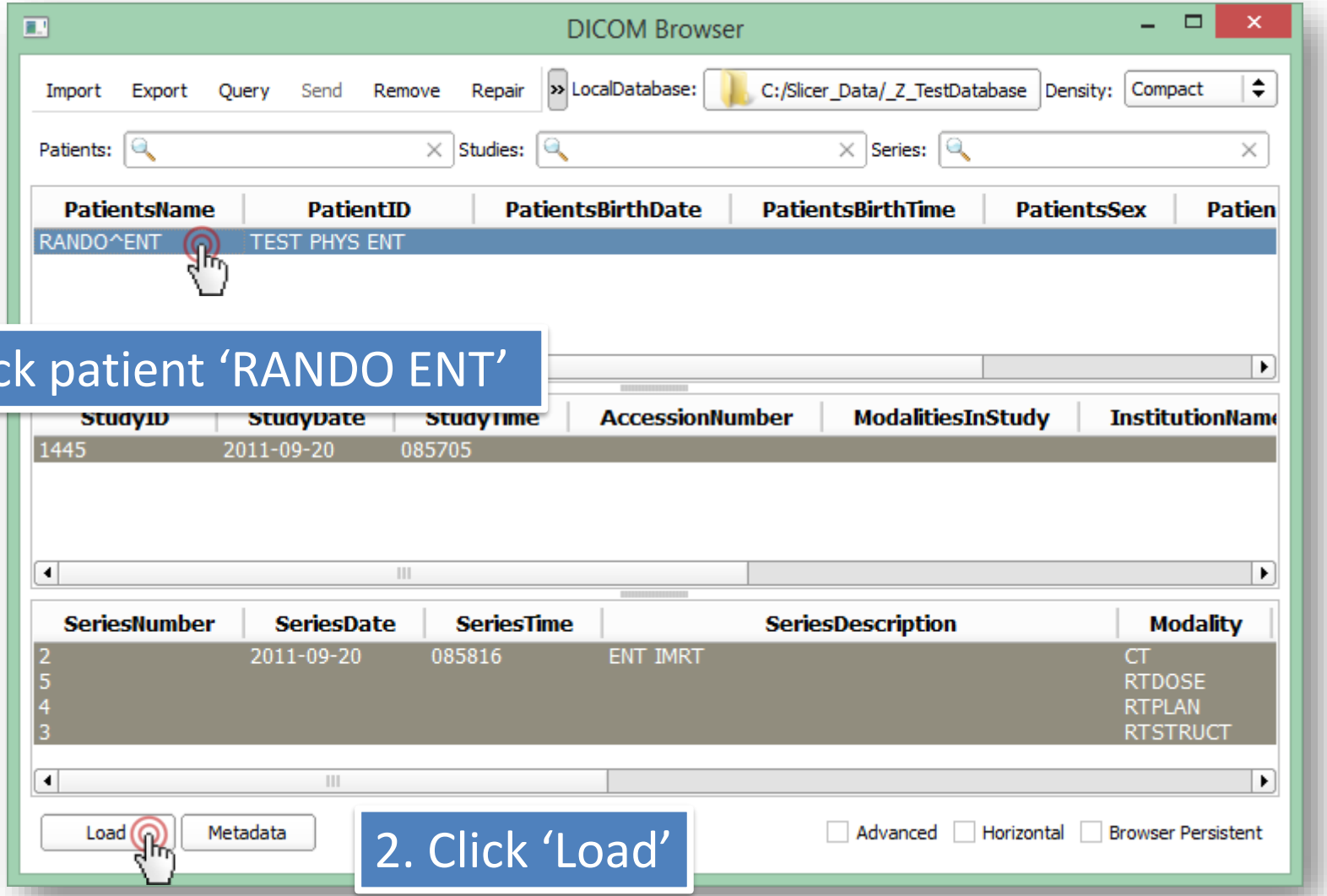


Note

If not importing via drag&drop, DICOM data can be imported and loaded from the DICOM browser that can be opened from the toolbar



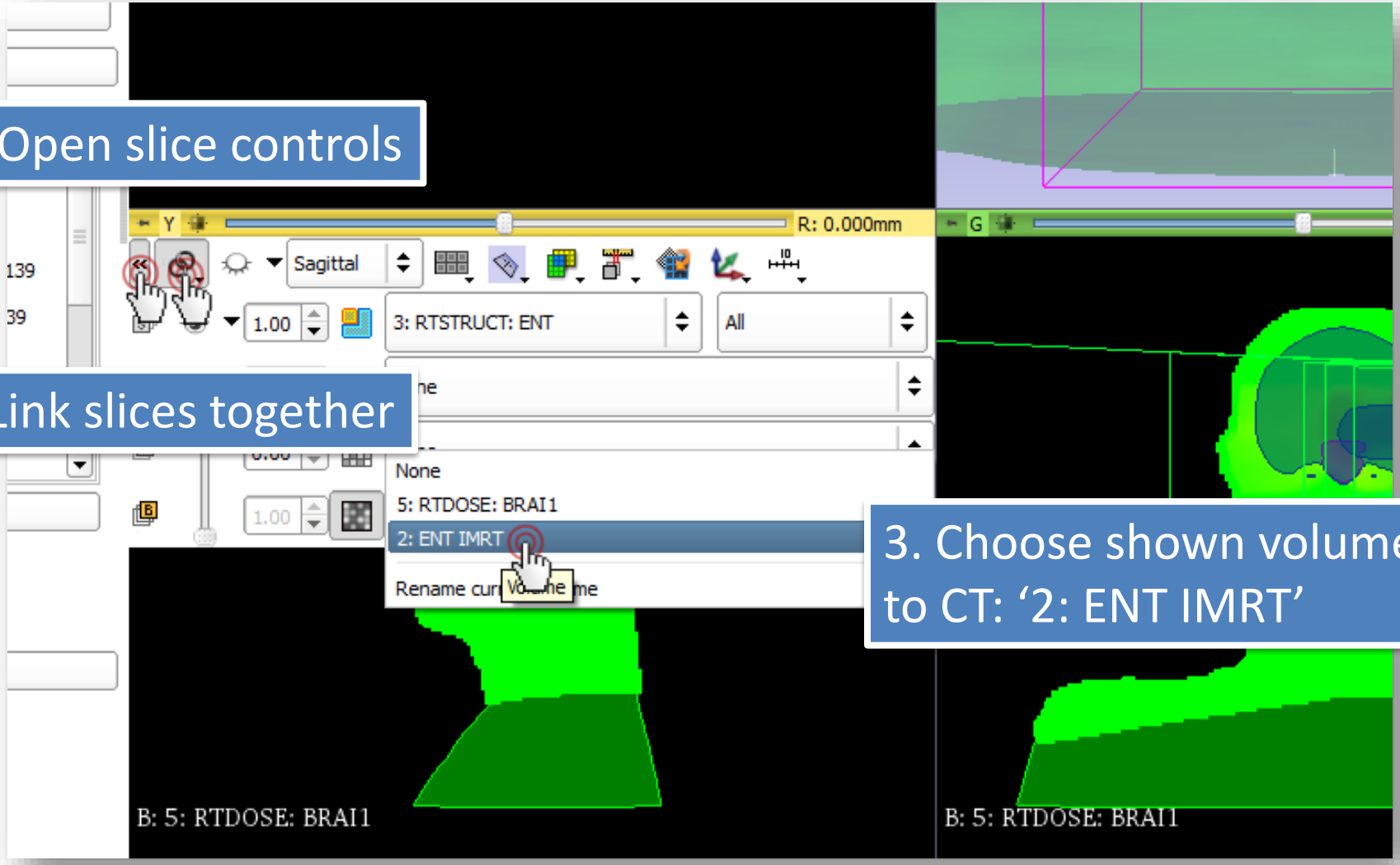
2/3. Load planning study



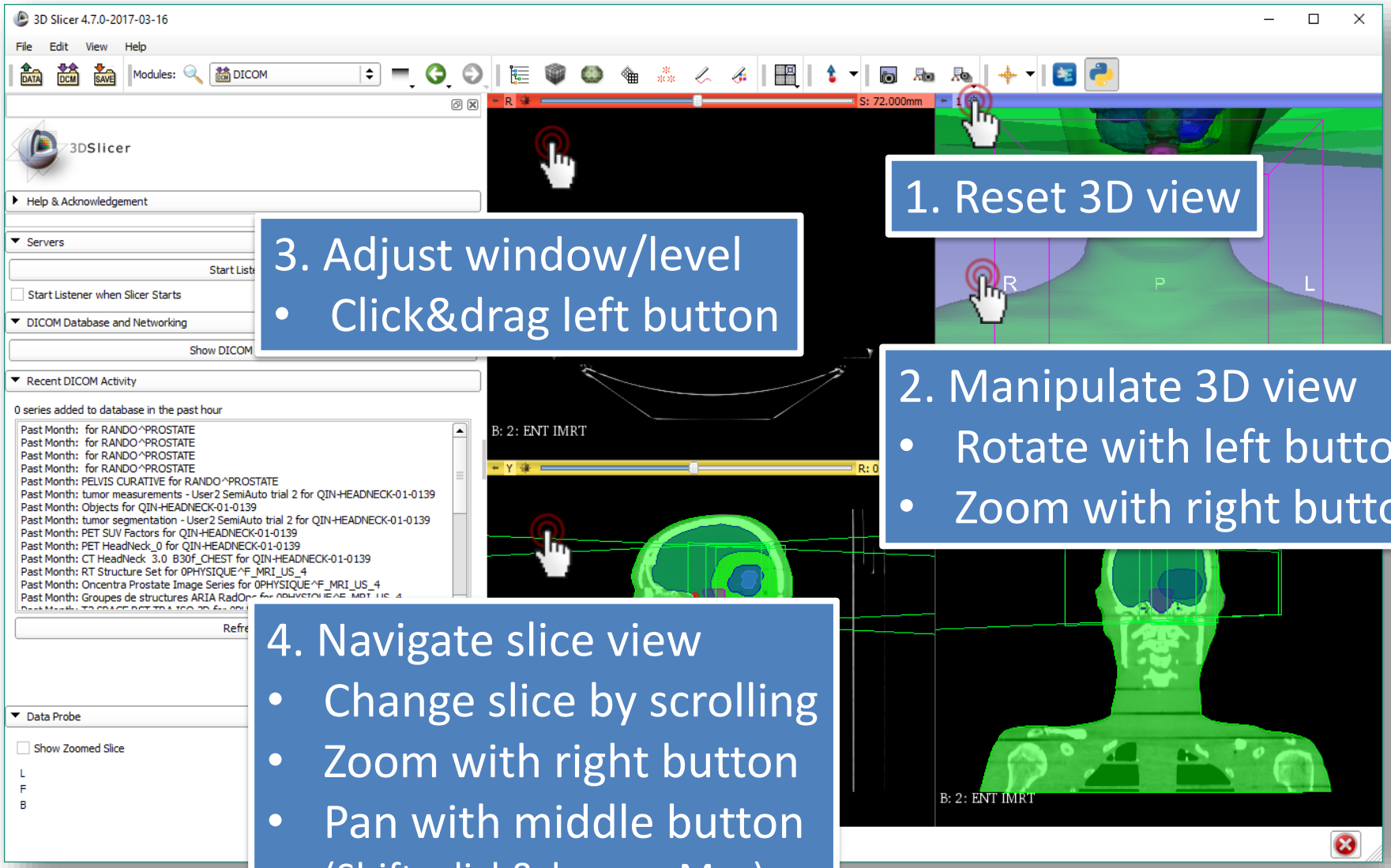
1. Click patient 'RANDO ENT'

2. Click 'Load'

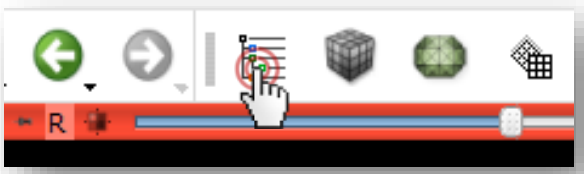
2/4. Change shown volumes

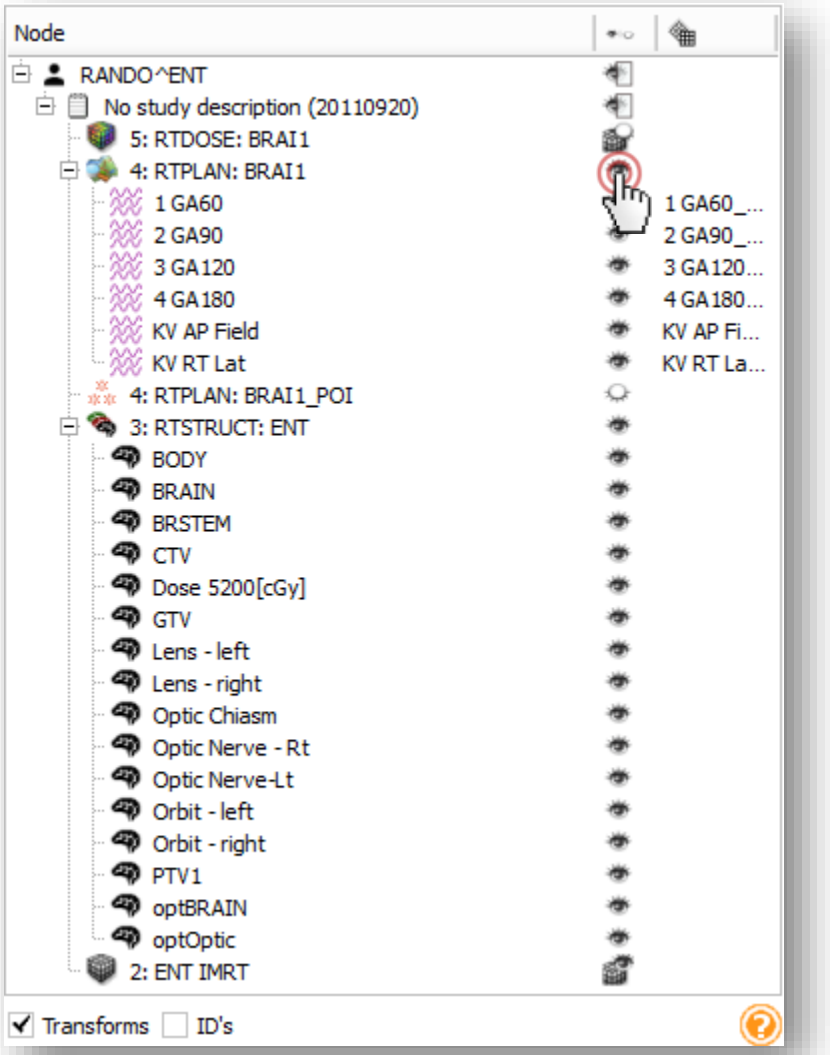


2/5. Tweak display



2/6. Explore loaded data



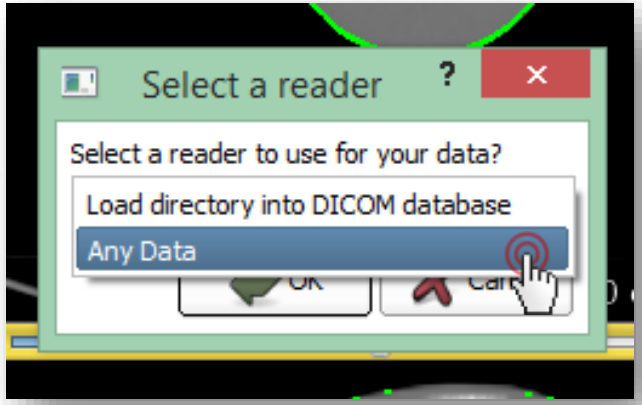


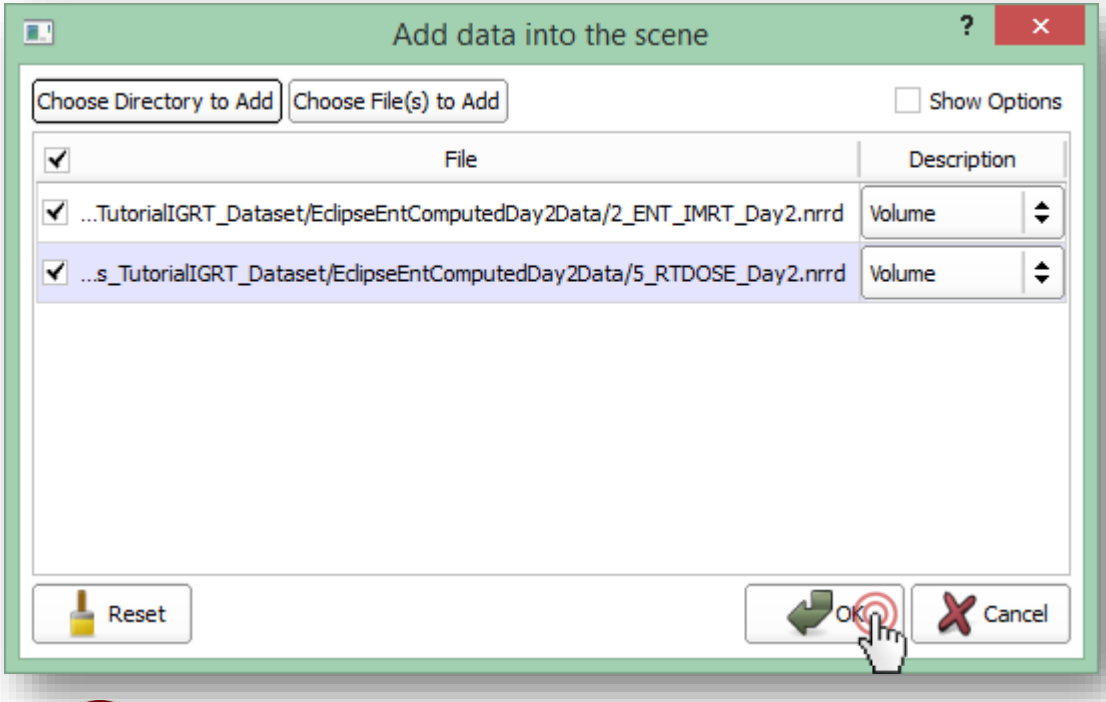
Subject hierarchy:

- Explore data in tree view
- Show/hide branches clicking the eye buttons
- Access options by right click

2/7. Load day 2 data

Drag&drop folder named *EclipseEntComputedDay2Data* onto Slicer



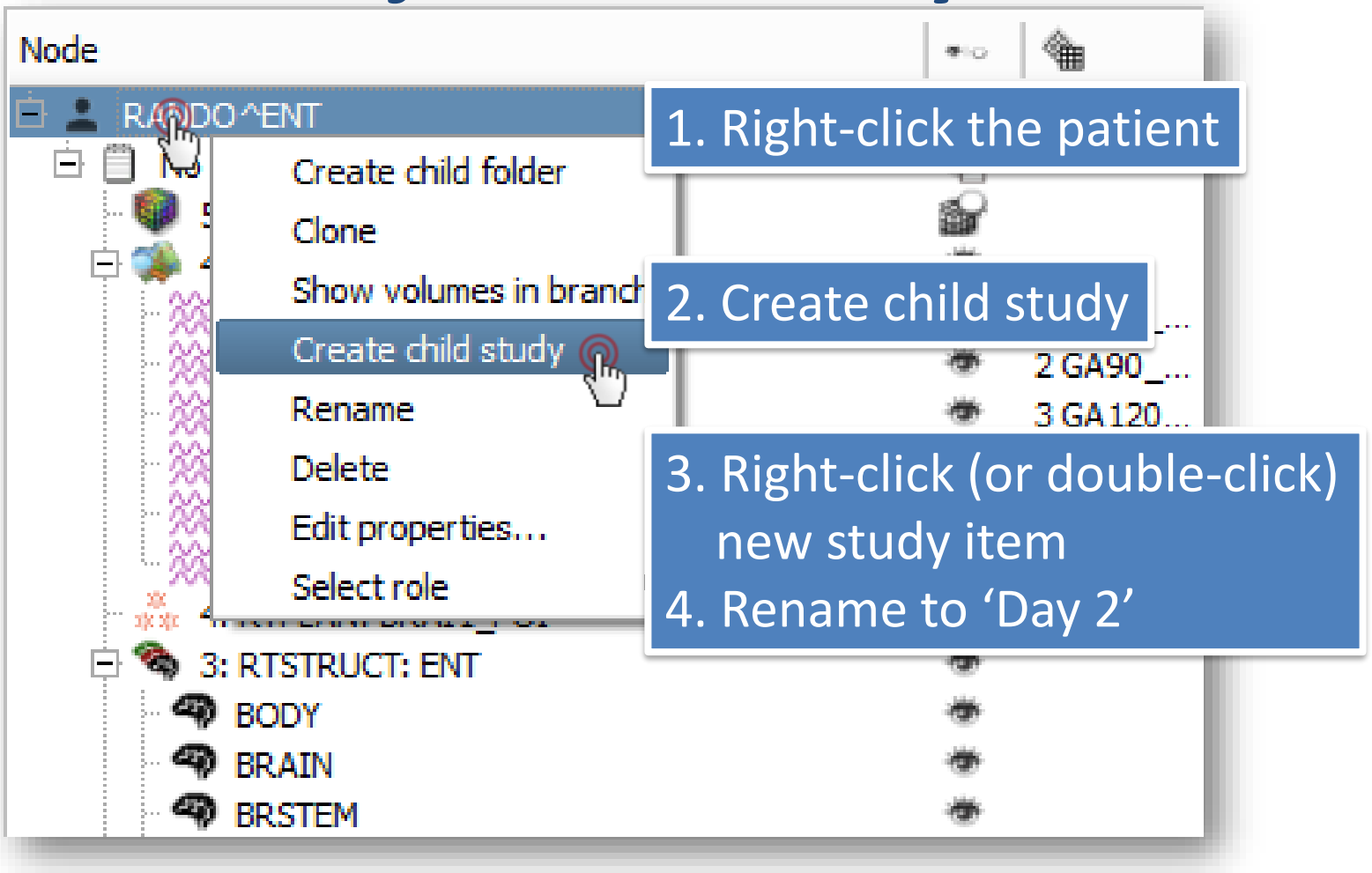


Note

- Data type selection dialog does not appear if you drag&drop files rather than folders, as files will be handled as non-DICOM
- Non-DICOM data can be also loaded in the dialog that appears after clicking

- Data can be saved using

2/8. Add day 2 non-DICOM data to subject hierarchy

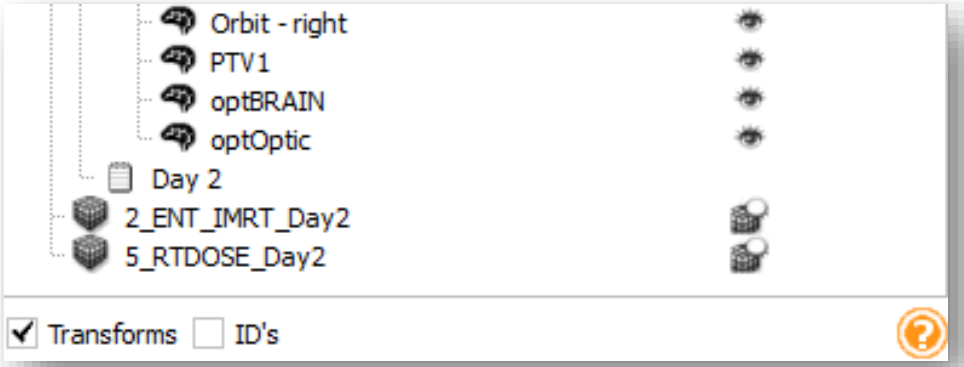


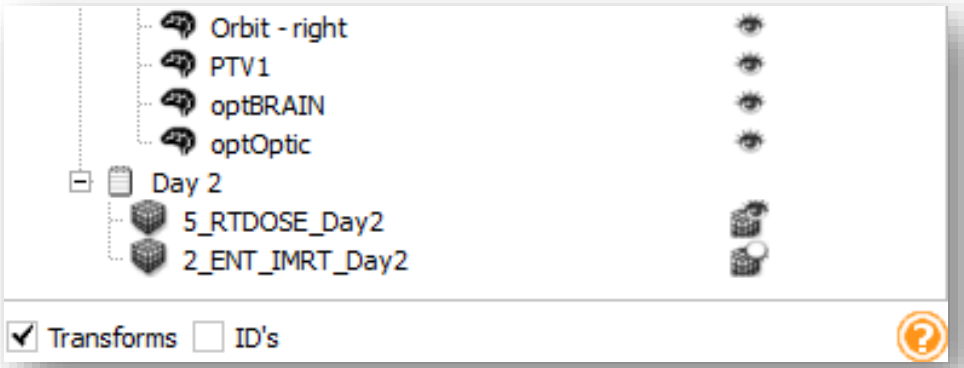
2/9. Add day 2 non-DICOM data to subject hierarchy

1. Drag&drop '2_ENT_IMRT_Day2' on the study 'Day 2'

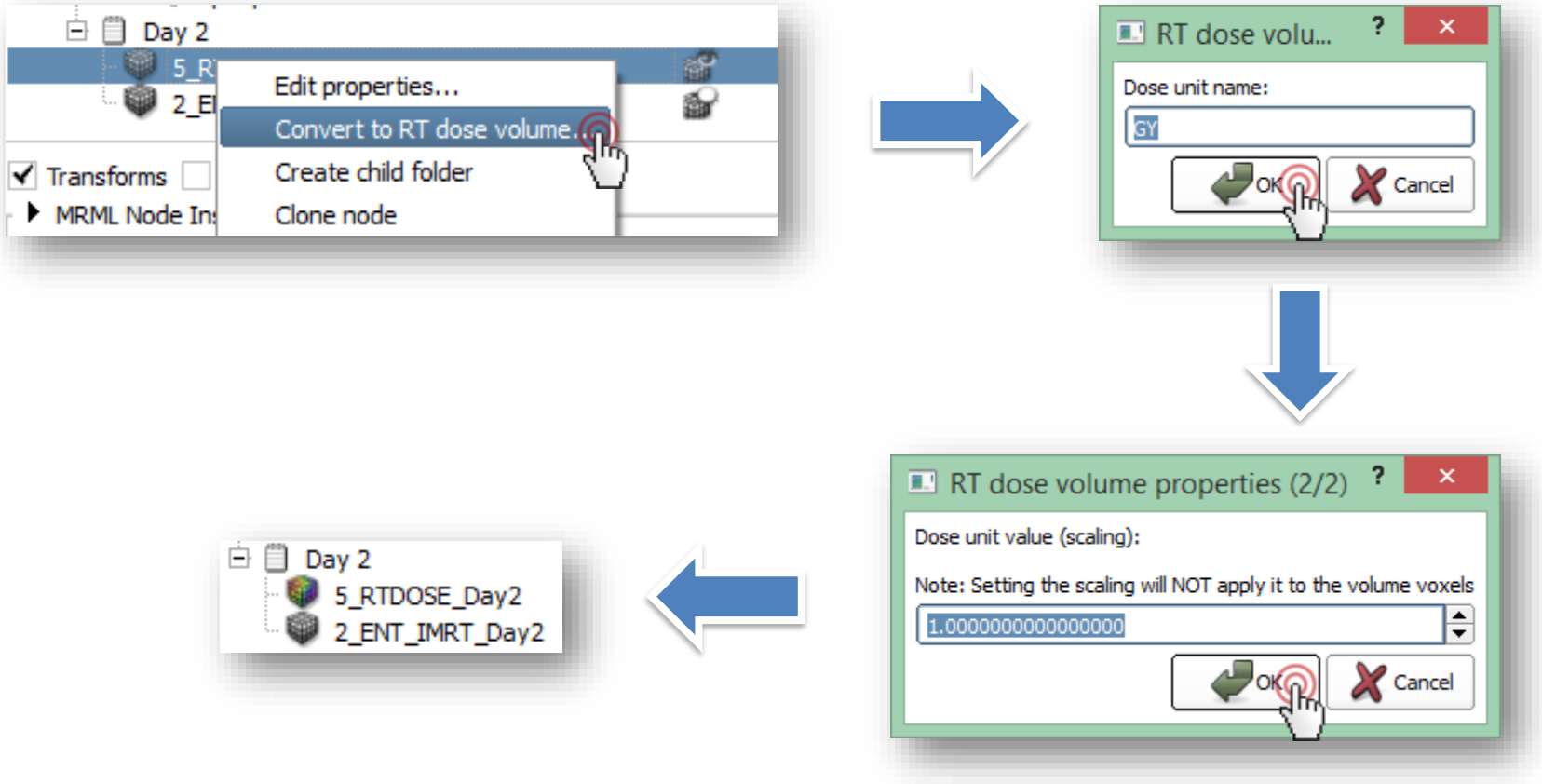
2. Do the same with '5_RTDOSE-Day2'

Note: You can select both nodes while holding the Control/Cmd or Shift button, then drag&drop both at the same time

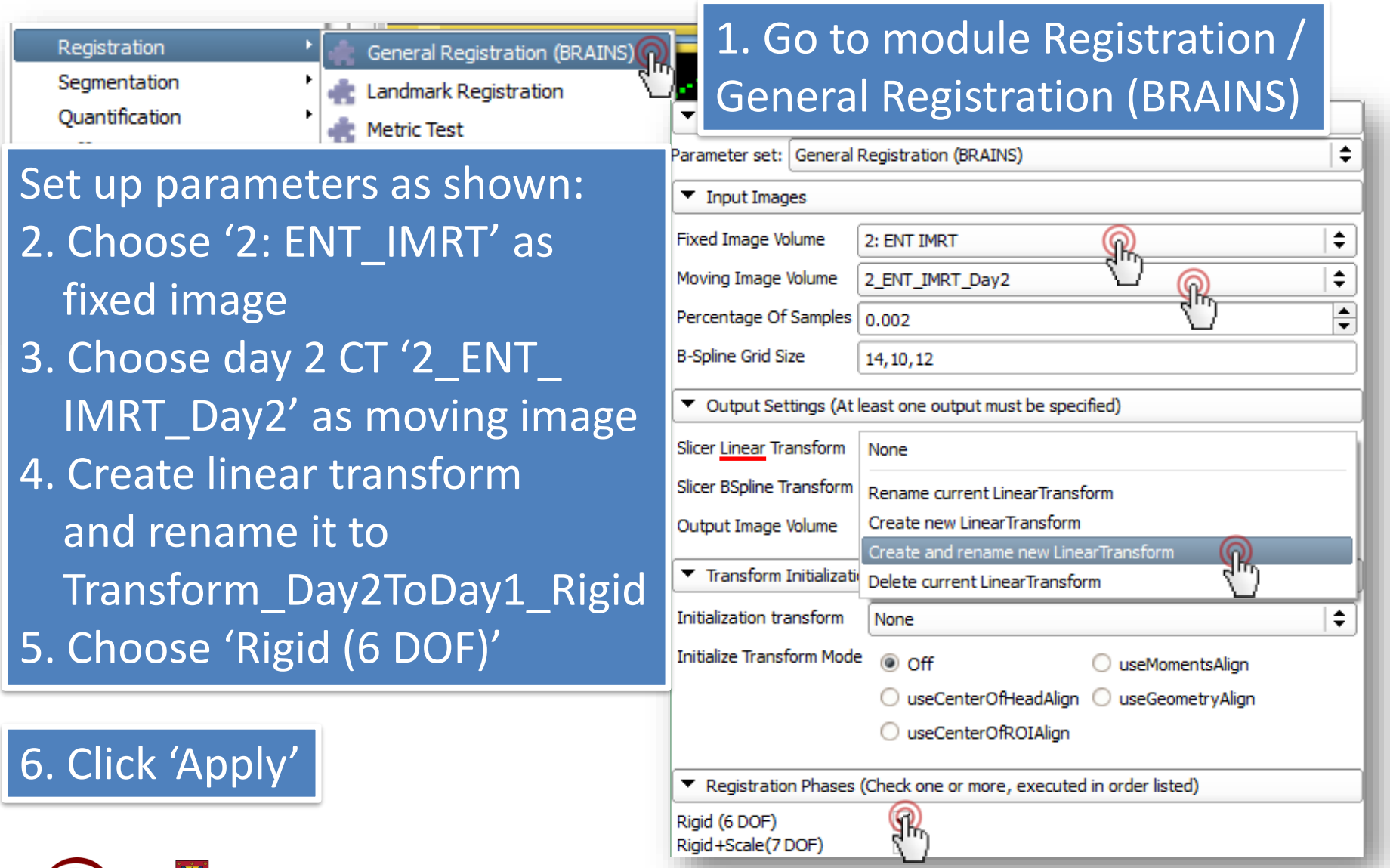




2/10. Convert day 2 dose volume actually a dose



3/1. Register CT volumes



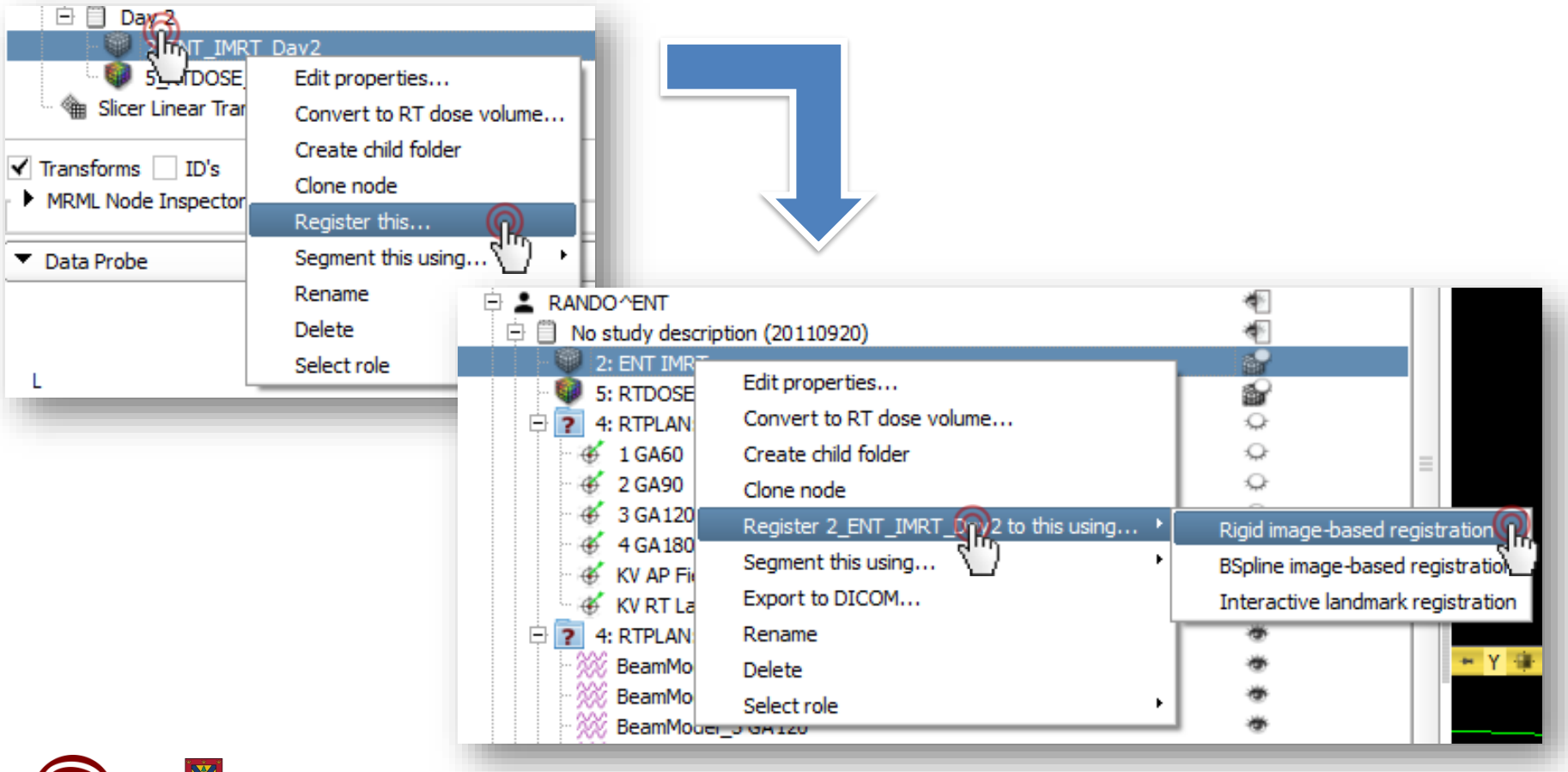
Set up parameters as shown:

2. Choose '2: ENT_IMRT' as fixed image
3. Choose day 2 CT '2_ENT_IMRT_Day2' as moving image
4. Create linear transform and rename it to Transform_Day2ToDay1_Rigid
5. Choose 'Rigid (6 DOF)'

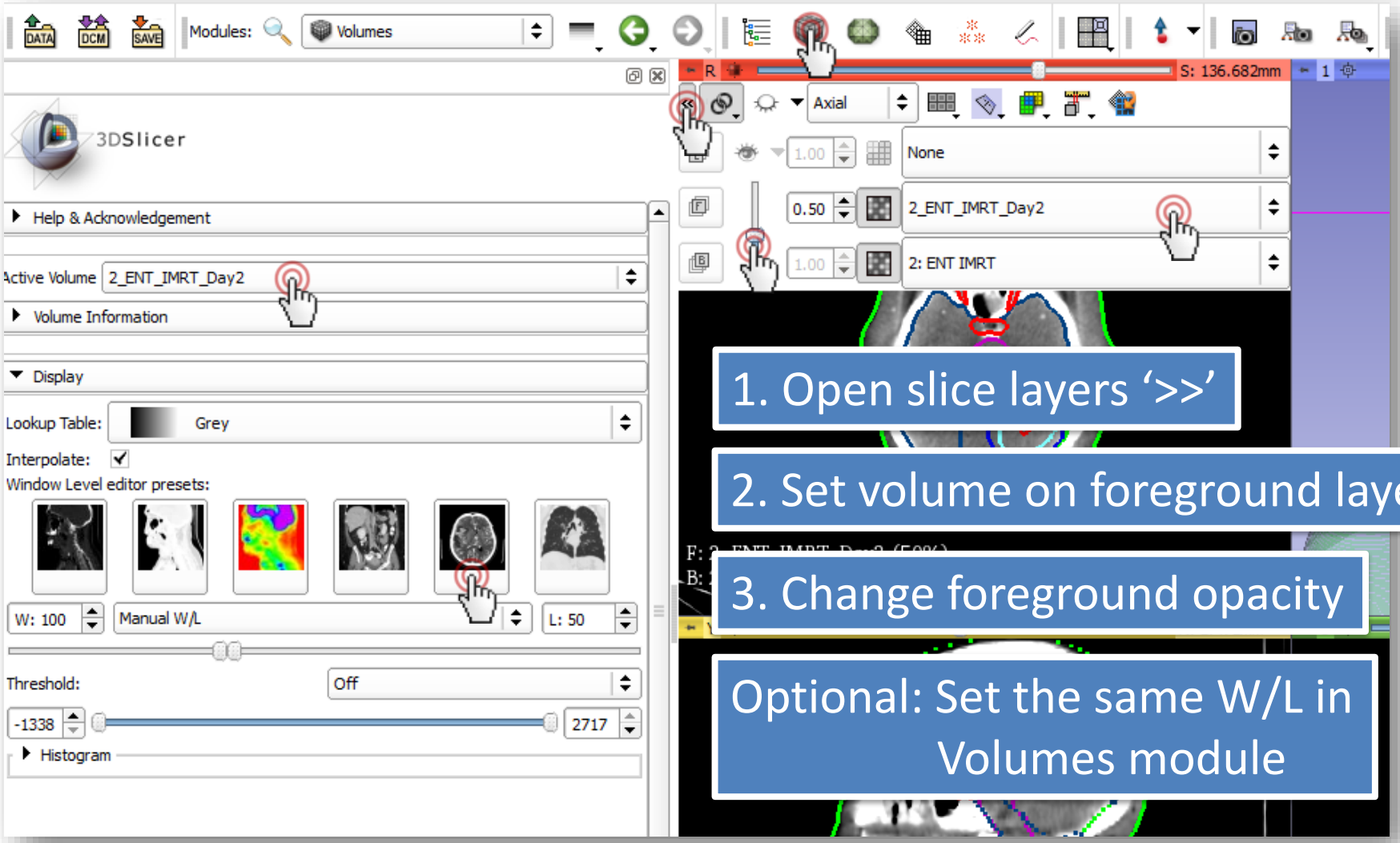
6. Click 'Apply'

Note

You can also initiate registration from subject hierarchy (alternative way for previous step):

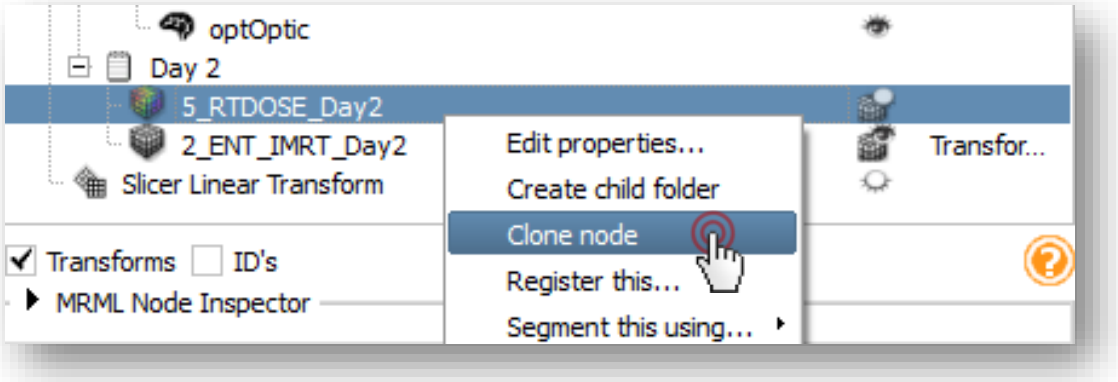


3/2. Explore volume differences



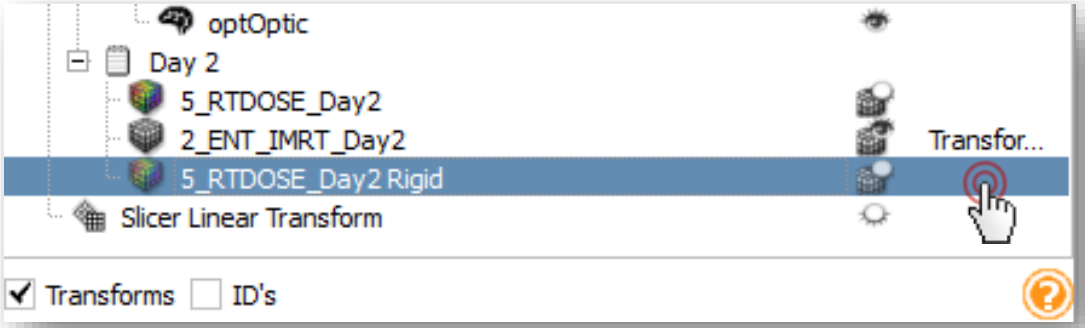
4/1. Clone dose volume

To be able to compare the non-registered (= uncorrected) and the registered (= isocenter shifted) results.



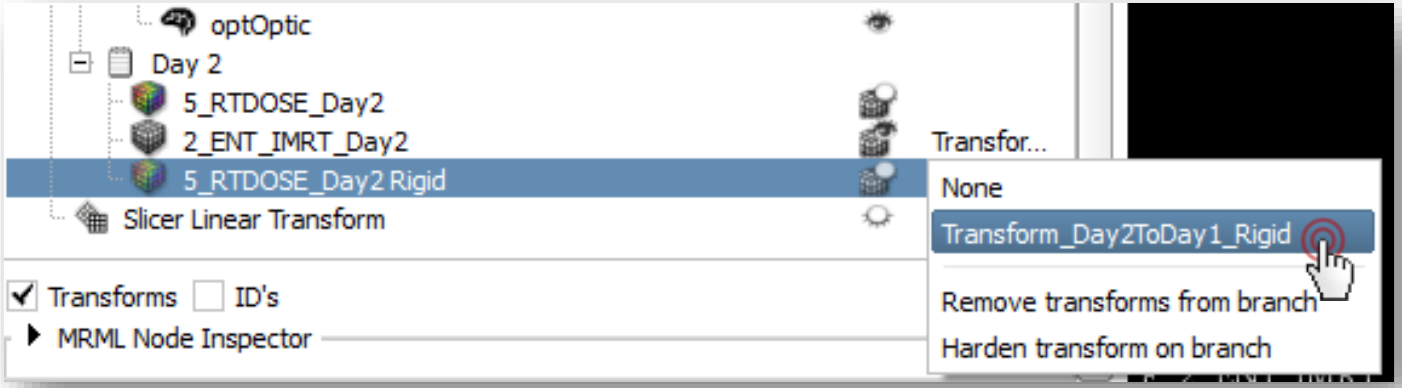
1. Switch to Subject hierarchy
2. Select ‘Clone node’ in context menu for day 2 dose
3. Rename it to ‘5_RTDOSE_Day2 Rigid’

4/2. Transform cloned dose volume



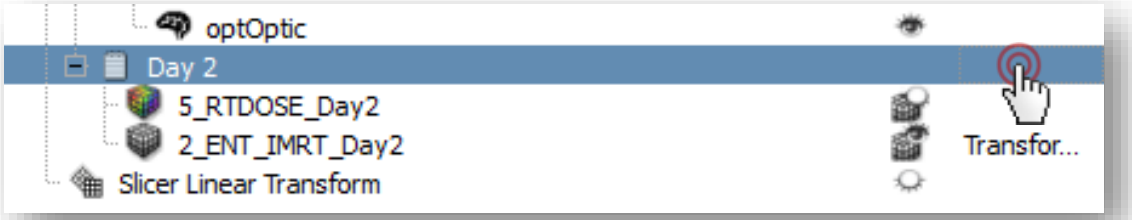
1. Double-click transform column of cloned dose

2. Click 'None' to open drop-down



Note

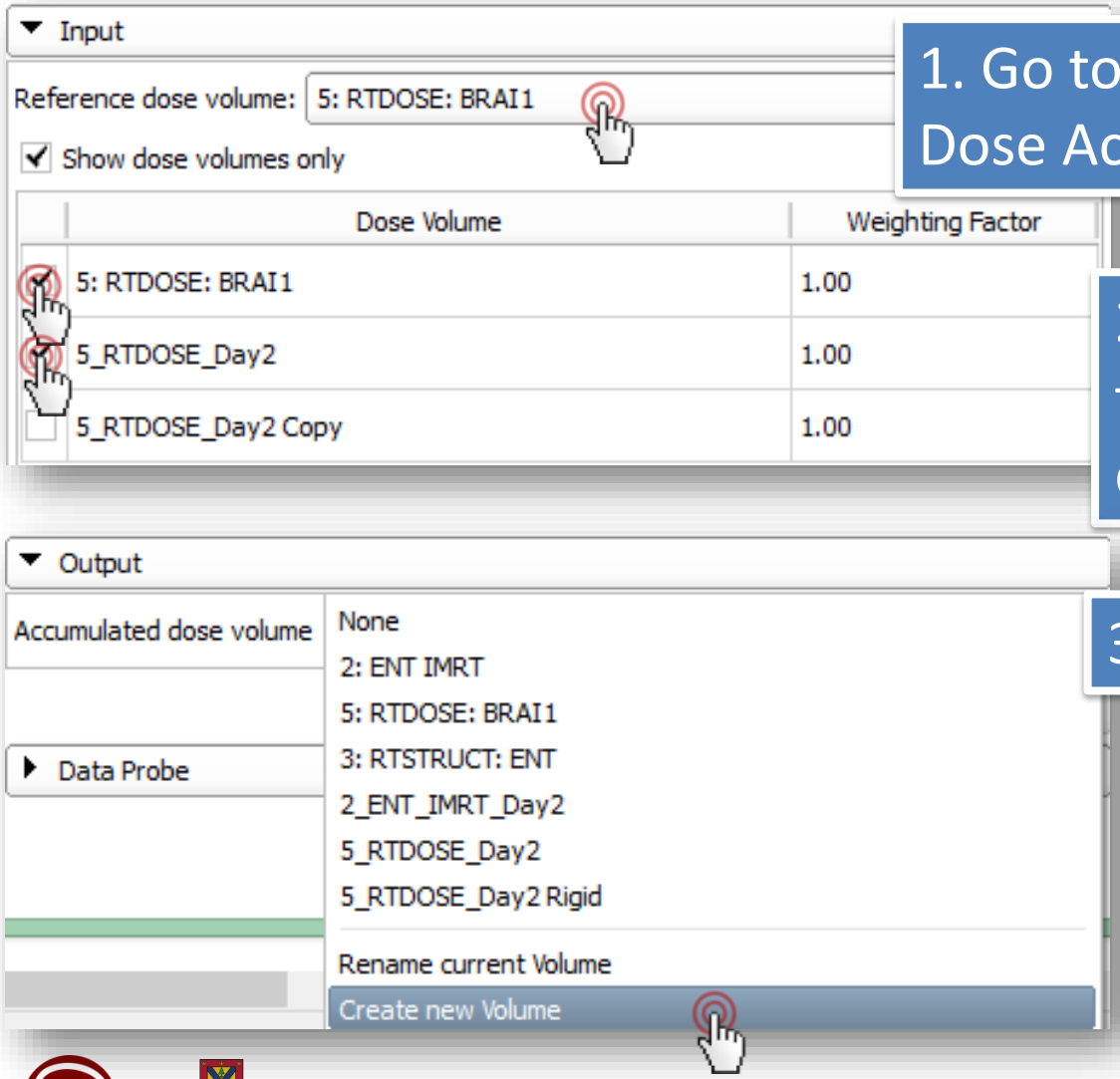
We can transform the whole study too if we want to transform multiple objects
(an alternative way for previous step):



1. Double-click transform column of study

2. Click ‘None’ to open drop-down

5/1. Accumulate dose distributions



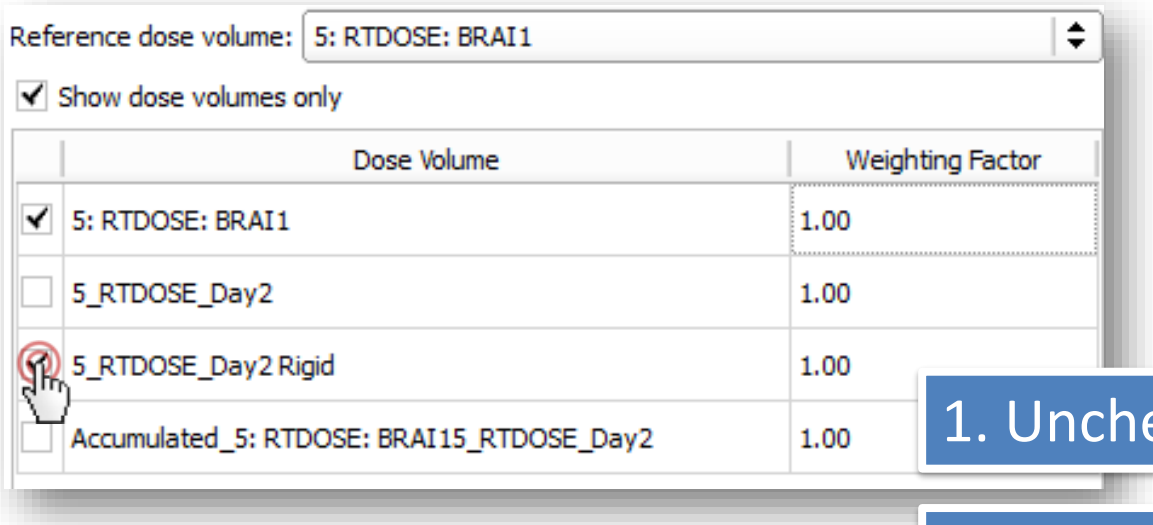
1. Go to module Radiotherapy / Dose Accumulation

2. Choose reference, then planning and day 2 dose volumes

3. Create output volume

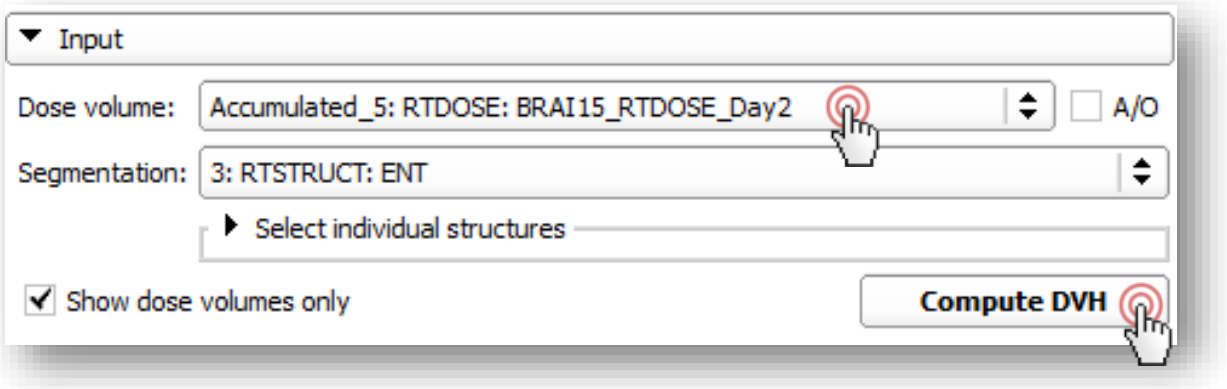
4. Click 'Apply'

5/2. Accumulate dose distributions



1. Uncheck day 2 dose volume
2. Select registered day 2 dose
3. Create new output volume
4. Click 'Apply'

6/1. Compute DVH for unregistered



1. Go to module Radiotherapy / Dose Volume Histogram

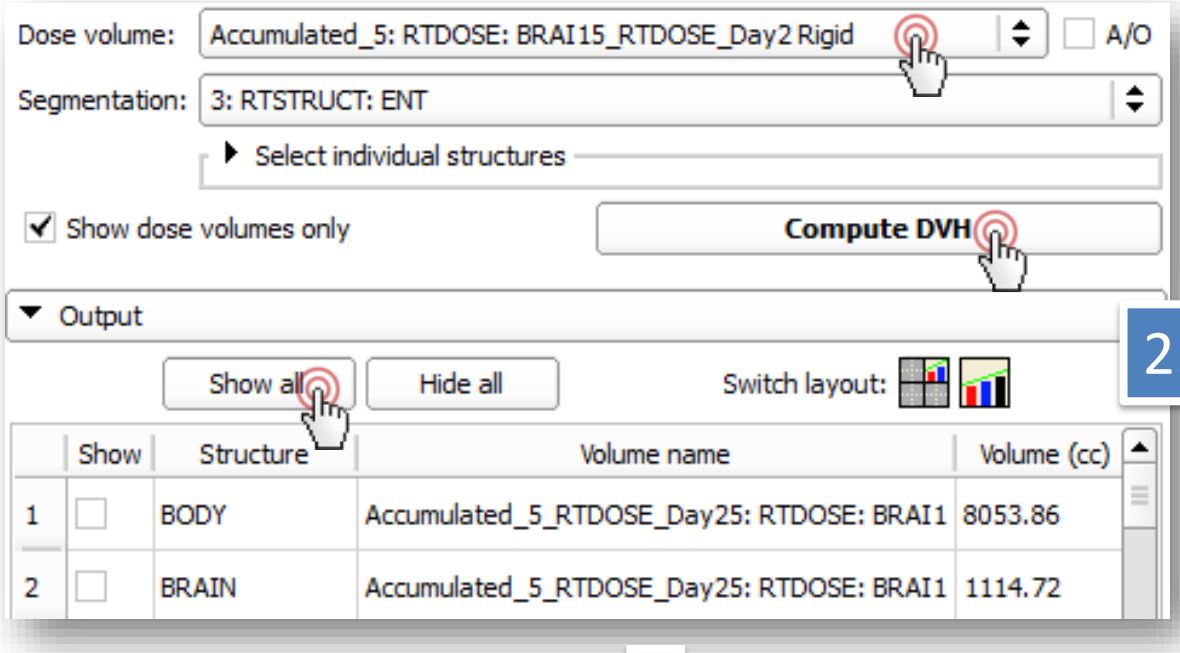
2. Choose unregistered accumulated dose

3. Choose '3: RTSTRUCT: ENT'

Optional: Choose individual structures to speed up computation

4. Click 'Compute DVH'

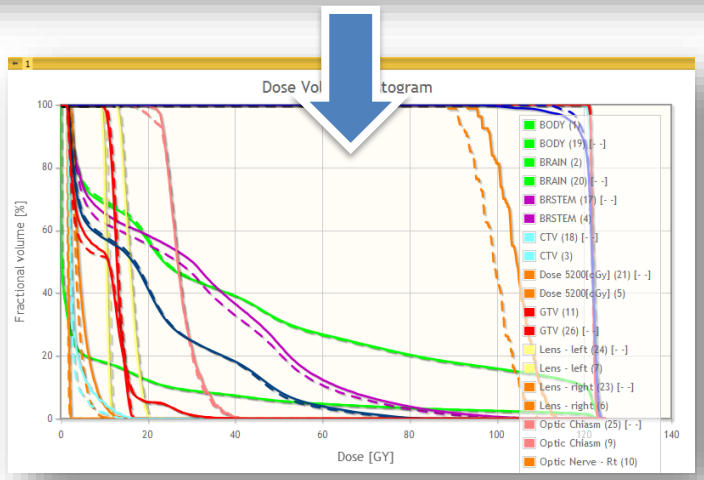
6/2. Compute DVH for registered



1. Choose registered accumulated dose

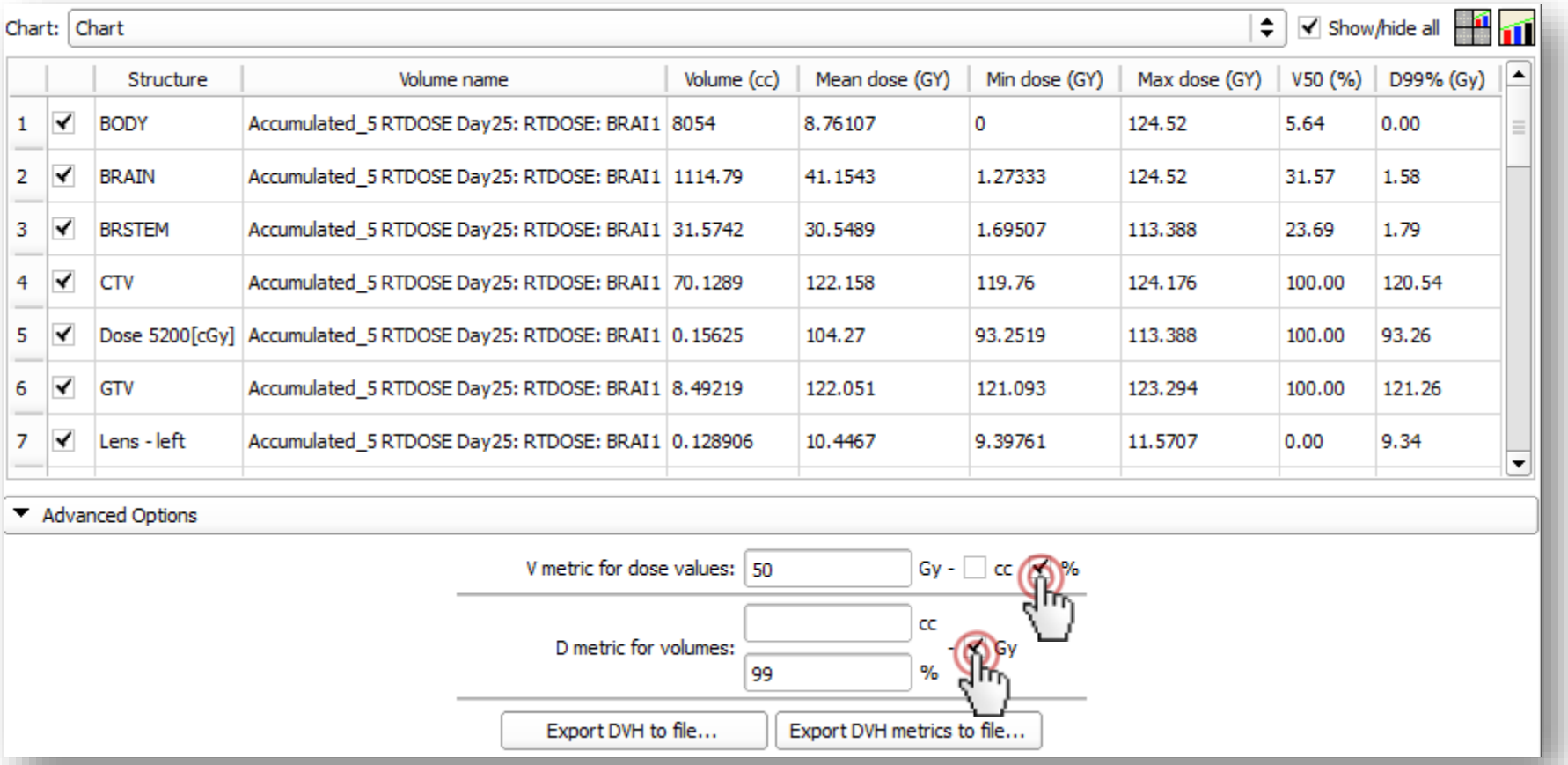
2. Click ‘Compute DVH’

3. Click ‘Show all’

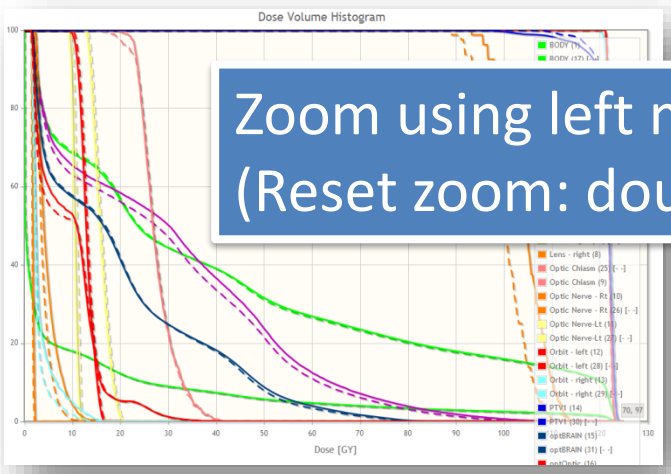


DVH curves appear

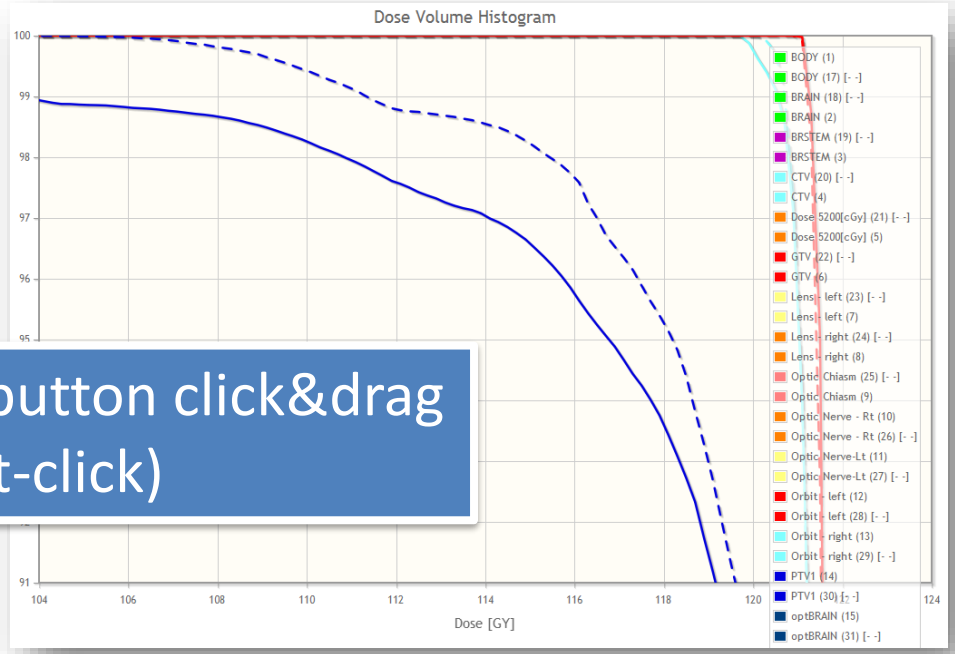
6/3. Quantify improvement



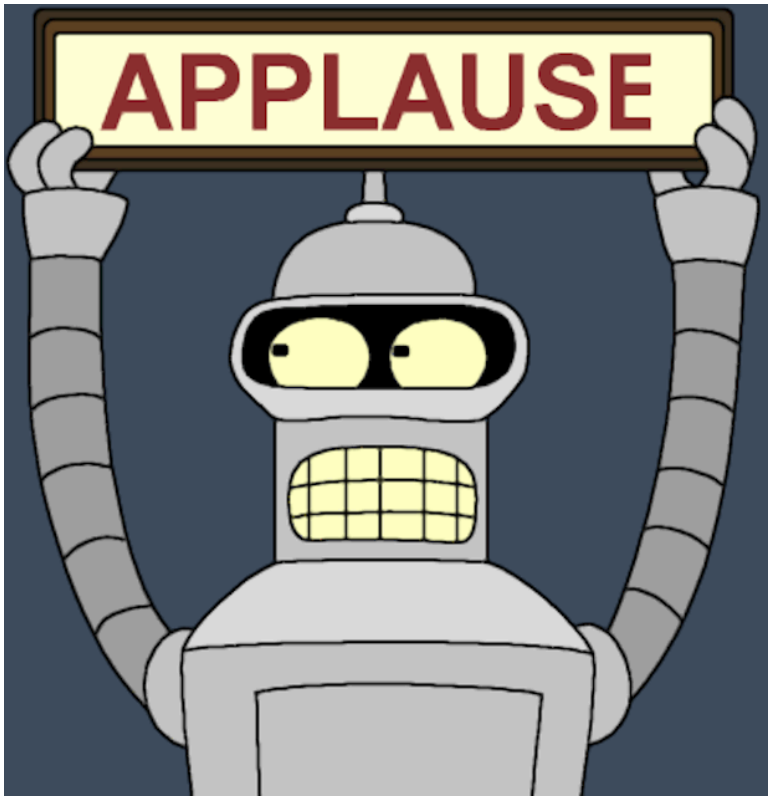
6/4. Visualize improvement



Zoom using left mouse button click&drag
(Reset zoom: double left-click)



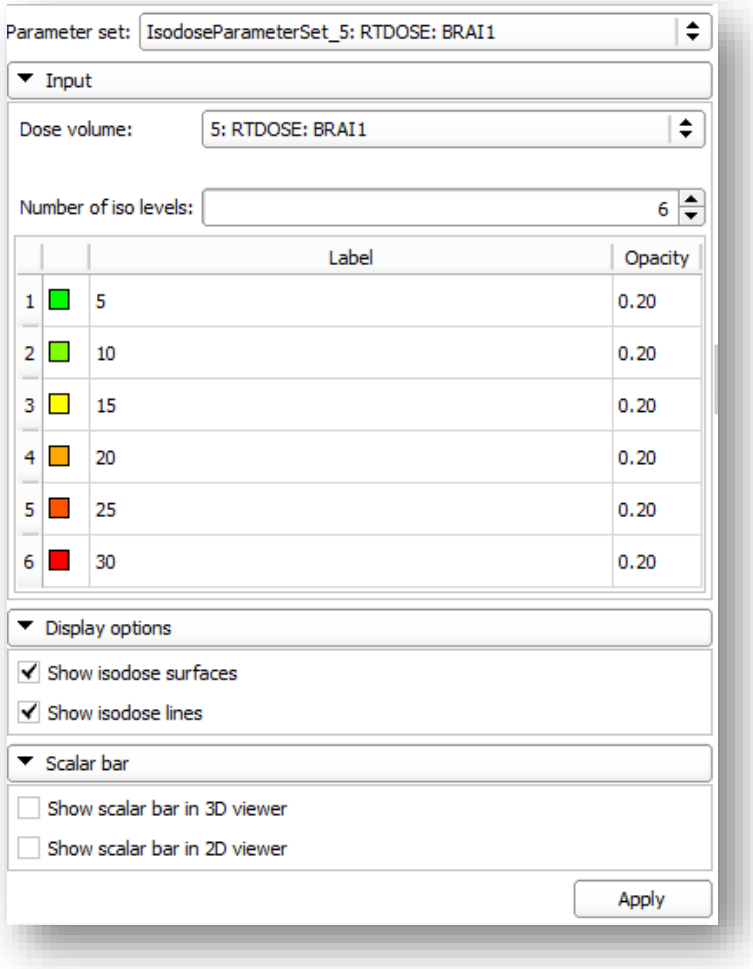
Congratulations!



Thanks for attending!

Appendix: Optional steps for IGRT

Optional 1/1. Isodose lines/surfaces



1. Choose Radiotherapy / Isodose module

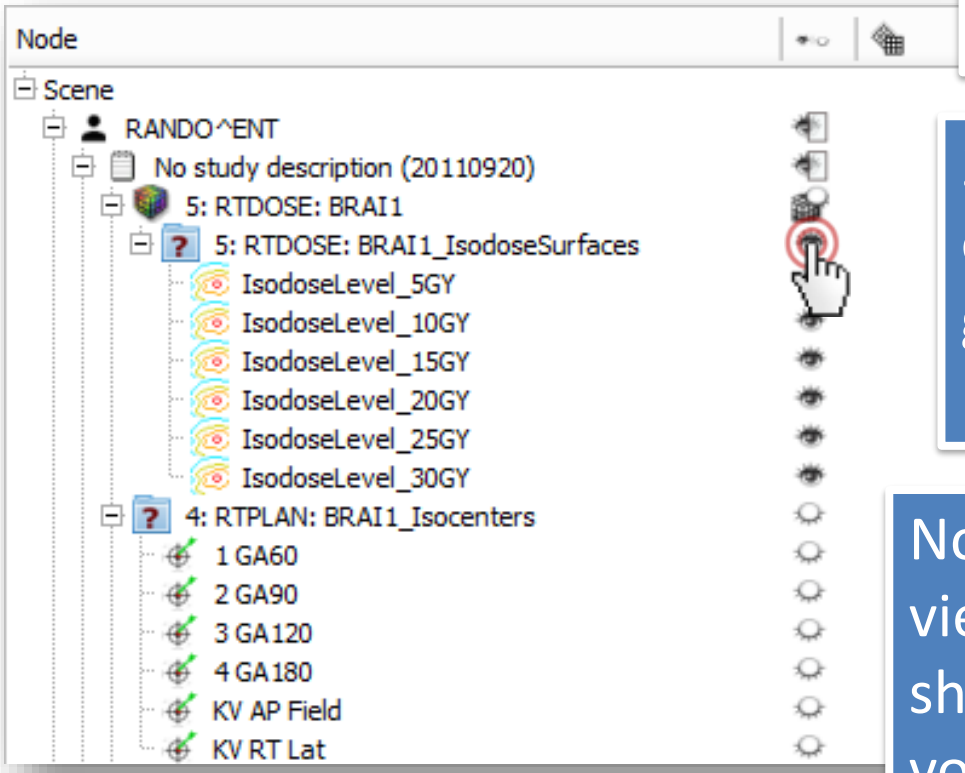
3. Select '5: RTDOSE: BRAI1' volume as Dose volume

2. Click Apply

3. Select '5_RTDOSE_Day2' volume as Dose volume

4. Click Apply

Optional 1/2. Visualize isodose lines

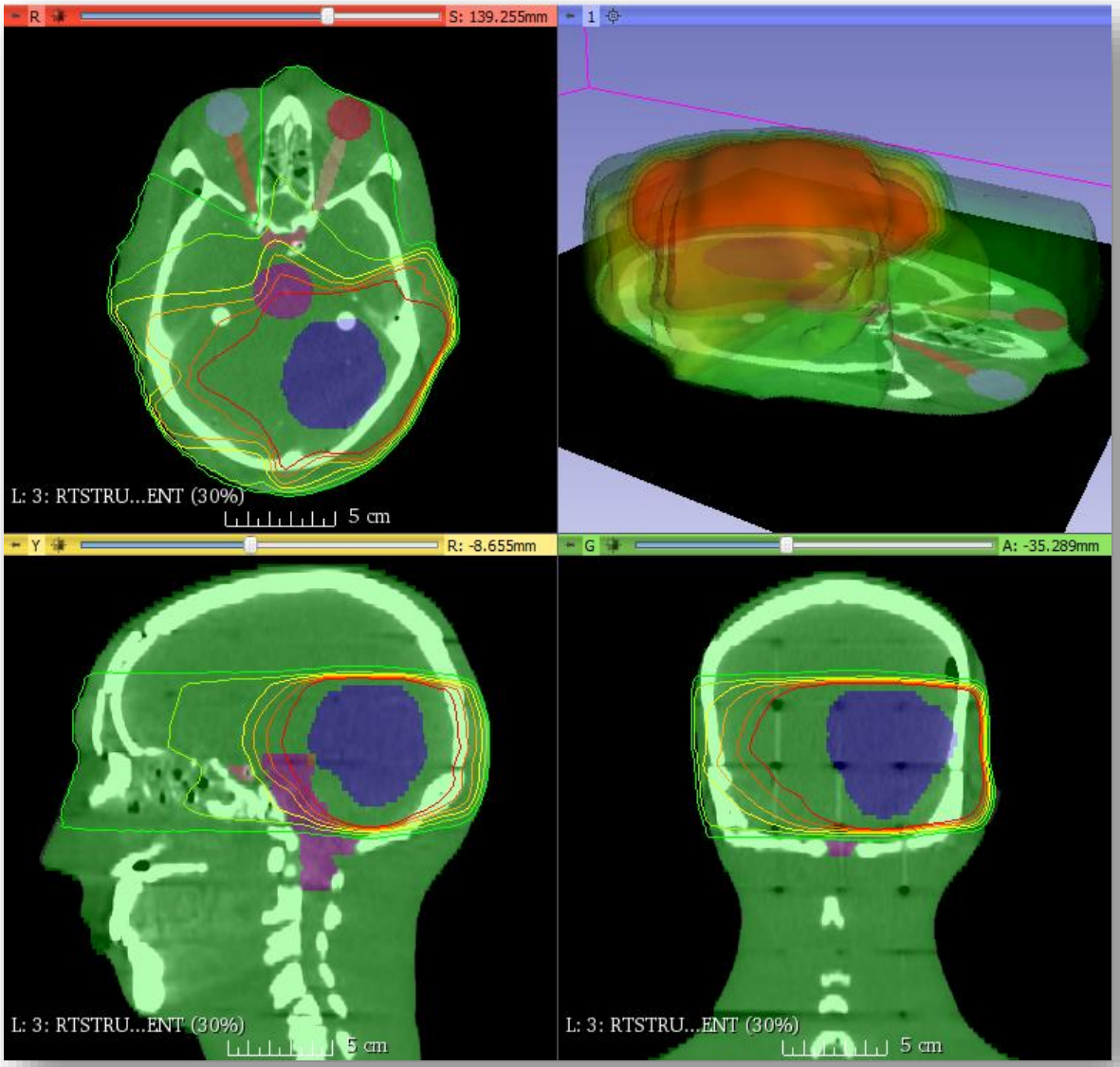


1. Switch to Subject Hierarchy

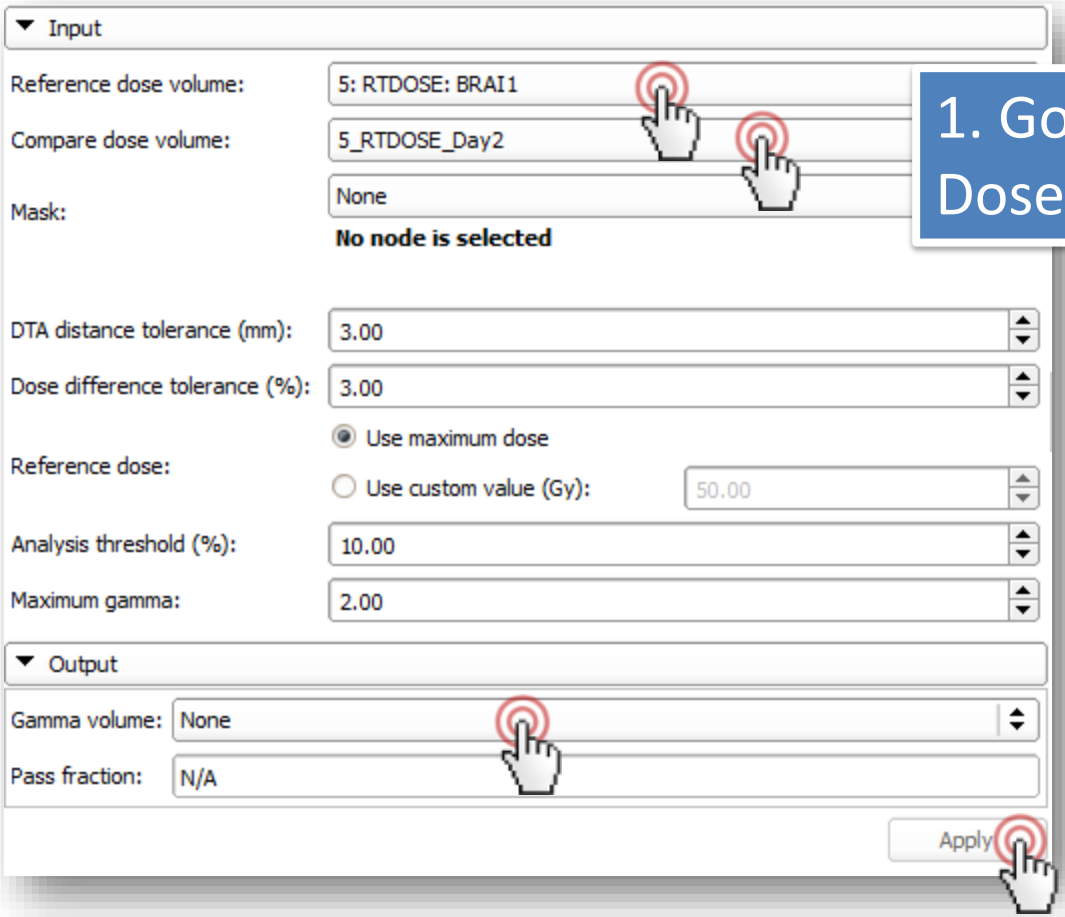
2. Turn on and off visualization of isodose line and surface groups by clicking the eye icon next to the parent node

Note: Display volumes in the 2D viewers by clicking the volume show/hide icon next to the volumes

Optional 1/3. Isodose lines/surfaces



Optional 2/1. Compare dose volumes using gamma comparison



1. Go to module Radiotherapy / Dose Comparison

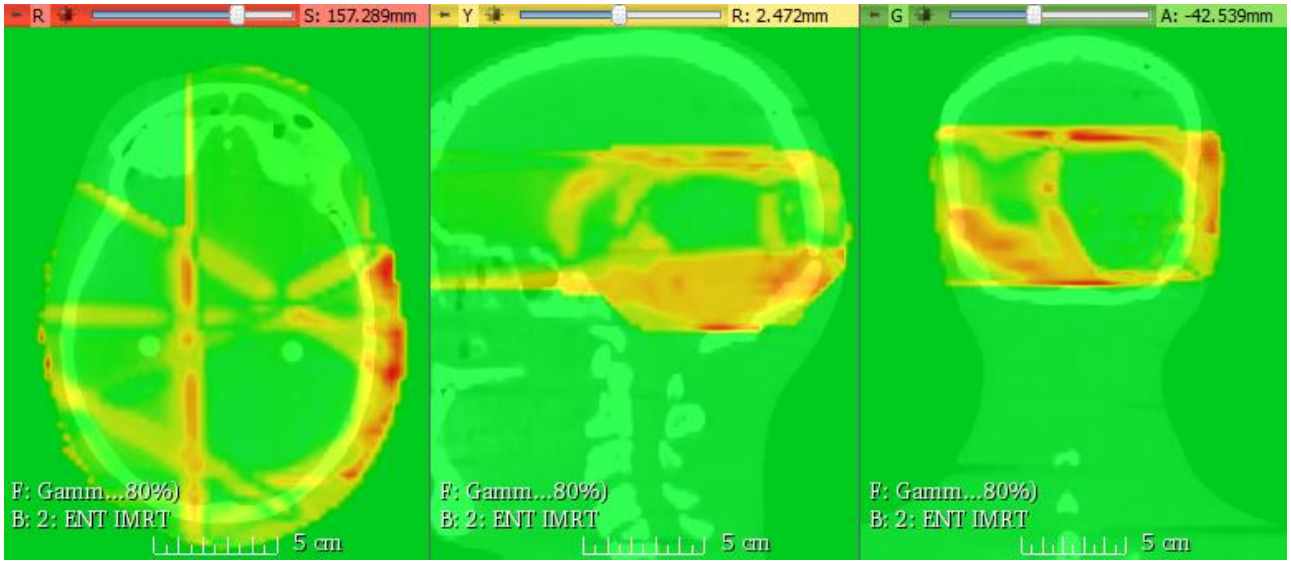
2. Set input volumes you want to compare

3. Create new output gamma volume

4. Click 'Apply'

Optional 2/2. Evaluate improvement

Plan dose
vs
Uncorrected
Day 2 dose



Plan dose
vs
Corrected
Day 2 dose