

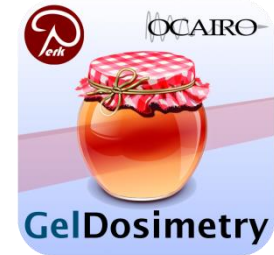
Tutorial:

Gel Dosimetry Analysis

Slicelet



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Queen's University
Kingston, Ontario, Canada



World Congress on Medical Physics and Biomedical Engineering 2015

June 7, 2015






Learning objective

This tutorial will teach you how to perform analysis of a gel dosimeter, imaged using an optical CT scanner.



Material

For those of you just joining us...

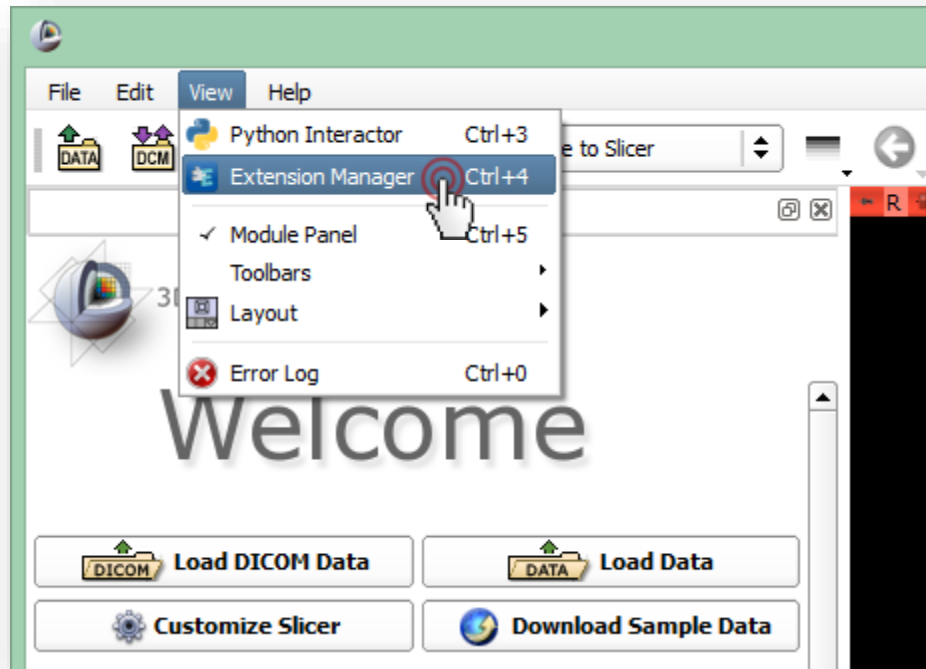
- Connect to tutorial wifi:
SSID: *SlicerRT1*, Password: *tutorial*
- Access download page:
Enter in your web browser: *130.15.7.247*
- Follow the instructions
- Supported platforms:
 Windows,  Mac OSX,  Linux
– 32-bit is not supported!

Install 3D Slicer

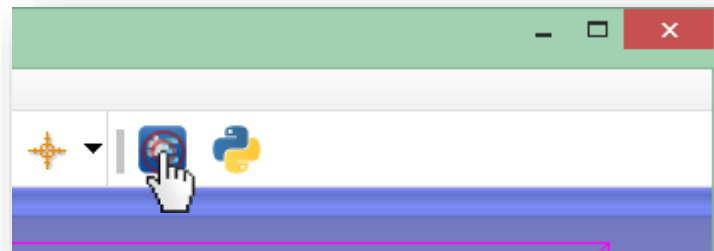
- Find the downloaded 3D Slicer package on your computer
- Follow the usual steps to install an application
 - Different for each operating system



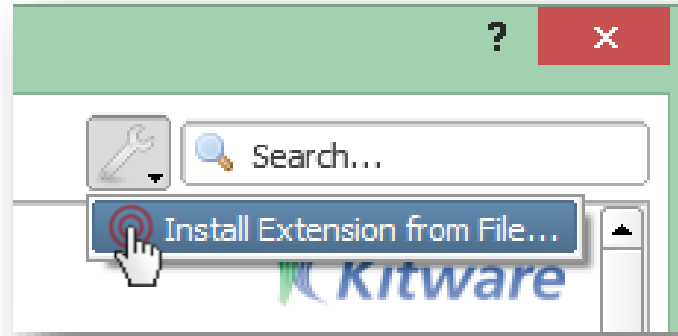
Install SlicerRT extension



or

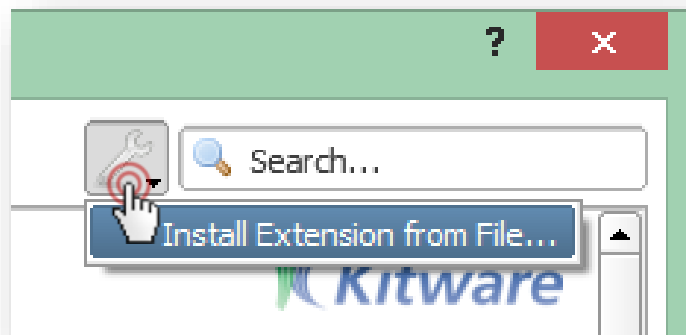


Install SlicerRT extension



Find the downloaded SlicerRT zip file on your computer

Install Gel Dosimetry Analysis extension



Find the downloaded Gel Dosimetry Analysis zip file on your computer



Click Restart

Unpack tutorial datasets

- Find the dataset you downloaded named *WC2015_Gel_Slicelet_Dataset.zip*
- Unpack it to a local folder of your choice
 - Different for each operating system



Your concerns

“Largest obstacle to the use of Slicer RT and gel dosimetry in general is managing the complexity of the process and keeping track of and managing the large software feature set that is needed for the process to work well.”



Your concerns

“Concerned about validating results produced from these tools.”



Your concerns

“Concerned about validating results produced from these tools.”

The screenshot shows the AAPM 2015 website with the following content:

- Header: AAPM2015 REIN VIGORATING SCIENTIFIC EXCELLENCE 57th Annual Meeting & Exhibition • July 12–16 • Anaheim, CA
- Navigation: Home, Attendees, Technical Exhibits, Meeting Program, Association Activities, Virtual Press Room, Contact Us
- Sub-navigation: Program Information, Track Directors, Presenter Information, Poster Displays, Abstract Submission, Review Courses
- Section: Program Information
- Buttons: Therapy General Poster Discussion, All Therapy General Poster Discussion, All Sessions, Program Home
- Abstract Title: Cross-Validation of 3D Gamma Comparison Tools
- Abstract Text: KM Alexander¹, C Jechel¹, C Pinter², G Salomons^{1,3,4}, A Lasso², G Fichtinger², LJ Schreiner^{1,3,4} (1) Department of Physics, Engineering Physics, and Astronomy, Queen's University, Kingston, Ontario, Canada (2) School of Computing, Queen's University, Kingston, Ontario, Canada (3) Department of Medical Physics, Cancer Centre of Southeastern Ontario at Kingston General Hospital, Kingston, Ontario, Canada (4) Department of Oncology, Queen's University, Kingston, Ontario, Canada
- Presentations: SU-E-T-231 (Sunday, July 12, 2015) 3:00 PM - 6:00 PM Room: Exhibit Hall
- Purpose: Moving the computational analysis for 3D gel dosimetry into the 3D clinically accessible. To ensure accuracy, we cross-validate the 3D gamma algorithm using simulated and measured dose distributions.

In progress!

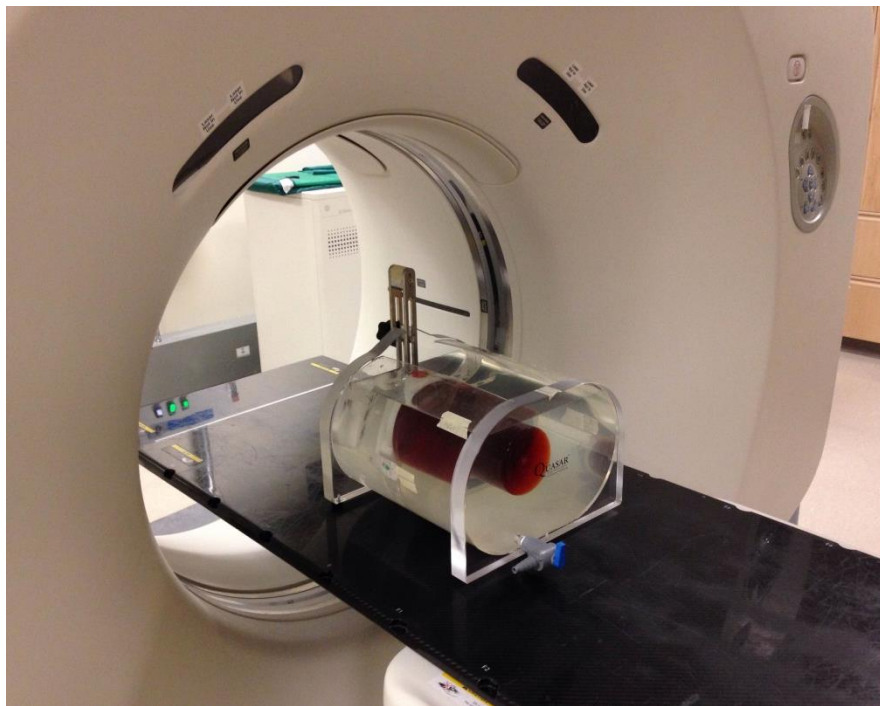
The abstract contains the following information:

- Title: 3D Slicer Gel Dosimetry Analysis Extension: Validation of the Calibration Process
- Authors: K.M. Alexander¹, C. Pinter², G. Fichtinger², and L.J. Schreiner^{1,3}
- Footnote 1: ¹ Department of Physics, Engineering Physics, and Astrophysics, Queen's University, Kingston, Ontario, Canada
- Footnote 2: ² School of Computing, Queen's University, Kingston, Ontario, Canada
- Footnote 3: ³ Medical Physics Department, Cancer Centre of Southeastern Ontario at Kingston General Hospital, Kingston, Ontario, Canada
- Abstract: An extension tailored to dose data processing and analysis has been developed in the open source imaging application 3D Slicer to aid in routine clinical use of gel dosimetry. This extension provides a fast and inexpensive method of acquiring full, 3D dose distribution information. However, gel dosimeters are not always easy to use as they require extensive post-irradiation data



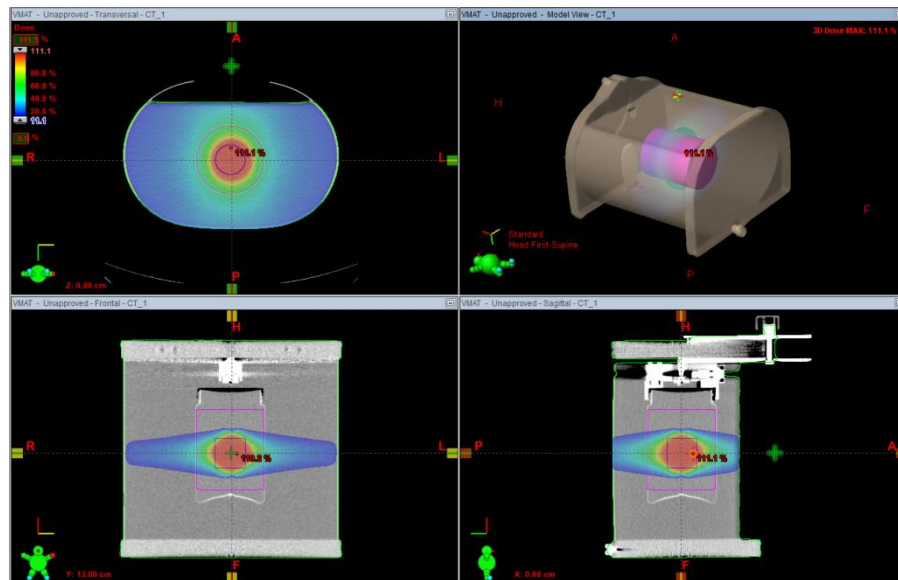
Where did this data come from?

- Gel dosimeter was positioned inside a phantom, and CT simulation images were acquired (**Planning CT volume**)



Where did this data come from?

- Treatment planning using Eclipse:
 - Single arc delivery with fixed field size
 - Gel jar was contoured and dose distribution was calculated



- Outputs: **Planning dose volume, Structures**

Where did this data come from?

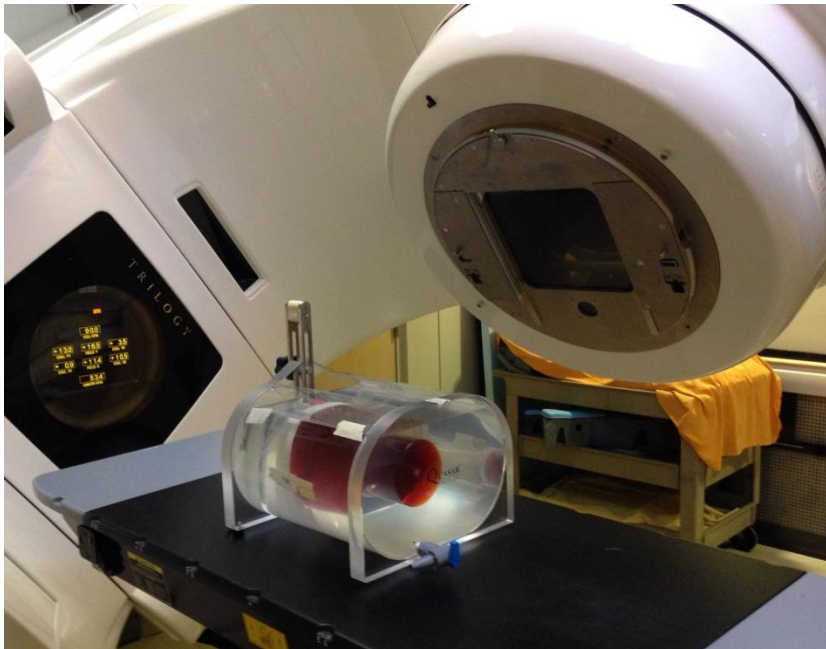
- Irradiation day:
 - Gel #1 is scanned using an optical CT scanner, then fiducial markings are made with a marker, and metal BBs are taped to those markings
 - Gel #2 is also optically scanned (no markings)
 - Phantom with gel is positioned on patient couch
 - Cone beam CT image is acquired using the On-Board Imager (OBI Volume)



Where did this data come from?

- Irradiation day:
 - Gel #1 is irradiated with planned delivery
 - Gel #2 is irradiated with an electron beam

Gel #1



Gel #2



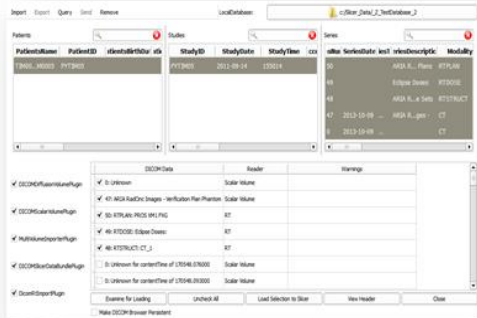
Where did this data come from?

- Irradiation day:
 - Both gels are scanned post-irradiation, and are reconstructed to create 3D digital volumes
(Measured gel dosimeter volume, calibration gel volume)

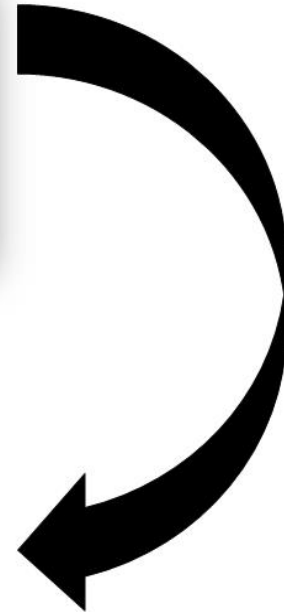
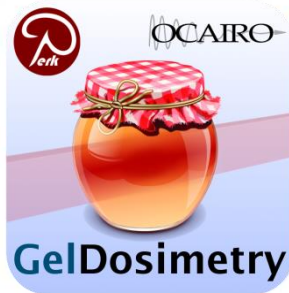
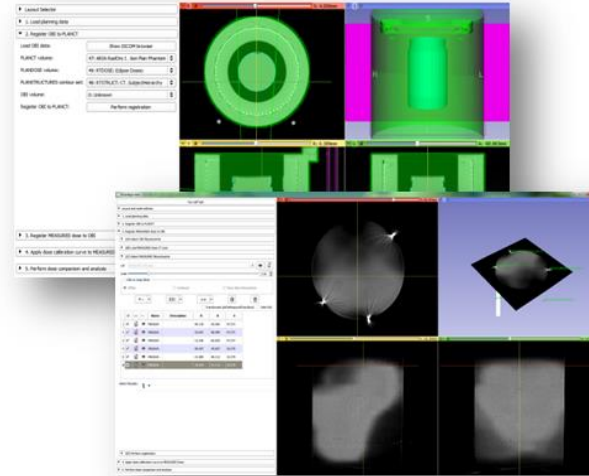


Gel Dosimetry Analysis Roadmap

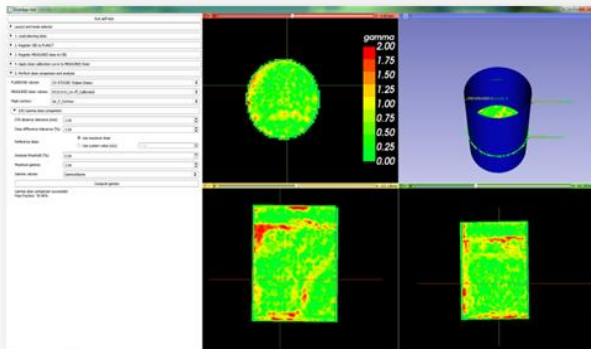
Data Import



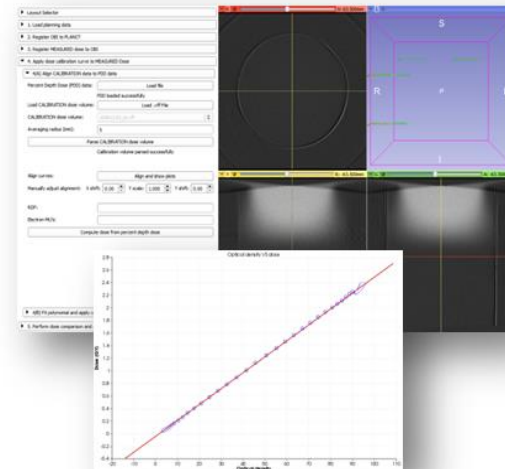
Registration



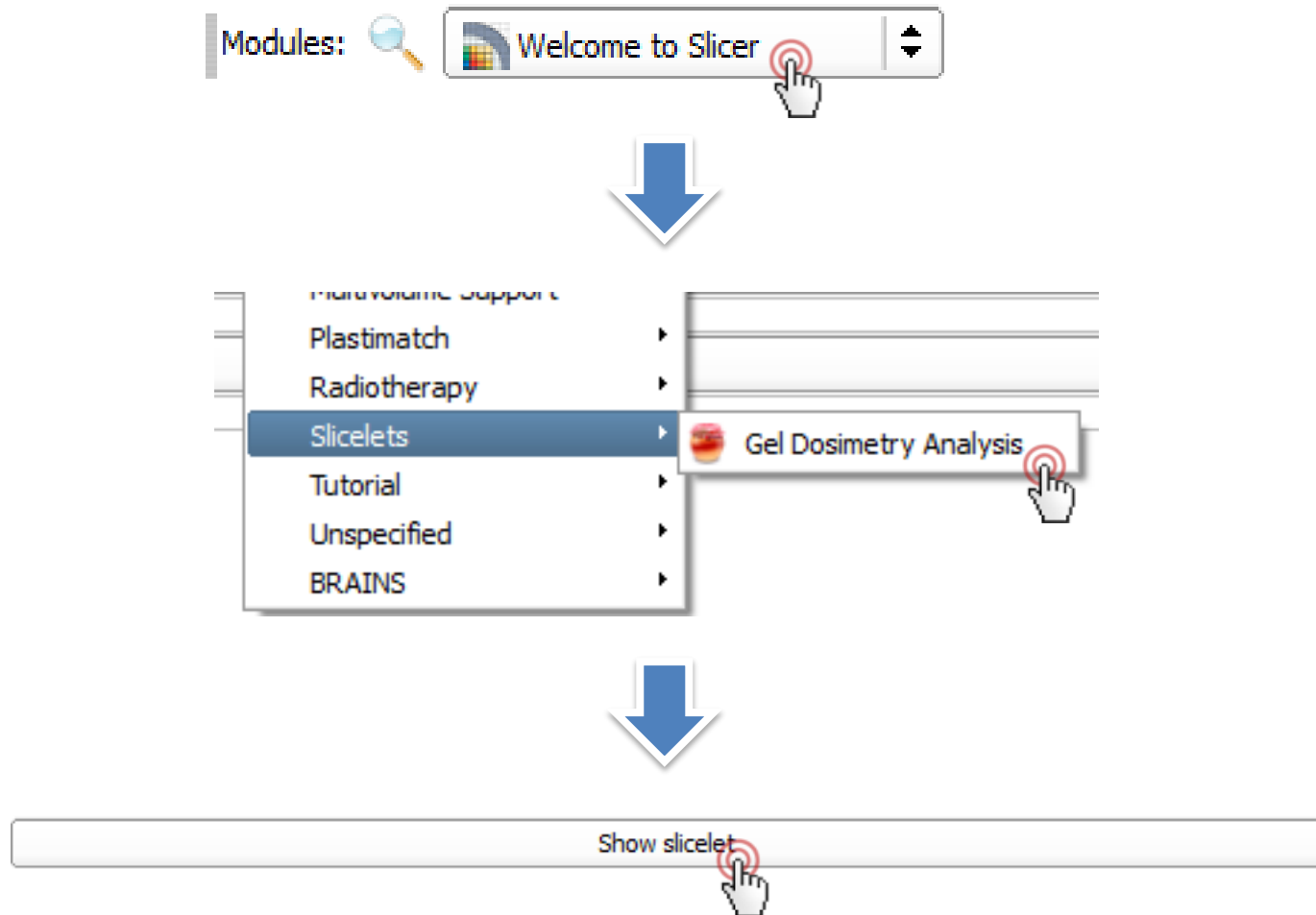
Dose Comparison



Calibration

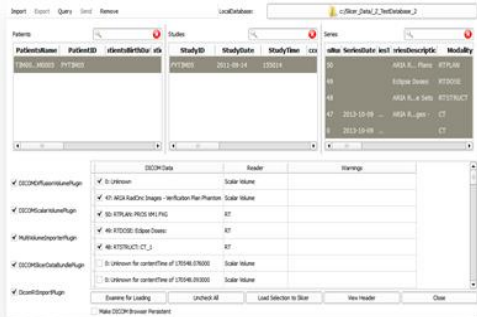


Open Gel Dosimetry Analysis Slicelet

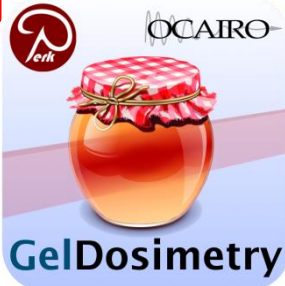
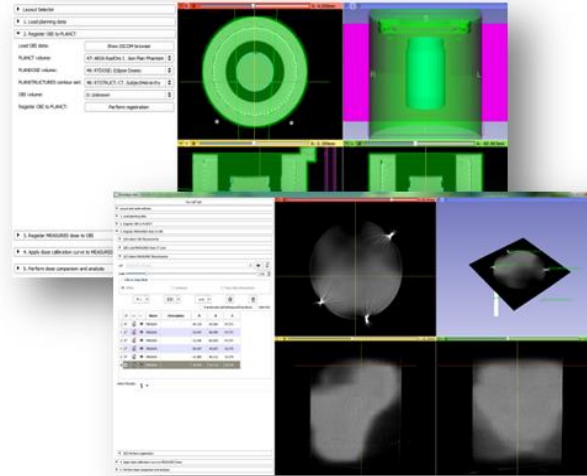


Gel Dosimetry Analysis Roadmap

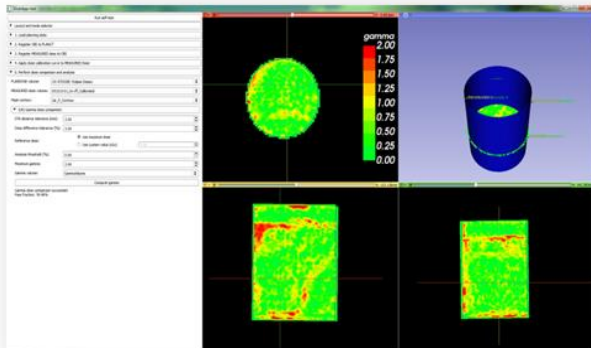
Data Import



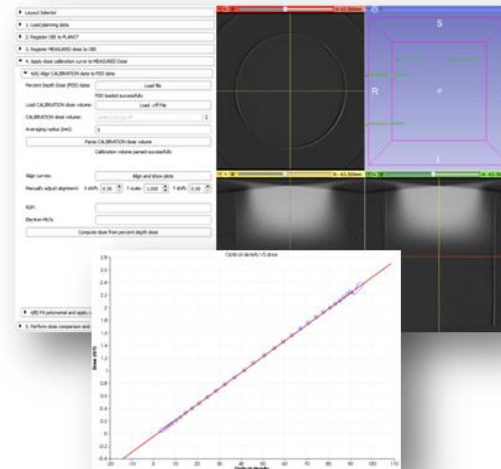
Registration



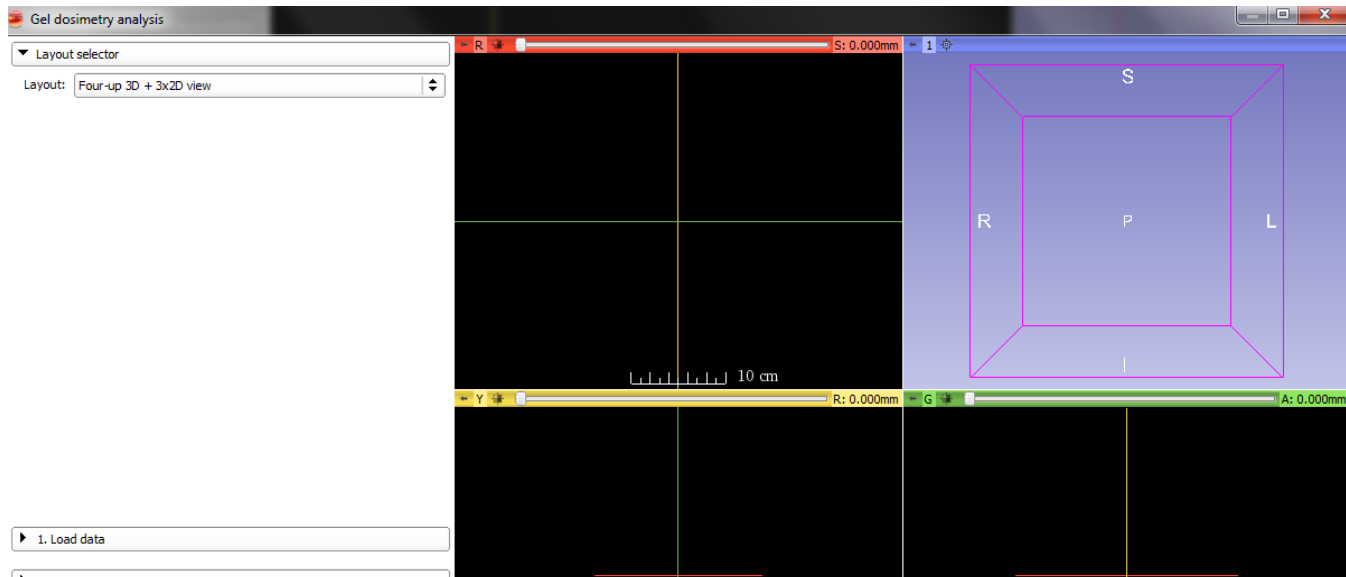
Dose Comparison



Calibration



Gel Dosimetry Analysis Slicelet



- ▶ 1. Load data
- ▶ 2. Registration
- ▶ 3. Dose calibration
- ▶ 4. 3D gamma dose comparison
- ▶ Tool: Line profile

▶ 1. Load data



▶ 2. Registration

▶ 3. Dose calibration

▶ 4. 3D gamma dose comparison

▶ Tool: Line profile

1. Load Data

Gel dosimetry analysis

Layout selector

1. Load data

Load all DICOM data involved in the workflow.
Note: Can return to this step later if more data needs to be loaded

Load DICOM data

Load non-DICOM data from file

Assign loaded data to roles.
Note: If this selection is changed later then all the following steps need to be performed again

Planning CT volume: Select a Volume

Plan dose volume: Select a Volume

Structures: None

OBI volume: Select a Volume

Measured gel dosimeter volume: Select a Volume

Calibration gel volume (optional): None



DICOM Browser

Import Export Query Send Remove Repair >>

Path



Select 'DICOM' folder that was just downloaded

1. Load Data

Select all data objects, and click Load.

Import Export Query Send Remove Repair >>

Patients: [] Studies: [] Series: []

PatientsName	PatientID	PatientsBirthDate	PatientsBirthTime	PatientsSex	PatientsAge	PatientsCon
TEST^WC2015	WC2015_TEST					

StudyID	StudyDate	StudyTime	AccessionNumber	ModalitiesInStudy	InstitutionName	Referring
8318	2015-04-29	165323				

SeriesNumber	SeriesDate	SeriesTime	SeriesDescription	Modality	BodyPartExamined	Acquisi
2	2015-04-29	171415.290000		CT		0
12			Eclipse Doses	RTDOSE		0
3			ARIA RadOnc Structure Sets	RTSTRUCT		0
0	2015-06-02	174136.866000		CT		1

Load Metadata Advanced Horizontal Browser Persistent



1. Load Data

Select Optical Gel VFF Files

Gel dosimetry analysis

Layout selector

1. Load data

Load all DICOM data involved in the workflow.
Note: Can return to this step later if more data needs to be loaded

Load DICOM data

Load non-DICOM data from file

Assign loaded data to roles.
Note: If this selection is changed later then all the following steps need to be performed again

Planning CT volume: Select a Volume

Plan dose volume: Select a Volume

Structures: None

OBI volume: Select a Volume

Measured gel dosimeter volume: Select a Volume

Calibration gel volume (optional): None

Open

Look in: Z:\ACADEMIC\Workspaces\Kevin\T...et\WC2015_Gel_Slicelet_Dataset

Name	Size	Type	Date Modified
DICOM		File...lder	05/06/2015 8:19:47 PM
Measured.vff	64.0 MB	vff File	05/06/2015 8:18:22 PM
Calibration.vff	64.0 MB	vff File	05/06/2015 8:18:14 PM
12MeV.csv	1 KB	csv File	05/06/2015 8:18:05 PM

File name: "Measured.vff" "Calibration.vff"

Files of type: All Files (*.*)

Open

Cancel



1. Load Data

Select Optical Gel VFF Files

Gel dosimetry analysis

► Layout selector

▼ 1. Load data

Load all DICOM data involved in the workflow.
Note: Can return to this step later if more data needs to be loaded

Load DICOM data

Load non-DICOM data from file

Assign loaded data to roles.
Note: If this selection is changed later then all the following steps need to be performed again

Planning CT volume: Select a Volume

Plan dose volume: Select a Volume

Structures: None

OBI volume: Select a Volume

Measured gel dosimeter volume: Select a Volume

Calibration gel volume (optional): None

Add data into the scene

Choose Directory to Add Choose File(s) to Add Show Options

<input checked="" type="checkbox"/>	File	Description
<input checked="" type="checkbox"/>	Z:/ACADEMIC/Workspaces/Kevin/Testing folder/WC2015_Gel_Slicelet_Dataset/WC2015_Gel_Slicelet_Dataset/Measured.vff	vff
<input checked="" type="checkbox"/>	Z:/ACADEMIC/Workspaces/Kevin/Testing folder/WC2015_Gel_Slicelet_Dataset/WC2015_Gel_Slicelet_Dataset/Calibration.vff	vff

Reset OK Cancel



1. Load Data

▼ 1. Load data

Load all DICOM data involved in the workflow.

Note: Can return to this step later if more data needs to be loaded

Load DICOM data

Load non-DICOM data from file

Assign loaded data to roles.

Note: If this selection is changed later then all the following steps need to be performed again

Planning CT volume: 2: Unknown

Plan dose volume: 12: RTDOSE: Eclipse Doses

Structures: 3: RTSTRUCT: CT_1

OBI volume: 0: Unknown

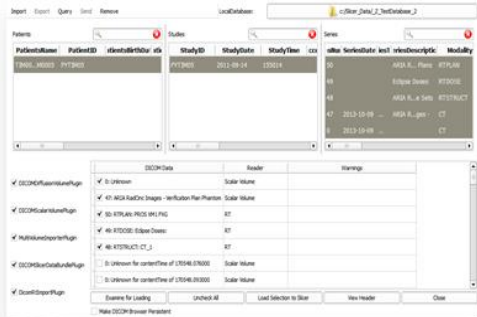
Measured gel dosimeter volume: measured.vff

Calibration gel volume (optional): calibration.vff

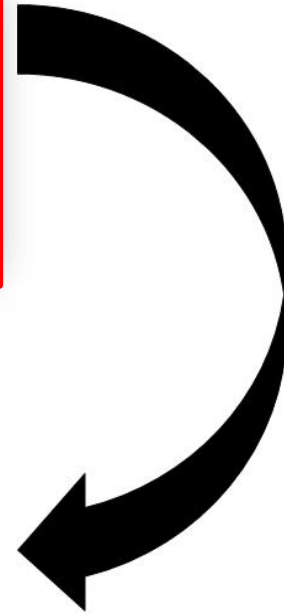
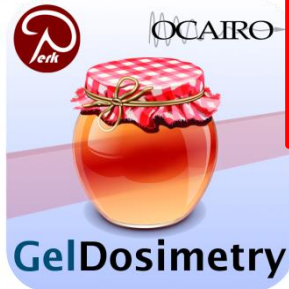
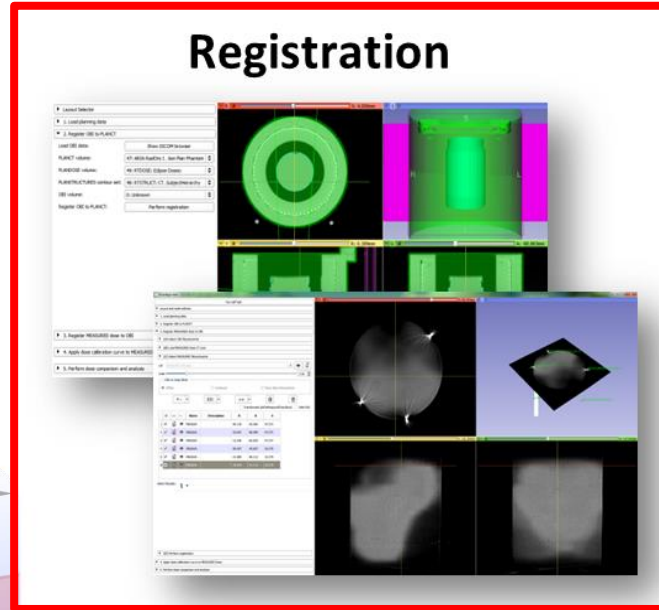
Assign data as shown

Gel Dosimetry Analysis Roadmap

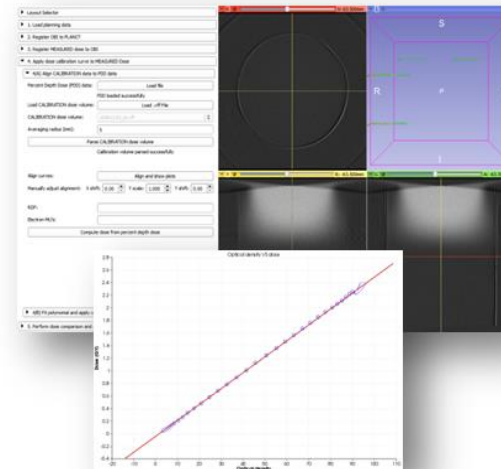
Data Import



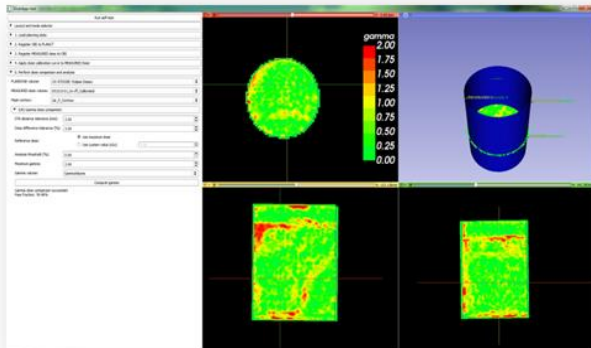
Registration



Calibration



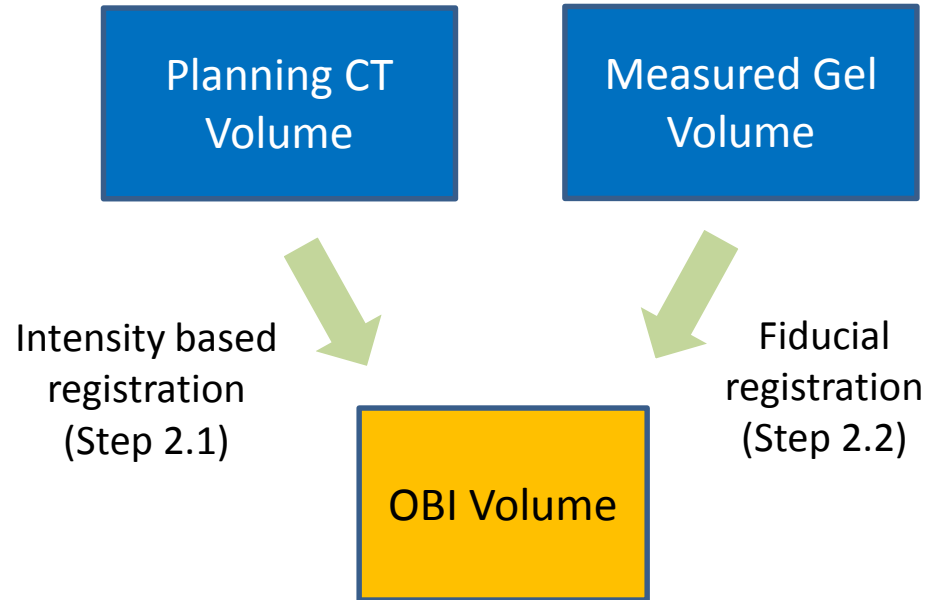
Dose Comparison



2. Registration

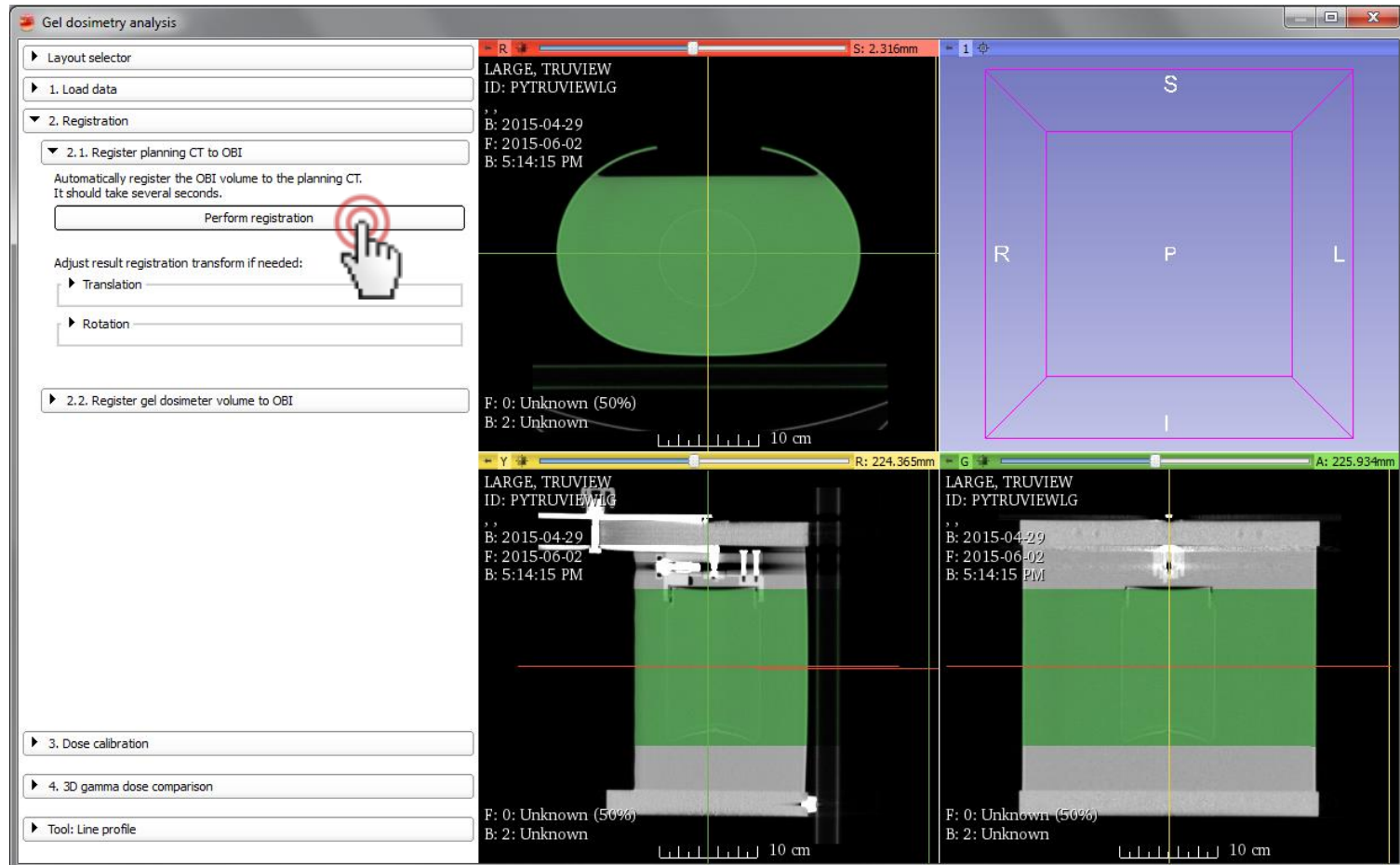
Gel dosimetry analysis

- Layout selector
- 1. Load data
- 2. Registration
 - 2.1. Register planning CT to OBI
 - Automatically register the OBI volume to the planning CT. It should take several seconds.
 - Perform registration**
 - Adjust result registration transform if needed:
 - Translation
 - Rotation
 - 2.2. Register gel dosimeter volume to OBI



All data is registered to the OBI space

2.1 Registration



Planning CT Volume: Grey

OBI Volume: Green

2.1 Registration

▼ 2. Registration

▼ 2.1. Register planning CT to OBI

Automatically register the OBI volume to the planning CT.
It should take several seconds.

Perform registration

Adjust result registration transform if needed:

▼ Translation

LR

PA

IS

Min Max

▼ Rotation

LR

PA

IS

▶ 2.2. Register gel dosimeter volume to OBI

If auto-registration fails or needs adjusting, manual adjustments can be performed

Use up/down arrows, or type in value

2.1 Registration

▼ 2. Registration

▼ 2.1. Register planning CT to OBI

Automatically register the OBI volume to the planning CT.
It should take several seconds.

Perform registration

Adjust result registration transform if needed:

▼ Translation

LR

PA

IS

Min Max

▼ Rotation

LR

PA

IS

▶ 2.2. Register gel dosimeter volume to OBI

If auto-registration fails,
or needs adjusting,
manual adjustments
can be performed

Use up/down arrows,
or type in value

2.2 Registration

Layout selector

1. Load data

2. Registration

2.1. Register planning CT to OBI

2.2. Register gel dosimeter volume to OBI

2.2.1 Select OBI fiducial points

Locate image plane of the OBI fiducials, then click the 'Place fiducials' button (blue arrow with red dot). Next, select the fiducial points in the displayed image plane.

OBI fiducials

Label	X	Y
-------	---	---

2.2.2 Select measured gel dosimeter fiducial points

2.2.3 Perform registration

3. Dose calibration

4. 3D gamma dose comparison

Tool: Line profile

The screenshot displays the registration software interface. On the left is a control panel with a tree view showing the current step: '2.2.1 Select OBI fiducial points'. Below the instructions is a table for recording fiducial points. The main area shows three image planes: 'R' (Right), 'S' (Superior), and 'G' (Gantry). The 'R' and 'S' planes show a green circular gel dosimeter with a grid and a 5 cm scale bar. The 'G' plane shows a green rectangular gel dosimeter with a grid and a 10 cm scale bar. A hand cursor is pointing at the 'Place fiducials' button in the control panel. A text box on the right side of the 'S' plane reads 'OBI fiducial point selection'.

2.2 Registration

Layout selector

1. Load data

2. Registration

2.1. Register planning CT to OBI

2.2. Register gel dosimeter volume to OBI

2.2.1 Select OBI fiducial points

Locate image plane of the OBI fiducials, then click the 'Place fiducials' button (blue arrow with red dot). Next, select the fiducial points in the displayed image plane.

OBI fiducials

Label	X	Y	Z

2.2.2 Select measured gel dosimeter fiducial points

2.2.3 Perform registration

3. Dose calibration

4. 3D gamma dose comparison

Tool: Line profile

Varian Medical Systems
OBI Cone-beam CT
HFS

LARGE, TRUVIEW
ID: PYTRUVIEWLG
2015-06-02
5:41:36 PM

S: 45.930mm

R: 224.804mm

A: 217.969mm

B: 0: Unknown

5 cm

10 cm

10 cm

OBI fiducial point selection

Tip: Hold the shift key and explore the volume



2.2 Registration

Layout selector

1. Load data

2. Registration

2.1. Register planning CT to OBI

2.2. Register gel dosimeter volume to OBI

2.2.1 Select OBI fiducial points

Locate image plane of the OBI fiducials, then click the 'Place fiducials' button (blue arrow with red dot). Next, select the fiducial points in the displayed image plane.

OBI fiducials

Label	X	Y	Z
-------	---	---	---

2.2.2 Select measured gel dosimeter fiducial points

2.2.3 Perform registration

3. Dose calibration

4. 3D gamma dose comparison

Tool: Line profile

The screenshot displays a software interface for registration. On the left is a sidebar with a task list. The main area is divided into three panels. The top panel shows a green circular gel dosimeter image with three fiducial points labeled #1, #2, and #3. A mouse cursor is clicking on point #1. The top-right panel is a white box with a purple border containing the text 'OBI fiducial point selection'. The bottom-left panel shows a green rectangular gel dosimeter image with two fiducial points. The bottom-right panel shows another green rectangular gel dosimeter image with two fiducial points. Each panel includes technical data such as 'LARGE, TRUVIEW ID: PYTRUVIEWLG', '2015-06-02 5:41:36 PM', and 'B: 0: Unknown'. Scale bars of 5 cm, 10 cm, and 10 cm are visible at the bottom of the panels.



2.2 Registration

The screenshot displays a software interface for registration. On the left, a sidebar contains a 'Layout selector' and a list of steps: '1. Load data', '2. Registration', '2.1. Register planning CT to OBI', '2.2. Register gel dosimeter volume to OBI', '2.2.1 Select OBI fiducial points', '2.2.2 Select measured gel dosimeter fiducial points', and '2.2.3 Perform registration'. The main window shows a 3D view of a patient's head with a green gel dosimeter volume and three fiducial points labeled 'OBI fiducials-1', 'OBI fiducials-2', and 'OBI fiducials-3'. A purple box on the right indicates the 'S' (Superior), 'I' (Inferior), 'P' (Posterior), and 'L' (Lateral) planes. A central dialog box titled '2. Registration' contains the same steps as the sidebar, with '2.2.1 Select OBI fiducial points' expanded. Below this step, a table is populated with the coordinates of the three fiducial points. A red box highlights this table. At the bottom of the dialog, the text 'Fiducial coordinates populate the table' is displayed. The bottom of the main window shows a 'Tool: Line profile' and two 'B: 0: Unknown' labels.

2. Registration

2.1. Register planning CT to OBI

2.2. Register gel dosimeter volume to OBI

2.2.1 Select OBI fiducial points

Locate image plane of the OBI fiducials, then click the 'Place fiducials' button (blue arrow with red dot). Next, select the fiducial points in the displayed image plane.

OBI fiducials

Label	X	Y	Z
1 OBI fiducials-1	218.272	173.761	45.344
2 OBI fiducials-2	189.288	253.466	45.344
3 OBI fiducials-3	232.764	268.476	45.344

Fiducial coordinates populate the table

2.2 Registration

Layout selector

1. Load data

2. Registration

2.1. Register planning CT to OBI

2.2. Register gel dosimeter volume to OBI

2.2.1 Select OBI fiducial points

2.2.2 Select measured gel dosimeter fiducial points

Select the fiducial points in the gel dosimeter volume in the same order as the OBI fiducials were selected.

MEASURED fiducials

Label	X	Y	Z

2.2.3 Perform registration

3. Dose calibration

4. 3D gamma dose comparison

Tool: Line profile

B: measured.vff

5 cm

S

Optical CT fiducial point selection

R: 110.816mm

S: 110.816mm

Y: -63.500mm

G: -65.139mm

A: -65.139mm

B: measured.vff

5 cm

B: measured.vff

5 cm

2.2 Registration

Layout selector

1. Load data

2. Registration

2.1. Register planning CT to OBI

2.2. Register gel dosimeter volume to OBI

2.2.1 Select OBI fiducial points

2.2.2 Select measured gel dosimeter fiducial points

Select the fiducial points in the gel dosimeter volume in the same order as the OBI fiducials were selected.

MEASURED fiducials

Label	X	Y	Z
-------	---	---	---

2.2.3 Perform registration

3. Dose calibration

4. 3D gamma dose comparison

Tool: Line profile

B: measured.vff

5 cm

R: -63.500mm

G

A: -65.139mm

B: measured.vff

5 cm

B: measured.vff

5 cm

Optical CT fiducial point selection

Tip: Adjust the window/level by clicking, holding, and dragging up/down and left/right



2.2 Registration

Layout selector

1. Load data

2. Registration

2.1. Register planning CT to OBI

2.2. Register gel dosimeter volume to OBI

2.2.1 Select OBI fiducial points

2.2.2 Select measured gel dosimeter fiducial points

Select the fiducial points in the gel dosimeter volume in the same order as the OBI fiducials were selected.

MEASURED fiducials

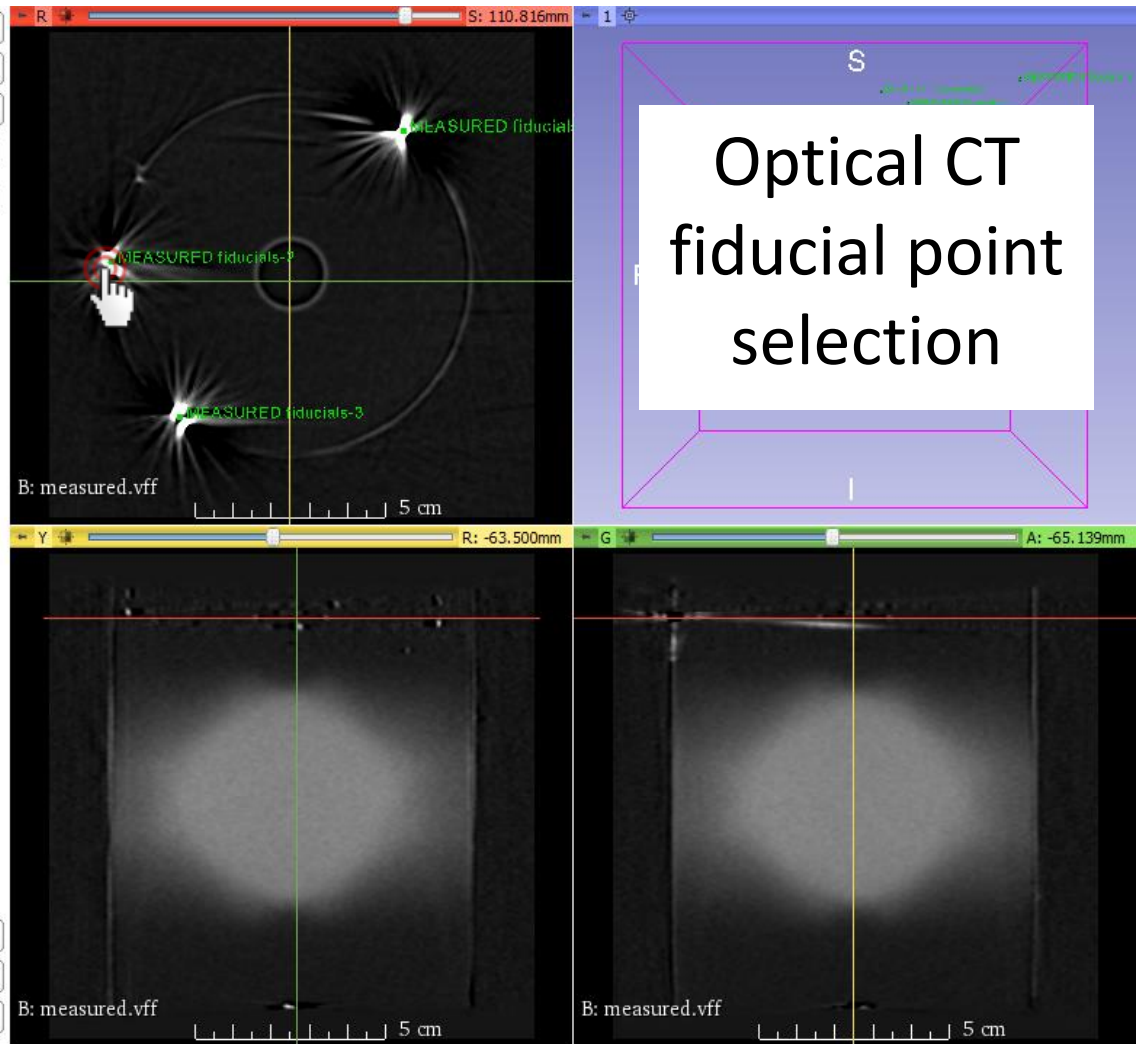
	Label	X	Y	Z
1	MEASURED fiducials-1	-93.362	-25.732	110.816
2	MEASURED fiducials-2	-16.562	-60.120	110.816
3	MEASURED fiducials-3	-34.520	-101.004	110.816

2.2.3 Perform registration

3. Dose calibration

4. 3D gamma dose comparison

Tool: Line profile



2.2 Registration

▼ 2.2.3 Perform registration

Register gel volume to OBI



Layout selector

1. Load data

2. Registration

- 2.1. Register planning CT to OBI
- 2.2. Register gel dosimeter volume to OBI
 - 2.2.1 Select OBI fiducial points
 - 2.2.2 Select measured gel dosimeter fiducial points
 - 2.2.3 Perform registration
 - Register gel volume to OBI
 - Fiducial registration error: 0.629293 mm
 - Note: Typical registration error is < 3mm

3. Dose calibration

4. 3D gamma dose comparison

Tool: Line profile

R: 0.666mm S: 0.666mm

F: measured.vff (50%)
B: 0: Unknown

10 cm

R: 224.804mm G: A: 225.586mm

F: measured.vff (60%)
B: 0: Unknown

10 cm

F: measured.vff (50%)
B: 0: Unknown

10 cm

From our online survey

“How accurate is fiducial registration?”

▼ 2.2.3 Perform registration

Register gel volume to OBI

Fiducial registration error: 0.629293 mm

From our online survey

“How accurate is fiducial registration?”

▼ 2.2.3 Perform registration

Register gel volume to OBI

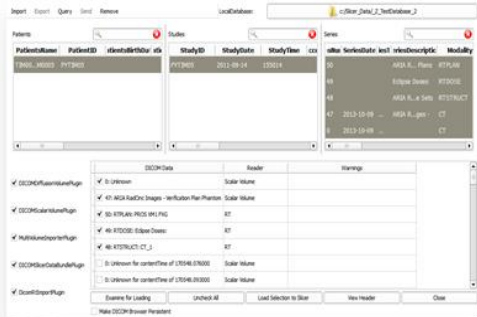
Fiducial registration error: 0.629293 mm



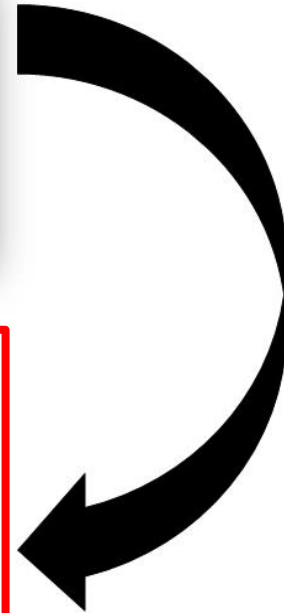
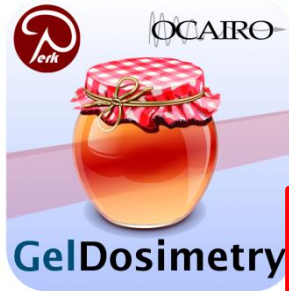
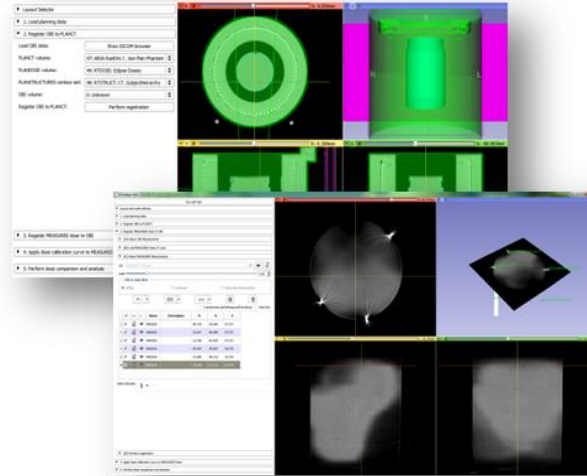
Root-mean square error
between the two sets of
fiducial points

Gel Dosimetry Analysis Roadmap

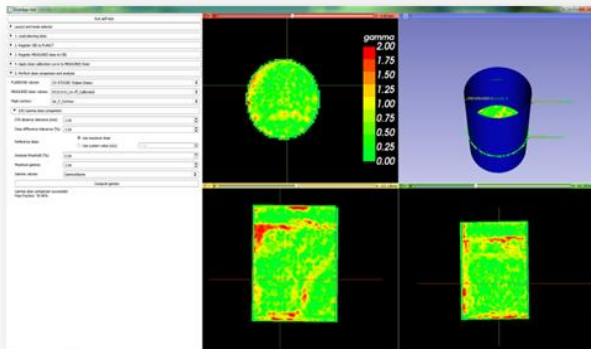
Data Import



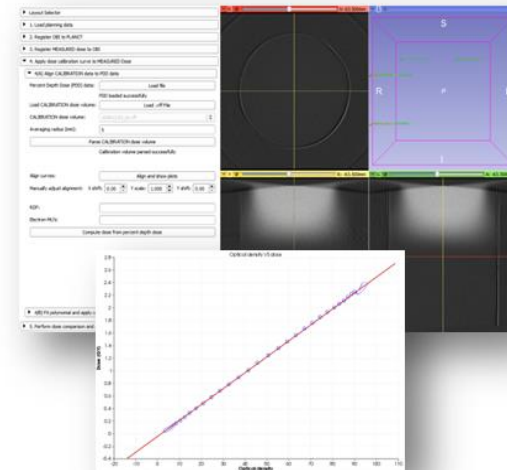
Registration



Dose Comparison



Calibration



3. Calibration

- Determine how optical density in the gel relates to dose
- Here, we use a percent depth-dose (PDD) method about the central axis of the gel jar
- We will align:
 - Gel optical density measurements
 - Water tank ion chamber PDD data



3.1 Calibration

▼ 3. Dose calibration

▼ 3.1. Perform calibration routine (optional)

Hint: Skip this step if calibration function is already available

Load reference percent depth dose (PDD) data from CSV file

Relative dose factor (RDF):


Delivered monitor units (MU's):

Averaging radius (mm):

Plot reference and gel PDD data

Manual adjustment: X shift: Y scale: Y shift:

Calculate dose from reference PDD

Plot optical density vs dose Optional: Remove selected points from plot 

Fit with what order polynomial function:

Fit data and determine calibration function

Gel #2



3.1 Calibration

3. Dose calibration

3.1. Perform calibration routine (optional)

Hint: Skip this step if calibration function is already available


Load reference percent depth dose (PDD) data from CSV file

Relative dose factor (RDF):

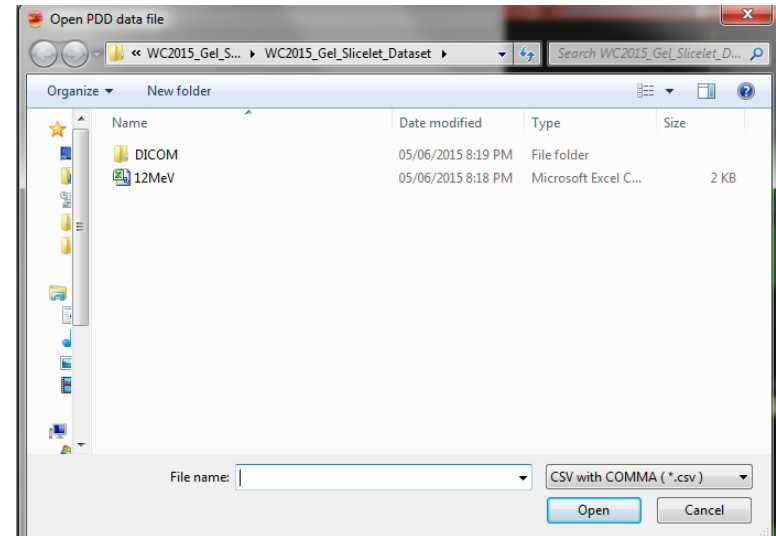
Delivered monitor units (MU's):

Averaging radius (mm):

Manual adjustment: X shift: Y scale: Y shift:

Optional: Remove selected points from plot 

Fit with what order polynomial function:



Select *12MeV.csv* file,
and click 'Open'

3.1 Calibration

3. Dose calibration

3.1. Perform calibration routine (optional)

Hint: Skip this step if calibration function is already available

Load reference percent depth dose (PDD) data from CSV file

Relative dose factor (RDF):


Delivered monitor units (MU's):

Averaging radius (mm):

Plot reference and gel PDD data

Manual adjustment: X shift: Y scale: Y shift:

Calculate dose from reference PDD

Plot optical density vs dose Optional: Remove selected points from plot 

Fit with what order polynomial function:

Fit data and determine calibration function

For this delivery:

Relative dose factor (RDF) = 0.989
(6x6 cm², 12 MeV electron beam)

Delivered monitor units (MUs) = 300

Averaging radius (mm) = 5



3.1 Calibration

▼ 3. Dose calibration

▼ 3.1. Perform calibration routine (optional)

Hint: Skip this step if calibration function is already available

Load reference percent depth dose (PDD) data from CSV file

Relative dose factor (RDF):


Delivered monitor units (MU's):

Averaging radius (mm):

Plot reference and gel PDD data

Manual adjustment: X shift: Y scale:

Calculate dose from reference PDD

Plot optical density vs dose Optional: Remove selected points from plot 

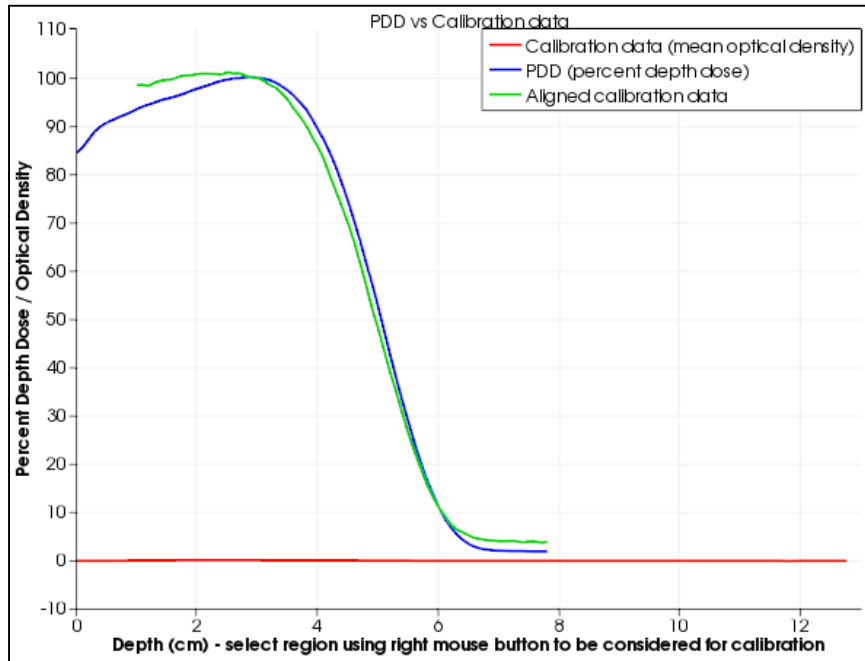
Fit with what order polynomial function:

Fit data and determine calibration function

3.1 Calibration



Automated PDD alignment



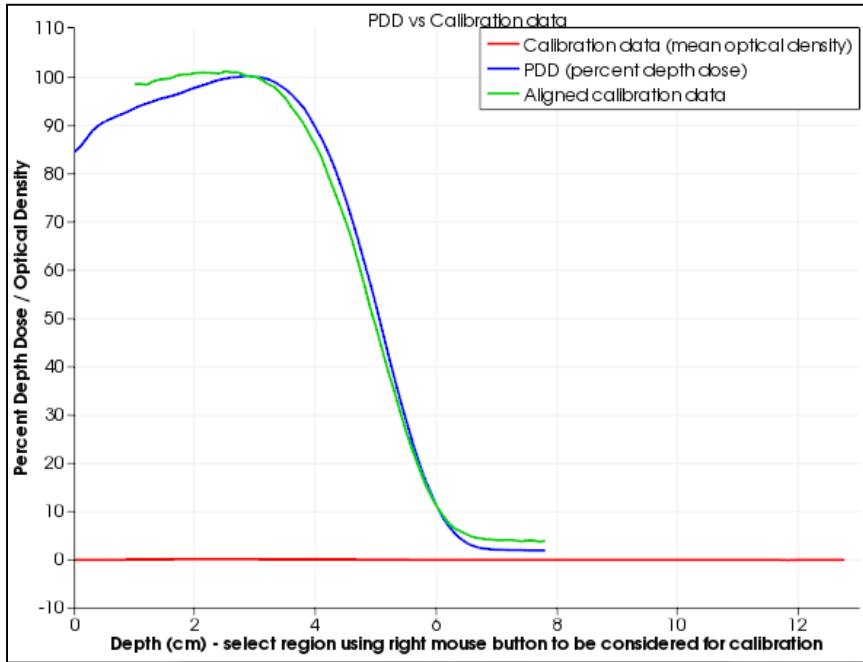
Adjust alignment using:

X shift: Y scale: Y shift:

- Blue: Commissioning PDD data
- Red: Raw optical density data
- Green: Shifted and scaled optical density data

3.1 Calibration

Automated PDD alignment



- Blue:** Commissioning PDD data
- Red:** Raw optical density data
- Green:** Shifted and scaled optical density data

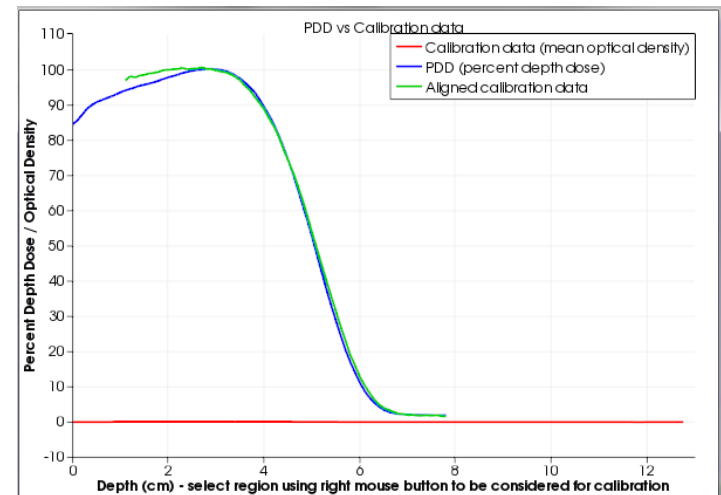


Adjust alignment using:

X shift: Y scale: Y shift:



X shift: Y scale: Y shift:




3.1 Calibration

Plot reference and gel PDD data

Manual adjustment: X shift: Y scale: Y shift:

Calculate dose from reference PDD

Plot optical density vs dose Optional: Remove selected points from plot 

Fit with what order polynomial function:


Fit data and determine calibration function

3.1 Calibration

Plot reference and gel PDD data

Manual adjustment: X shift: Y scale: Y shift:

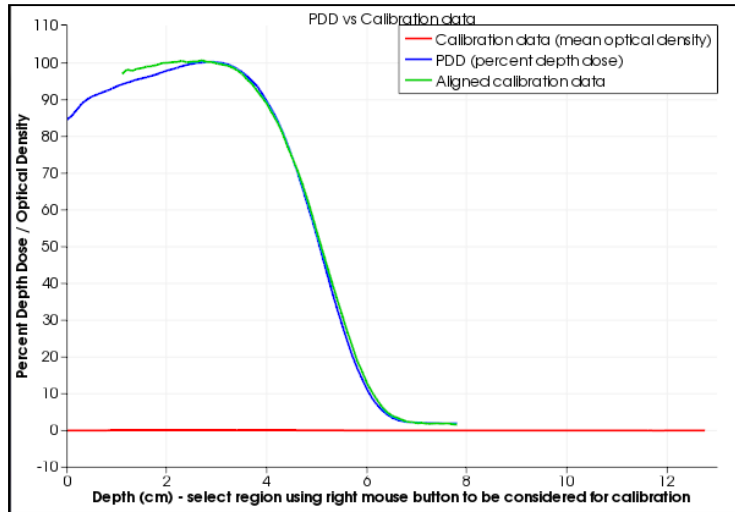
Calculate dose from reference PDD

Plot optical density vs dose Optional: Remove selected points from plot 

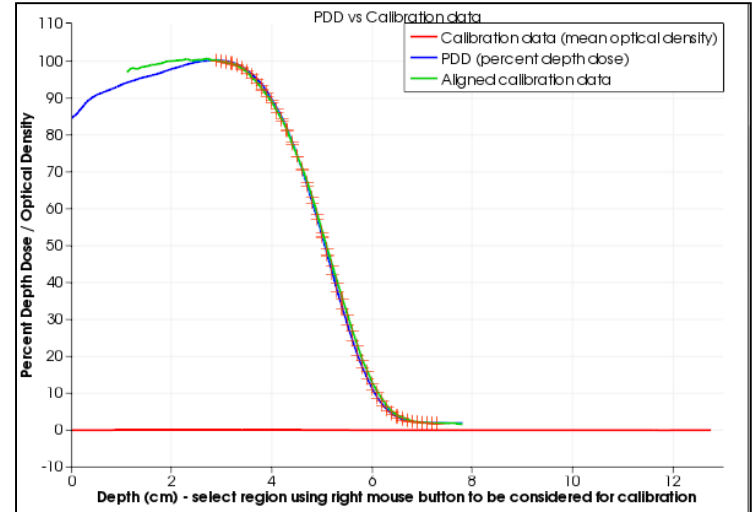
Fit with what order polynomial function:

Fit data and determine calibration function

3.1 Calibration



Right click and draw box around region to use for calibration



Plot reference and gel PDD data

Manual adjustment: X shift: Y scale: Y shift:

Calculate dose from reference PDD

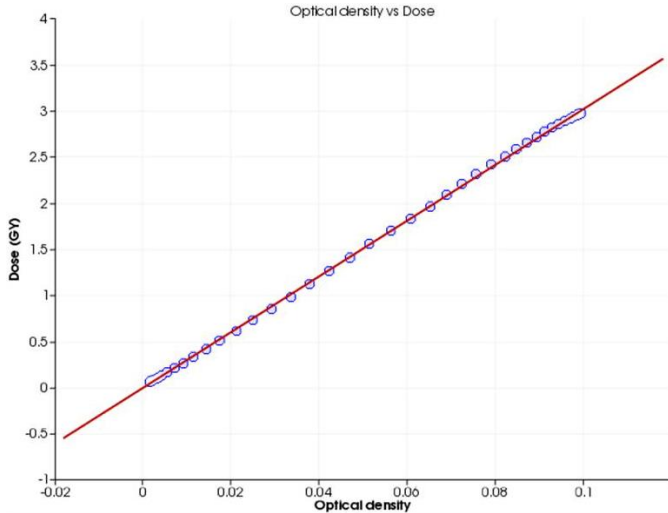
Plot optical density vs dose Optional: Remove selected points from plot

Fit with what order polynomial function:

Fit data and determine calibration function



3.2 Calibration



Fit with what order polynomial function:



▼ 3.2. Apply calibration

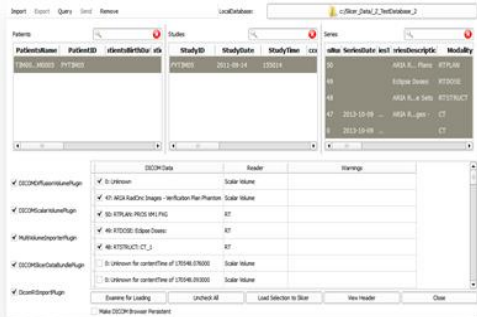
Calibration function:
(either determined from step 3.1., or can be manually input/alterd)

$$\text{Dose (Gy)} = \text{[-0.024698]} \text{ OD}^0 + \text{[30.139127]} \text{ OD}^1 + \text{[]} \text{ OD}^2 + \text{[]} \text{ OD}^3 + \text{[]} \text{ OD}^4$$

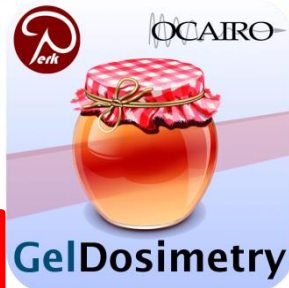
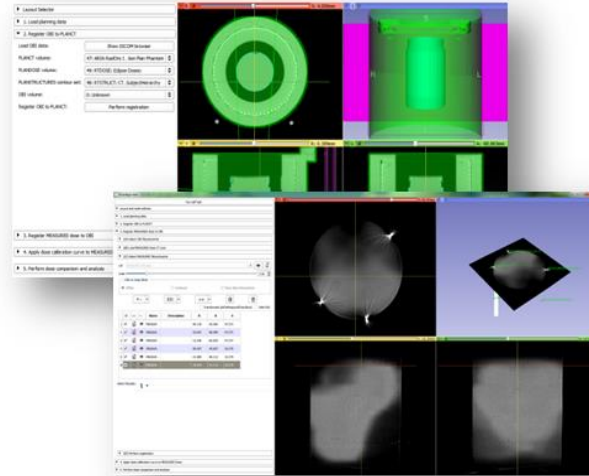
Calibration function is determined and applied to measured gel volume

Gel Dosimetry Analysis Roadmap

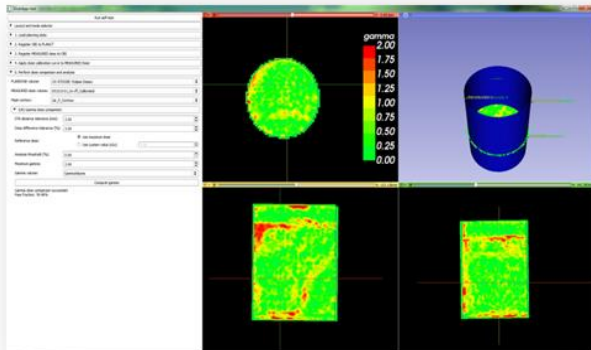
Data Import



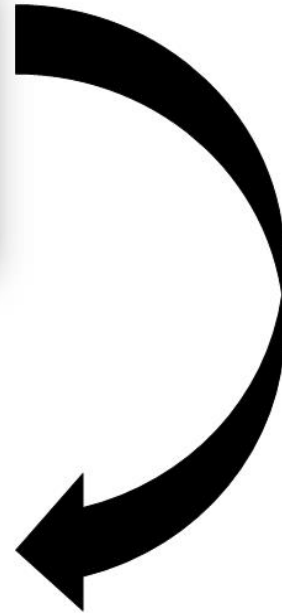
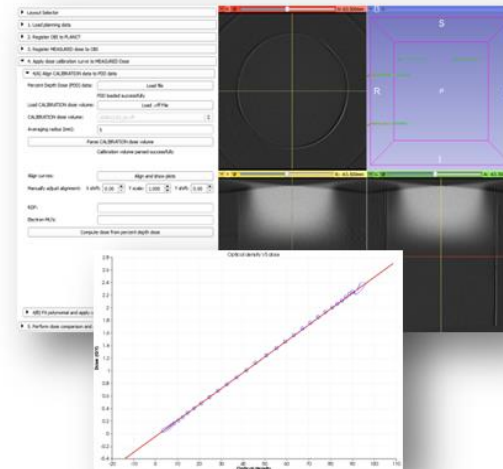
Registration



Dose Comparison



Calibration



4. Dose Comparison

- Last step! Compare the measured gel dose volume with the planned dose volume (using the treatment planning system)
- We will use a 3D gamma comparison
- Criteria: 3% dose difference, 3mm distance-to-agreement



4. Dose Comparison

Volumes are automatically assigned

4. 3D gamma dose comparison

Plan dose volume (reference): 12: RTDOSE: Eclipse Doses
Calibrated gel volume (evaluated): measured.vff_Calibrated

Mask structure: 3: RTSTRUCT: CT_1
Segment: Jar

Distance-to-agreement criteria (mm): 3.00

Dose difference criteria is 3.00 % of:
 the maximum dose (calculated from plan dose volume)
 a custom dose value (cGy): 5.00

Do not calculate gamma values for voxels below 0.00 % of the maximum dose, or the custom dose value (depending on selection above).

Use linear interpolation:

Upper bound for gamma calculation: 2.00

Gamma volume: Select a Volume

Calculate gamma volume



Select 'CT_1' structure set
Choose the 'Jar' structure

4. Dose Comparison

4. 3D gamma dose comparison

Plan dose volume (reference): 12: RTDOSE: Eclipse Doses
Calibrated gel volume (evaluated): measured.vff_Calibrated

Mask structure: 3: RTSTRUCT: CT_1
Segment: Jar

Distance-to-agreement criteria (mm): 3.00

Dose difference criteria is 3.00 % of:
 the maximum dose (calculated from plan dose volume)
 a custom dose value (cGy): 5.00

Do not calculate gamma values for voxels below 0.00 % of the maximum dose, or the custom dose value (depending on selection above).

Use linear interpolation:

Upper bound for gamma calculation: 2.00

Gamma volume: Select a Volume

Calculate gamma volume

Note: Two ways to specify dose difference



4. Dose Comparison

▼ 4. 3D gamma dose comparison

Plan dose volume (reference): 12: RTDOSE: Eclipse Doses
Calibrated gel volume (evaluated): measured.vff_Calibrated

Mask structure: 3: RTSTRUCT: CT_1
Segment: Jar

Distance-to-agreement criteria (mm): 3.00

Dose difference criteria is 3.00 % of:
 the maximum dose (calculated from plan dose volume)
 a custom dose value (cGy): 5.00

Do not calculate gamma values for voxels below 0.00 % of the maximum dose, or the custom dose value (depending on selection above).

Use linear interpolation:

Upper bound for gamma calculation: 2.00

Gamma volume: Select a Volume

Calculate gamma volume



Dose threshold:
Where to calculate
gamma

4. Dose Comparison

▼ 4. 3D gamma dose comparison

Plan dose volume (reference): 12: RTDOSE: Eclipse Doses
Calibrated gel volume (evaluated): measured.vff_Calibrated

Mask structure: 3: RTSTRUCT: CT_1
Segment: Jar

Distance-to-agreement criteria (mm): 3.00

Dose difference criteria is 3.00 % of:
 the maximum dose (calculated from plan dose volume)
 a custom dose value (cGy): 5.00

Do not calculate gamma values for voxels below 0.00 % of the maximum dose, or the custom dose value (depending on selection above).

Use linear interpolation:

Upper bound for gamma calculation: 2.00

Gamma volume: Select a Volume

Calculate gamma volume



Create new gamma volume

4. Dose Comparison

▼ 4. 3D gamma dose comparison

Plan dose volume (reference): 12: RTDOSE: Eclipse Doses
Calibrated gel volume (evaluated): measured.vff_Calibrated

Mask structure: 3: RTSTRUCT: CT_1
Segment: Jar

Distance-to-agreement criteria (mm): 3.00

Dose difference criteria is 3.00 % of:
 the maximum dose (calculated from plan dose volume)
 a custom dose value (cGy): 5.00

Do not calculate gamma values for voxels below 0.00 % of the maximum dose, or the custom dose value (depending on selection above).

Use linear interpolation:

Upper bound for gamma calculation: 2.00

Gamma volume: GammaVolume

Calculate gamma volume



4. Dose Comparison

Layout selector

1. Load data

2. Registration

3. Dose calibration

4. 3D gamma dose comparison

Plan dose volume (reference): 12: RTDOSE: Eclipse Doses
 Calibrated gel volume (evaluated): measured.vff_Calibrated

Mask structure: 3: RTSTRUCT: CT_1

Segment: Jar

Distance-to-agreement criteria (mm): 3.00

Dose difference criteria is 3.00 % of:

 the maximum dose (calculated from plan dose volume)

 a custom dose value (cGy): 5.00

Do not calculate gamma values for voxels below 0.00 % of the maximum dose, or the custom dose value (depending on selection above).

Use linear interpolation:

Upper bound for gamma calculation: 2.00

Gamma volume: GammaVolume

Calculate gamma volume

Gamma dose comparison succeeded
 Pass fraction: 95.96%

Show report

Tool: Line profile

4. Dose Comparison

Dose threshold at 40% of max. dose

Layout selector

- 1. Load data
- 2. Registration
- 3. Dose calibration
- 4. 3D gamma dose comparison

Plan dose volume (reference): 12: RTDOSE: Eclipse Doses
Calibrated gel volume (evaluated): measured.vff_Calibrated
Mask structure: 3: RTSTRUCT: CT_1
Segment: Jar

Distance-to-agreement criteria (mm): 3.00

Dose difference criteria is % of:
 the maximum dose (calculated from plan dose volume)
 a custom dose value (cGy):

Do not calculate gamma values for voxels below % of the maximum dose, or the custom dose value (depending on selection above).

Use linear interpolation:

Upper bound for gamma calculation:

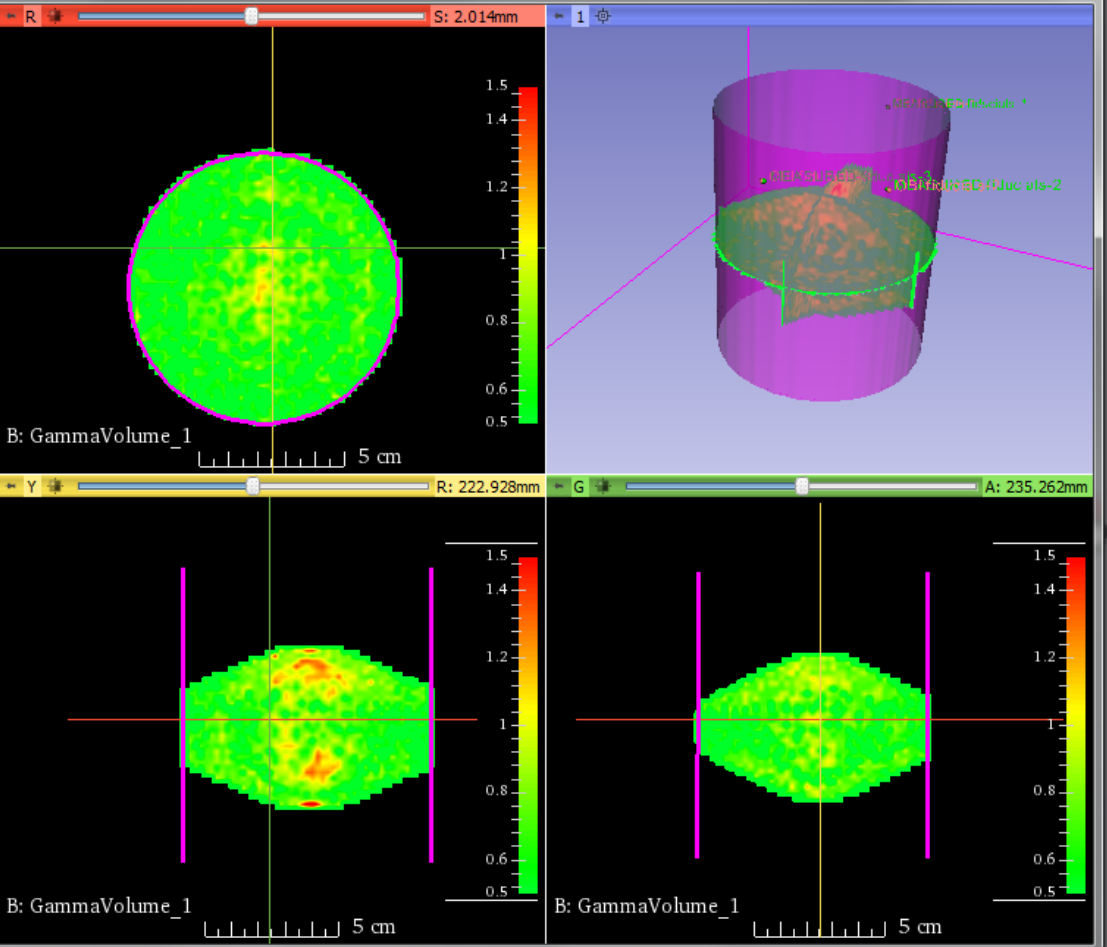
Gamma volume: GammaVolume_1

Calculate gamma volume

**Gamma dose comparison succeeded
Pass fraction: 96.03%**


Show report

Tool: Line profile




Line Profile

▼ Tool: Line profile

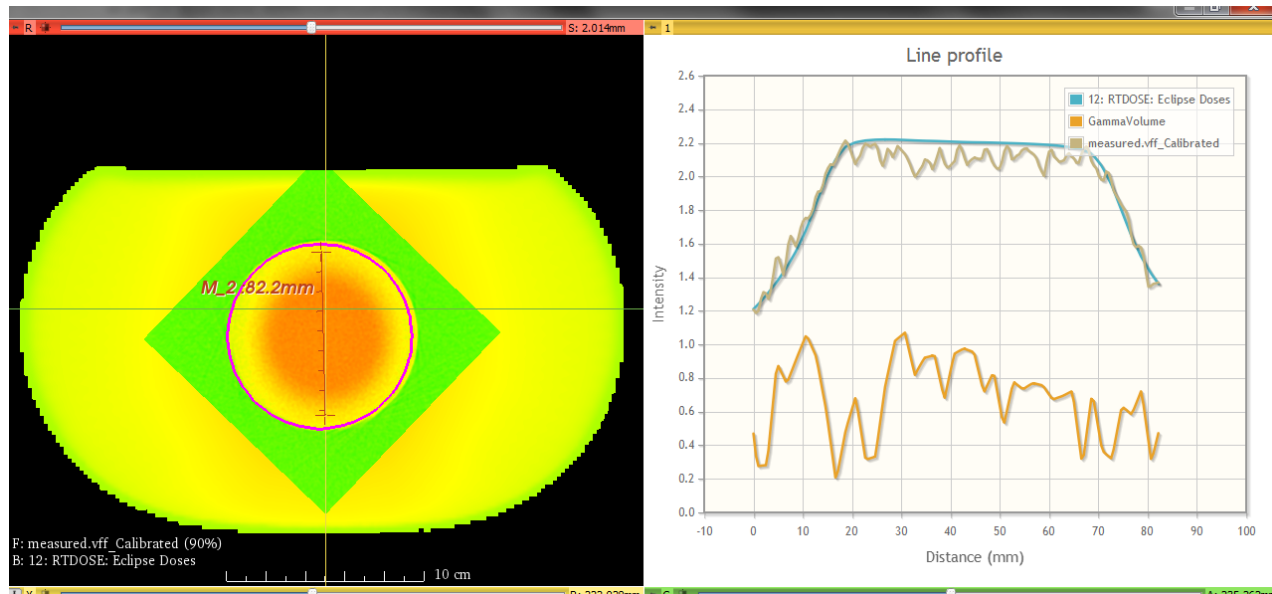
Create ruler: 

Input ruler: M_2

Line resolution (mm):  0.5

Draw line profile, with ruler tool, then click 'Create line profile' to view.

Hint: Full screen plot view is available in the layout selector tab (top one)



From our online survey

“Concerning Gel Dosimetry slicelet:

*Is it possible to save the result of an analysis?
What if I don't want to go over the procedure
every time for the same piece of data?”*



Are you gellin'?

Outrageous comfort and support
with *Massaging Gel*

- Gel supports comfort with Dual Gel Technology
- Guaranteed comfort — or your money back

massaging
gel

The advertisement features a man in a green sweater and dark pants standing next to a small dog. To the right is a large, upright package of 'massaging gel'. The background is a solid blue color. The text 'Are you gellin'?' is in a large, yellow, playful font. Below it, the tagline 'Outrageous comfort and support with Massaging Gel' is in white. Two bullet points describe the product's features. The product name 'massaging gel' is written in a stylized font at the bottom right of the package.





Wrap-up

- Thanks for participating!
- Let us know if you have any questions/suggestions
- Have a great week and conference!



