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Dosimetric Analysis Report

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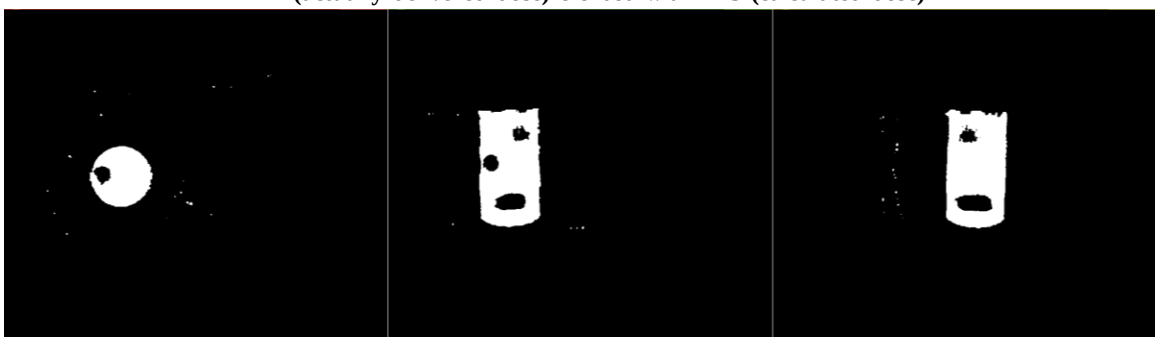
3D Relative Dosimetry (Gel)

Date of report:	---
Date of irradiation:	---
Phantom type:	SBRT phantom
Phantom S/N:	---
Gel Insert Kit S/N:	---
Treatment Planning System:	---
Number of target volumes (PTVs):	3
Institution:	----

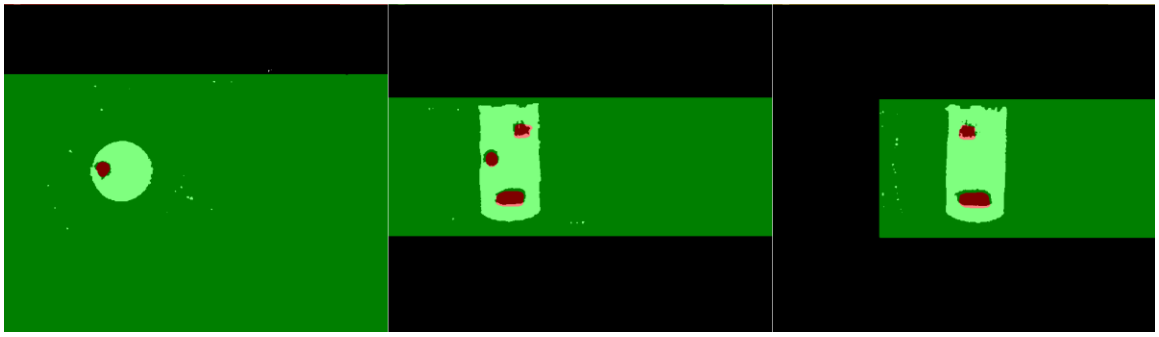
PART I: *Qualitative comparison*

Image registration between post-irradiation MRI and planning RTDose TPS data with structures of the Gel phantom. This is to demonstrate the coincidence of each treated target to its planned location.

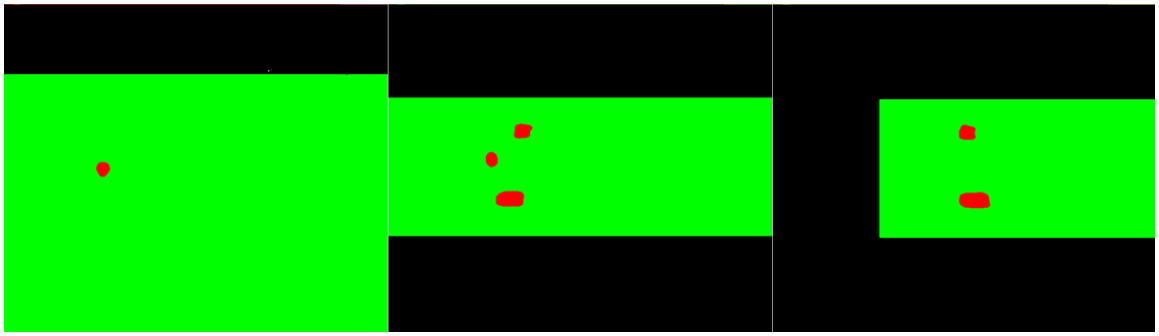
MRI (actually delivered dose) blended with **TPS (calculated dose)**



MRI 100% - RTDOSE TPS 0%



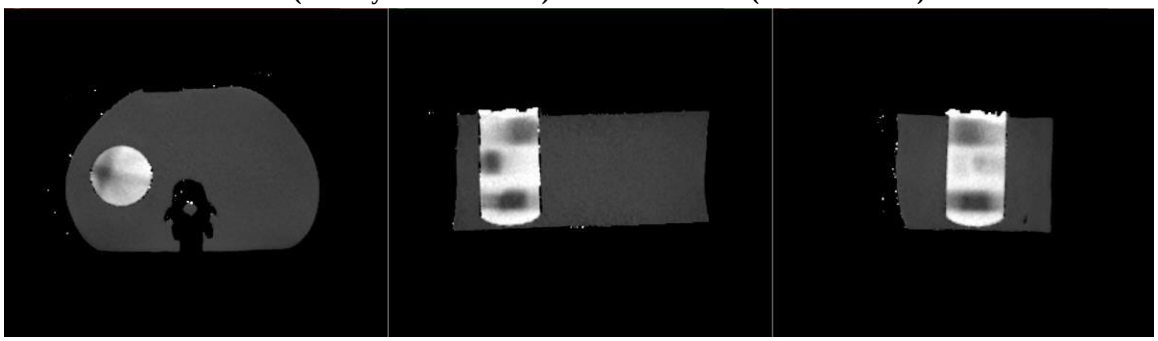
MRI 50% - RTDOSE TPS 50%



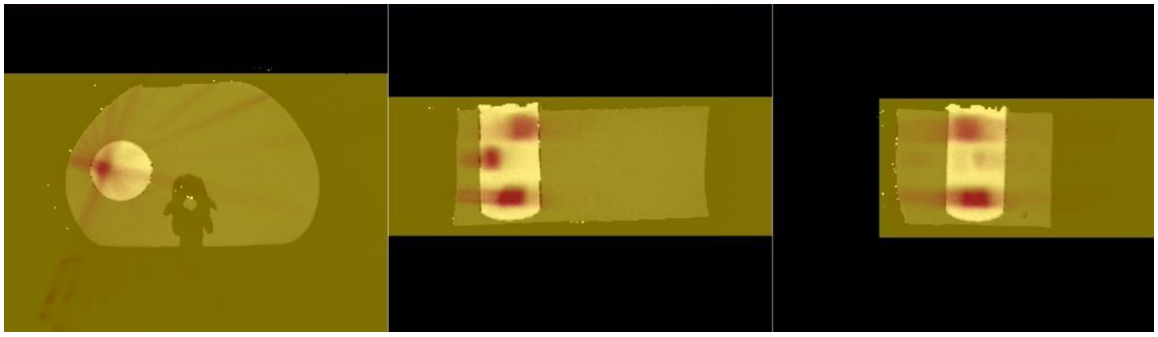
MRI 0% - RTDOSE TPS 100%

(Brightness and contrast adjusted so that only high dose areas are depicted)

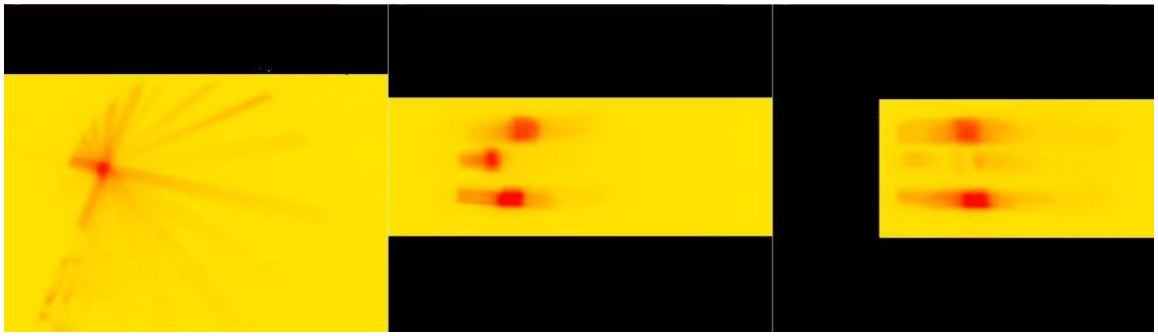
MRI (actually delivered dose) blended with **TPS (calculated dose)**



MRI 100% - RTDOSE TPS 0%



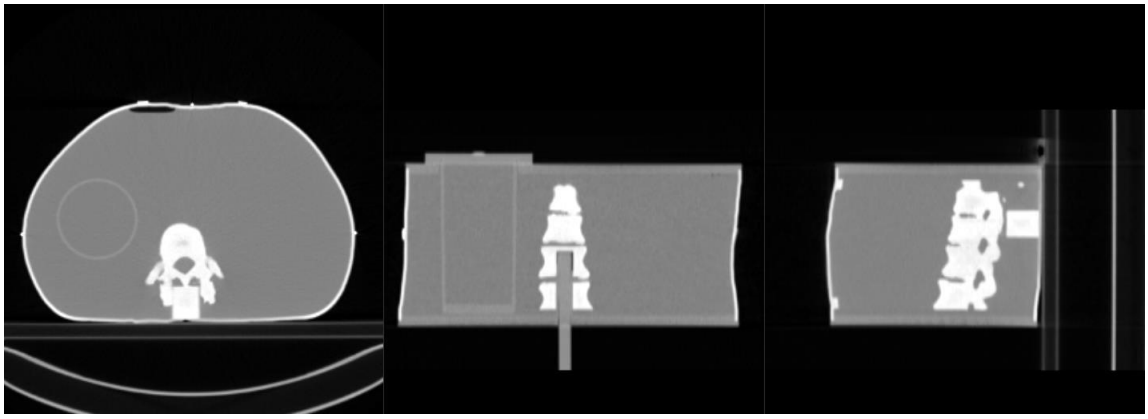
MRI 50% - RTDOSE TPS 50%



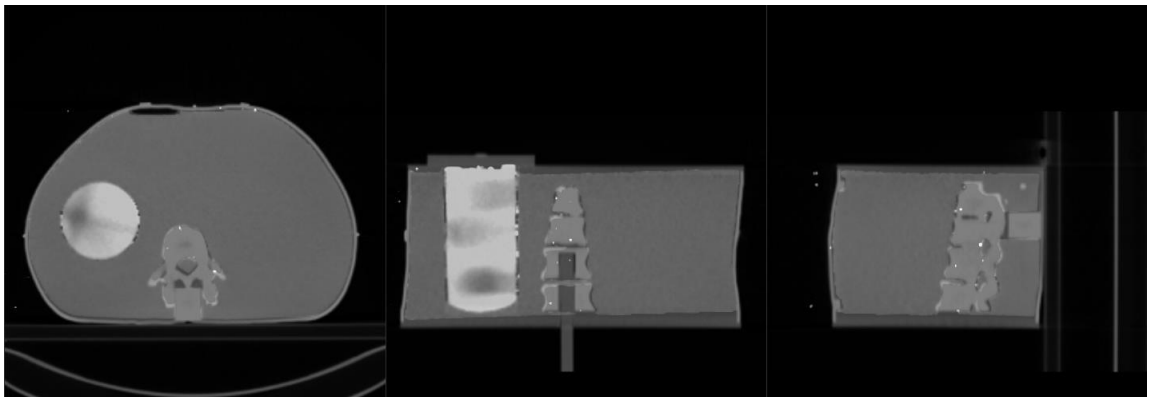
MRI 0% - RTDOSE TPS 100%

(Brightness and contrast adjusted so that also low dose areas are depicted)

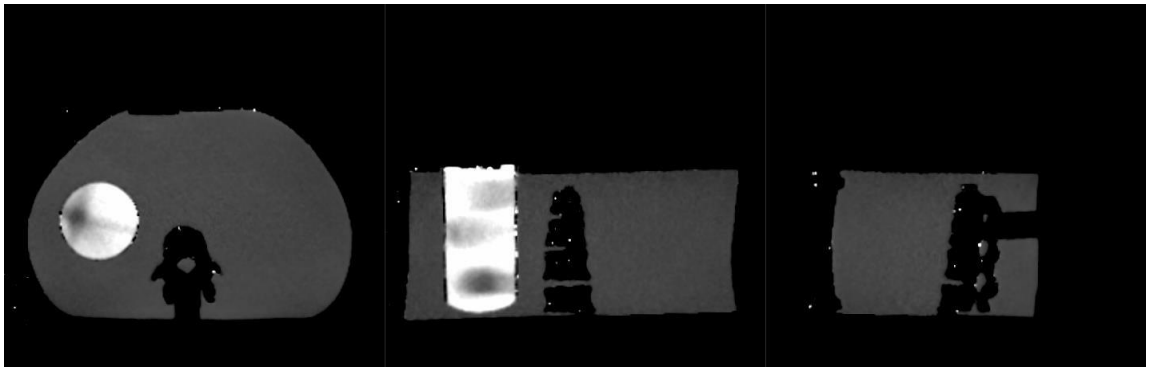
Image registration between post-irradiation MRI and planning CT data.



MRI 0% - CT 100%



MRI 50% - CT 50%



MRI 100% - CT 0%

PART II: *Profiles comparison*

Indicatively, a number of relative dose profiles for both the measured and TPS-calculated datasets are presented in the following figures. In order to quantitatively assess agreement between the two datasets, 1D gamma index calculations are also included. Passing criteria were 2 mm distance-to-agreement and 5% dose difference.

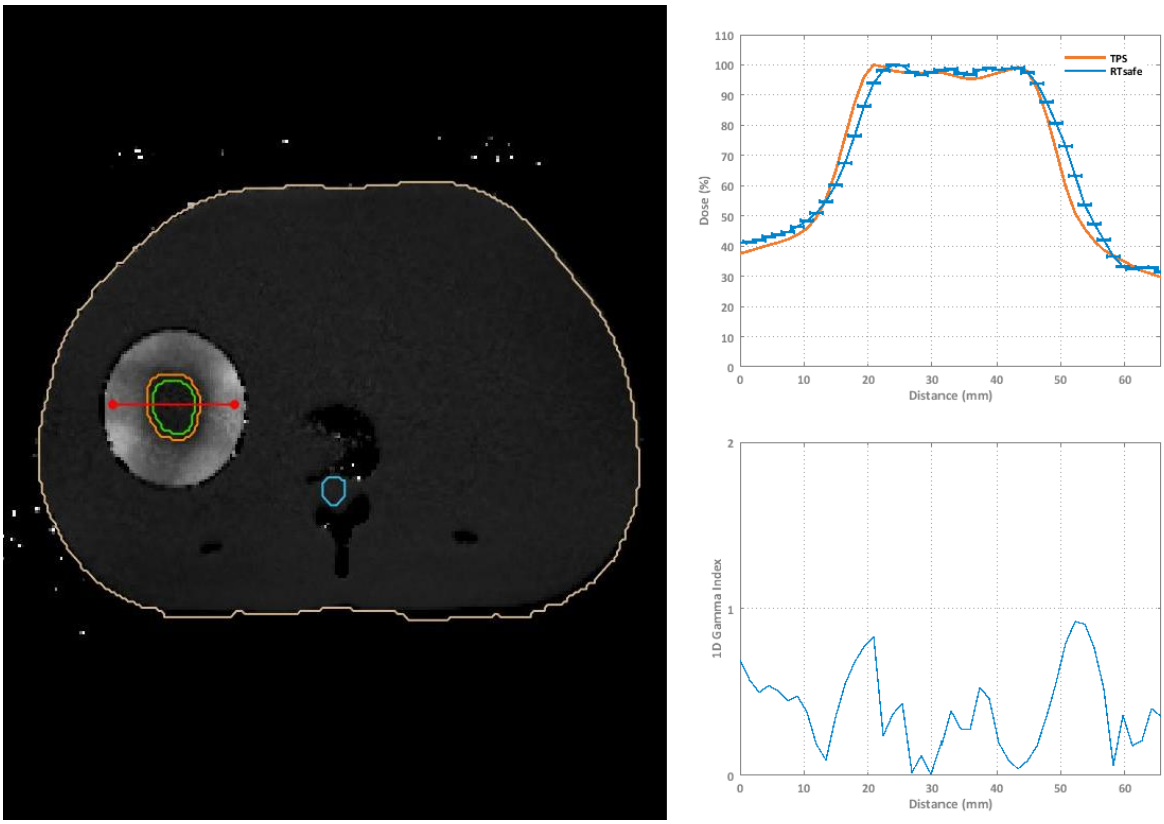
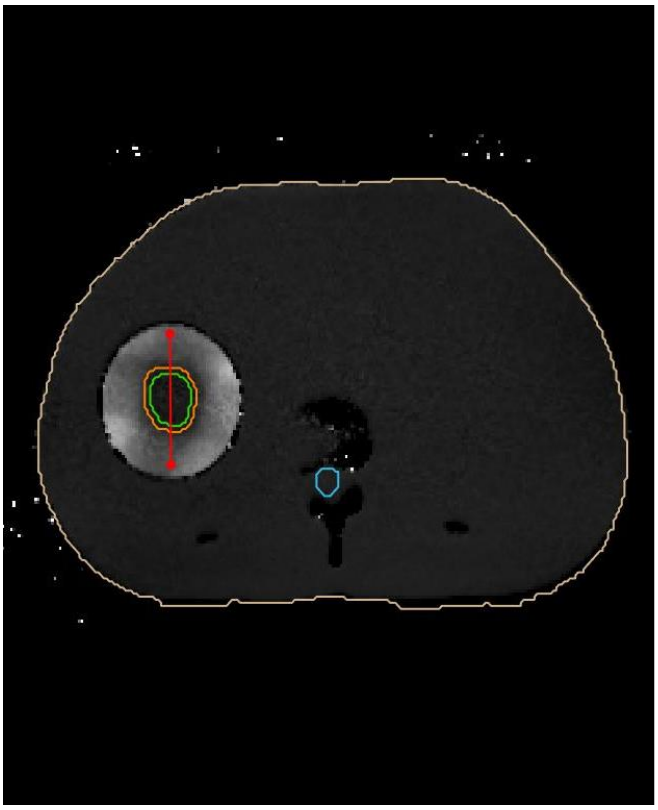
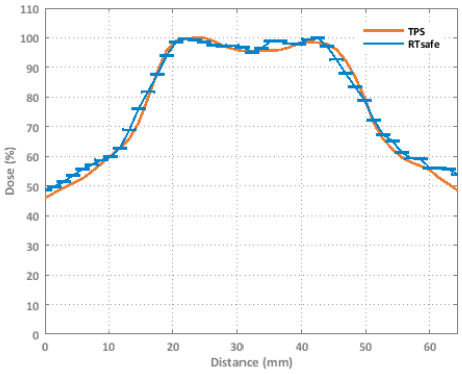
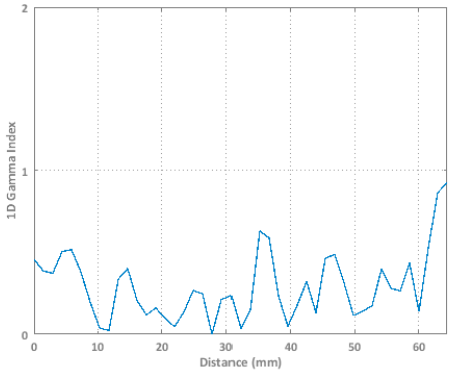


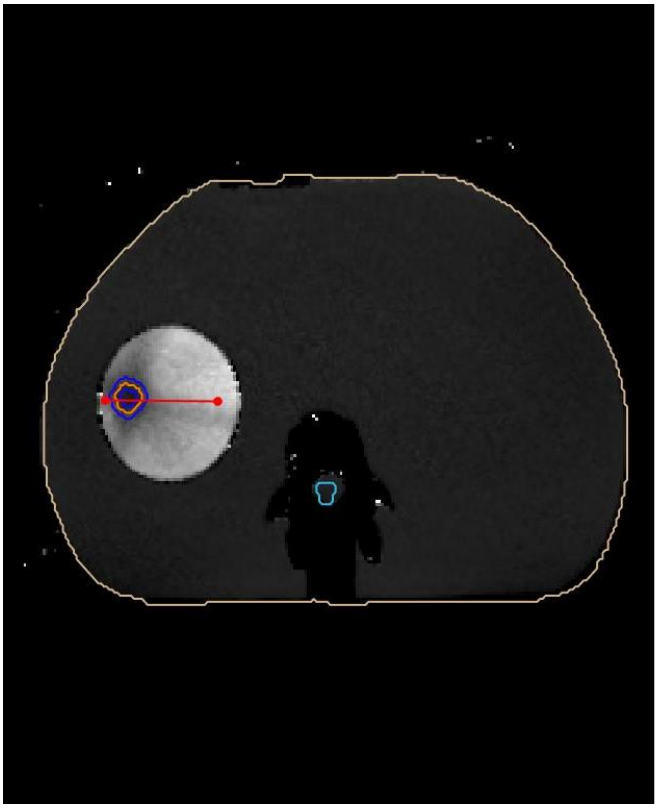
Figure: (left) Slice of the derived T2 maps of the irradiated phantom. High dose regions correspond to darker areas. (right) 1D profile comparison between calculated (TPS) and measured (RTsafe) dose distributions at the location depicted by the red line. Error bars correspond to ± 1mm spatial uncertainty. 1D gamma index calculations are also given using passing criteria 5%/2mm.

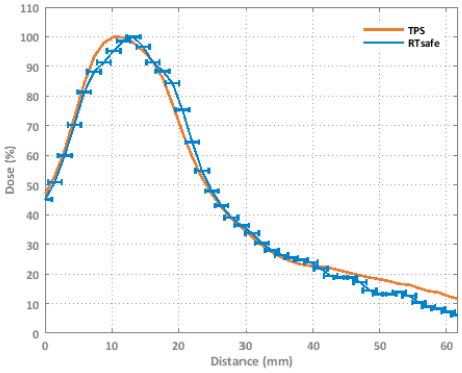
The same figure caption applies to all following figures in Part II.

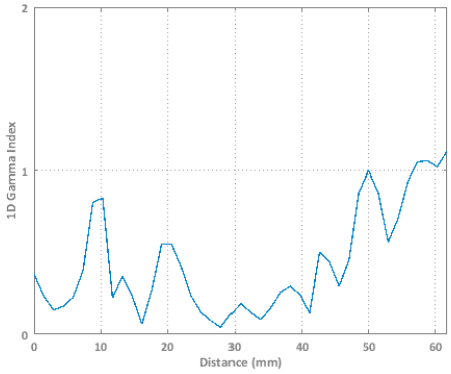


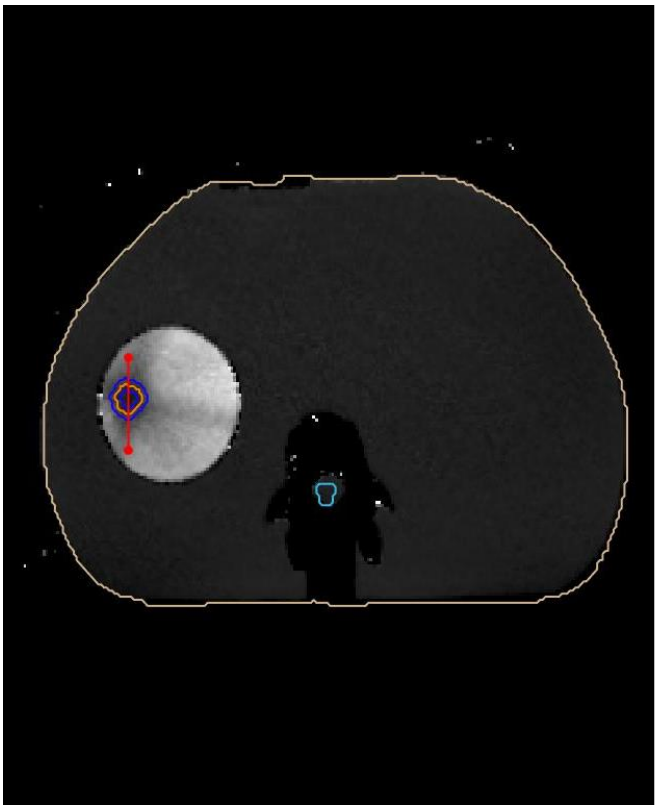

TPS
RTsafe
Dose (%)
Distance (mm)

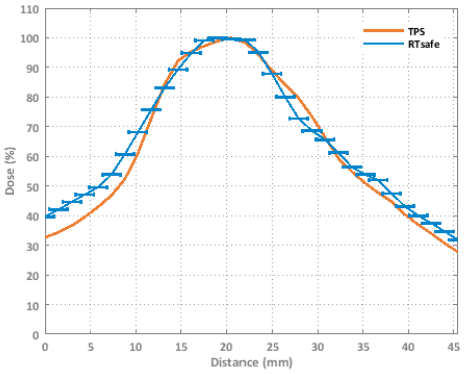

1D Gamma Index
Distance (mm)

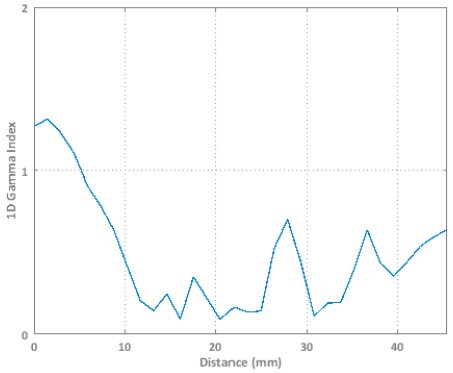


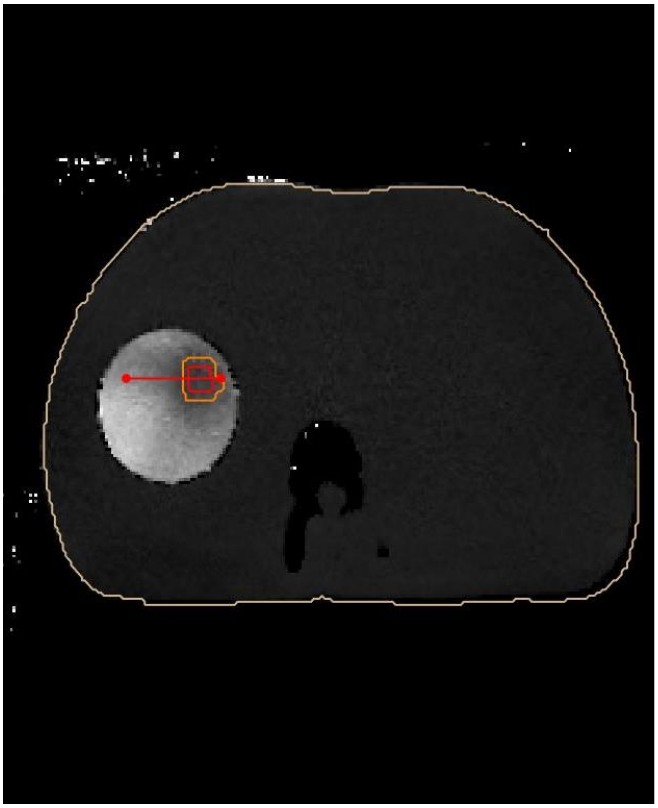

TPS
RTsafe
Dose (%)
Distance (mm)

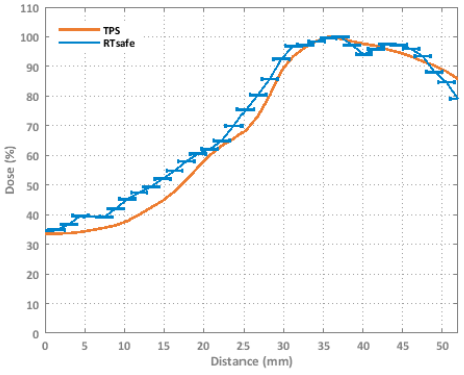

1D Gamma Index
Distance (mm)

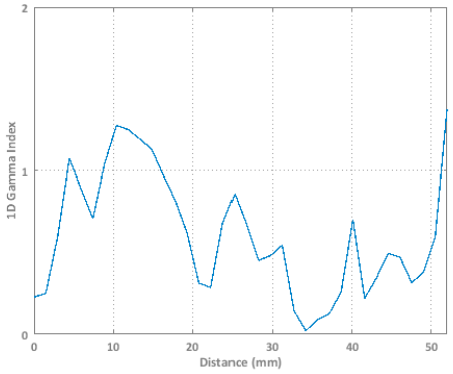


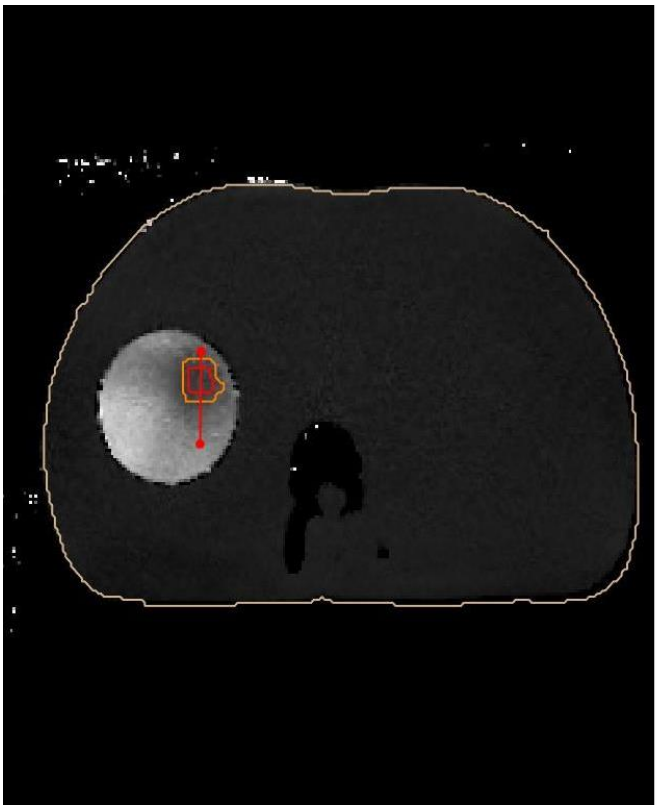

TPS
RTsafe
Dose (%)
Distance (mm)

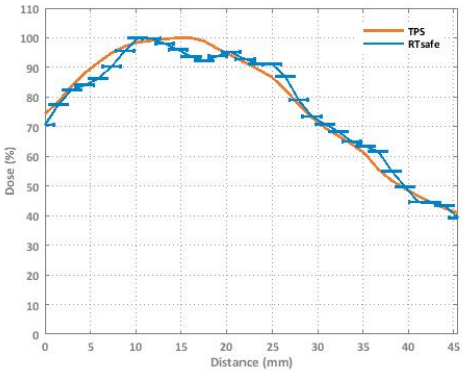

1D Gamma Index
Distance (mm)




TPS
RTsafe
Dose (%)
Distance (mm)


1D Gamma Index
Distance (mm)

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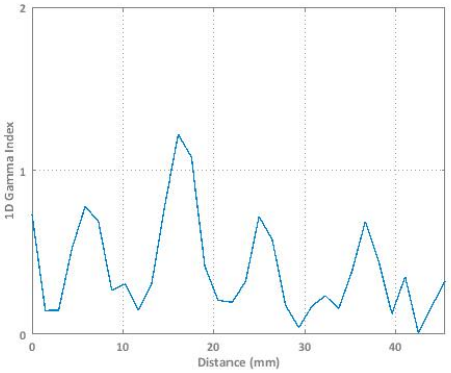
RTsafe
Dose (%)
Distance (mm)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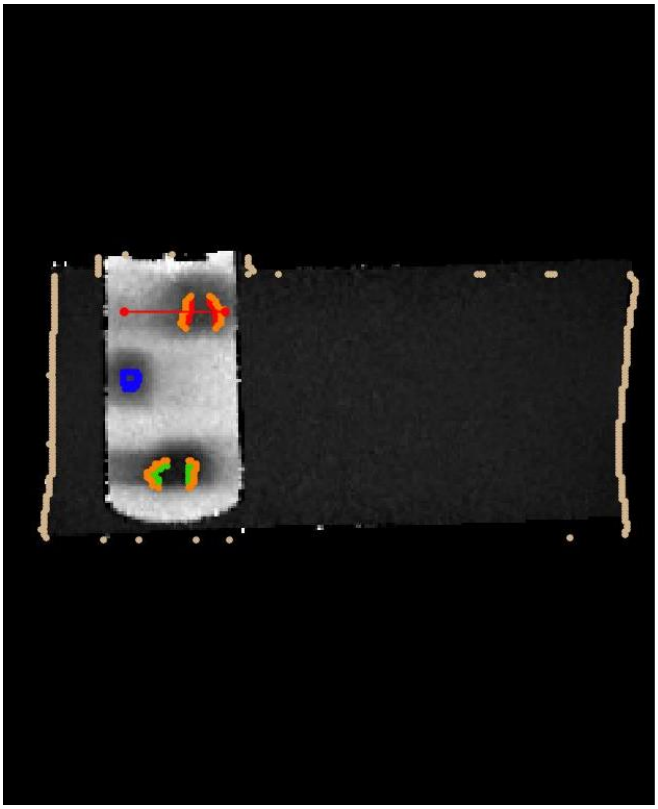
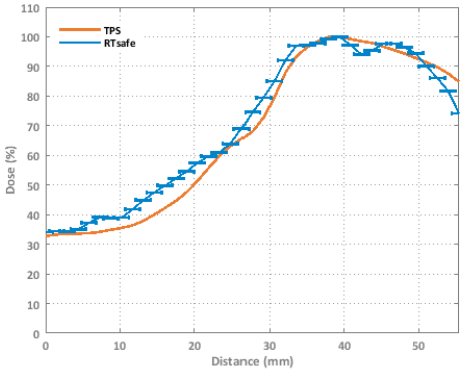
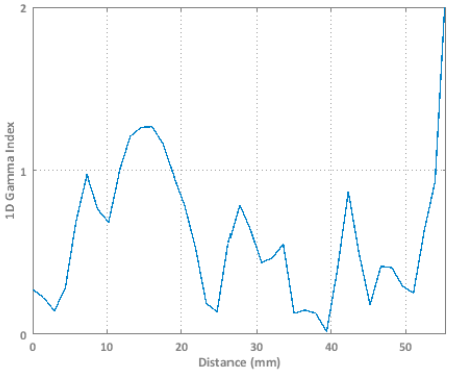
Distance (mm)




TPS
RTsafe
Dose (%)
Distance (mm)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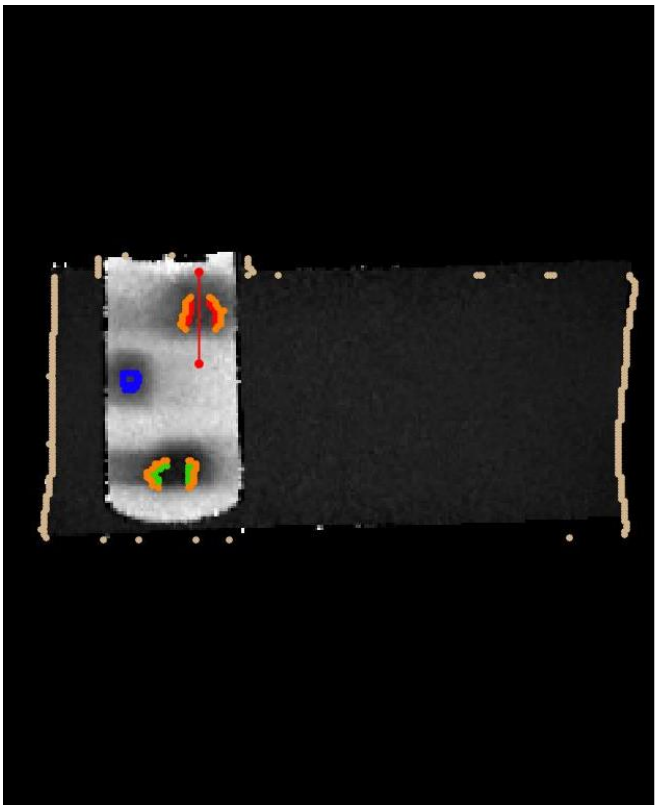
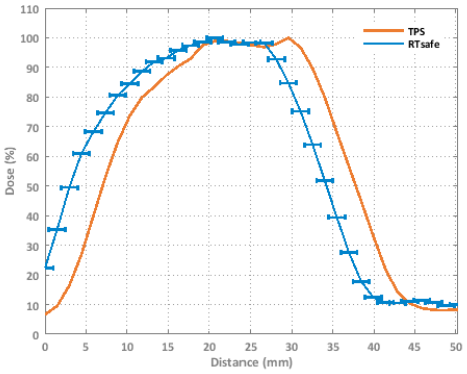
Distance (mm)

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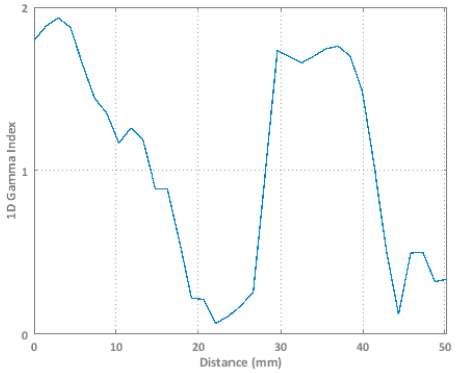
RTsafe
Dose (%)
Distance (mm)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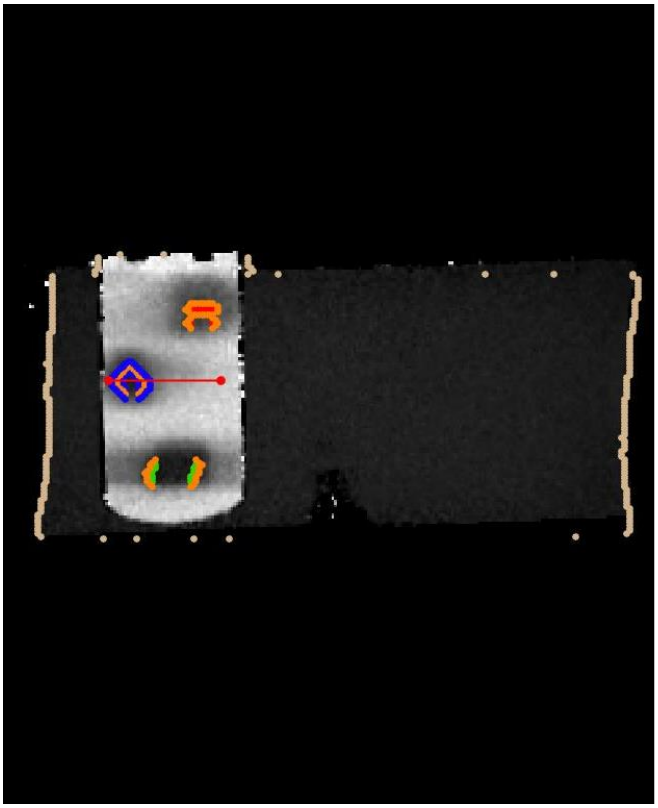

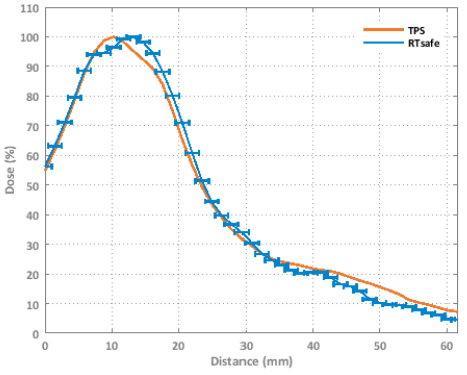
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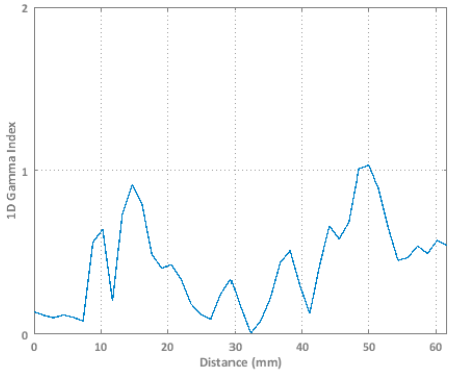
Dose (%)
Distance (mm)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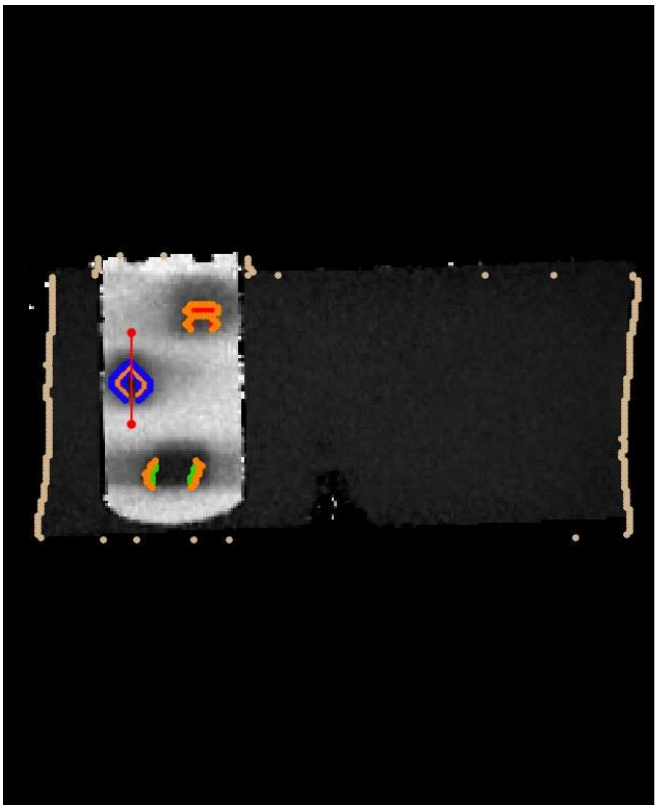

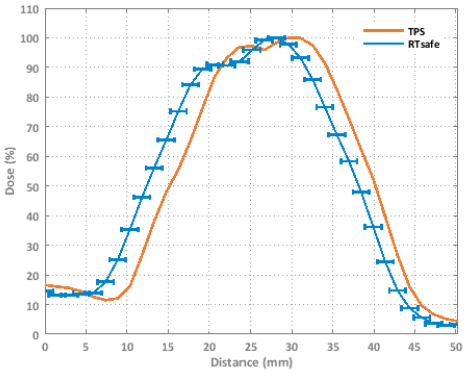
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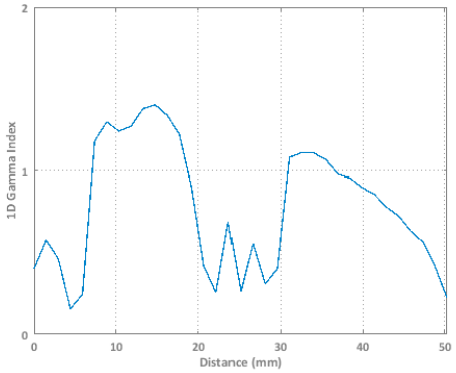
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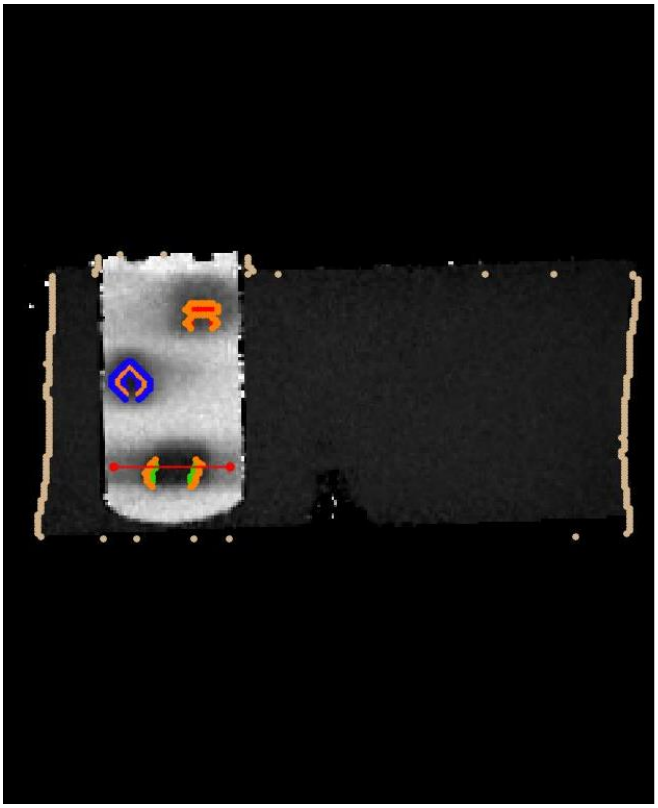

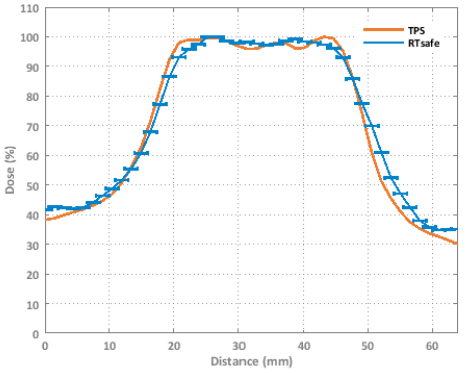
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Dose (%)
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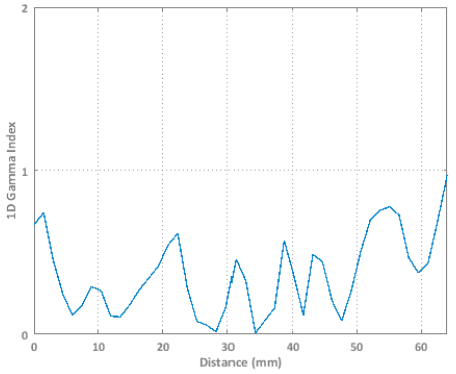
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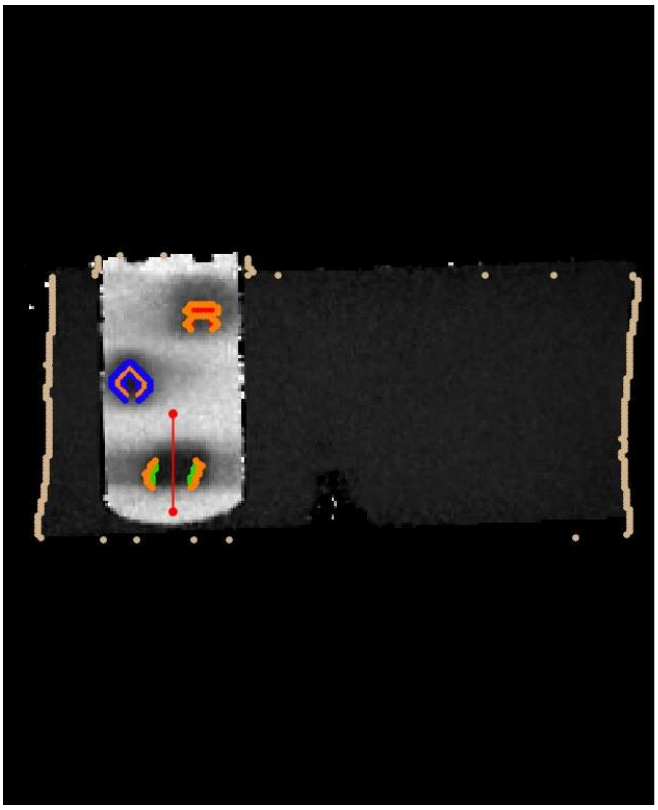

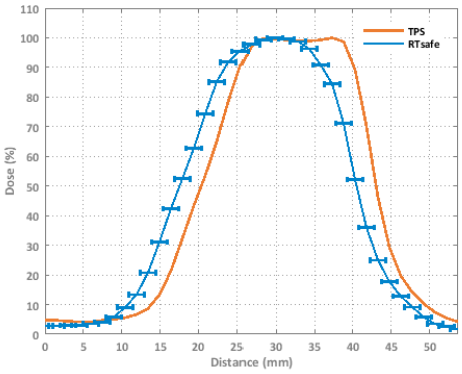
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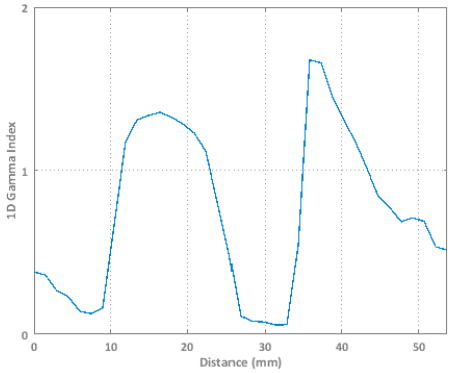
Dose (%)
Distance (mm)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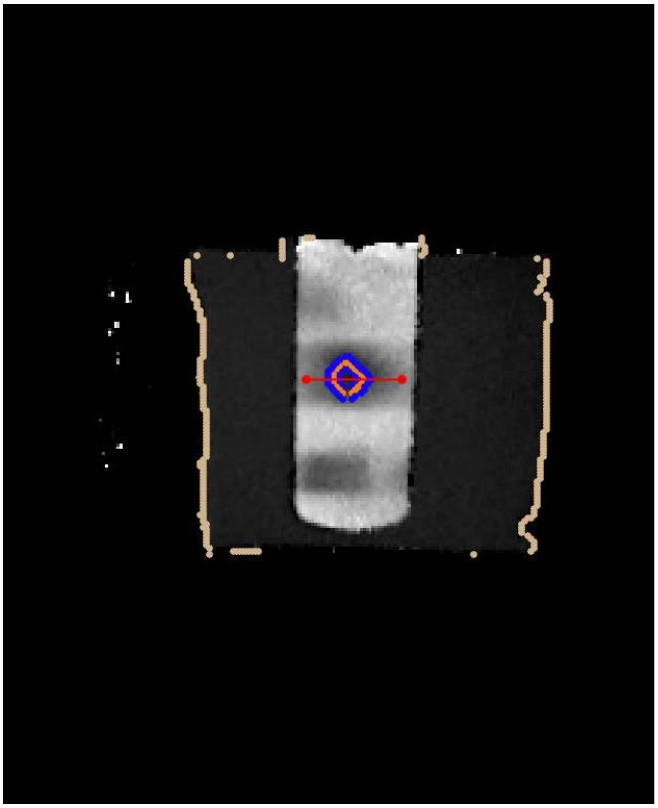
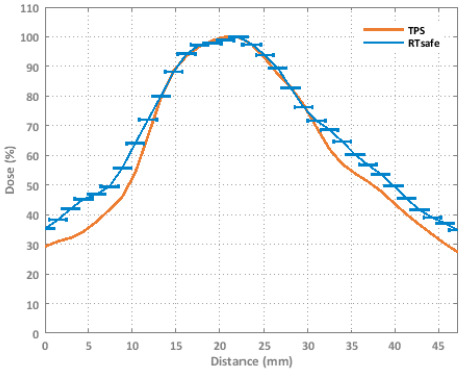
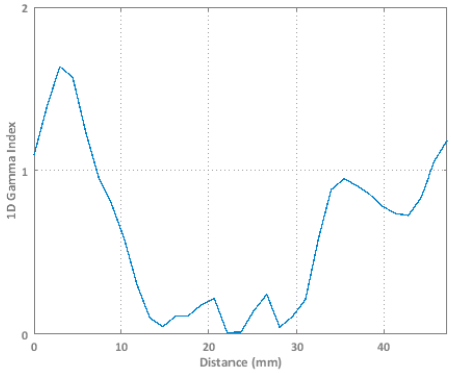
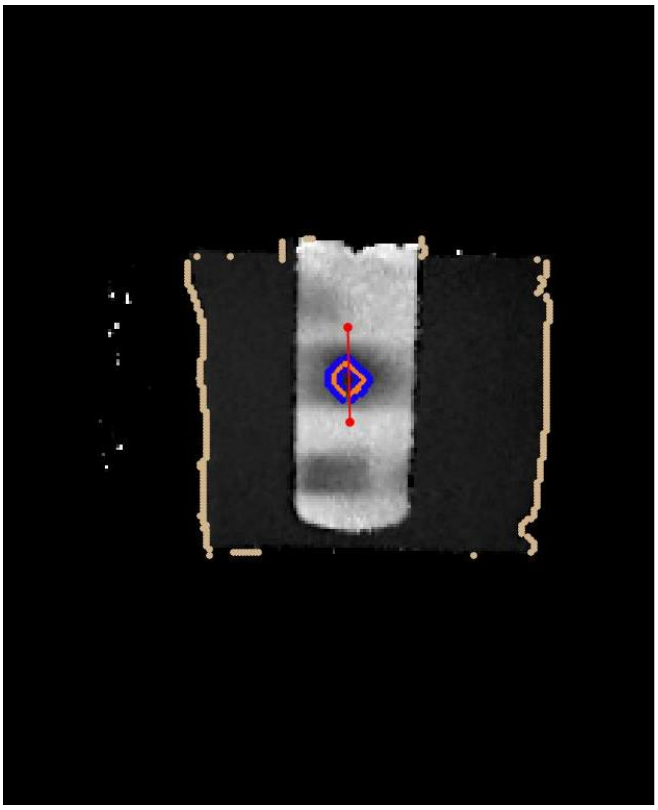
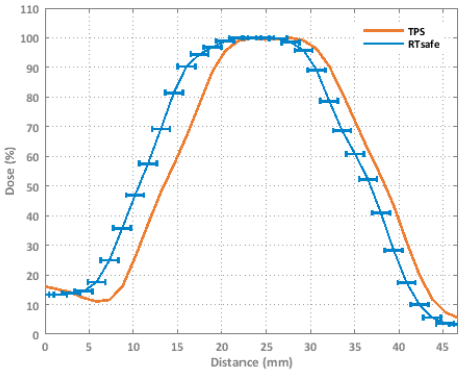



TPS
RTsafe
Dose (%)
Distance (mm)


1D Gamma Index
Distance (mm)




TPS
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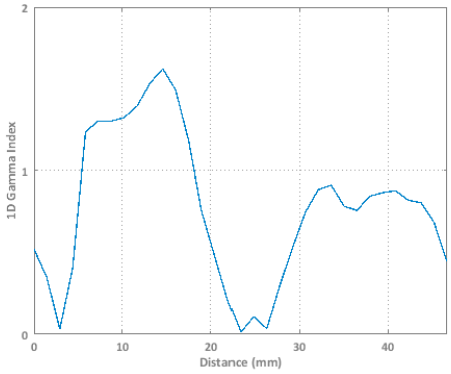
Dose (%)
Distance (mm)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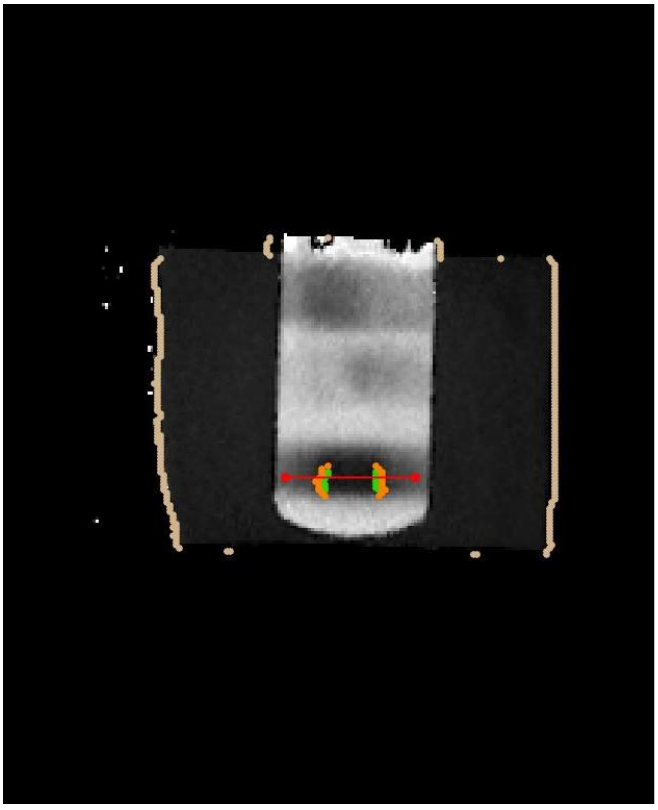
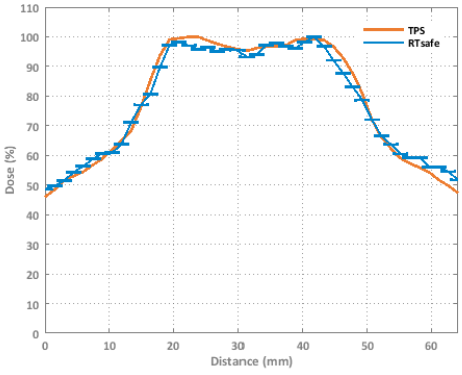
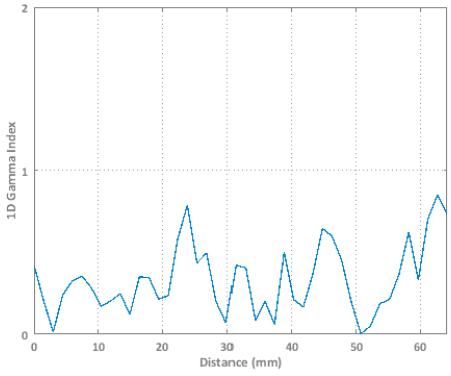
Distance (mm)




TPS
RTsafe
Dose (%)
Distance (mm)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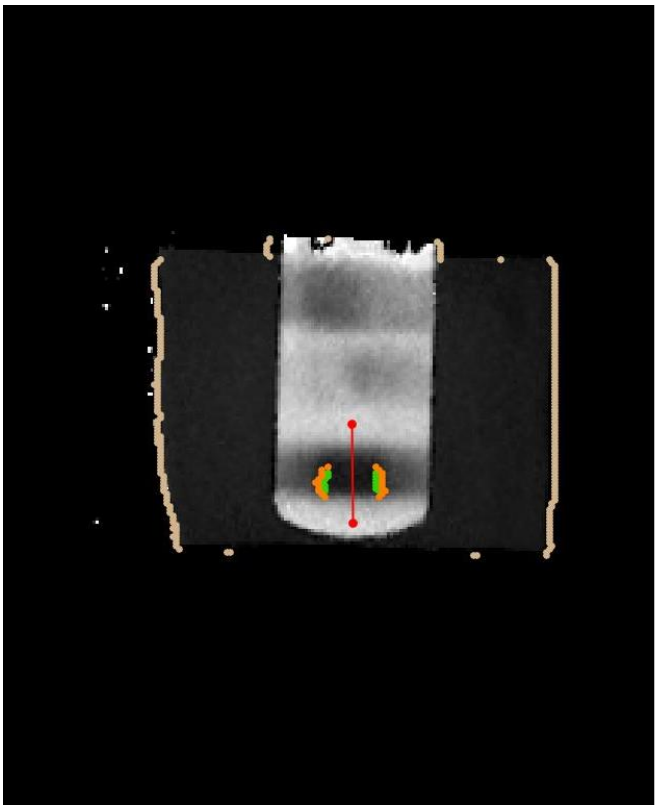
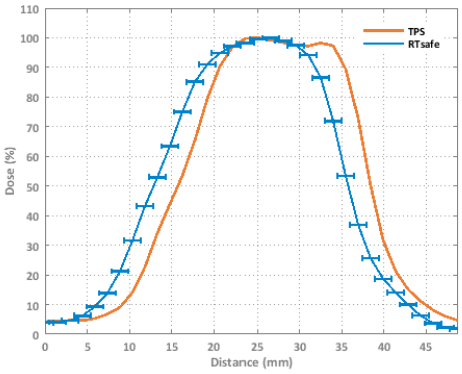
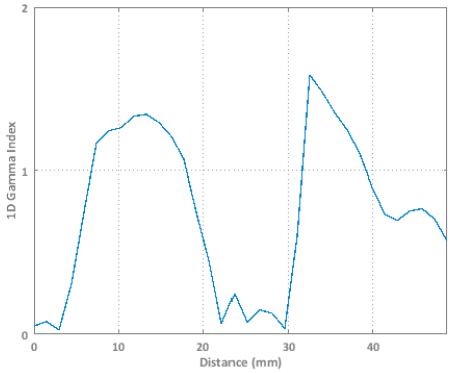
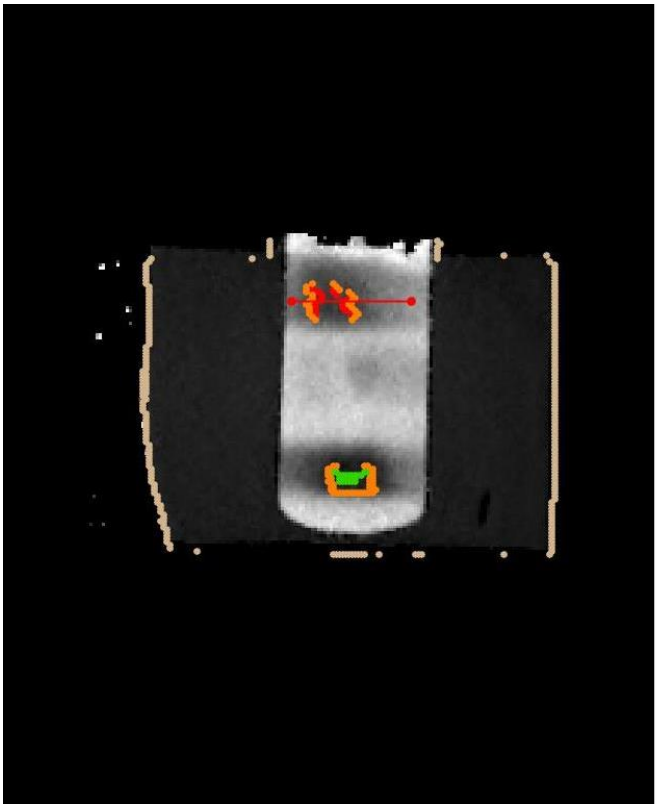
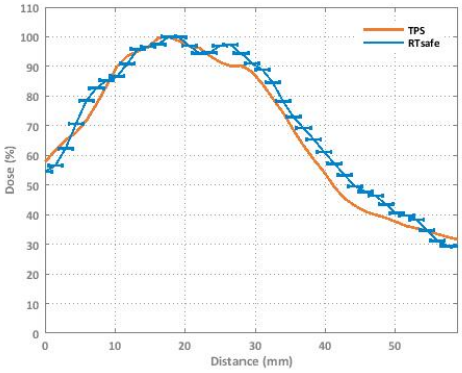
Distance (mm)

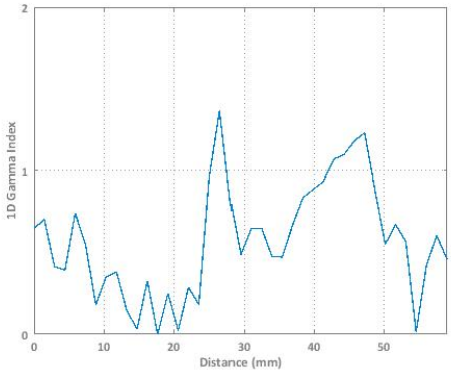


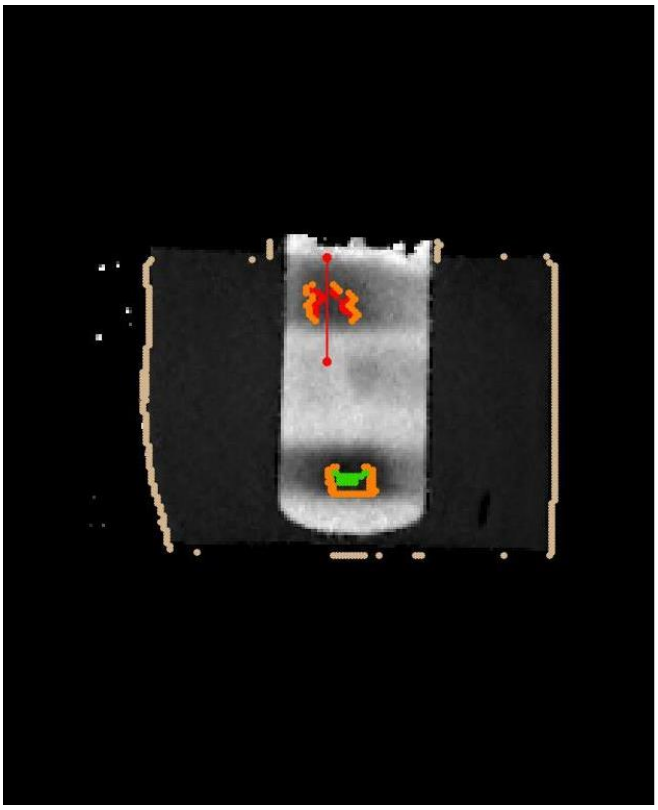

TPS
RTsafe
Dose (%)
Distance (mm)

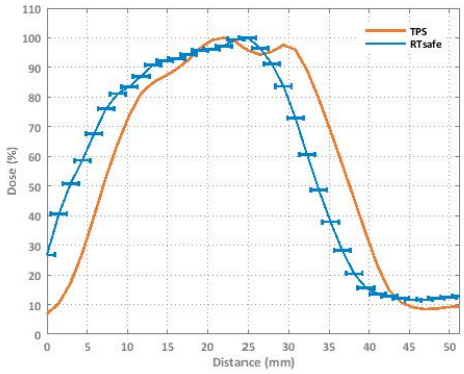

1D Gamma Index
Distance (mm)

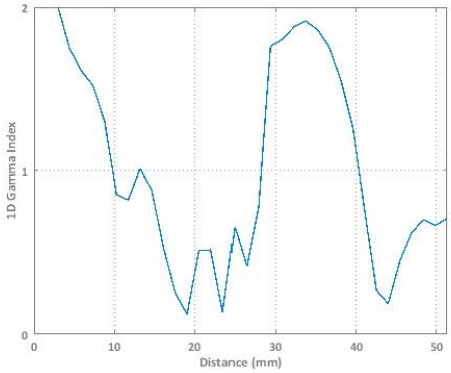



TPS
RTsafe
Dose (%)
Distance (mm)


1D Gamma Index
Distance (mm)




TPS
RTsafe
Dose (%)
Distance (mm)


1D Gamma Index
Distance (mm)

PART III: *2D Gamma Index comparison*

For selected slices of the irradiated phantom, 2D gamma index calculations are presented in the following figures. Again, passing criteria were 2 mm distance-to-agreement and 5% dose difference. However, a dose threshold of 1% has been applied to exclude corresponding voxels from the gamma index calculations. Isodose lines are also plotted to assist comparison.

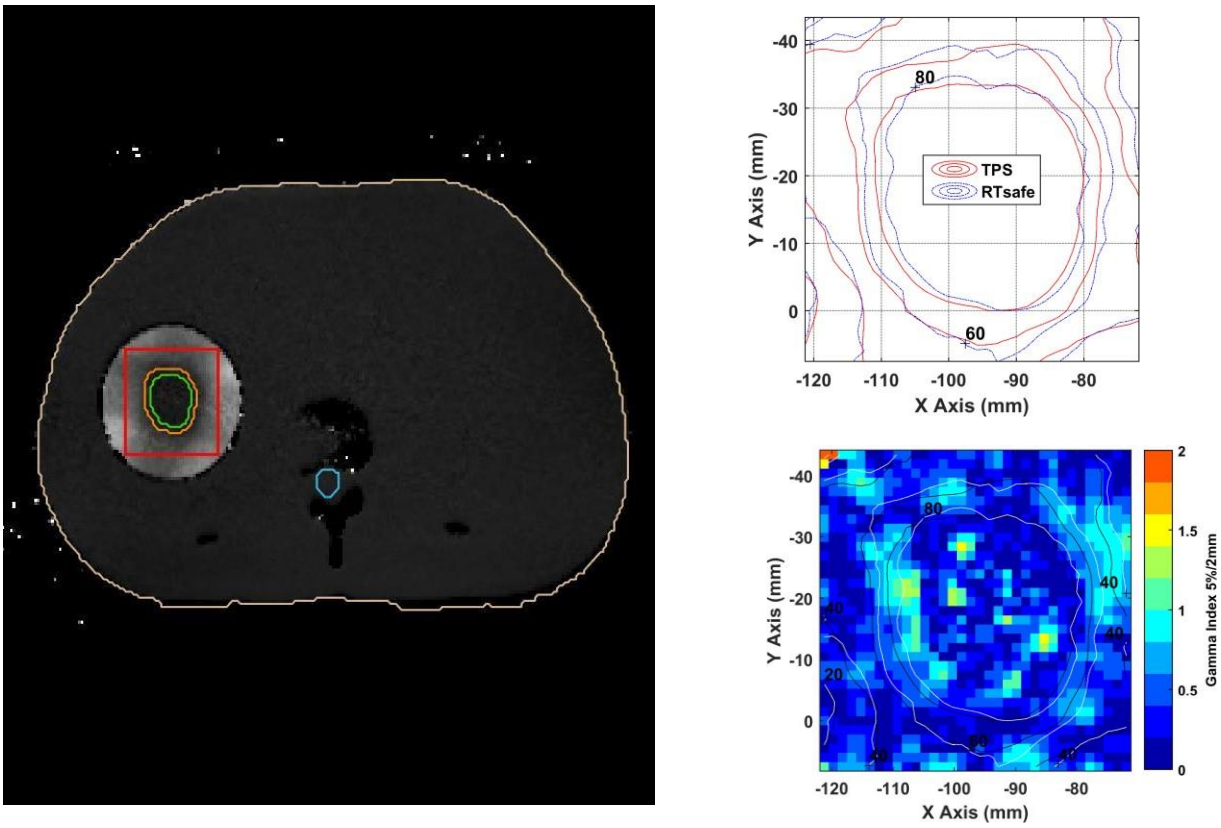
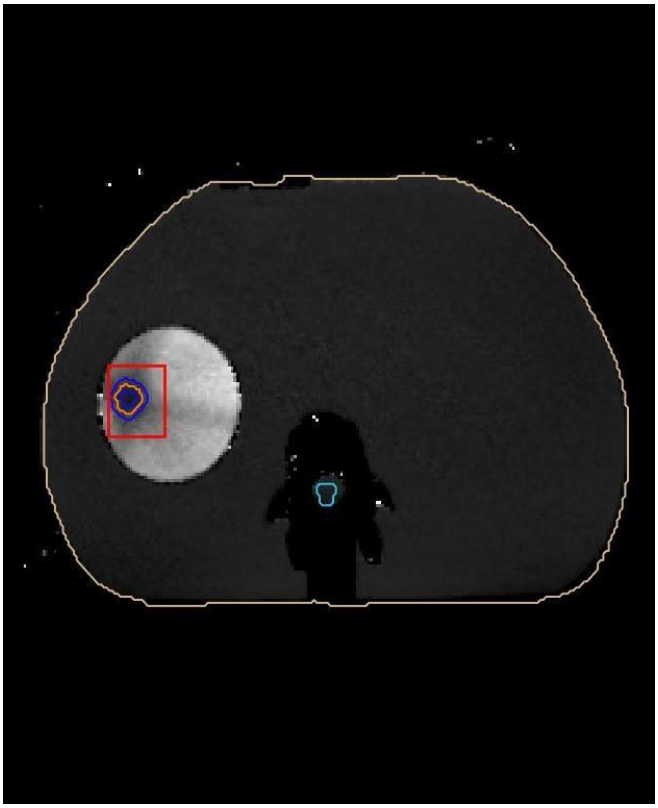
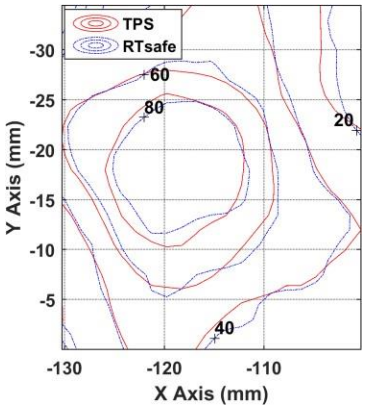
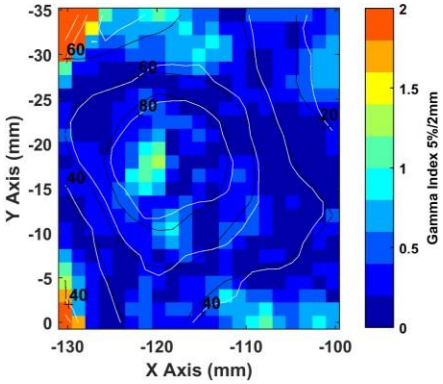


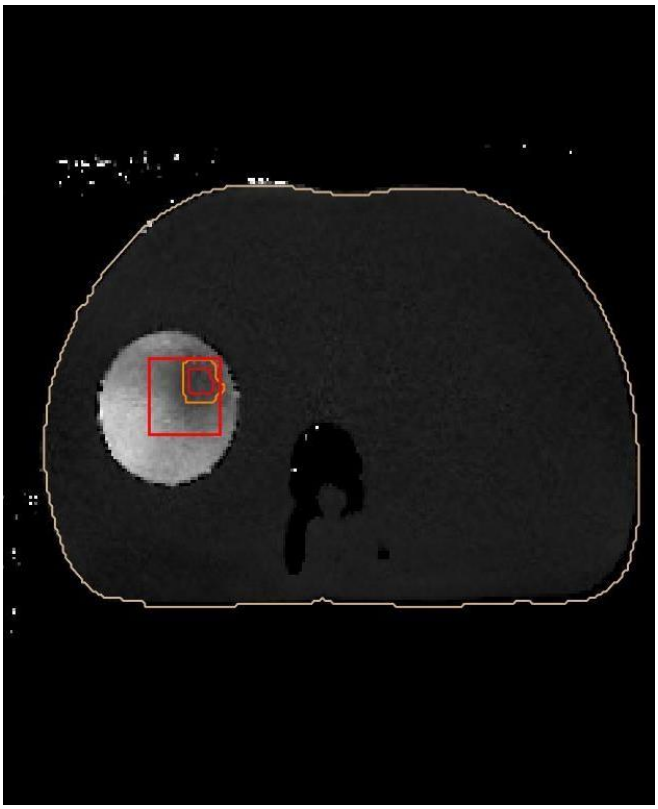
Figure: (left) Slice of the derived T2 maps of the irradiated phantom. High dose regions correspond to darker areas. (right) 2D comparison between calculated (TPS) and measured (RTsafe) dose distributions at the location depicted by the red contour. 2D gamma index calculations are also given using passing criteria 5%/2mm.

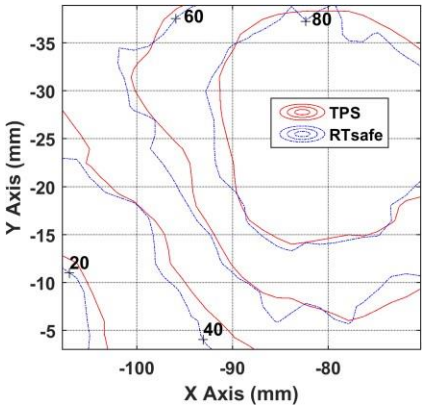
The same figure caption applies to all following figures in Part III.

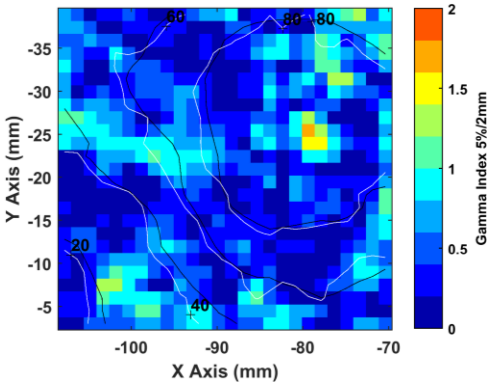


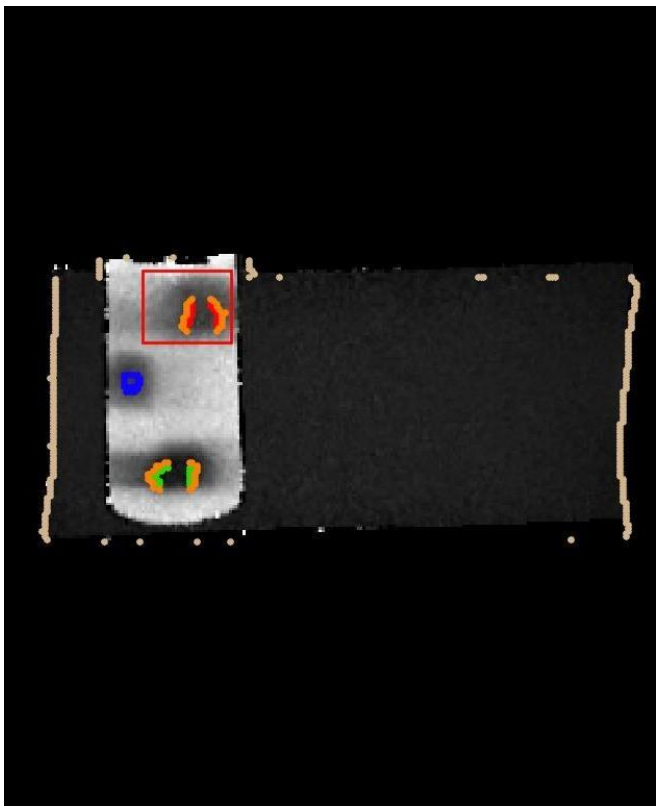

TPS
RTsafe
60
80
20
40
Y Axis (mm)
X Axis (mm)

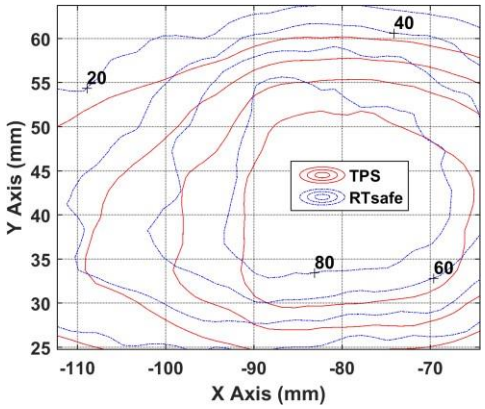

Y Axis (mm)
X Axis (mm)
Gamma Index 5%/2mm

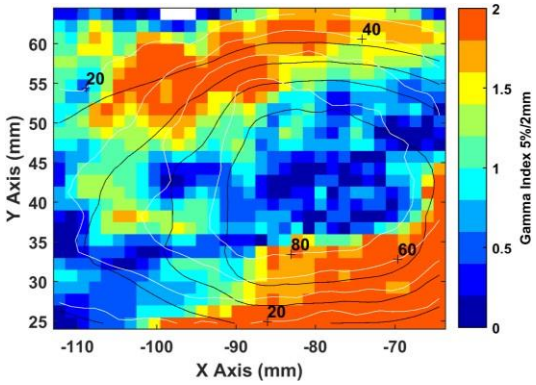


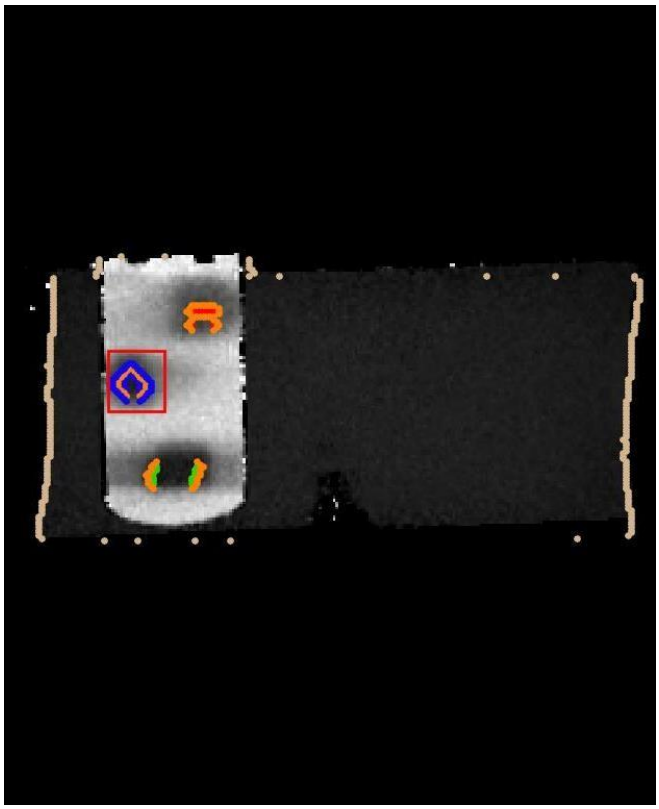

60
80
TPS
RTsafe
20
40
Y Axis (mm)
X Axis (mm)

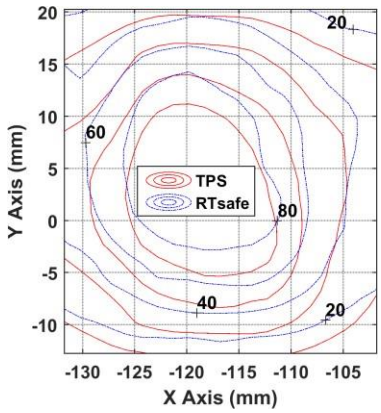

Y Axis (mm)
X Axis (mm)
Gamma Index 5%/2mm

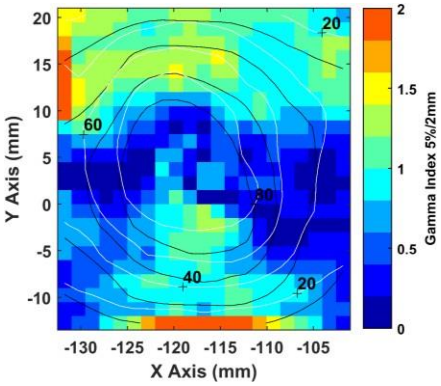


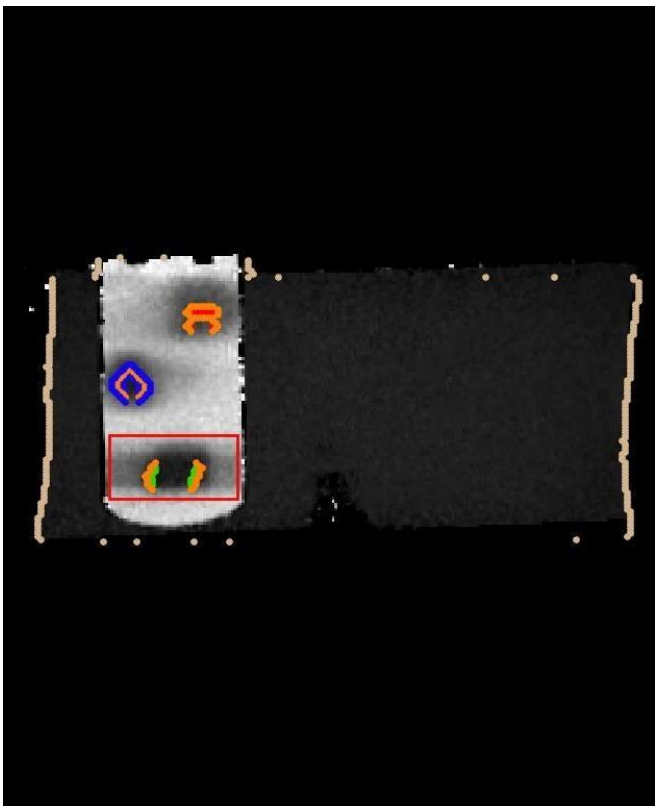

TPS
RTsafe
Y Axis (mm)
X Axis (mm)

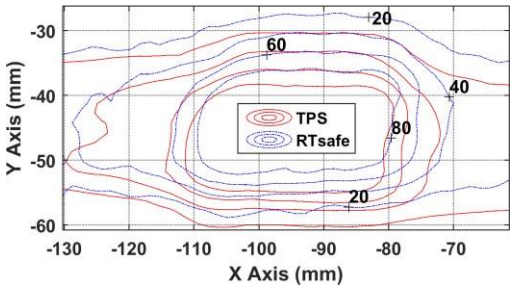

Gamma Index 5%/2mm
Y Axis (mm)
X Axis (mm)

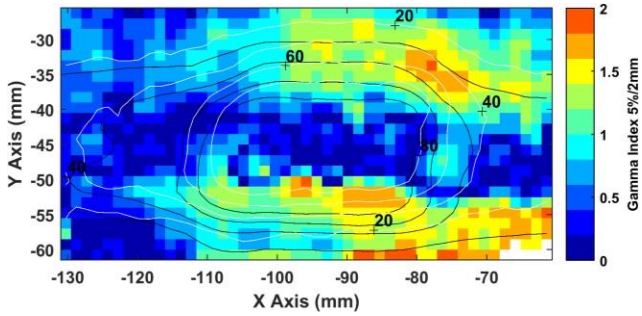


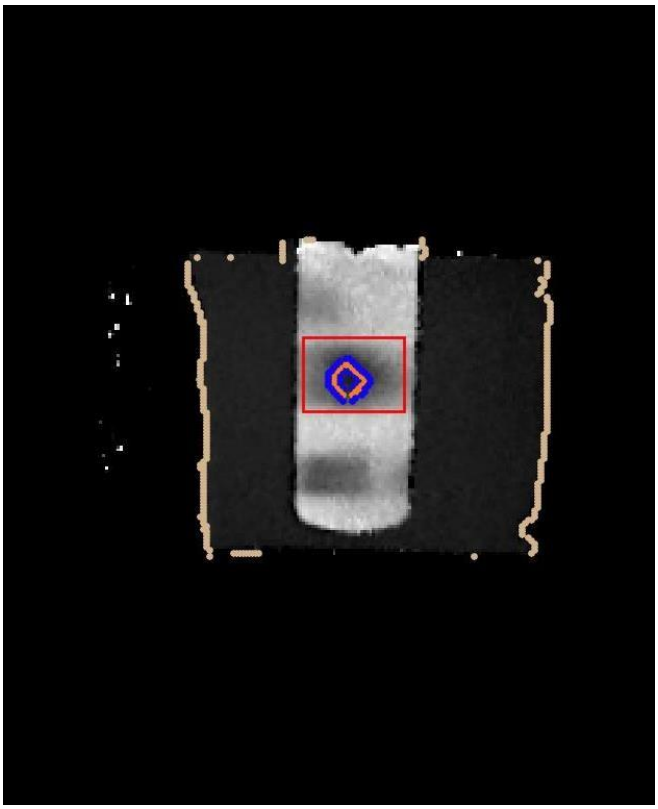

TPS
RTsafe
Y Axis (mm)
X Axis (mm)

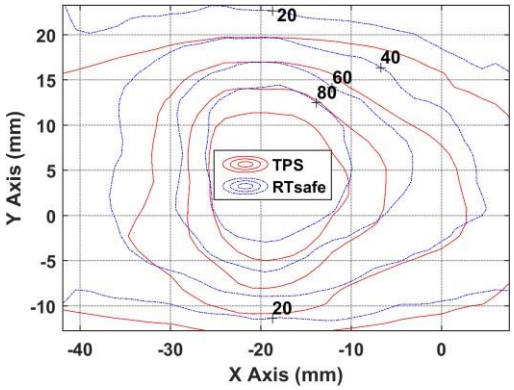

Gamma Index 5%/2mm
Y Axis (mm)
X Axis (mm)

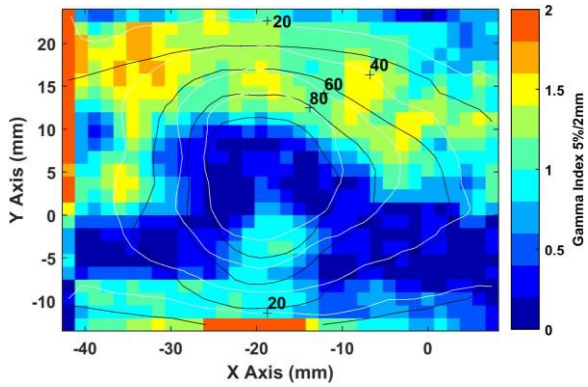


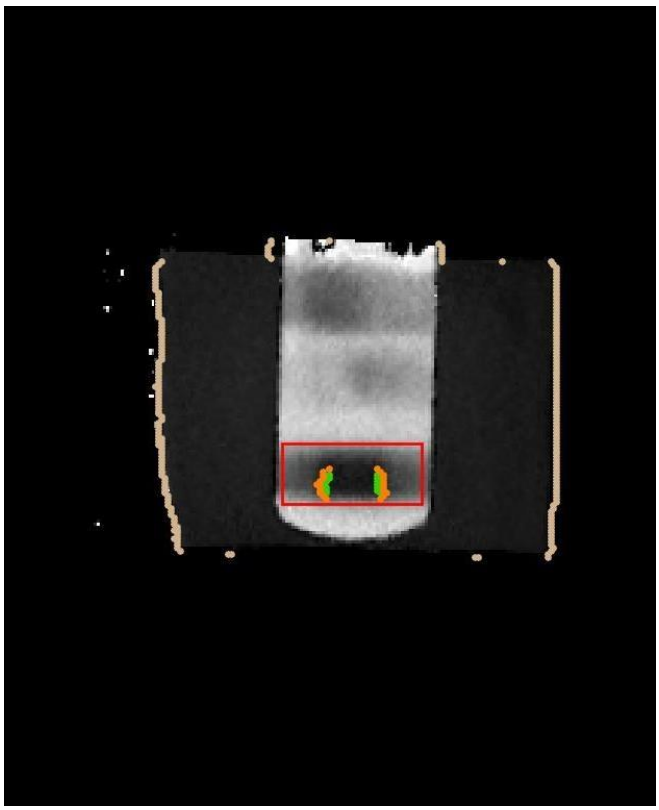

TPS
RTsafe
20
40
60
80
Y Axis (mm)
X Axis (mm)

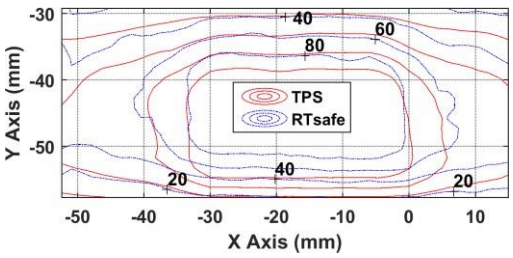

Gamma Index 5%/2mm
Y Axis (mm)
X Axis (mm)

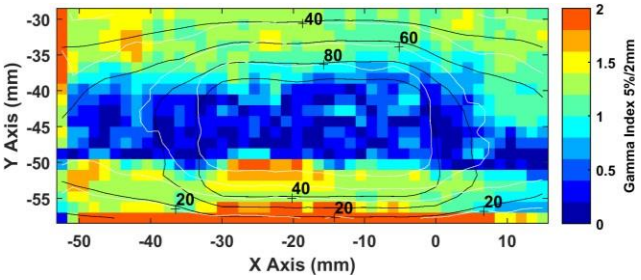


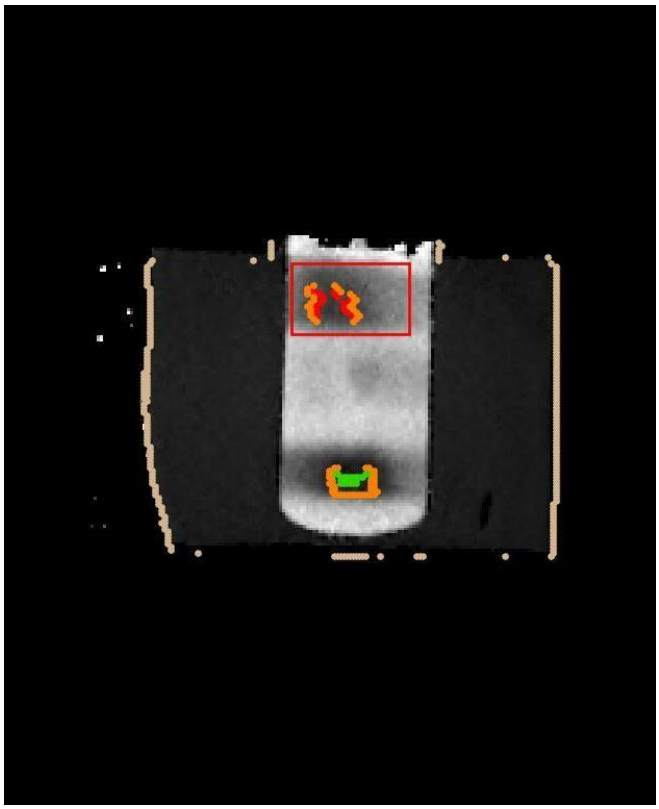

TPS
RTsafe
20
40
60
80
Y Axis (mm)
X Axis (mm)

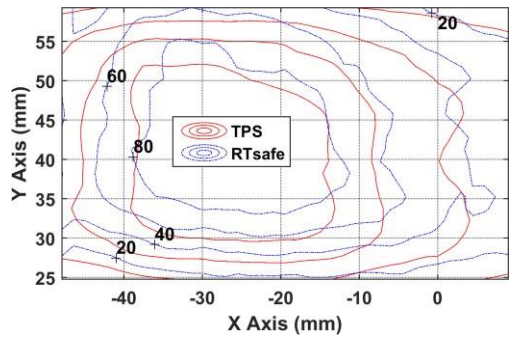

Gamma Index 5%/2mm
Y Axis (mm)
X Axis (mm)

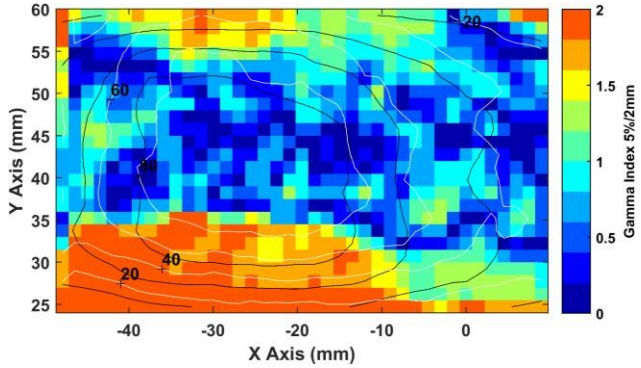



TPS
RTsafe
Y Axis (mm)
X Axis (mm)


Y Axis (mm)
X Axis (mm)
Gamma Index 5%/2mm




TPS
RTsafe
Y Axis (mm)
X Axis (mm)


Y Axis (mm)
X Axis (mm)
Gamma Index 5%/2mm

PART IV: *3D Gamma Index comparison*

Gamma index calculations were also performed in 3D using a variety of passing criteria and a low-dose cut off threshold of 1%. For the indicative targets considered, gamma index comparison was performed within a volume of interest that includes the target(s) along with an extended region of surrounding soft tissue. Corresponding results are summarized in the following table. Moreover, histograms of the corresponding 3D gamma values are given in the following figures.

Table: Results for the 3D gamma index test, comparing gel-measured (reference) with the TPS-calculated (evaluated) dose distributions using a variety of passing criteria. Note that the volume of interest considered for each target includes the total contoured volume along with an extended area of surrounding soft tissue.

Structure	**Passing criteria**		**Passing Rate**
	DTA (mm)	**DD (%)**	**GI ≤ 1 (%)**
PTV 1	**2**	**5**	68.10
	1	**5**	54.92
	2	**3**	58.16
PTV 2	**2**	**5**	86.80
	1	**5**	69.57
	2	**3**	76.90
PTV 3	**2**	**5**	63.50
	1	**5**	43.13
	2	**3**	56.45

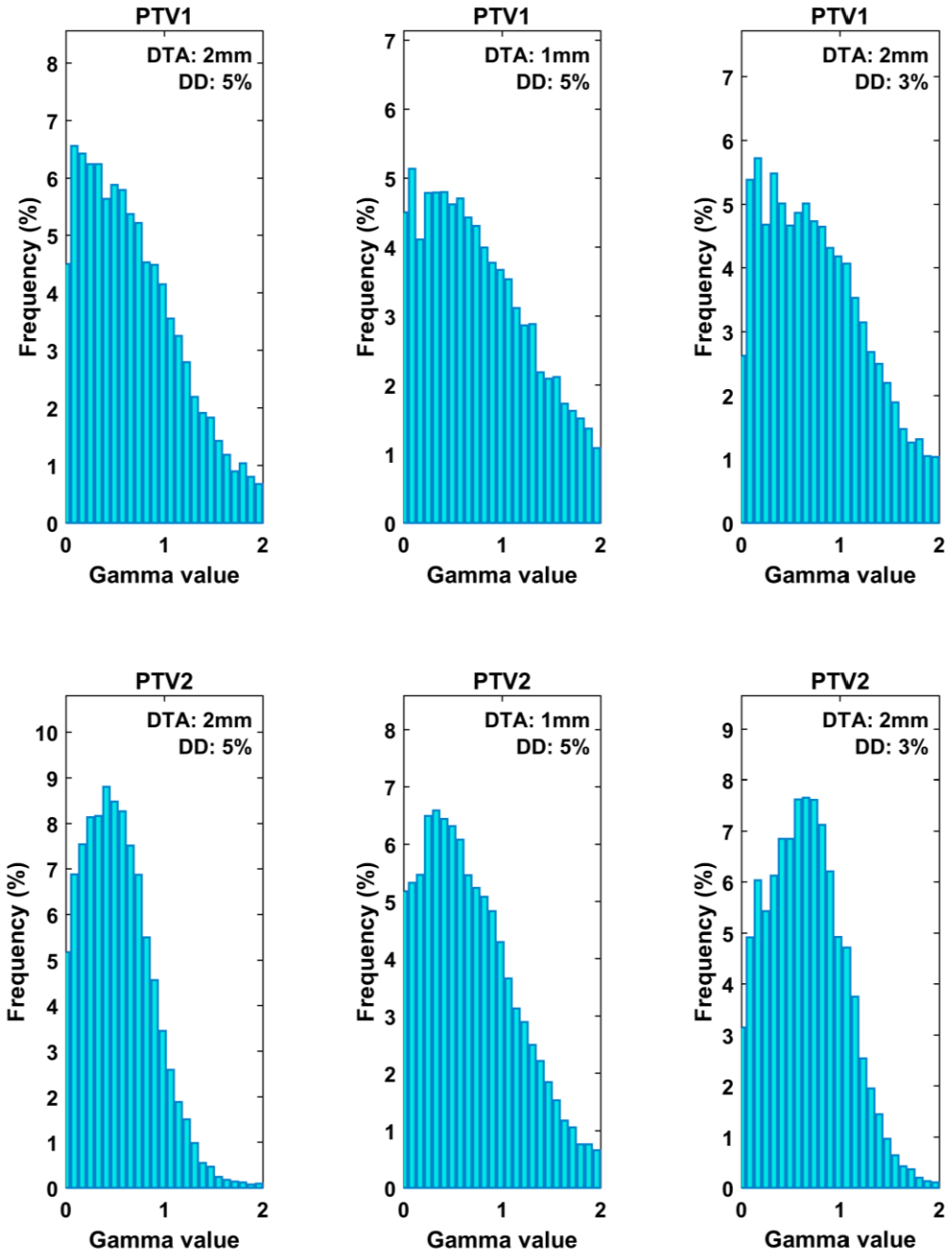
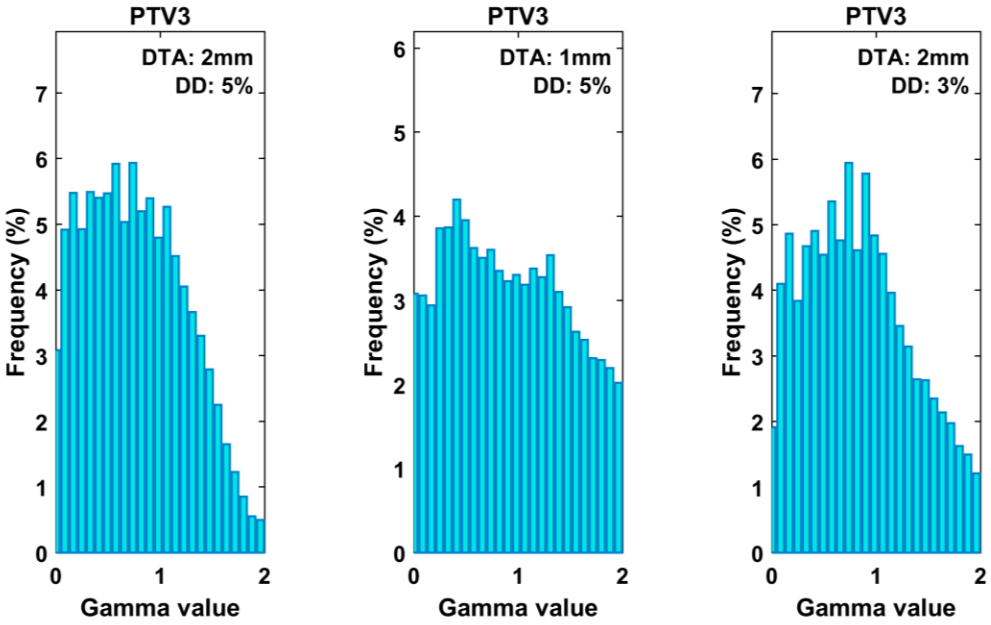


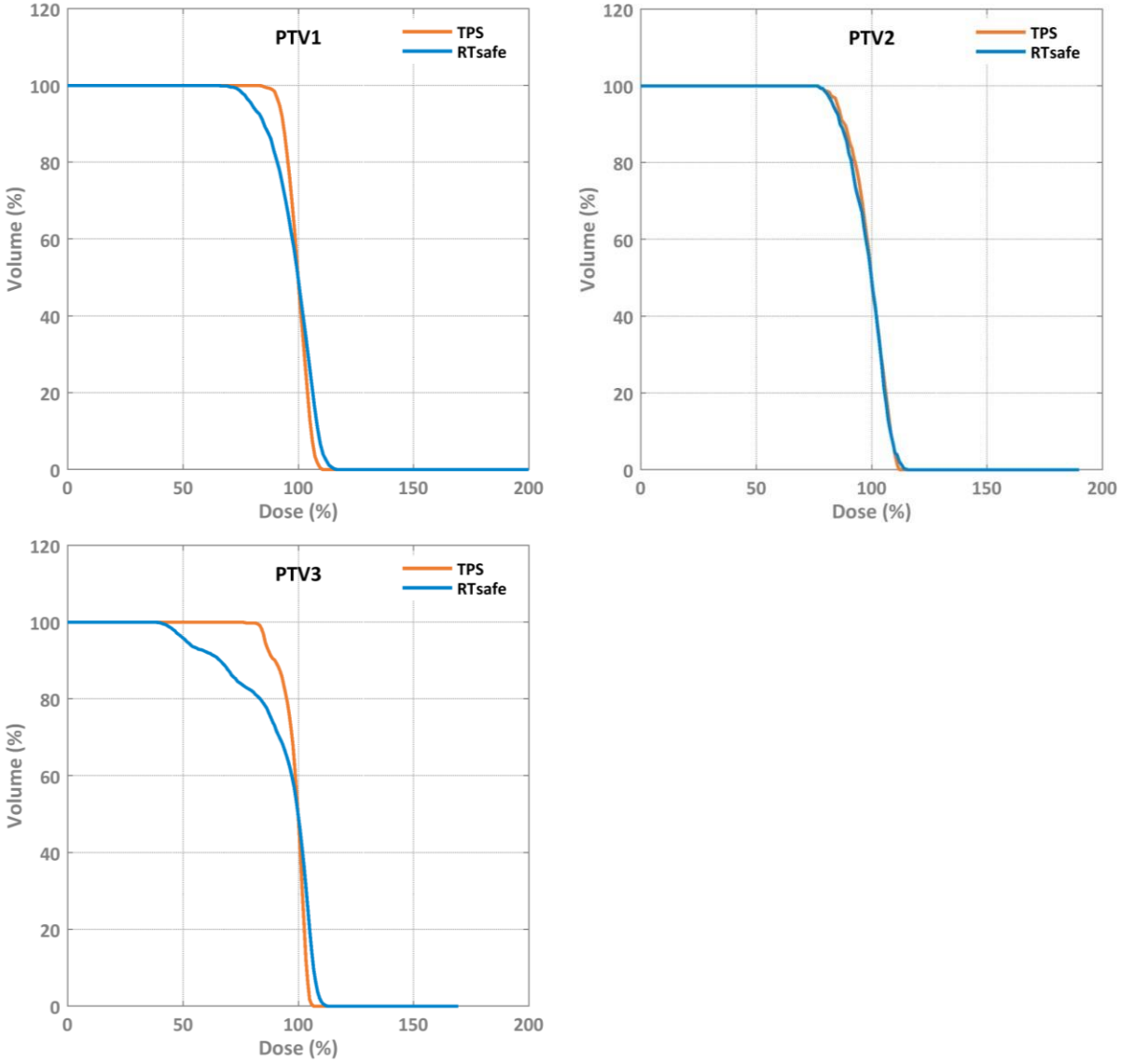
Figure: Histograms for the calculated gamma values of the 3D gamma index comparison test using a variety of passing criteria. The volume of interest considered for each target includes the total contoured volume along with an extended area of surrounding soft tissue.

The same figure caption applies to all following figures in Part IV.


PTV3
DTA: 2mm
DD: 5%
Frequency (%)
Gamma value
PTV3
DTA: 1mm
DD: 5%
Frequency (%)
Gamma value
PTV3
DTA: 2mm
DD: 3%
Frequency (%)
Gamma value

PART V: *DVH comparison*

Comparison between planned and measured relative dose distributions is presented in the following figures, in terms of cumulative Dose Volume Histograms (DVHs) for all PTVs. All dose distributions were normalized to the corresponding $D_{50\%}$ metric (i.e., the minimum dose received by at least the 50% of the volume) of each structure.



Figures: cumulative Dose Volume Histograms derived from the calculated (TPS) and measured (RTsafe) dose distributions for all the structures considered.

The same figure caption applies to all following figures in Part V.

PART VI: *DVH metrics comparison*

Using the aforementioned normalization (100% corresponds to $D_{50\%}$), metrics derived from the above DVHs are given in the following table.

Table: Indicative dose volume metrics for the structures considered.

	Mean (%)		**D95 (%)**	
Structure	**TPS**	**Meas.**	**TPS**	**Meas.**
PTV 1	99.25	98.68	85.32	83.40
PTV 2	99.25	98.68	85.32	83.40
PTV 3	98.46	93.13	85.69	51.64

2D Absolute Dosimetry (Film)

Date of report:	---
Date of irradiation:	---
Phantom type:	SBRT phantom
Phantom S/N:	---
Film Insert Kit S/N:	---
Treatment Planning System:	---
Number of target volumes (PTVs):	3
Institution:	---

PART I: ***Profiles comparison***

Indicatively, a number of absolute dose profiles for both the film-measured and TPS-calculated datasets are presented in the following figures.

Film 1 - Coronal

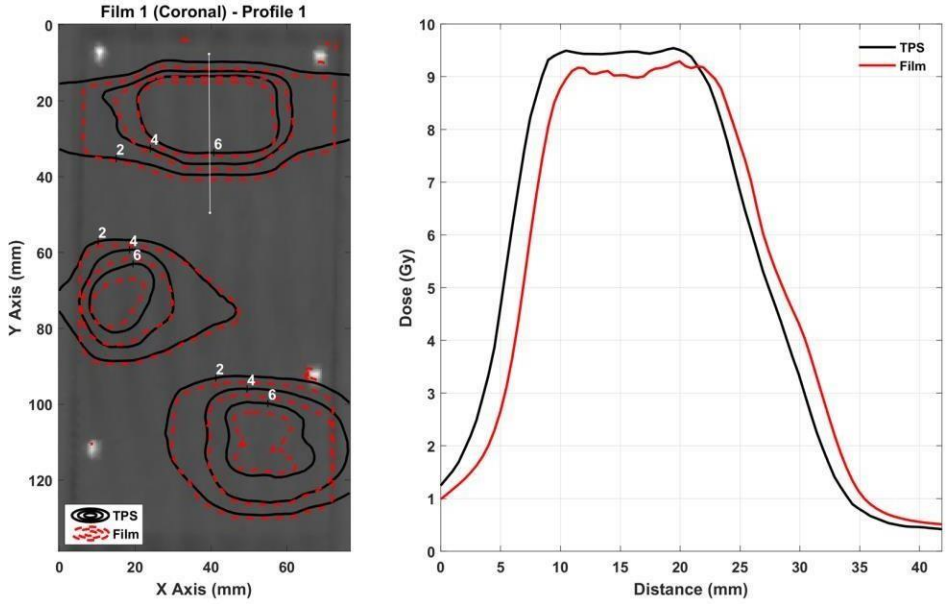
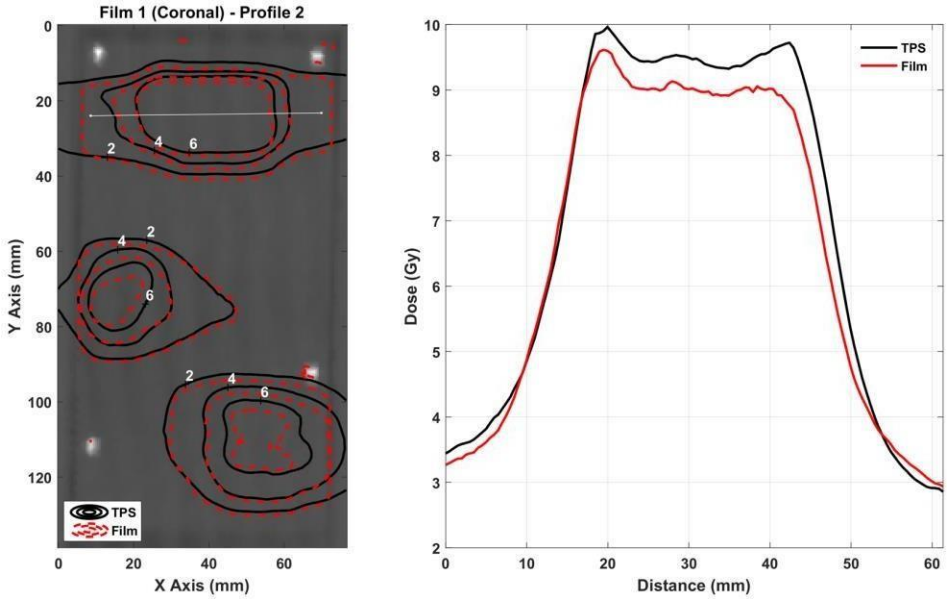
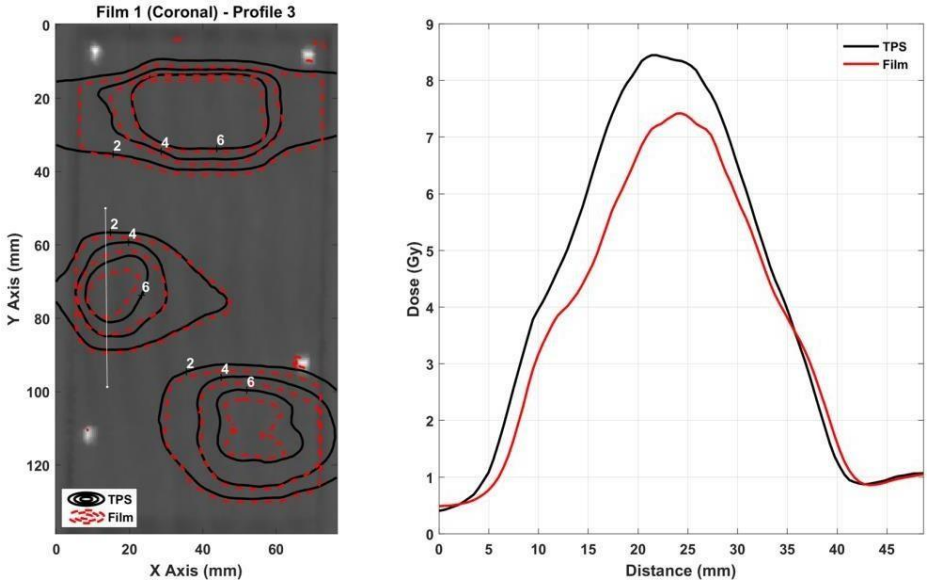
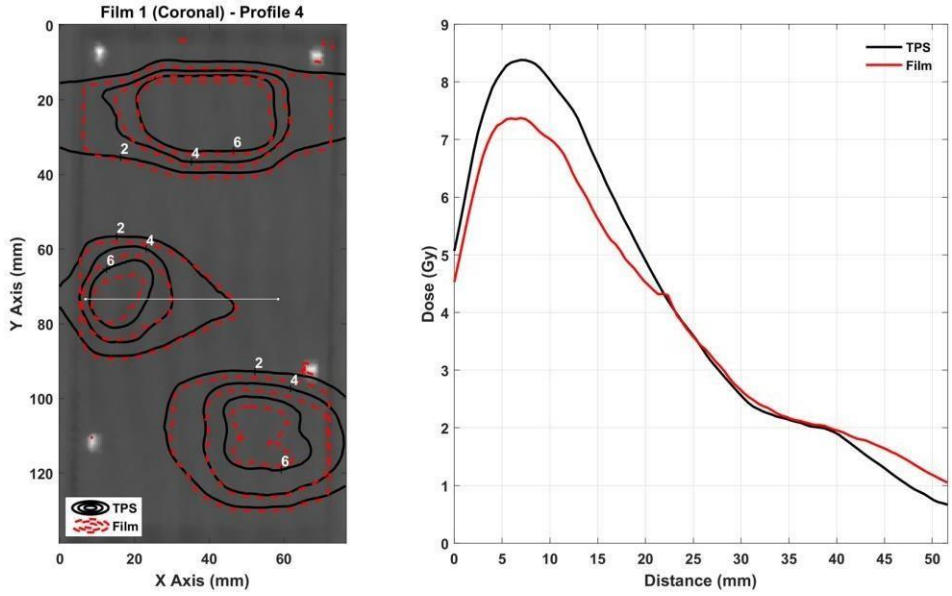


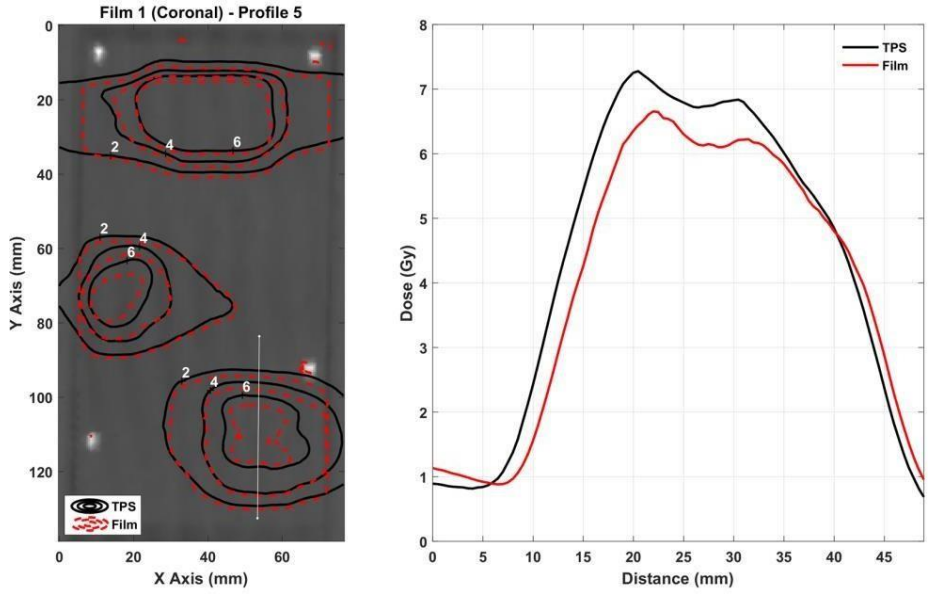
Figure: (left) Slice of the reconstructed CT scan of the film phantom. Contours correspond to TPS calculations (black solid lines) and film measurements (red dashed lines) in Gy. (right) 1D profile comparison between calculated (TPS) and measured (Film) dose distributions at the location depicted by the white line.

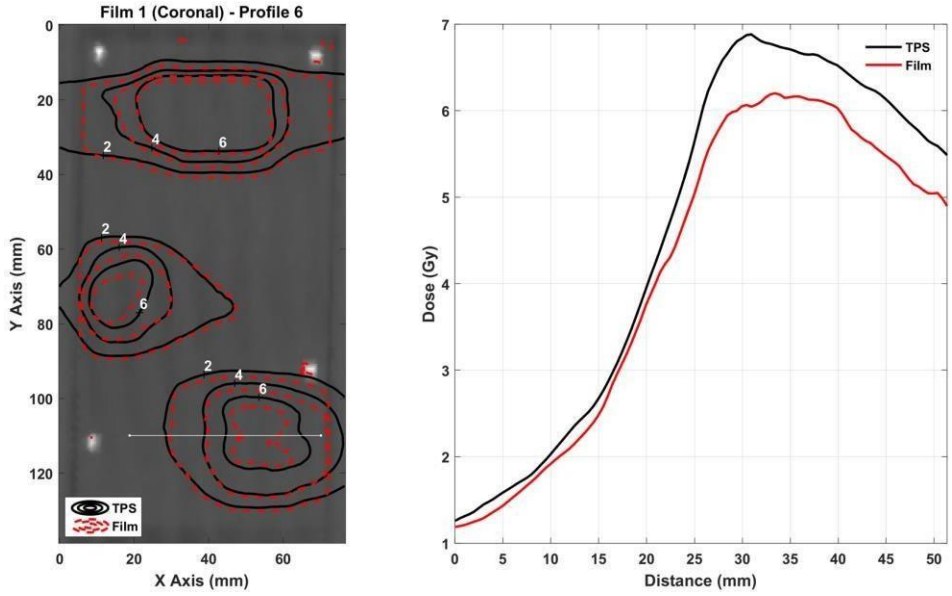
The same figure caption applies to all following figures in Part I.


Film 1 (Coronal) - Profile 2
Y Axis (mm)
X Axis (mm)
TPS
Film
Dose (Gy)
Distance (mm)

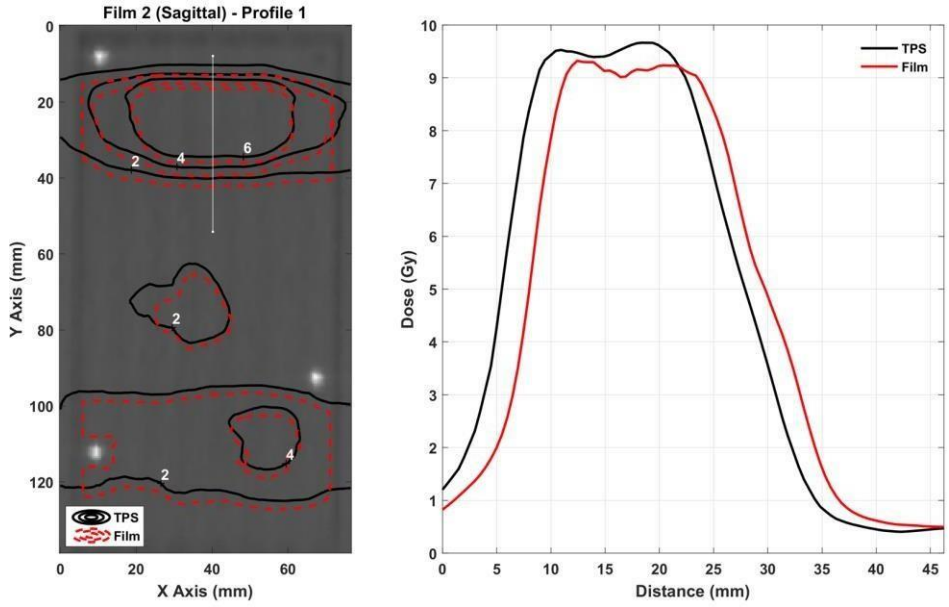

Film 1 (Coronal) - Profile 3
Y Axis (mm)
X Axis (mm)
TPS
Film
Dose (Gy)
Distance (mm)

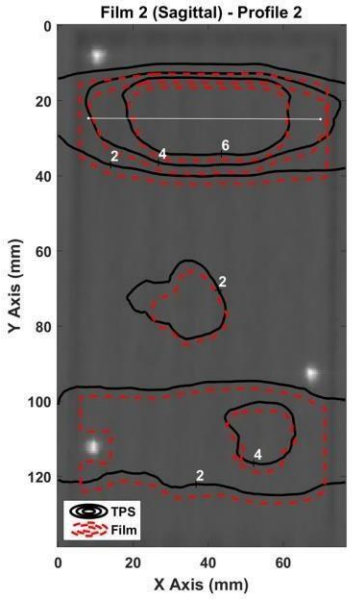

Film 1 (Coronal) - Profile 4
Y Axis (mm)
X Axis (mm)
TPS
Film
Dose (Gy)
Distance (mm)

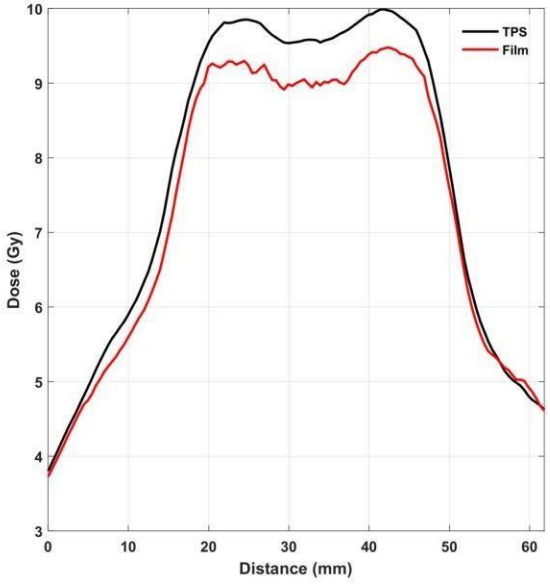

Film 1 (Coronal) - Profile 5
Y Axis (mm)
X Axis (mm)
TPS
Film
Dose (Gy)
Distance (mm)

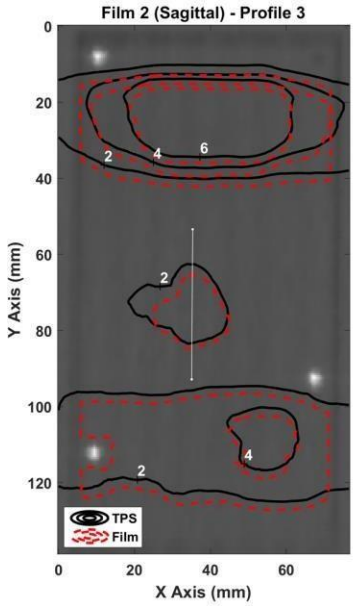


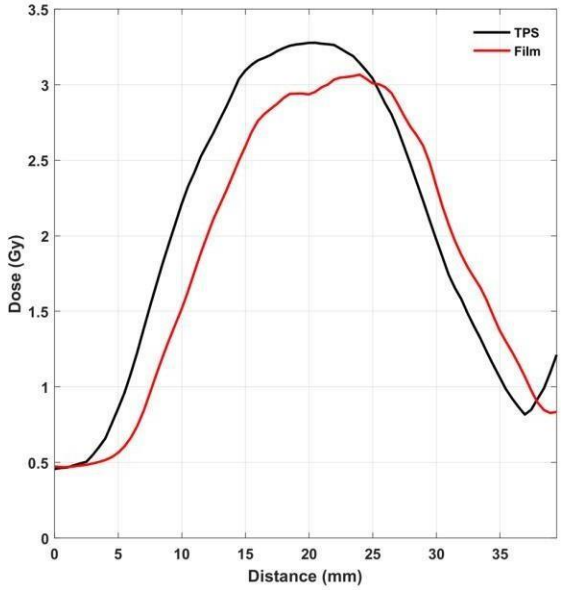
Film 2 – Sagittal

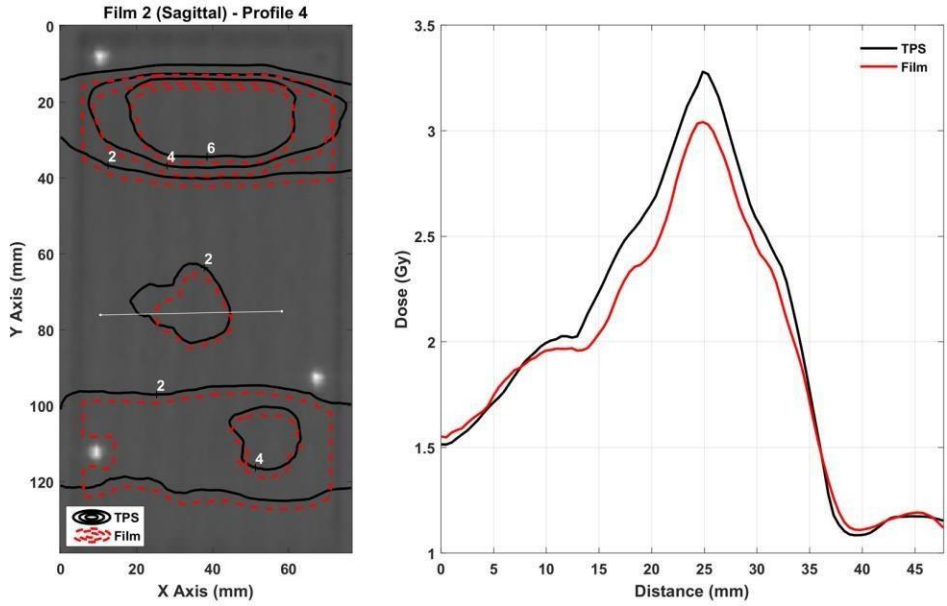


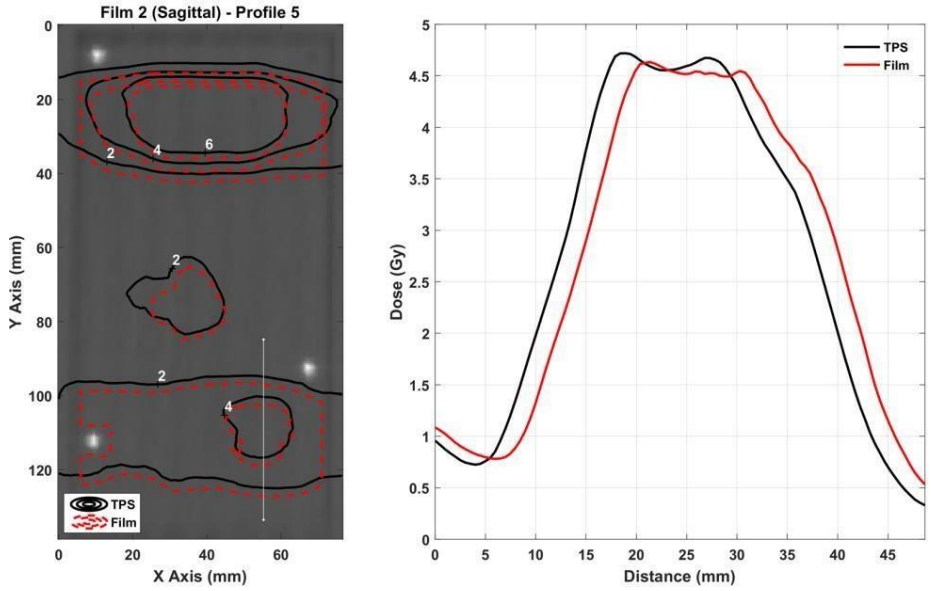

Film 2 (Sagittal) - Profile 2
Y Axis (mm)
X Axis (mm)
TPS
Film

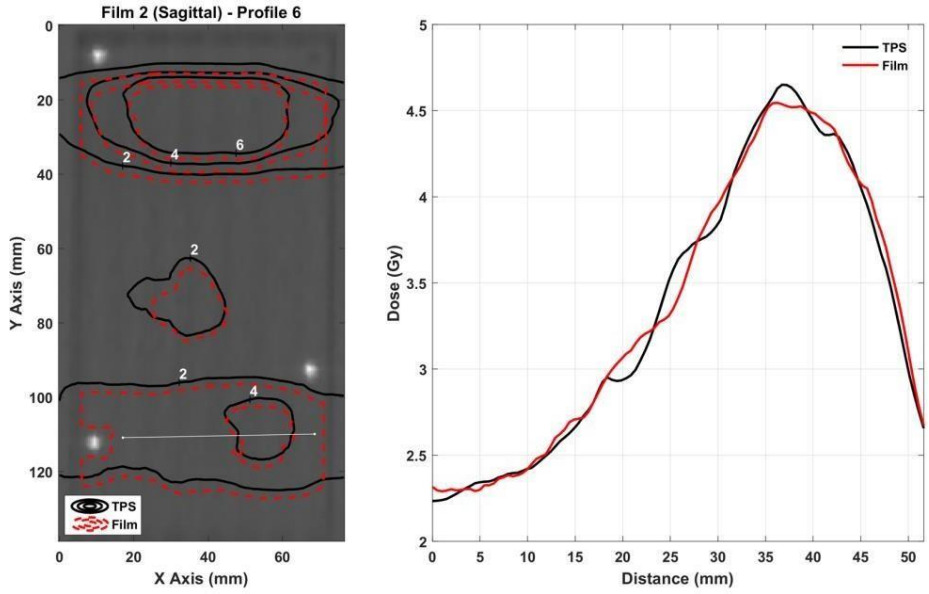

TPS
Film
Dose (Gy)
Distance (mm)


Film 2 (Sagittal) - Profile 3
Y Axis (mm)
X Axis (mm)
TPS
Film


TPS
Film
Dose (Gy)
Distance (mm)


Film 2 (Sagittal) - Profile 4
Y Axis (mm)
X Axis (mm)
TPS
Film
Dose (Gy)
Distance (mm)


Film 2 (Sagittal) - Profile 5
Y Axis (mm)
X Axis (mm)
TPS
Film
Dose (Gy)
Distance (mm)


Film 2 (Sagittal) - Profile 6
Y Axis (mm)
X Axis (mm)
TPS
Film
Dose (Gy)
Distance (mm)

PART II: 2D Gamma Index comparison

For the slice between film insert slabs of the film phantom, 3D gamma index calculations (i.e., reference data: 2D film measurements, evaluated data: 3D TPS calculations) are presented in the following figures. Passing criteria were 3 mm distance-to-agreement and 3% dose difference, 2 mm and 3%, 1 mm and 3%, as well as 2 mm and 2%. However, a dose thresholdof 1 Gy has been applied to exclude corresponding voxels from the gamma index calculations. Isodose lines are also plotted to assist comparison.

Film 1 - Coronal

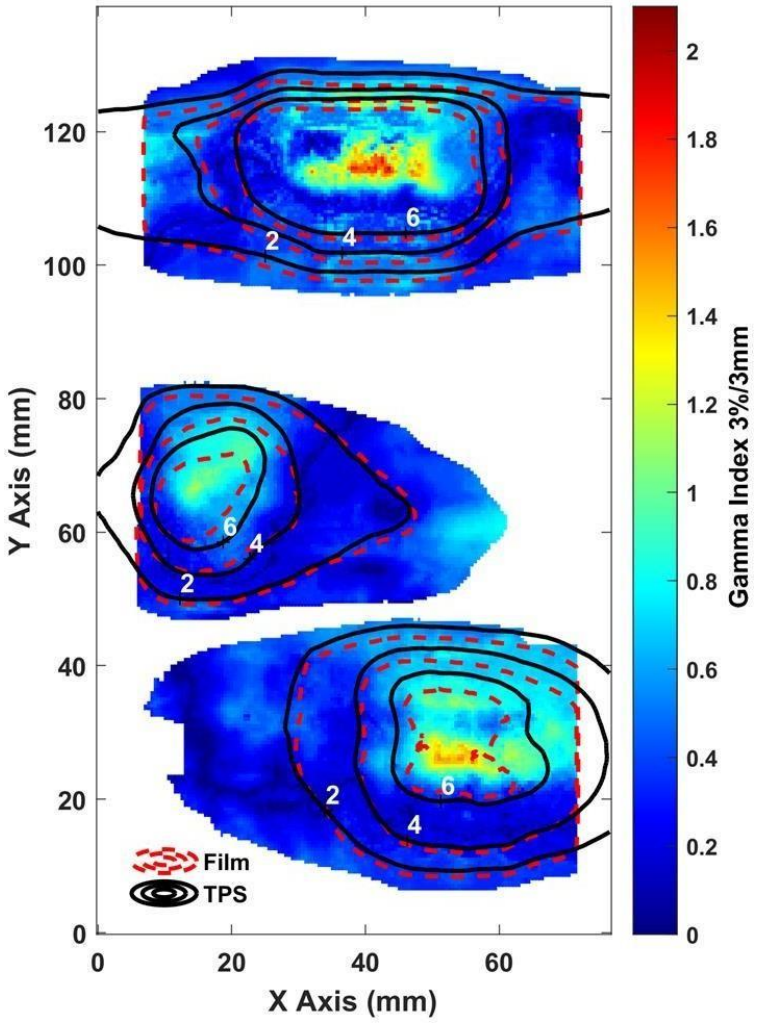


Figure: 2D comparison between calculated (TPS) and measured (Film) dose distributions in Gy values applying a dose threshold of 1 Gy. 3D gamma index calculations are given using passing criteria 3%/3mm.

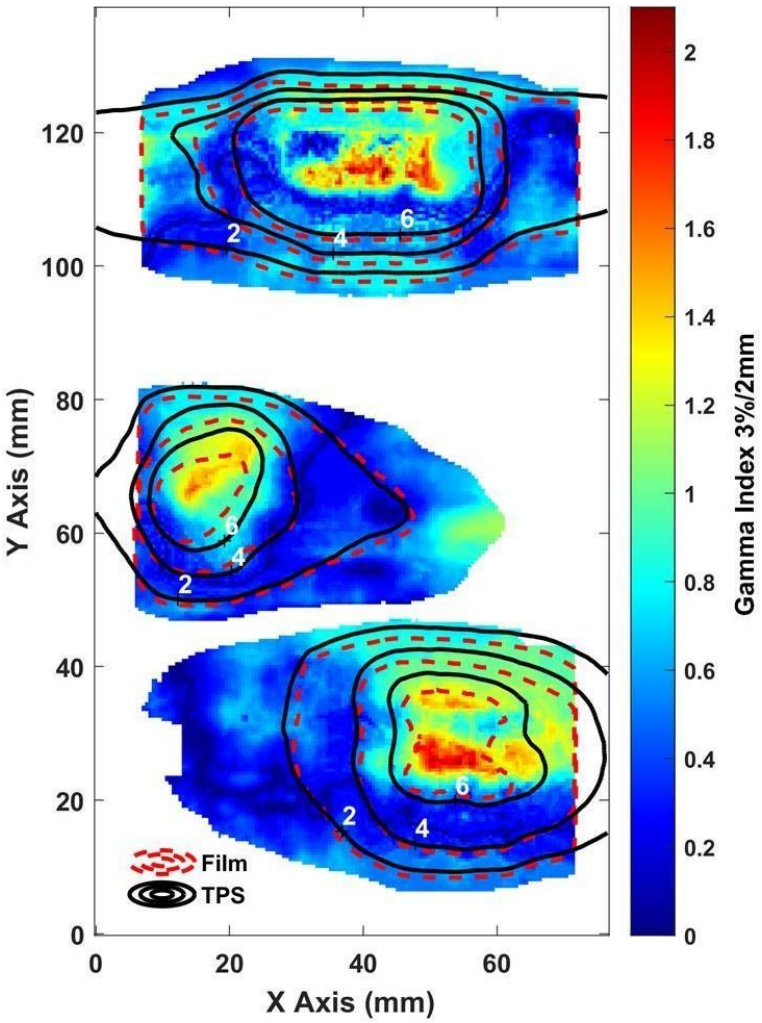


Figure: 2D comparison between calculated (TPS) and measured (Film) dose distributions in Gy values applying a dose threshold of 1 Gy. 3D gamma index calculations are given using passing criteria 3%/2mm.

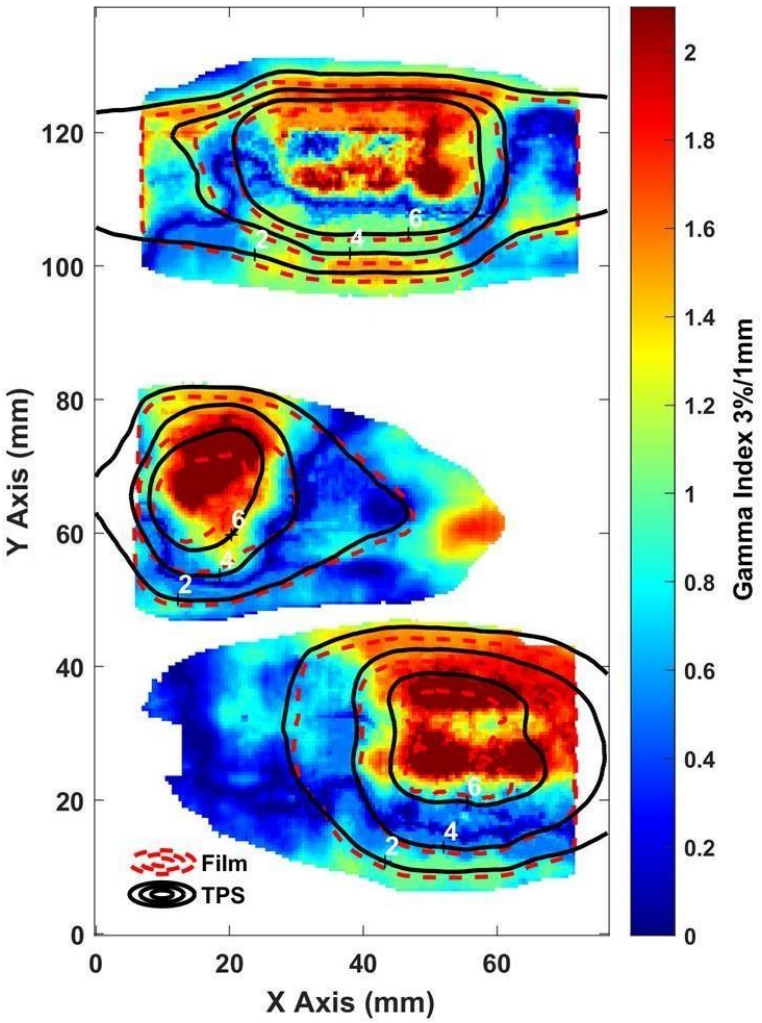


Figure: 2D comparison between calculated (TPS) and measured (Film) dose distributions in Gy values applying a dose threshold of 1 Gy. 3D gamma index calculations are given using passing criteria 3%/1mm.

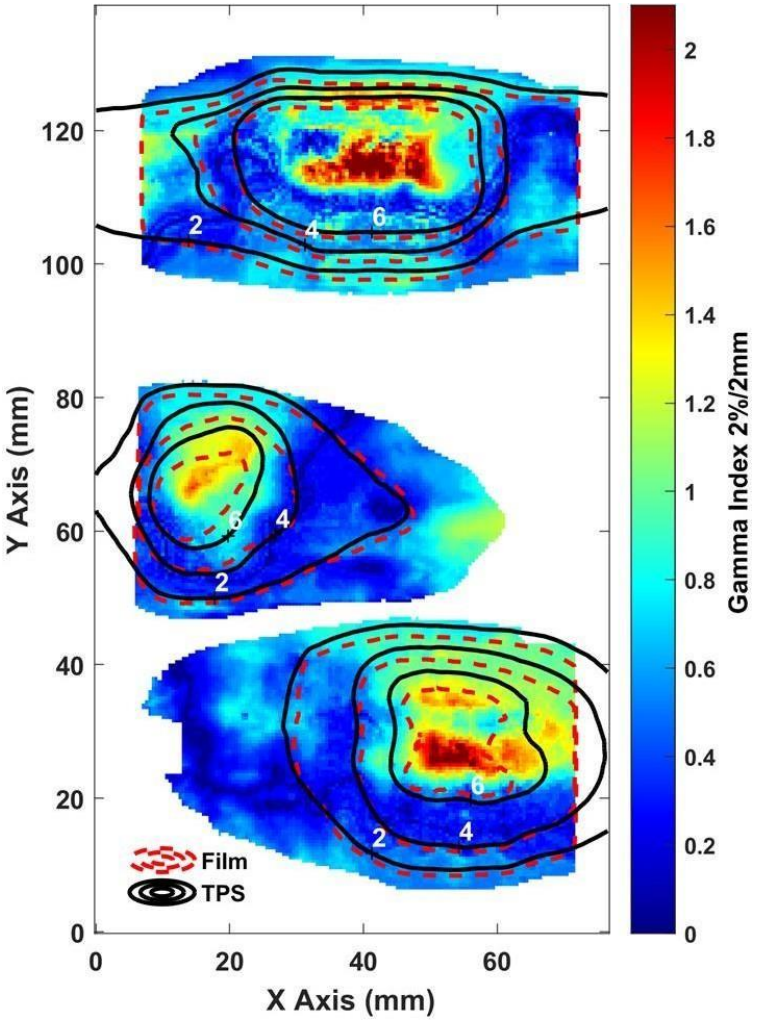


Figure: 2D comparison between calculated (TPS) and measured (Film) dose distributions in Gy values applying a dose threshold of 1 Gy. 3D gamma index calculations are given using passing criteria 2%/2mm.

Film 2 – Sagittal

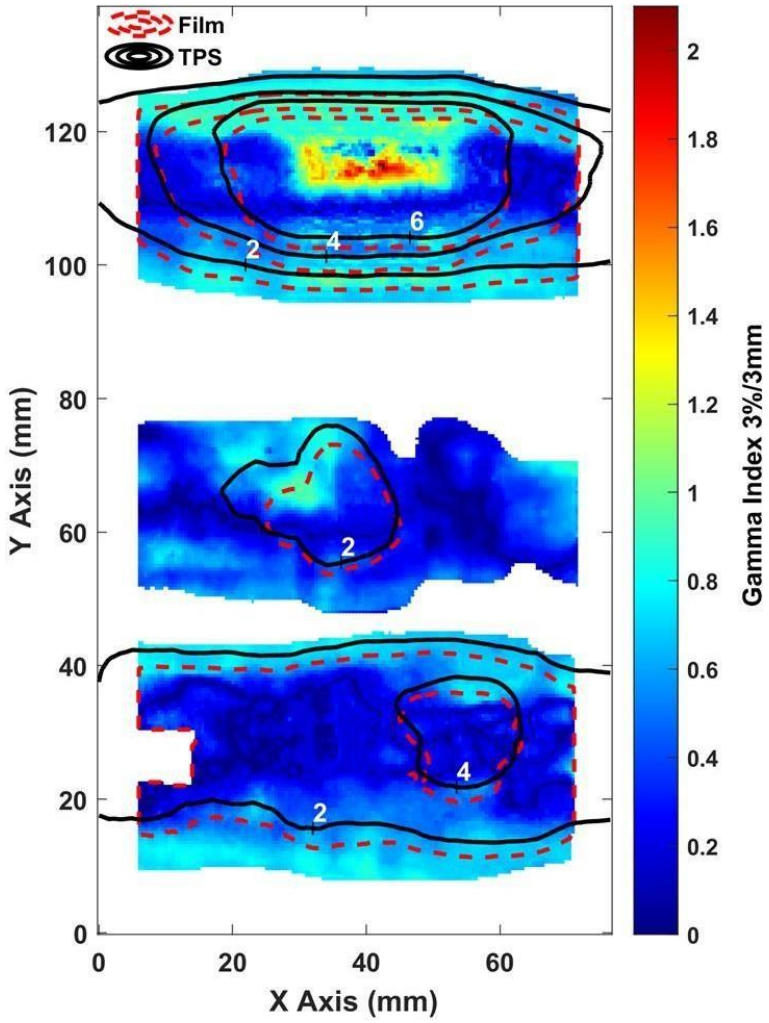


Figure: 2D comparison between calculated (TPS) and measured (Film) dose distributions in Gy values applying a dose threshold of 1 Gy. 3D gamma index calculations are given using passing criteria 3%/3mm.

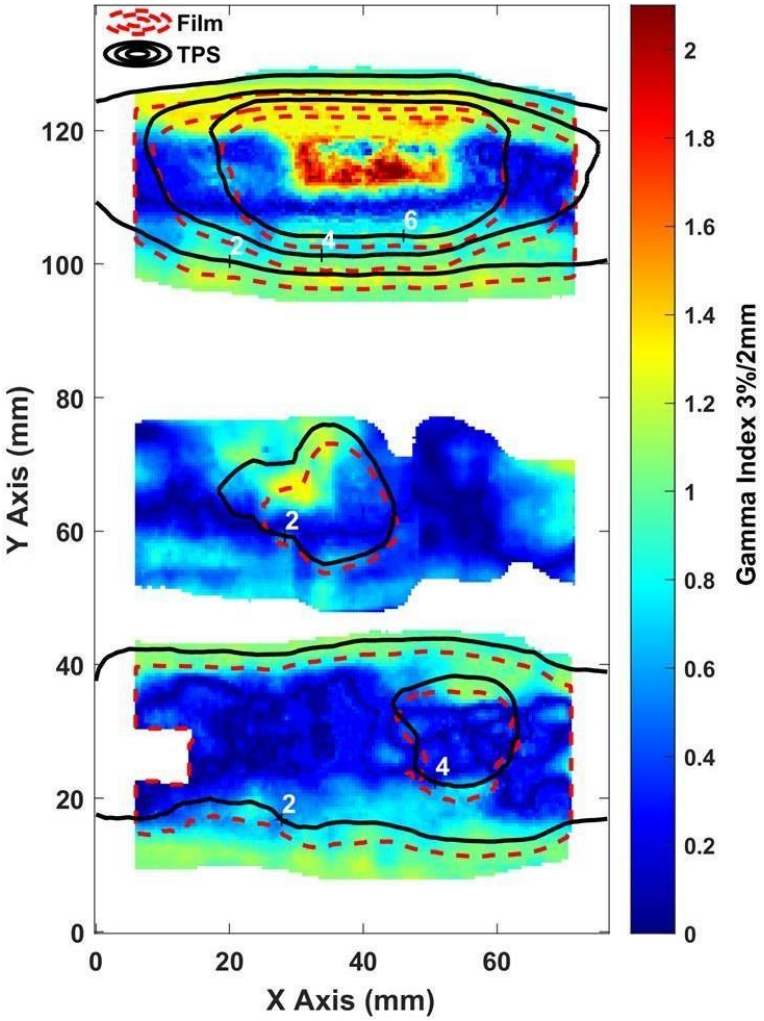


Figure: 2D comparison between calculated (TPS) and measured (Film) dose distributions in Gy values applying a dose threshold of 1 Gy. 3D gamma index calculations are given using passing criteria 3%/2mm.

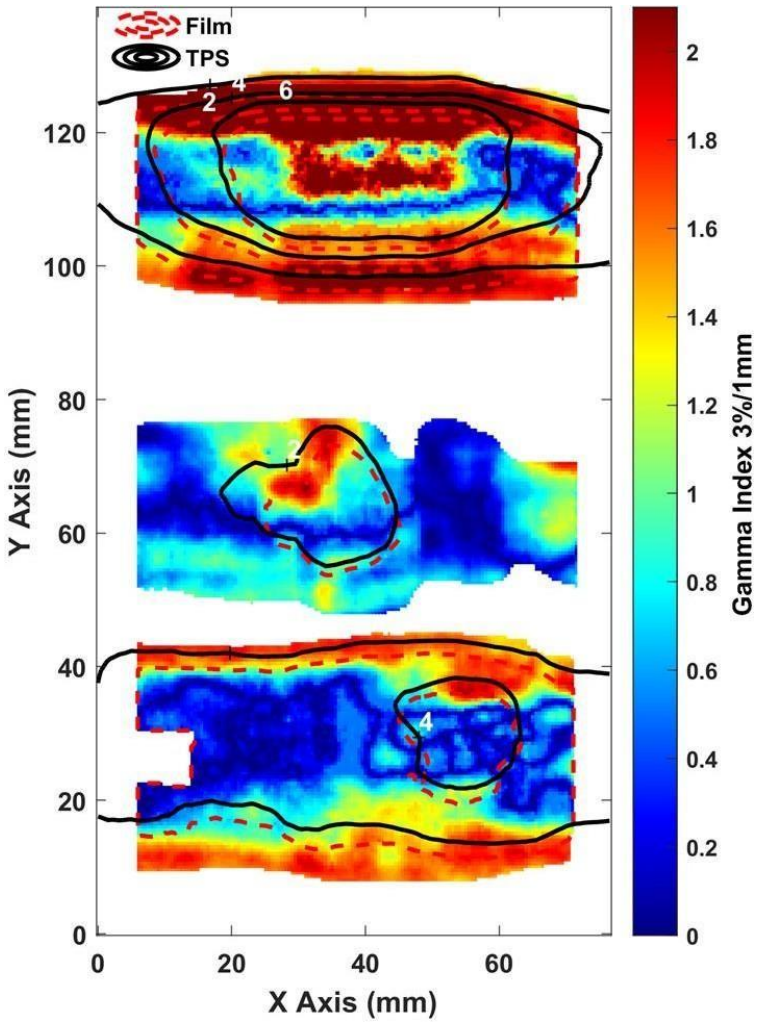


Figure: 2D comparison between calculated (TPS) and measured (Film) dose distributions in Gy values applying a dose threshold of 1 Gy. 3D gamma index calculations are given using passing criteria 3%/1mm.

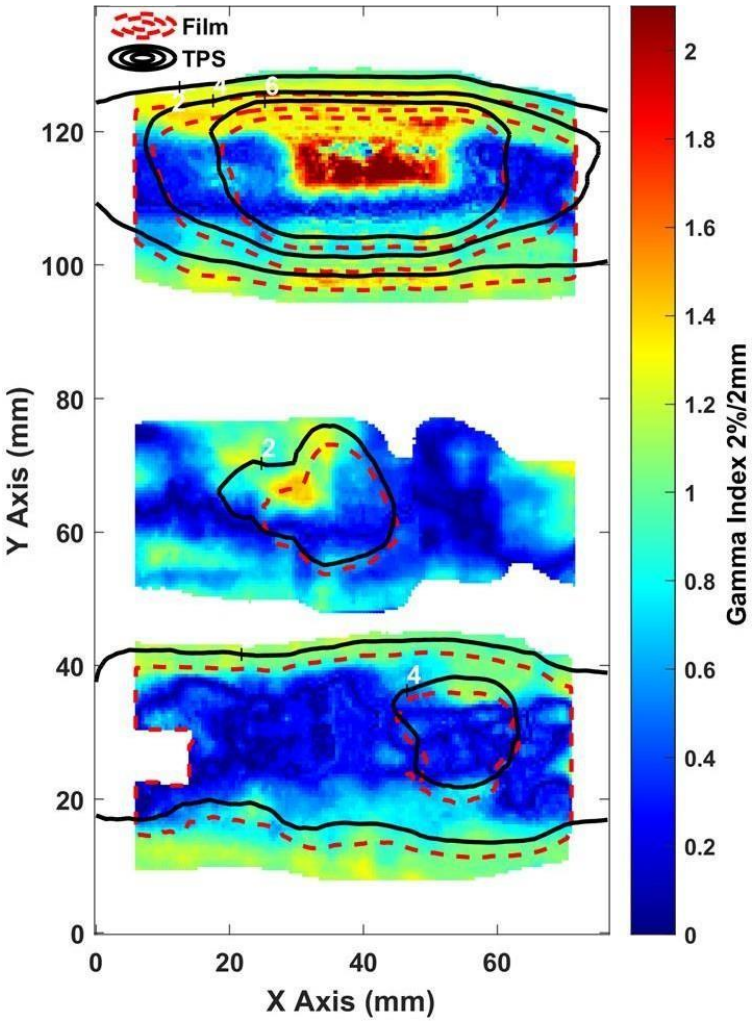


Figure: 2D comparison between calculated (TPS) and measured (Film) dose distributions in Gy values applying a dose threshold of 1 Gy. 3D gamma index calculations are given using passing criteria 2%/2mm.

PART III: 3D Gamma Index comparison

Gamma index calculations were also performed in 3D using a variety of passing criteria and a low-dose cut off threshold of 1 Gy. Corresponding results are summarized in the following table.

Table: Results for the 3D gamma index test of Film 1 (Coronal), comparing film-measured (reference) with the TPS-calculated (evaluated) dose distributions using a variety of passing criteria. Note that passing rates were calculated using a dose threshold of 1 Gy.

Structure	Passing criteria		Passing Rate
	DTA (mm)	DD (%)	GI ≤ 1 (%)
Targets	3	3	96.88
	2	3	85.61
	1	3	56.27
	2	2	82.81

Table: Results for the 3D gamma index test of Film 2 (Sagittal), comparing film-measured (reference)with the TPS-calculated (evaluated) dose distributions using a variety of passing criteria. Note that passing rates were calculated using a dose threshold of 1 Gy.

Structure	Passing criteria		Passing Rate
	DTA (mm)	DD (%)	GI ≤ 1 (%)
Targets	3	3	97.64
	2	3	74.72
	1	3	51.68
	2	2	68.75

Point absolute dosimetry (OSL)

Date of report:	---
Date of irradiation:	---
Phantom type:	SBRT phantom
Phantom S/N:	---
OSL Insert Kit S/N:	---
Treatment Planning System:	---
Number of target volumes (PTVs):	3
Institution:	---

PART I: Point-dose comparison

The following table shows the OSLD results for each dosimeter. Results from dosimeters lying at high dose gradient regions were excluded from the analysis. An energy correction factor was applied to the OSLD results to take into account the decrease in sensitivity of the dosimeters when calibrated in ^{60}Co energy and irradiated at higher energies.

To facilitate the reader to understand the results, the following figure shows the position of the dosimeters on the cassette.

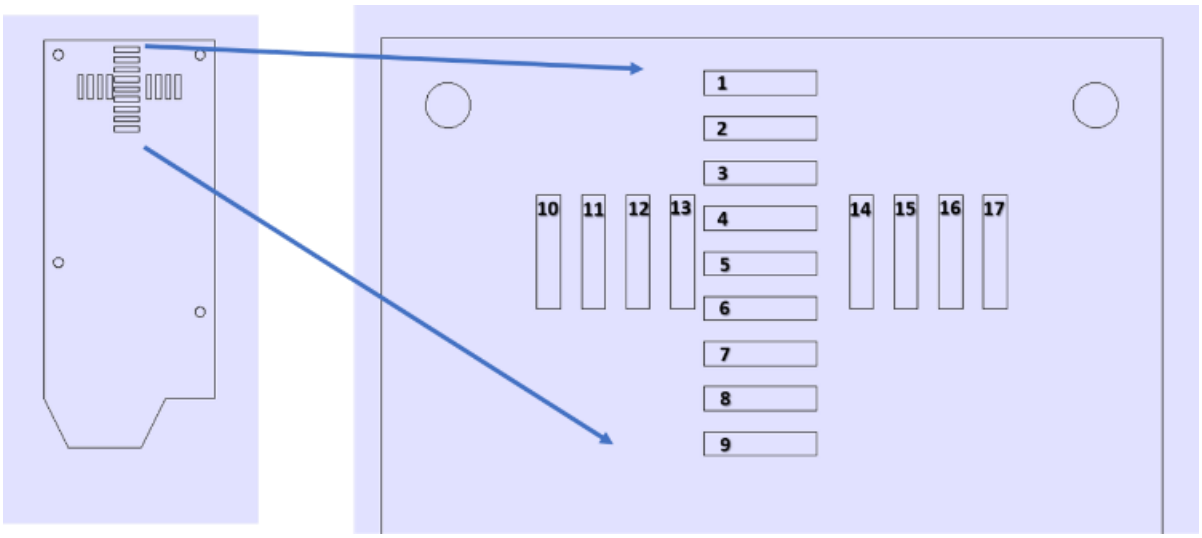


Figure: Schematic representation of the dosimetry cassette placed along the coronal plane through the phantom showing all OSL dosimeters.

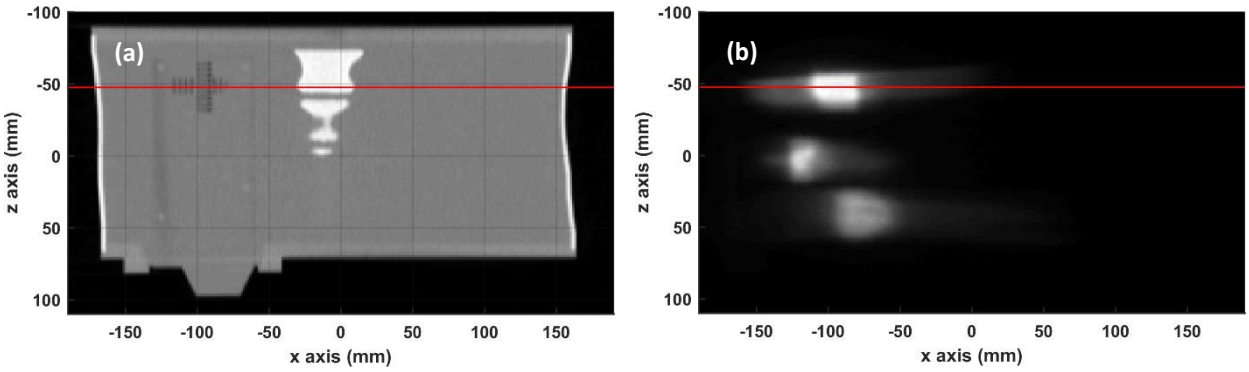
NOTE: OSLDs response within steep dose gradients is associated with high level of uncertainty and therefore it should be used for information only.

Table: OSL dosimetry results during the end-to-end procedures using Prime phantom. The total combined uncertainty at k=1 is ± 4%.

a/a	OSL dosimeter S/N	TPS calculated dose (Gy)	OSL measured dose (Gy)	Dose difference (%)
4	DN087708598	9.46	9.27	2.02
5	DC09112444S	9.45	8.99	5.05
13	DN08970066R	9.43	9.21	2.39
15	DC09416107P	9.50	9.22	3.06
16	DC09010931S	6.93	7.00	-1.09

PART II: Profile's comparison

Lateral (right-left) and superior-inferior absolute dose profiles for the OSL-measured and TPS-calculated datasets for PTV - are presented in the following figures, respectively. 4% error bars are also shown for the OSL measurements.



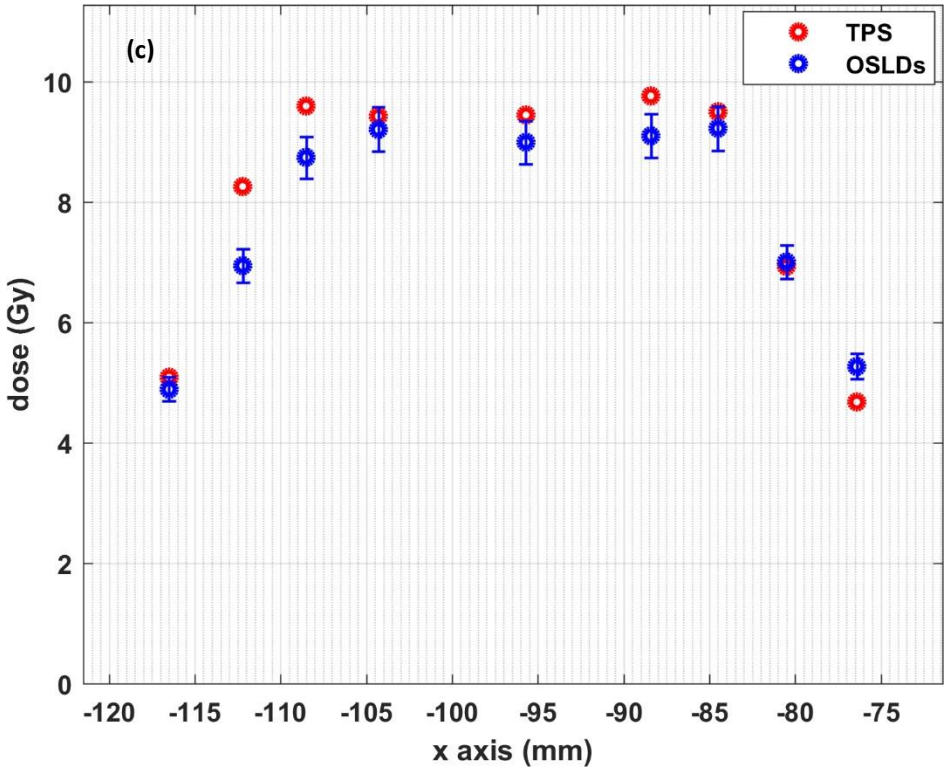
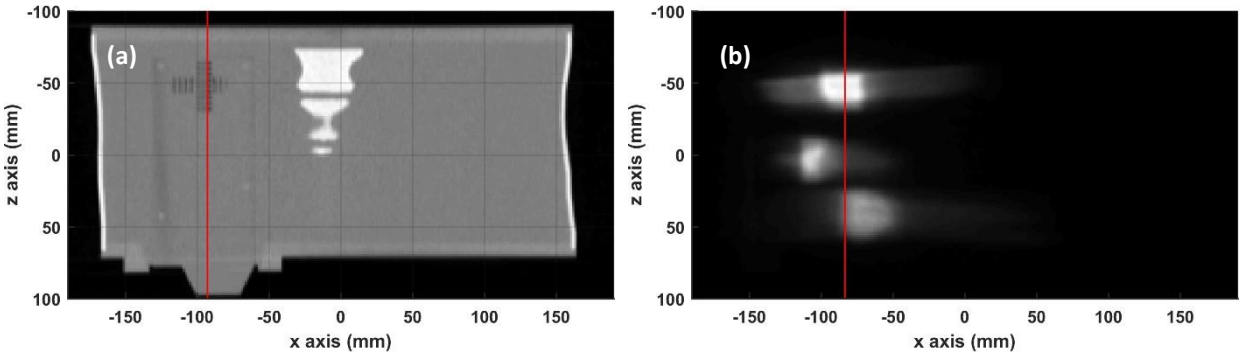


Figure 1: Lateral dose profile for PTV -: (a) Slice of the reconstructed CT scan of the OSLDs phantom and (b) Slice of the exported RTDOSE calculated on the OSLDs phantom. The red solid line displays the direction in which the OSLDs effective volumes lie. (c) 1D profile comparison between calculated (TPS) and measured (OSL) dose measurements at the dosimeters' locations depicted by the red line.



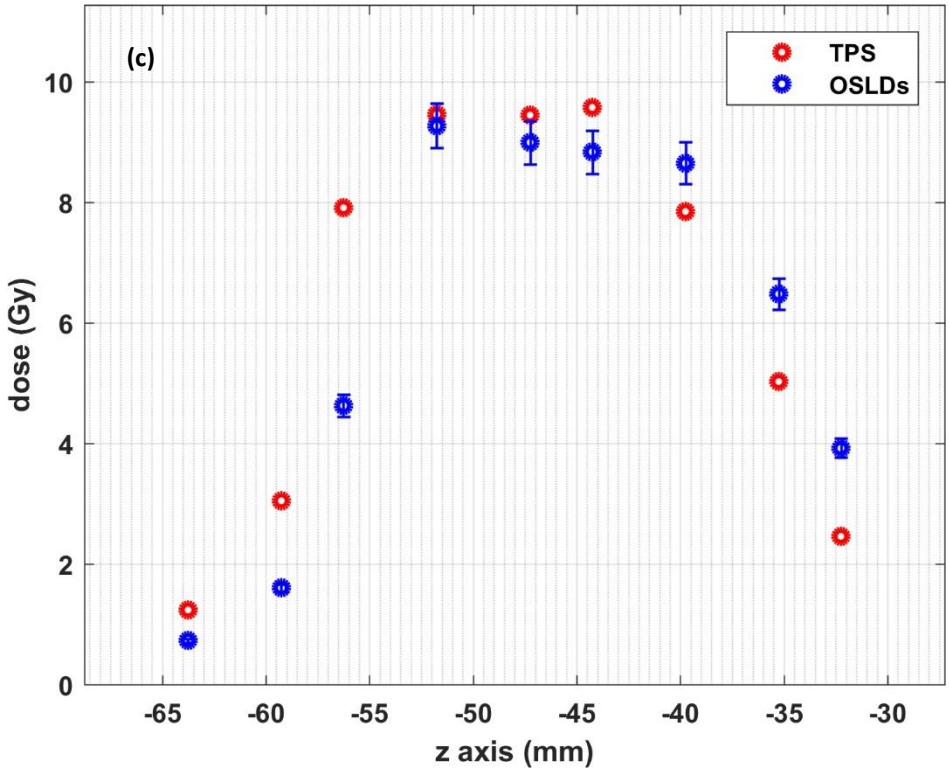


Figure 2: Superioinferior dose profile for PTV -: (a) Slice of the reconstructed CT scan of the OSLDs phantom and (b) Slice of the exported RTDOSE calculated on the OSLDs phantom. The red solid line displays the direction in which the OSLDs effective volumes lie. (c) 1D profile comparison between

calculated (TPS) and measured (OSL) dose measurements at the dosimeters' locations depicted by the red line.

Disclaimer

Results presented in this report were deduced based on an experimental procedure performed by the end-user following the guidelines of RTsafe staff. Results are provided "as is". No warranties, express or implied, that these results are free of error, or is consistent with any particular standard of merchantability, or that it will meet your requirements for any particular application, is made. No responsibility for any physical or technical limitations of the procedures and functions which make up this experimental methodology is accepted. The presented dosimetric report should not be relied on for solving a problem whose incorrect solution could result in injury to a person or loss of property. RTsafe shall not, in any event, be liable for any damages, whether direct or indirect, special or general, consequential or incidental, arising from the use of the results of this report. RTsafe does not suggest any specific actions for improving your radiotherapy treatment protocol. The interpretation of the presented results is entirely at your own risk.