

RADIOTERAPIJSKE TEHNIKE



doc dr Neda Milosavljević

PODELA RADIOTERAPIJE PREMA UDALJENOSTI IZVORA ZRAČENJA

- Iz neposredne blizine (brahiterapija)
- Sa određene distance od površine tela i/ili tumora (teleradioterapija, transkutana radioterapija).

Radioterapijski aparati – linearni akceleratori

- Kilovoltažne mašine – produkuje X-zrake energija $< 500 \text{ kV}$.
- Koriste se za tretman površnih lezija
- Megavoltažne mašine – produkuje zračenje energija $> 1 \text{ MV}$
- Linearni akceleratori (savremene teleterapijske mašine)

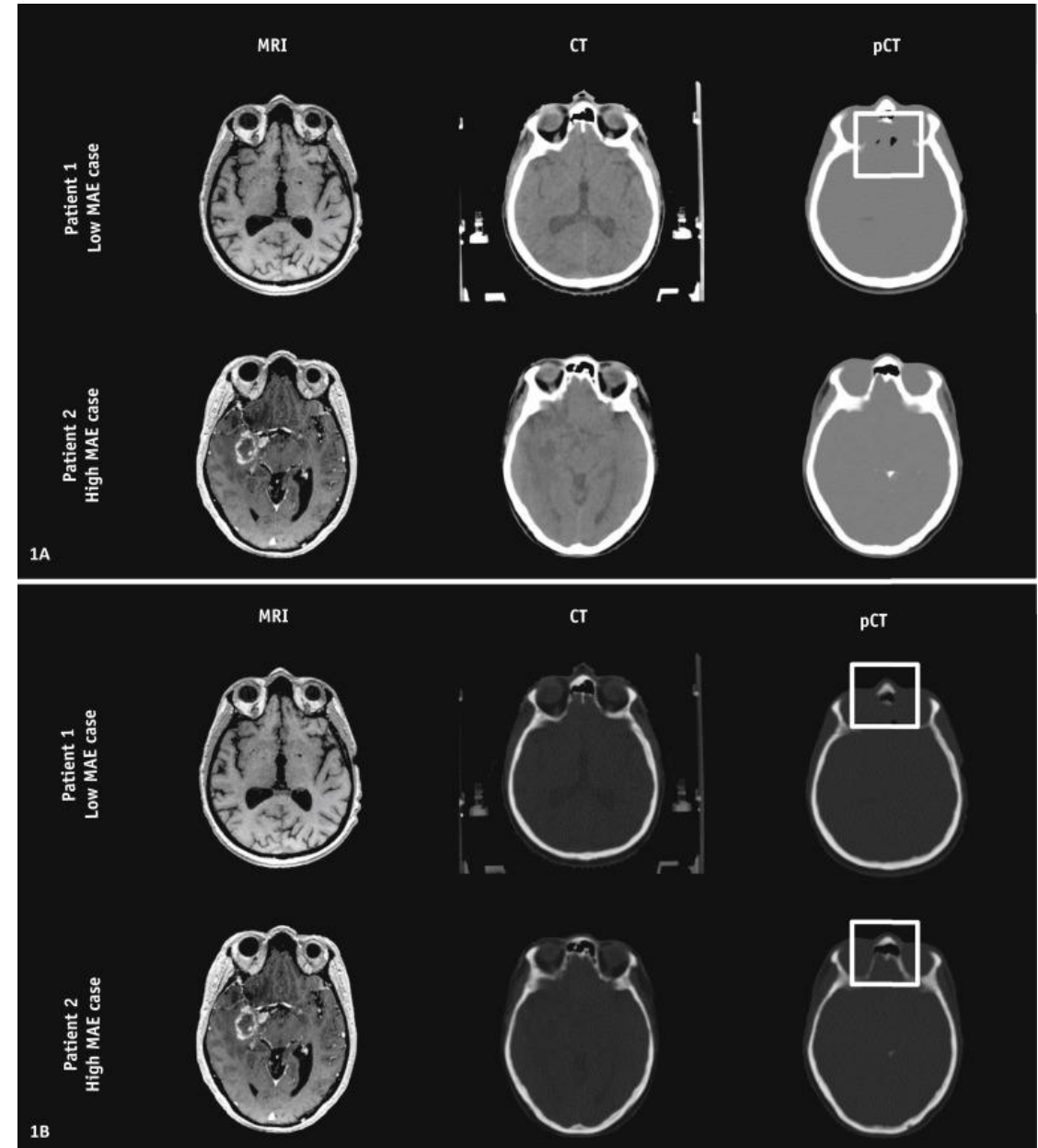
Ro simulator



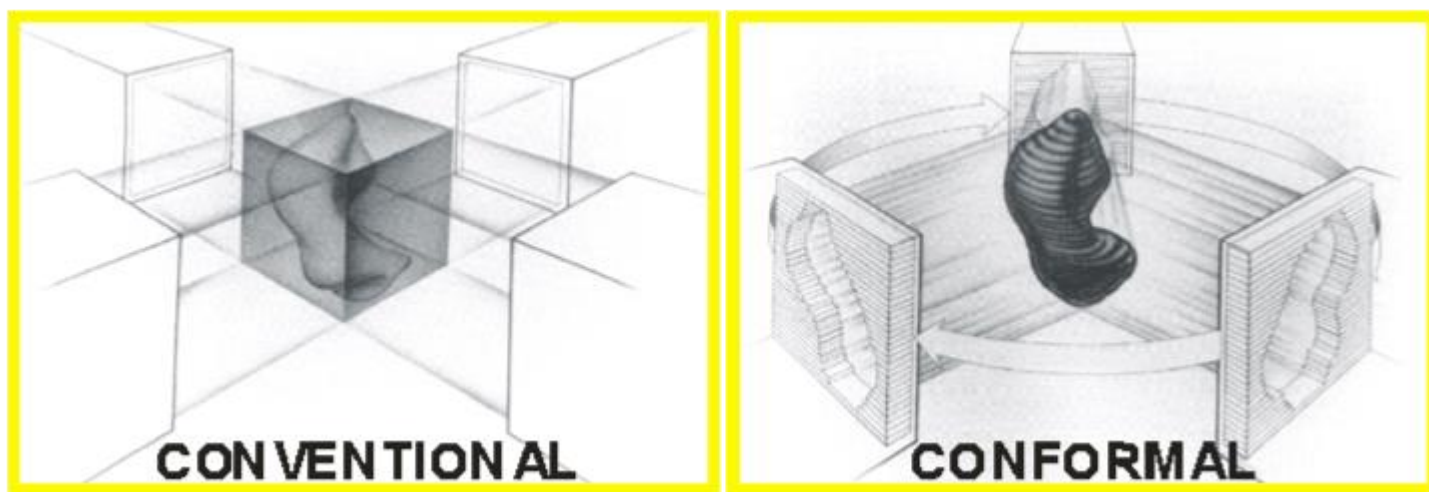
CT/MR simulator

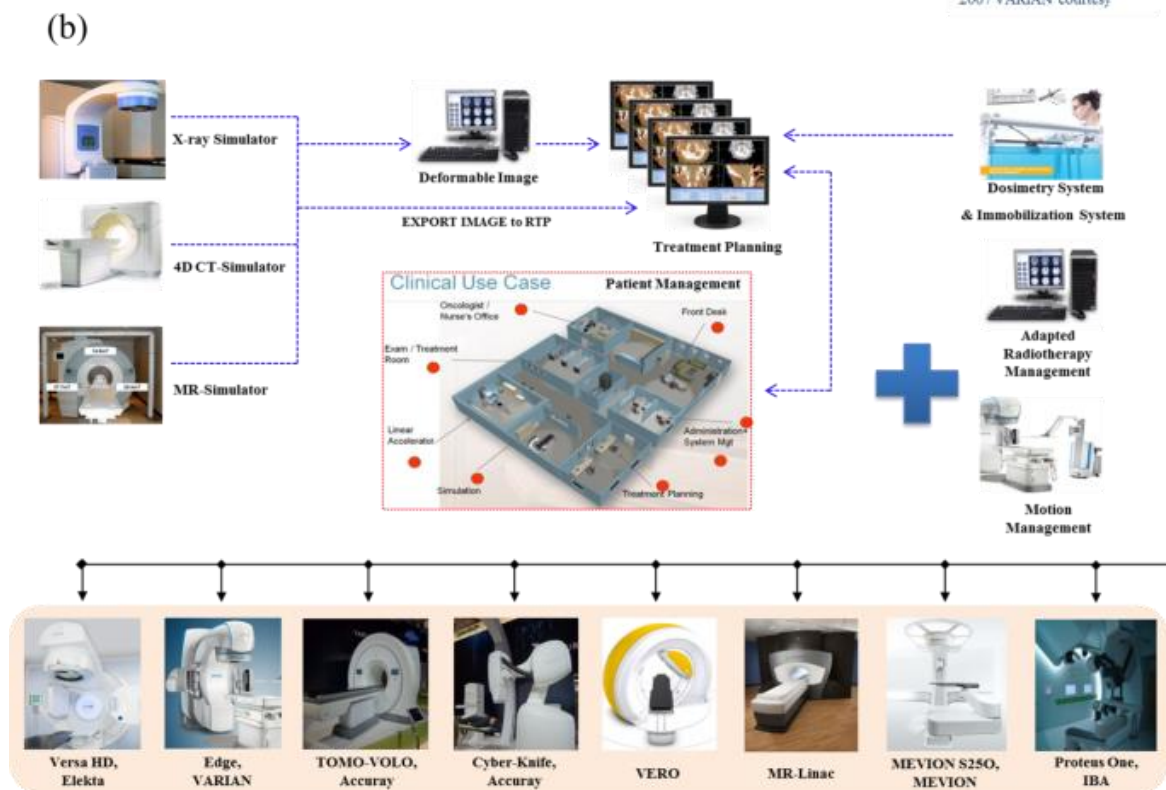
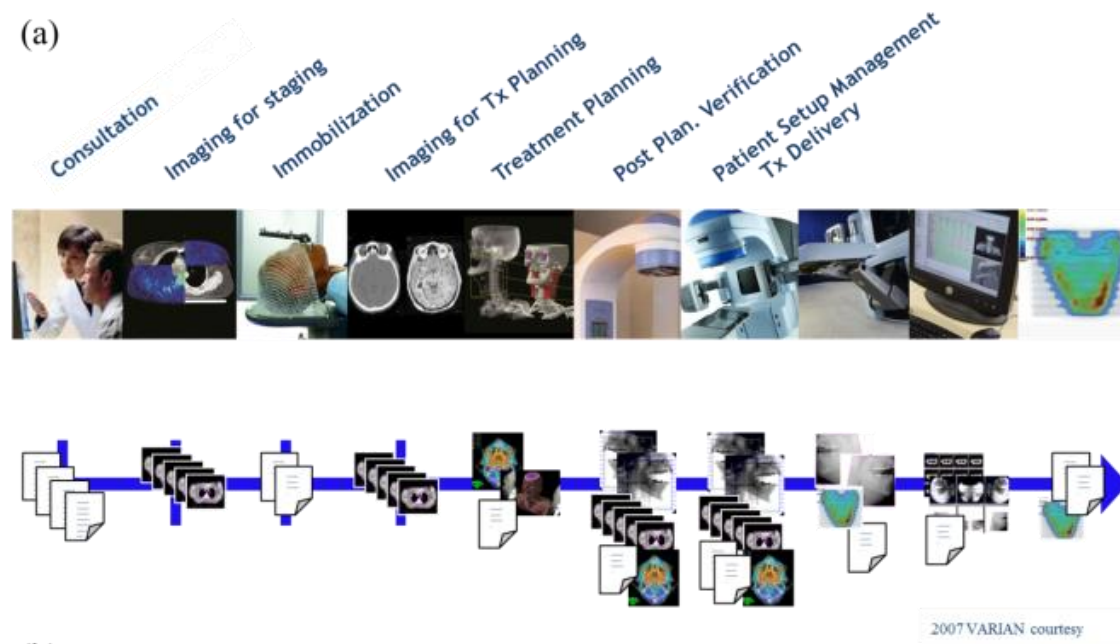


- Andres A. E. Int J of Radiation Oncology, Biology, Physics. , 2020.

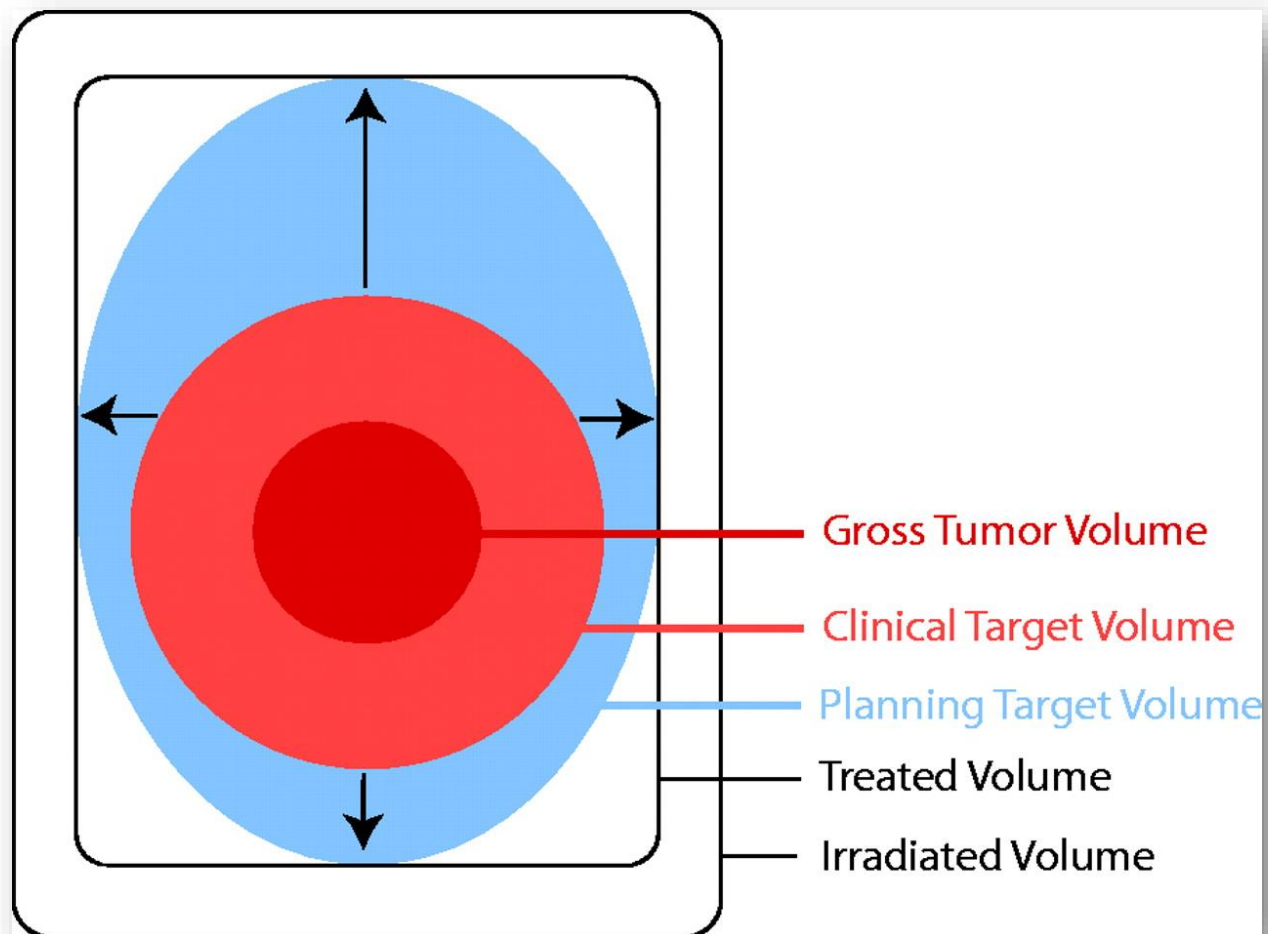


PRECIZNA ISPORUKA MAKSIMALNE RADIOTERAPIJSKE DOZE U TUMORSKOM TKIVU UZ MINIMALNO OŠTEĆENJE OKOLNOG, ZDRAVOG TKIVA





Lee S. 2014.
Evolution of Ionizing Radiation Research



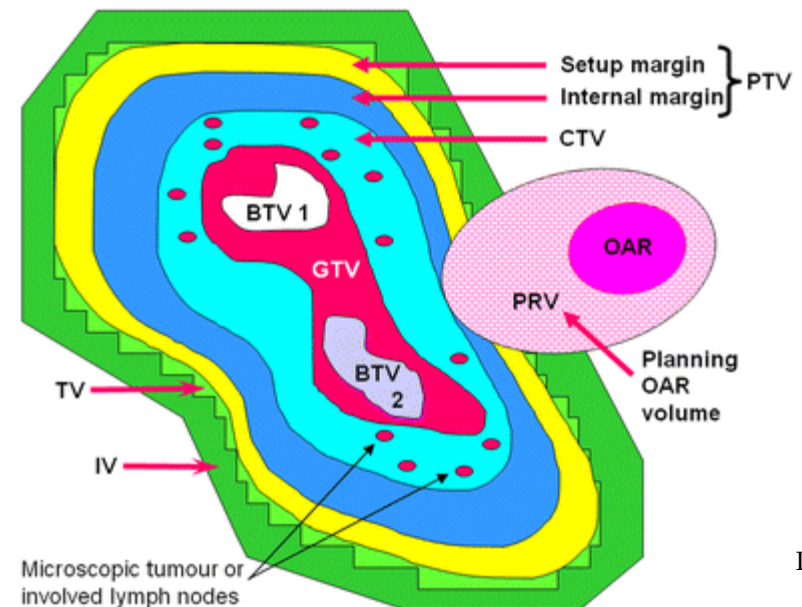
- Konformalna radioterapija (CRT) – počeci 1960.
- Razvoj imaging metoda (CT, MRI, PET), informacione tehnologije, savremeni radioterapijski uređaju - omogućen razvoj CRT
- Lokalna kontrola bolesti u funkciji isporučene doze
- Poštuda okolnih, zdravih tkiva
- Eskalacija doze

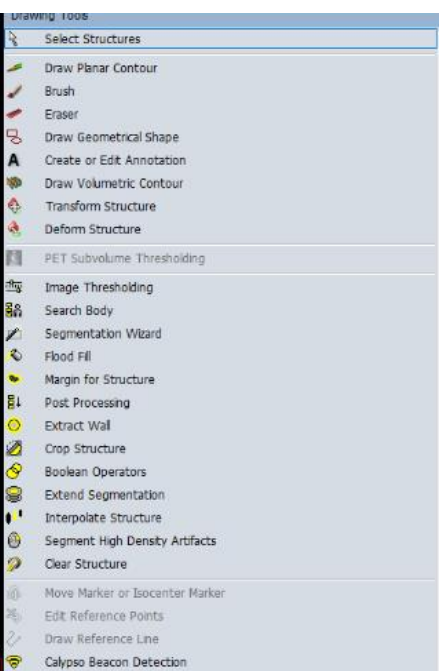
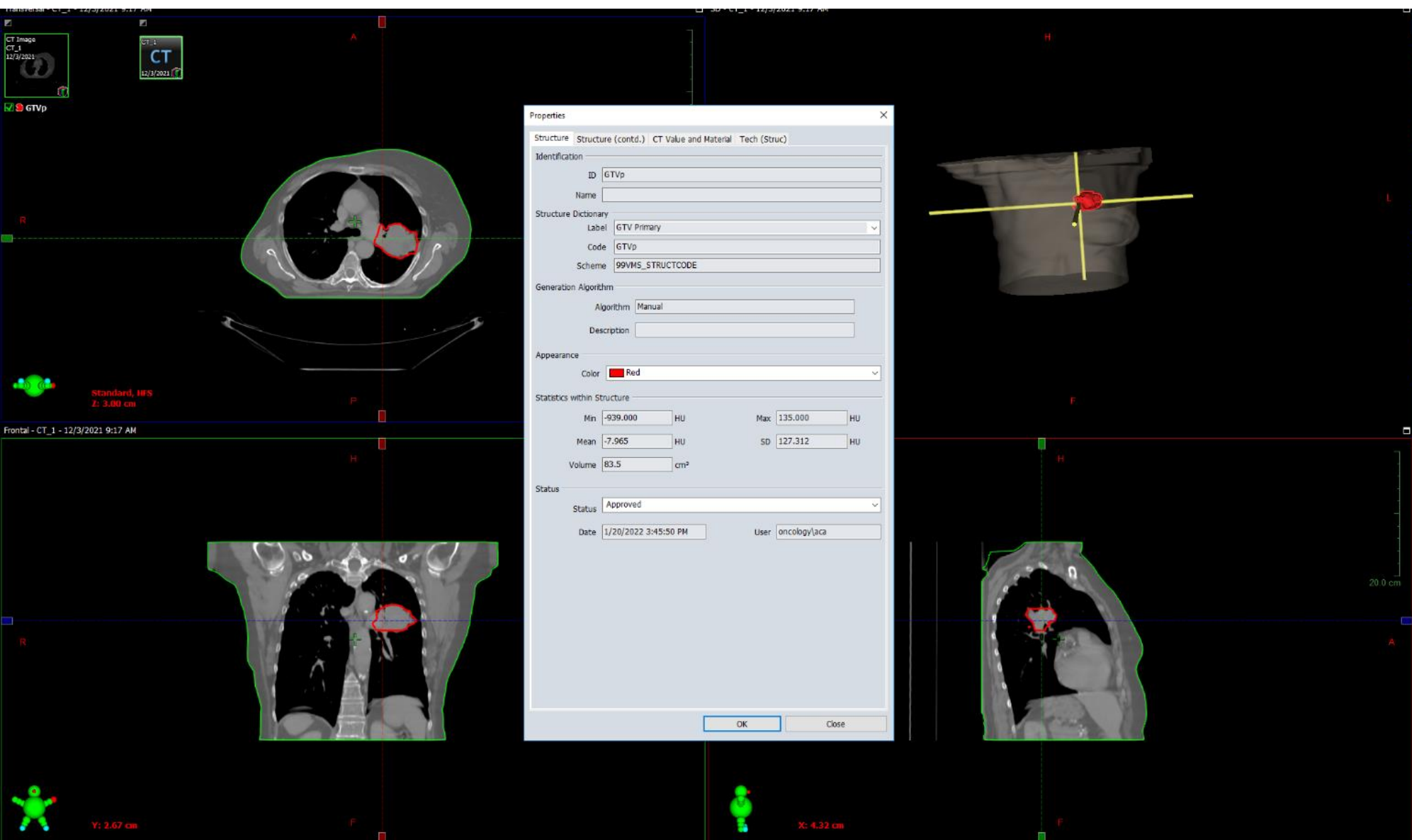
Target volumeni

- Gross Tumor Volume (GTV): vidljivi deo tumora (ili limfnog čvora), na osnovu urađenih kliničko-dijagnostičkih procedura. Nakon radikalno operisanog tumora (R0 resekcija) GTV nije vidljiv.
- Clinical Target Volume (CTV): obuhvata zonu mikroskopskog širenja malignih ćelija oko vidljivog dela tumora. Takođe, oko uvećanih regionalnih limfnih čvorova (GTVn) se definiše CTVn, a on po pravilu obuhvata najmanje cijelu anatomsku grupu limfnih čvorova kojoj pripada involvirani čvor.
- Planning Target Volume (PTV): margina koja pokriva interfrakcijske/ intrafrakcijske varijacije položaja CTV-a u odnosu na geometriju snopa/polja zračenja, a nastaje zbog: varijacija u preciznosti, fizioloških pokreta.

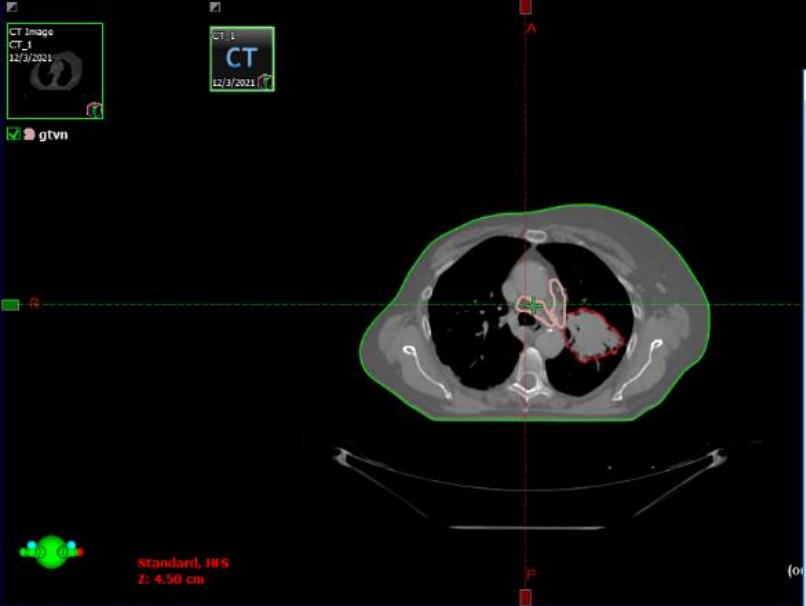
Organs at Risk (OAR - organi pod rizikom)

- Zdrava, okolna tkiva, o čijoj poštedi/radiosenzitivnosti se vodi računa pri izradi plana zračenja i sprovođenju lečenja radioterapijom
- Dodatni volumen oko OAR (PRV - Planning Risk Volume)
- 3D model „virtuelnog pacijenta“, s volumnim prikazom geometrije ciljnog volumena i prostornih odnosa ciljnog volumena i OAR

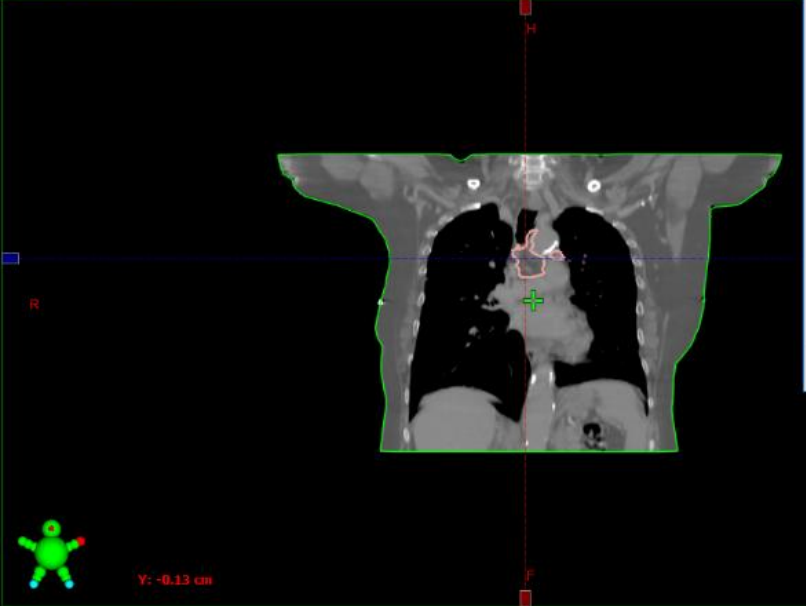




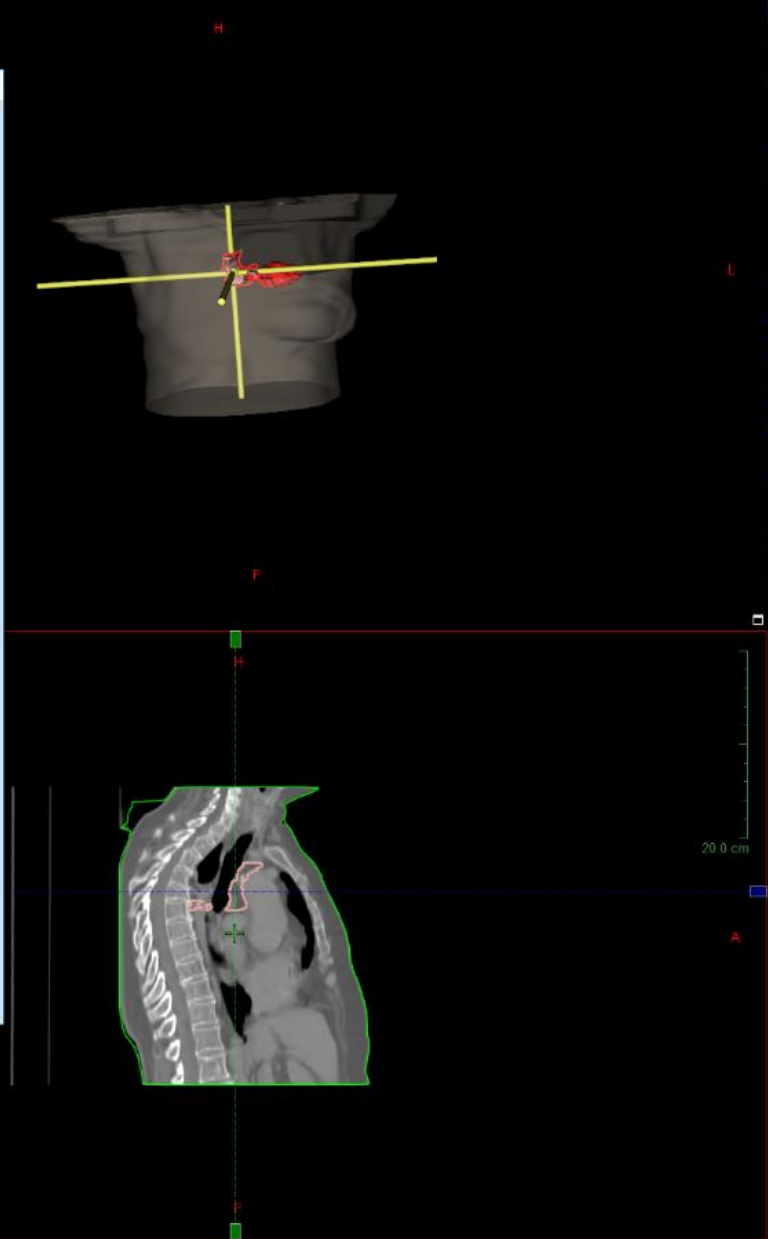
Transversal - CT_1 - 12/3/2021 9:17 AM



Frontal - CT_1 - 12/3/2021 9:17 AM



3D - CT_1 - 12/3/2021 9:17 AM



Properties

Structure Structure (contd.) CT Value and Material Tech (Struc)

Identification

ID gtvn

Name

Structure Dictionary

Label GTV Nodal

Code GTVn

Scheme 99VMS_STRUCTURE

Generation Algorithm

Algorithm Manual

Description

Appearance

Color RGB223166159

Statistics within Structure

Min	-885.000	HU	Max	344.000	HU
Mean	-52.123	HU	SD	118.084	HU
Volume	27.3	cm³			

Status

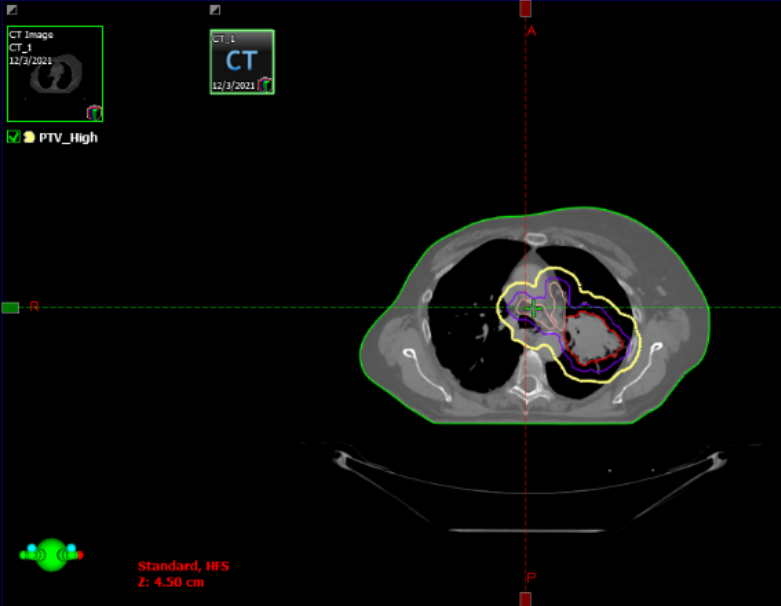
Status Approved

Date 1/20/2022 3:45:50 PM User oncology\jaca

OK Close

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 - Calypso Beacon Detection

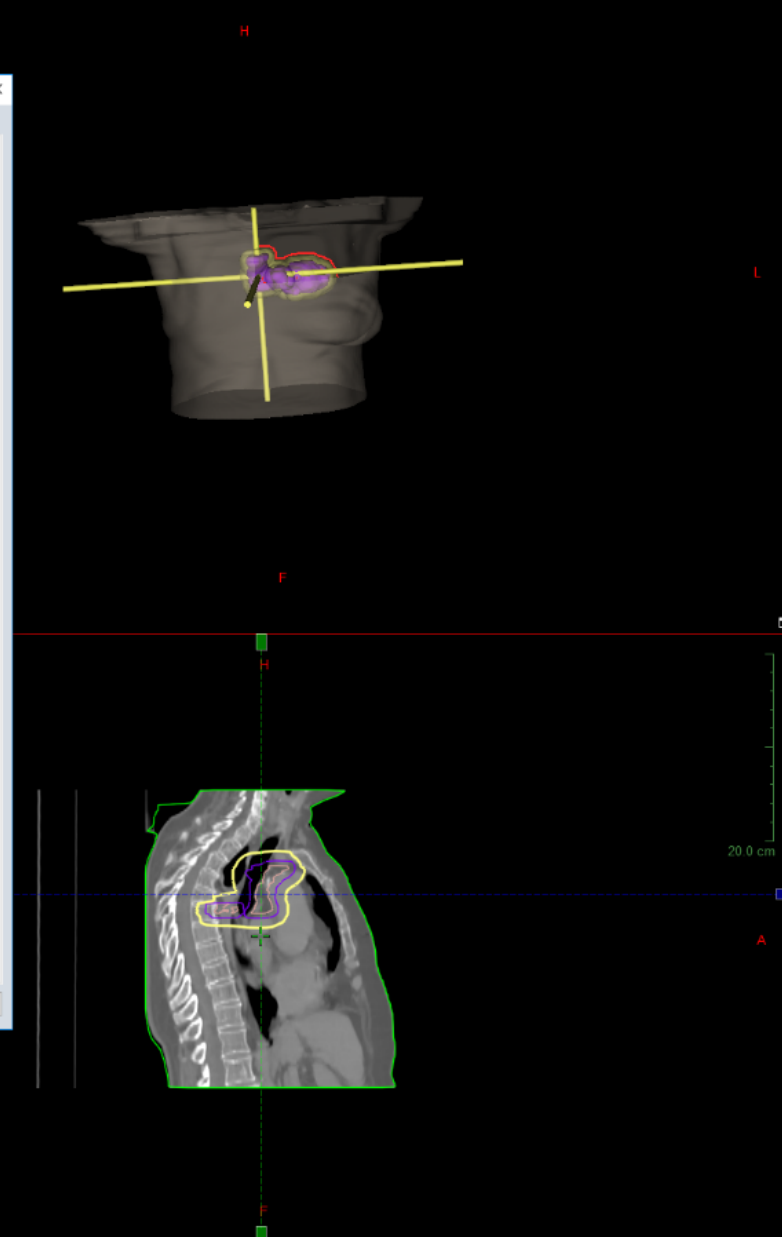
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Frontal - CT_1 - 12/3/2021 9:17 AM



3D - CT_1 - 12/3/2021 9:17 AM



Properties

Structure (contd.) CT Value and Material Tech (Struc)

Identification

ID PTV_High

Name

Structure Dictionary

Label PTV High Risk

Code PTV_High

Scheme 99VMS_STRUCTCODE

Generation Algorithm

Algorithm Manual

Description

Appearance

Color Translucent : Yellow

Statistics within Structure

Min	-1000.000	HU	Max	1216.000	HU
Mean	-317.710	HU	SD	403.285	HU
Volume	710.4	cm³			

Status

Status Approved

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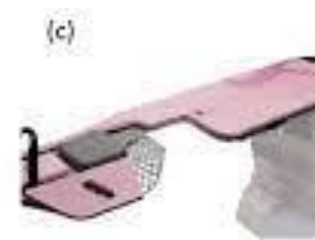
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POZICIONIRANJE I IMOBILIZACIJA PACIJENTA

- Prva odluka u procesu planiranja radioterapije je pozicioniranje
- Zavisi od lokalizacije tumora i imobilizacionih uređaja koji su na raspolaganju
- I više od 30 radioterapijskih frakcija tokom jednog tretmana - bitno adekvatno pozicioniranje i imobilizacija koji treba da omoguće visoku preciznost u sprovođenju planirane RT

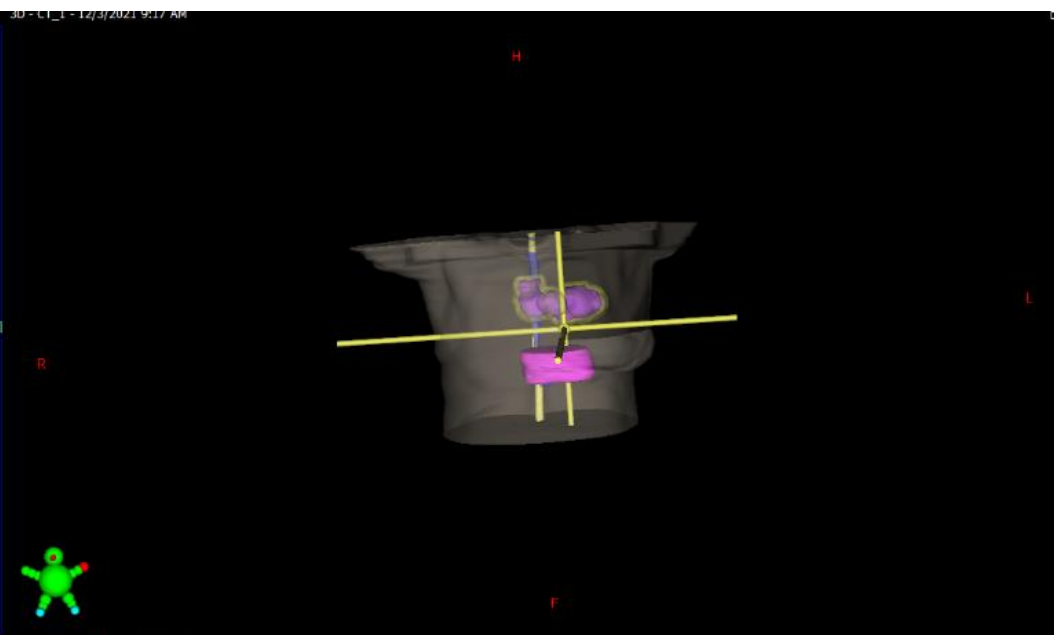
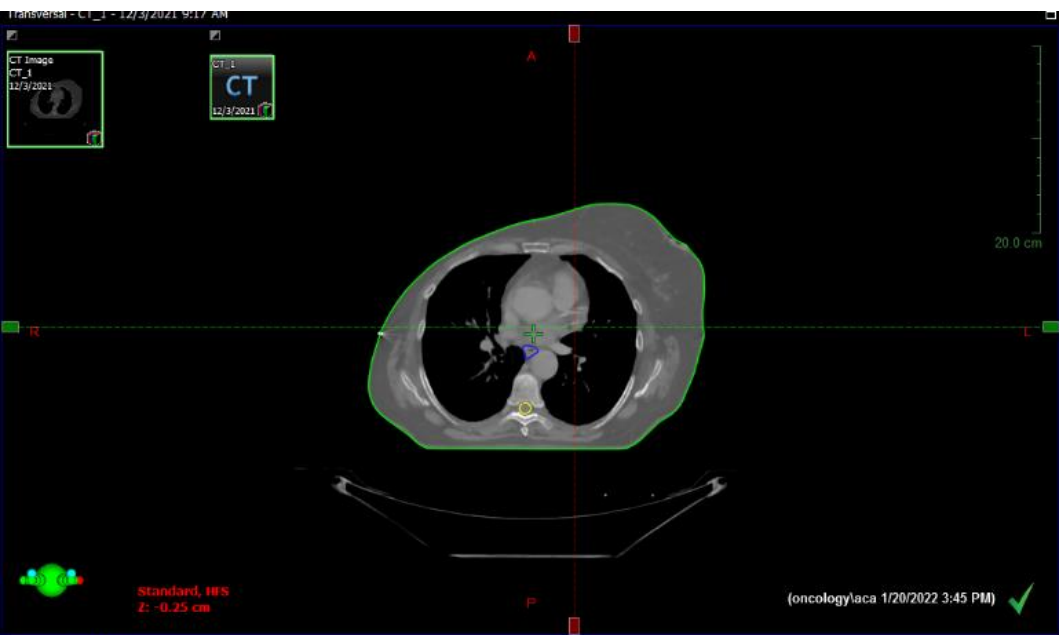


QUANTEC Summary:
Approximate Dose/Volume/Outcome Data for Several Organs Following Conventional Fractionation 3D-CRT

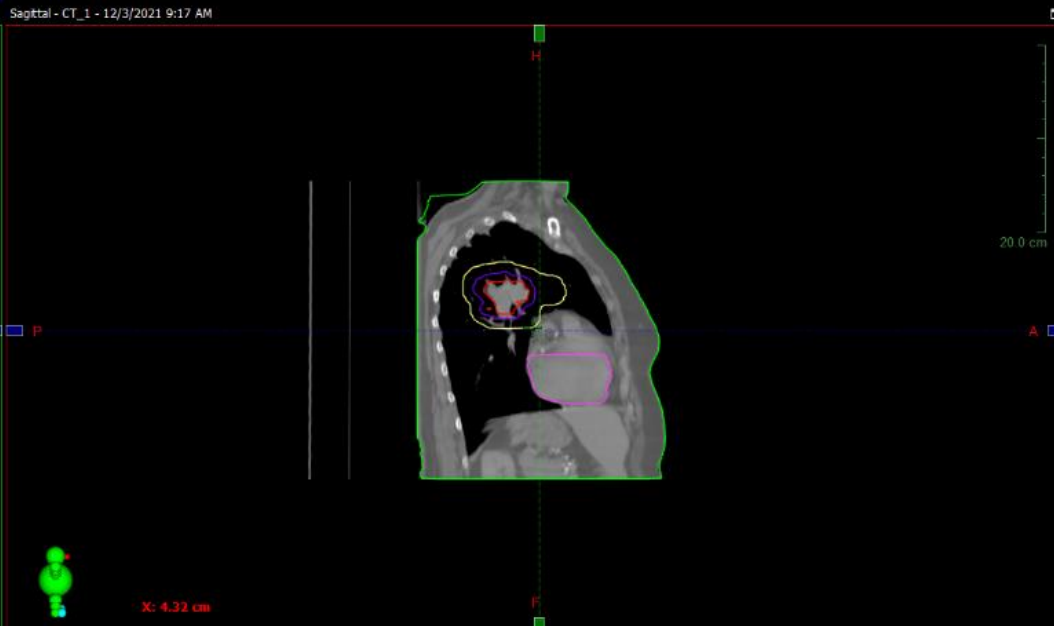
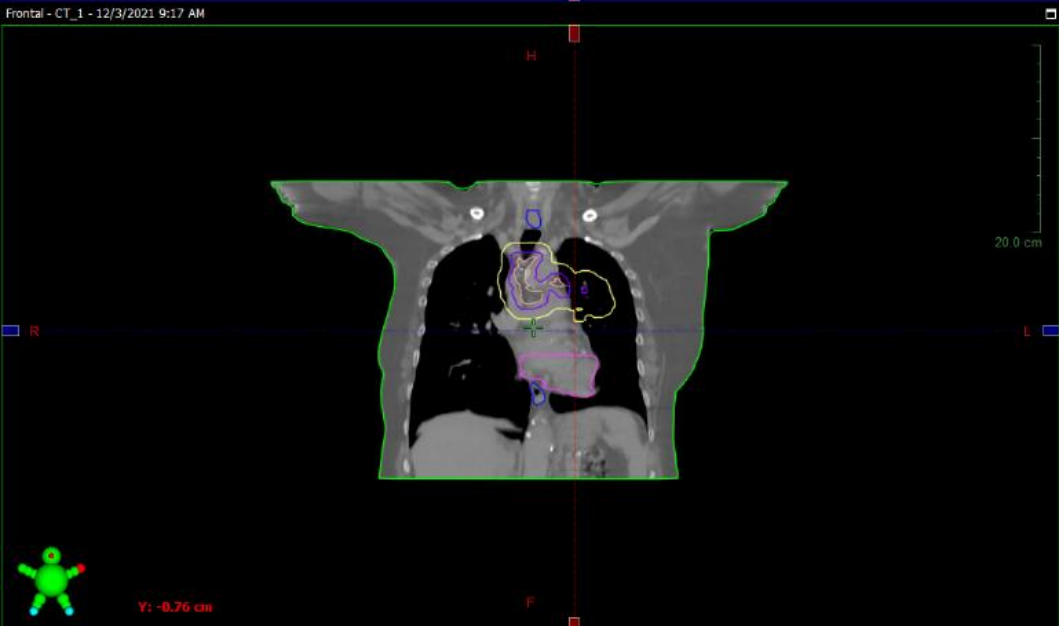
Organ	Endpoint	Dose (Gy), or dose/volume parameters	Rate (%)	Volume segmented	Irradiation type (partial organ unless otherwise stated)
Brain	Symptomatic necrosis	Dmax <60	<3	Whole organ	3D-CRT
		Dmax = 72	5		
		Dmax = 90	10		
Brain stem	Permanent cranial neuropathy or necrosis	Dmax <54	<5	Whole organ	Whole organ
		D1-10 cc * ≤59	<5		3D-CRT
		Dmax <64 <<1 cc (Point dose)	<5		3D-CRT
Optic nerve/ chiasm	Optic neuropathy	Dmax <55	<3	Whole organ	Given the small size, 3D-CRT is often whole organ
		Dmax 55-60	3-7		
		Dmax >60	>7-20		
Spinal cord	Myelopathy	Dmax = 50	0.2	Partial organ	3D-CRT
		Dmax = 60	6		
		Dmax = 69	50		
Cochlea	Sensory neural hearing loss (hearing at 4 kHz)	Mean dose ≤45	<30	Whole organ	Given the small size, 3D-CRT is often whole organ
Parotid	Long term parotid salivary function reduced to <25% of pre-RT level	Mean dose <25 (for combined parotid glands)**	<20	Bilateral whole parotid glands	3D-CRT
		Mean dose <20 (for single parotid gland)**	<20	Unilateral whole parotid gland	
		Mean dose <39 (for combined parotid glands)**	<50	Bilateral whole parotid glands	
Pharynx constrictors	Symptomatic dysphagia and aspiration	Mean dose <50	<20	Pharyngeal constrictors	Whole organ
Larynx	Vocal dysfunction (with chemo, based on single study)	Dmax <66	<20	Whole organ	3D-CRT
	Aspiration (with chemo, based on single study)	Mean dose <50	<30		
	Edema (without chemo, based on single study in patients without larynx cancer)	Mean dose <44	<20		
		V50 <27%	<20		
Lung	Symptomatic pneumonitis	V20 ≤ 30% (for combined lung)	<20	Whole organ	3D-CRT
		Mean dose = 7	5		3D-CRT (excludes purposeful whole lung irradiation)
		Mean dose = 13	10		
		Mean dose = 20	20		
		Mean dose = 24	30		

3D CRT

- Trodimenzionalna (3D) konformalna radioterapija je precizna tehnika, koja se bazira na trodimenzionalnom volumetrijskom definisanju tumora i okolnih zdravih organa.
- Predstavlja minimum standarda danas
- Koristi se prethodnih 20 godina



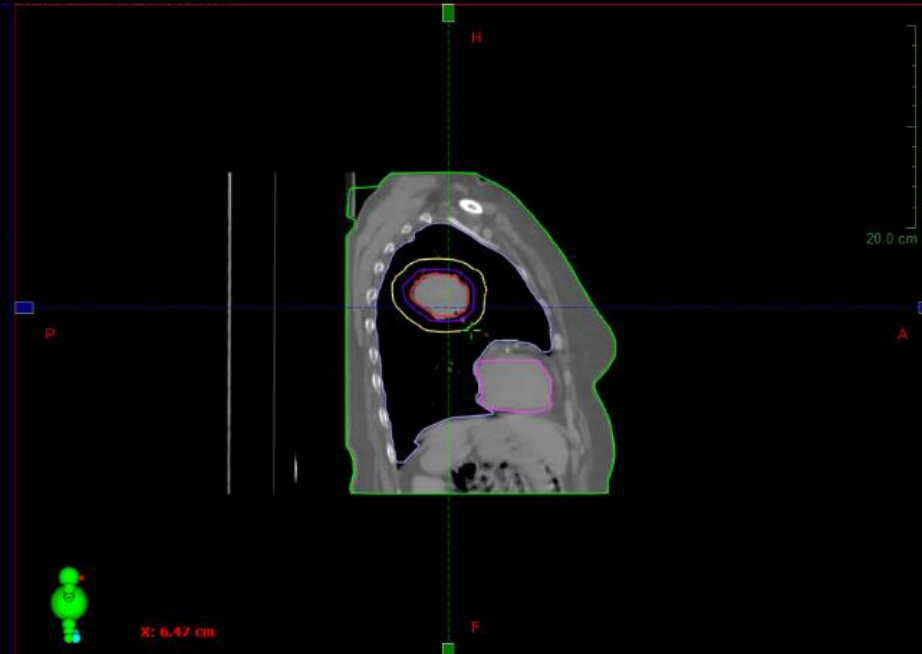
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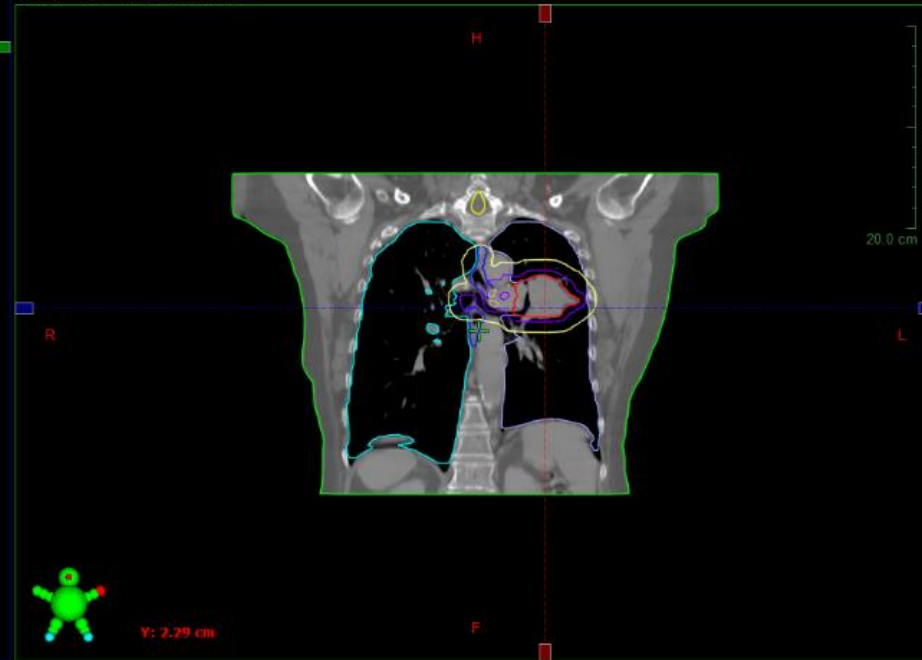
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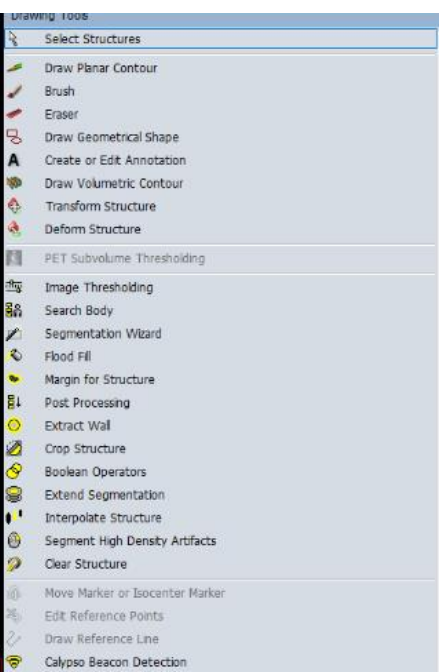
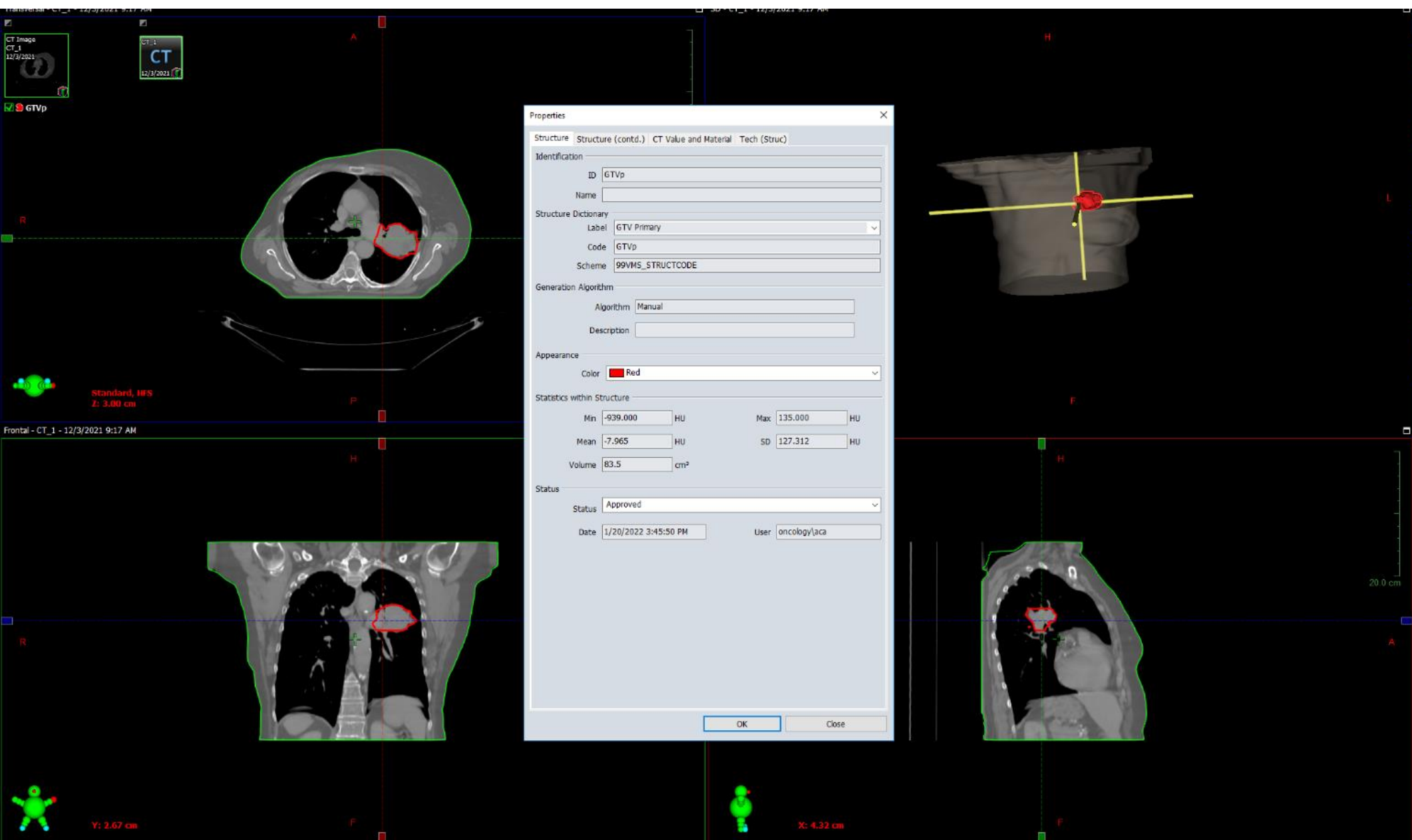


Sagittal - CT_1 - 12/3/2021 9:17 AM

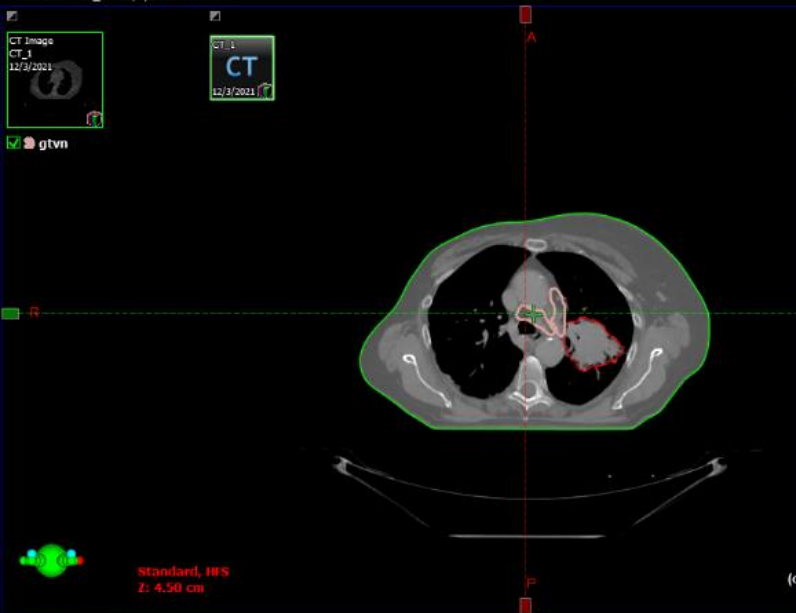


Frontal - CT_1 - 12/3/2021 9:17 AM





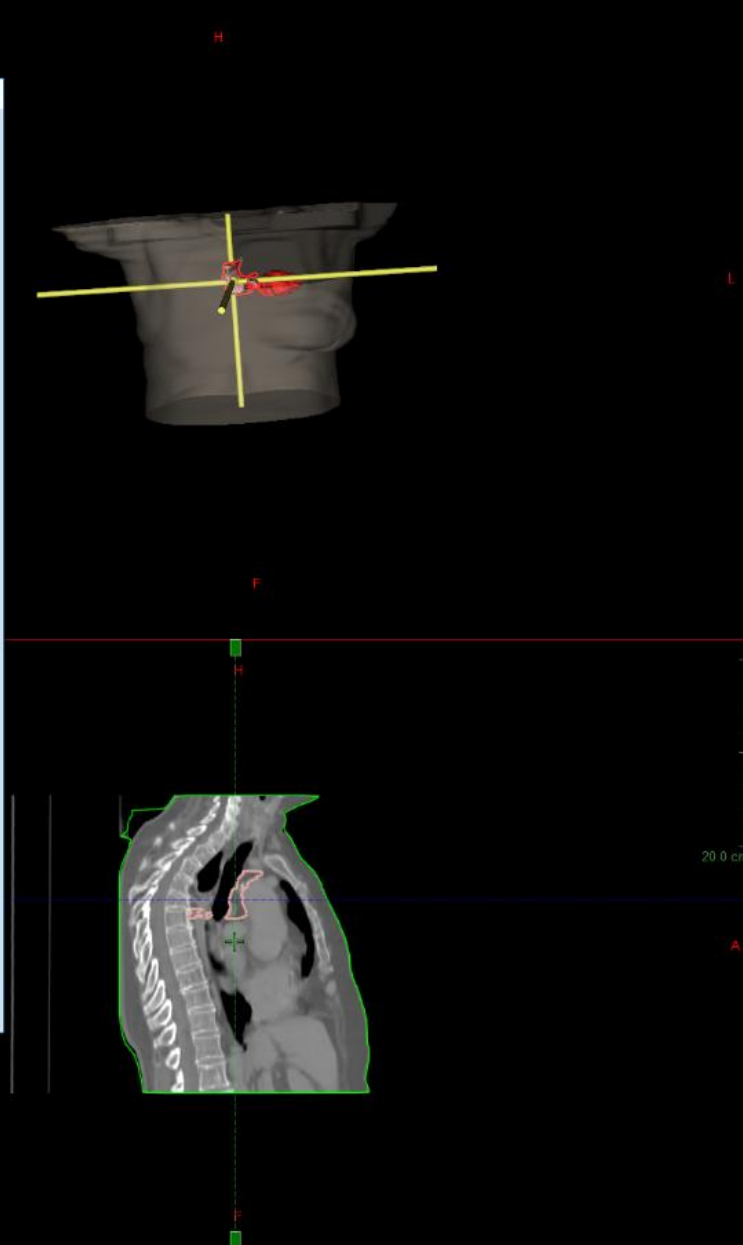
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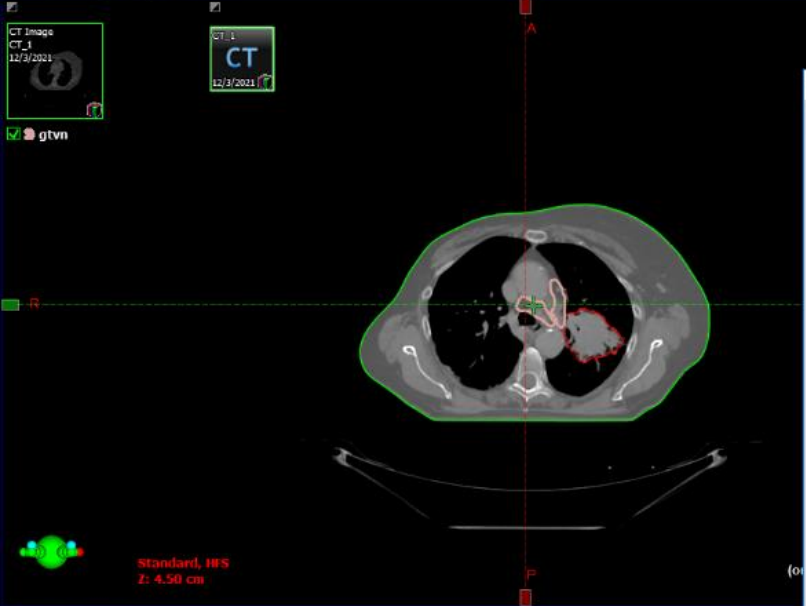
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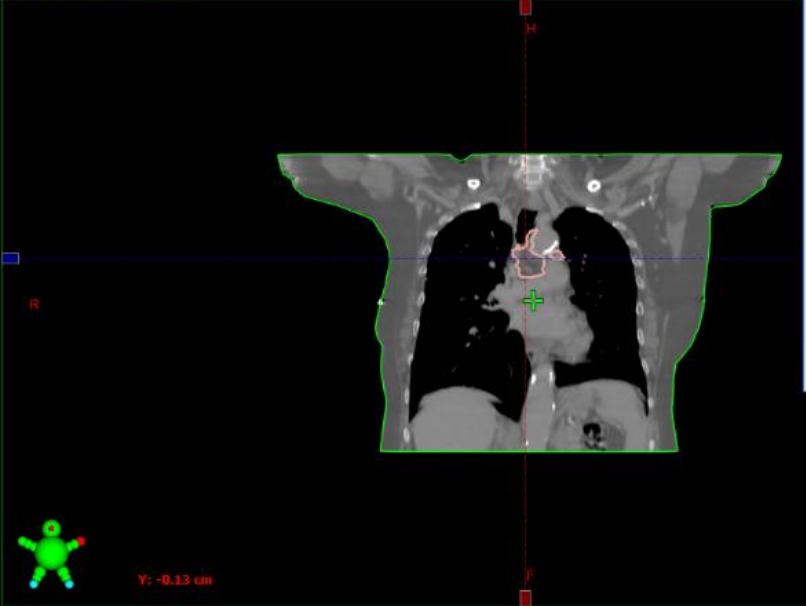
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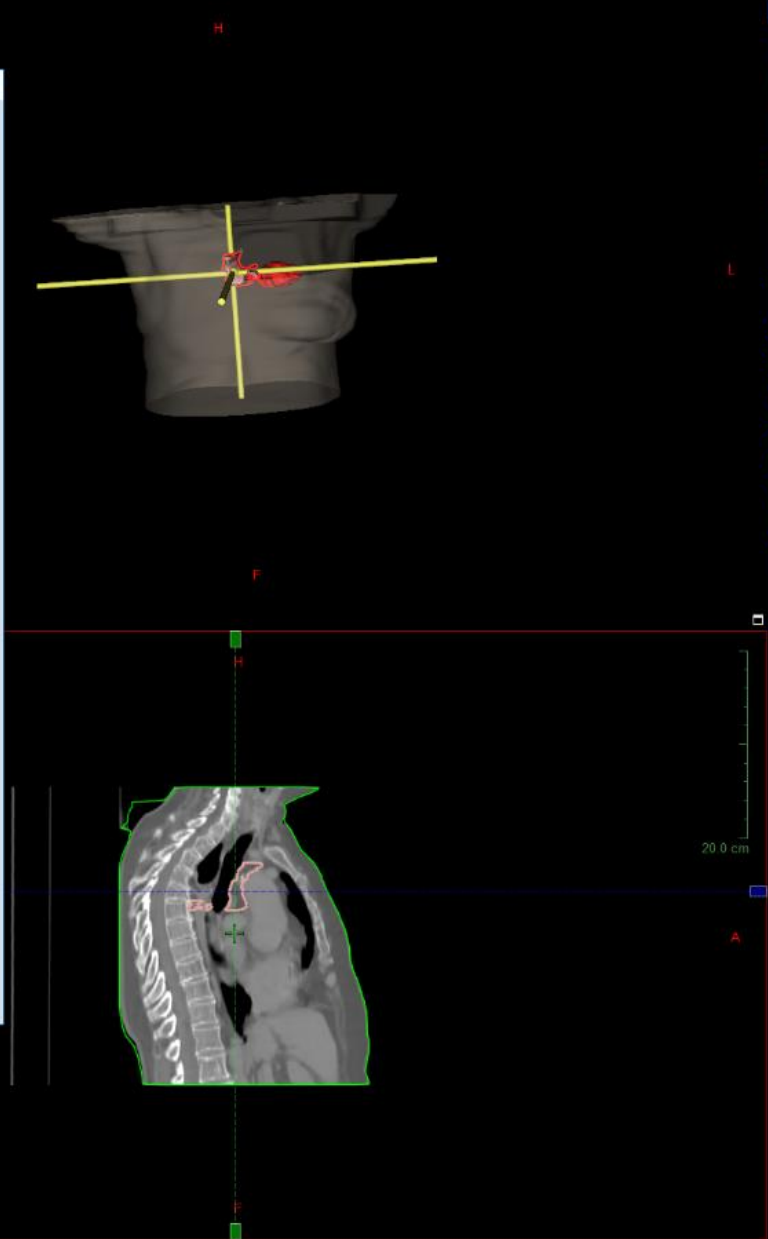
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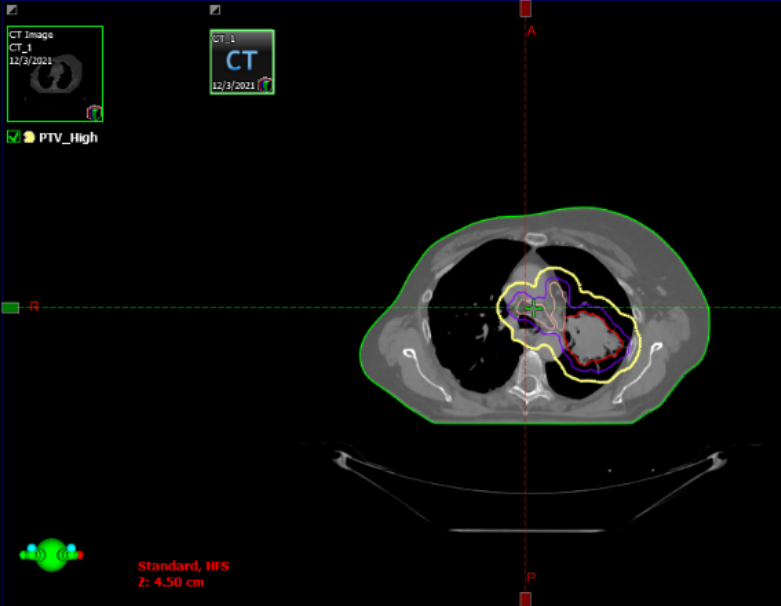
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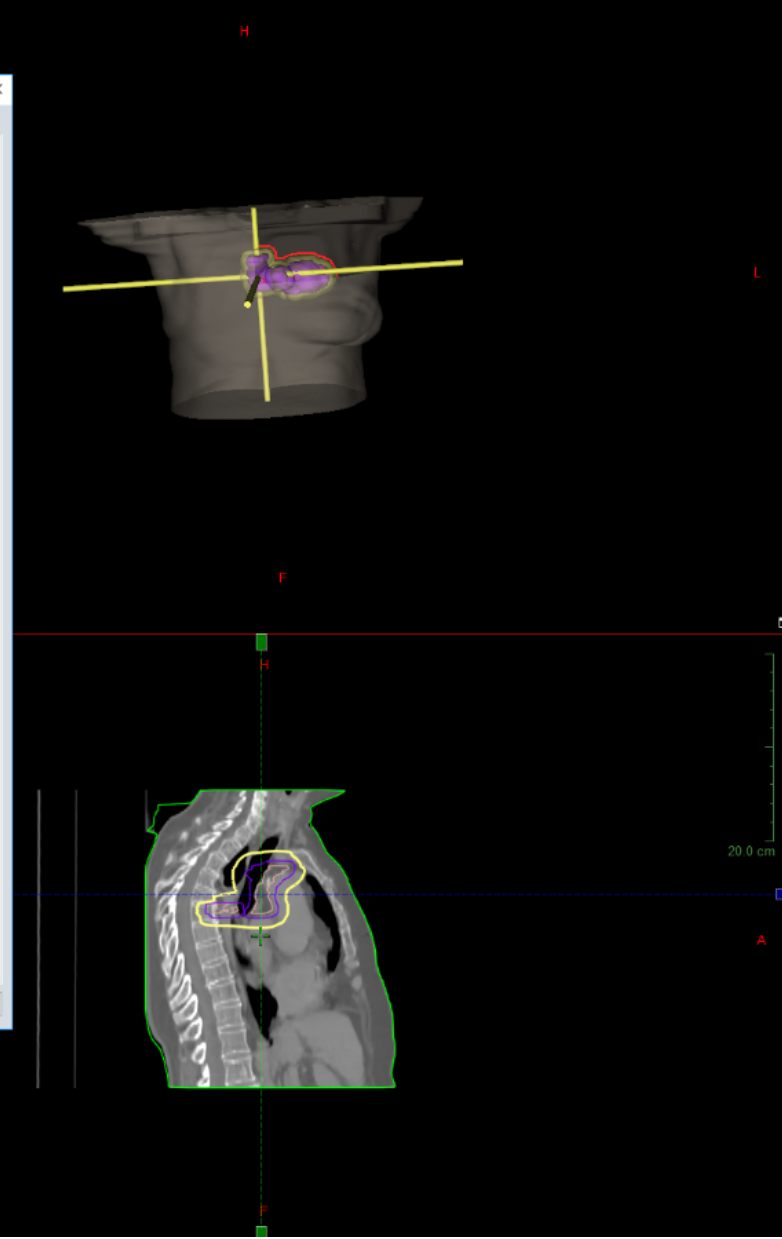
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Frontal - CT_1 - 12/3/2021 9:17 AM



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Properties

Structure (contd.) CT Value and Material Tech (Struc)

Identification

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Name

Structure Dictionary

Label PTV High Risk

Code PTV_High

Scheme 99VMS_STRUCTCODE

Generation Algorithm

Algorithm Manual

Description

Appearance

Color Translucent : Yellow

Statistics within Structure

Min	-1000.000	HU	Max	1216.000	HU
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1

1: R0

Plan_1

Plan_1

CT_1

Registered Images

CT_1

BODY

CouchInterior

CouchSurface

CTV_High

Esophagus

gtvn

GTVvp

Heart

Lung_L

Lung_R

PTV_High

SpinalCord

User Origin

Reference Points

PTV_High

Dose

Fields

Isocenter Group I

pi0

pi0-DRR (Live)

pi90

pi270-DRR (Live)

foto

foto-DRR (Live)

48

Field 3-DRR (Live)

MLC

48.0

Field3--DRR (Live)

MLC

79

Field 5-DRR (Live)

MLC

79.0

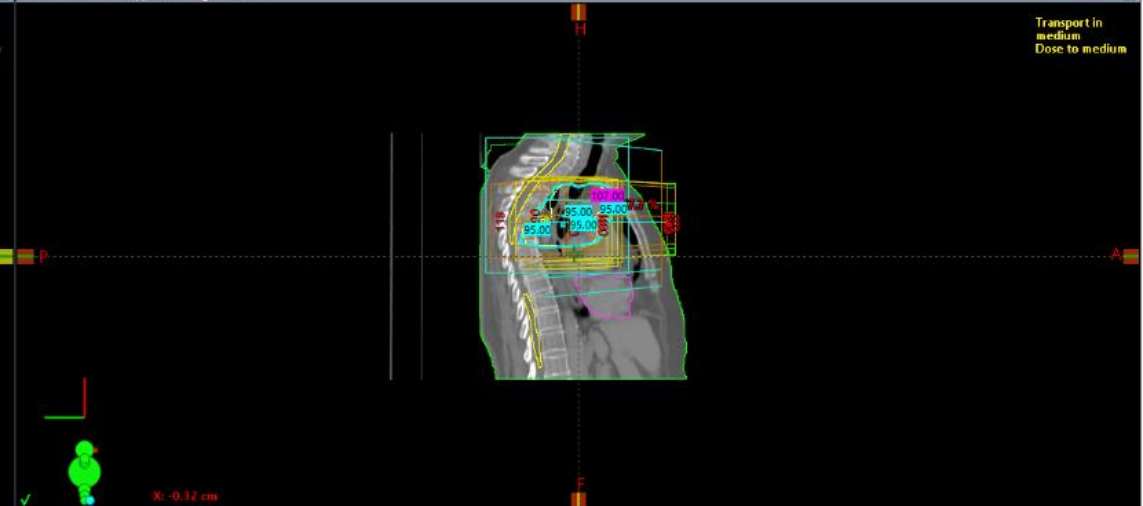
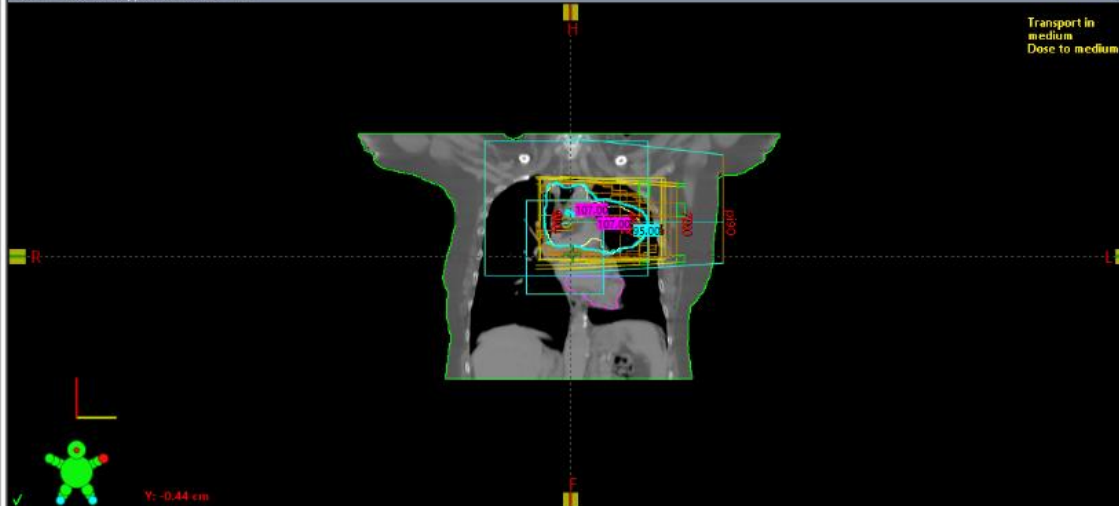
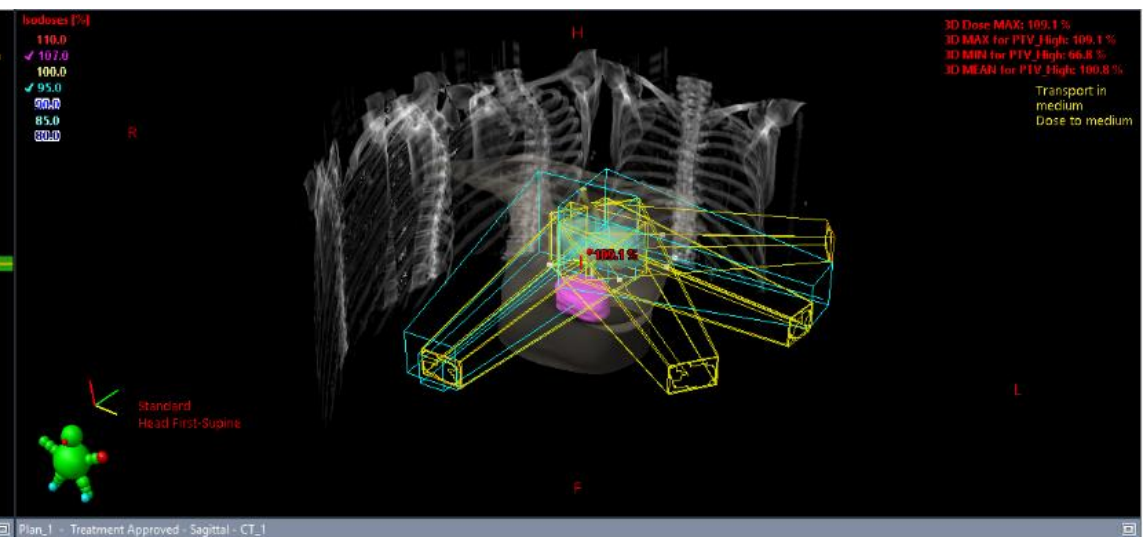
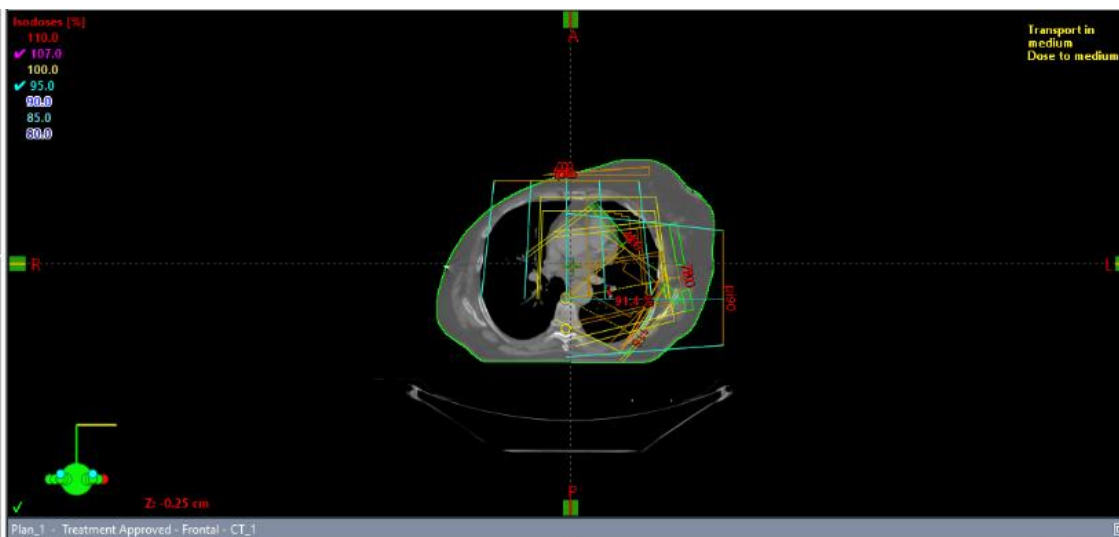
Field 5--DRR (Live)

Fields

Dose

Reference Points

Dose Statistics



Group	Field ID	Technique	Machine/Energy	MLC	Field Weight	Scale	Gantry Angle [deg]	Coll Rtn [deg]	Iso Rtn [deg]	Wedge	Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]	Calculated SSD [cm]	MU	Ref. D [cGy]
I	pi0	STATIC-I	Elekta3 - 6X		0.000	IEC61217	0.0	0.0	0.0	None	22.0	-11.0	+11.0	18.1	-7.1	+11.0	-0.85	4.05	4.09	85.8		
I	pi90	STATIC-I	Elekta3 - 6X		0.000	IEC61217	90.0	0.0	0.0	None	18.5	-11.0	+7.5	17.5	-6.5	+11.0	-0.85	4.05	4.09	80.8		
I	foto	STATIC-I	Elekta3 - 6X		0.000	IEC61217	0.0	0.0	0.0	None	10.4	-5.4	+5.0	12.6	-9.6	+3.0	-0.85	4.05	4.09	85.8		
I	48	STATIC-I	Elekta3 - 6X	Static	0.419	IEC61217	48.7	0.0	0.0	None	18.3	-7.8	+10.5	11.2	-5.5	+5.7	-0.85	4.05	4.09	81.3	38	56.8
I	48.0	STATIC-I	Elekta3 - 6X	Static	0.081	IEC61217	48.7	0.0	0.0	None	18.2	-7.3	+10.9	12.0	-6.0	+6.0	-0.85	4.05	4.09	81.3	7	11.1
I	79	STATIC-I	Elekta3 - 6X	Static	0.329	IEC61217	79.2	0.0	0.0	None	15.0	-8.8	+6.2	10.5	-5.0	+5.5	-0.85	4.05	4.09	80.1	37	56.4
I	79.0	STATIC-I	Elekta3 - 6X	Static	0.071	IEC61217	79.2	0.0	0.0	None	13.3	-8.1	+5.2	12.0	-6.0	+6.0	-0.85	4.05	4.09	80.1	8	12.6



JOVVER211203

- 1
- R 1: R0
- Plan_1

Plan_1

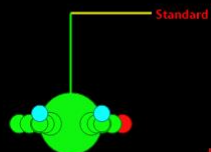
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 - CT_1
 - BODY
 - CouchInterior
 - CouchSurface
 - CTV_High
 - Esophagus
 - gtvn
 - GTVp
 - Heart
 - Lung_L
 - Lung_R
 - PTV_High
 - SpinalCord
 - User Origin
 - Reference Points
 - PTV_High
 - Dose
 - Fields
 - Isocenter Group 1
 - pi0
 - pi0-DRR (Live)
 - pi90
 - pi270-DRR (Live)
 - foto
 - foto-DRR (Live)
 - 48
 - Field 3-DRR (Live)
 - MLC
 - 48.0
 - Field3--DRR (Live)
 - MLC
 - 79
 - Field 5-DRR (Live)
 - MLC

Plan_1 - Treatment Approved - Transversal - CT_1

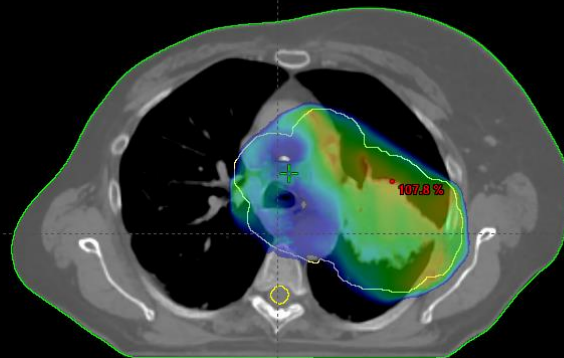
Color wash [%]



R



Standard

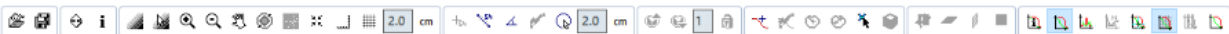
Head First-Supine
Z: 4.09 cm

3D Dose MAX: 109.1 %
3D MAX for PTV_High: 109.1 %
3D MIN for PTV_High: 66.8 %
3D MEAN for PTV_High: 100.8 %

Transport in
medium
Dose to medium

Fields Dose Reference Points Dose Statistics

Plan ID	Dose per Fraction [cGy]	Number of Fractions	Total Dose [cGy]	Treatment Percentage [%]	Target Volume	Primary Reference Point			Plan Normalization Mode	Plan Normalization Value [%]
						ID	Planned Dose per Fraction [cGy]	Planned Total Dose [cGy]		
Plan_1	200.0	32	6400.0	100.00	PTV_High	PTV_High	200.0	6400.0	95.00% covers 95.00% of Target Volume	319.5



JOVVER11203

1

1 : R0

Plan_1

Plan_1

CT_1

Registered Images

CT_1

BODY

CouchInterior

CouchSurface

CTV_High

Esophagus

gtvn

GTVp

Heart

Lung_L

Lung_R

PTV_High

SpinalCord

User Origin

Reference Points

PTV_High

Dose

Fields

Isocenter Group I

pi0

pi0-DRR (Live)

pi90

pi270-DRR (Live)

foto

foto-DRR (Live)

48

Field 3-DRR (Live)

MLC

48.0

Field3--DRR (Live)

MLC

79

Field4 5-DRR (Live)

MLC

79

Field4 5-DRR (Live)

MLC

79

Field4 5-DRR (Live)

MLC

79

Field4 5-DRR (Live)

MLC

79

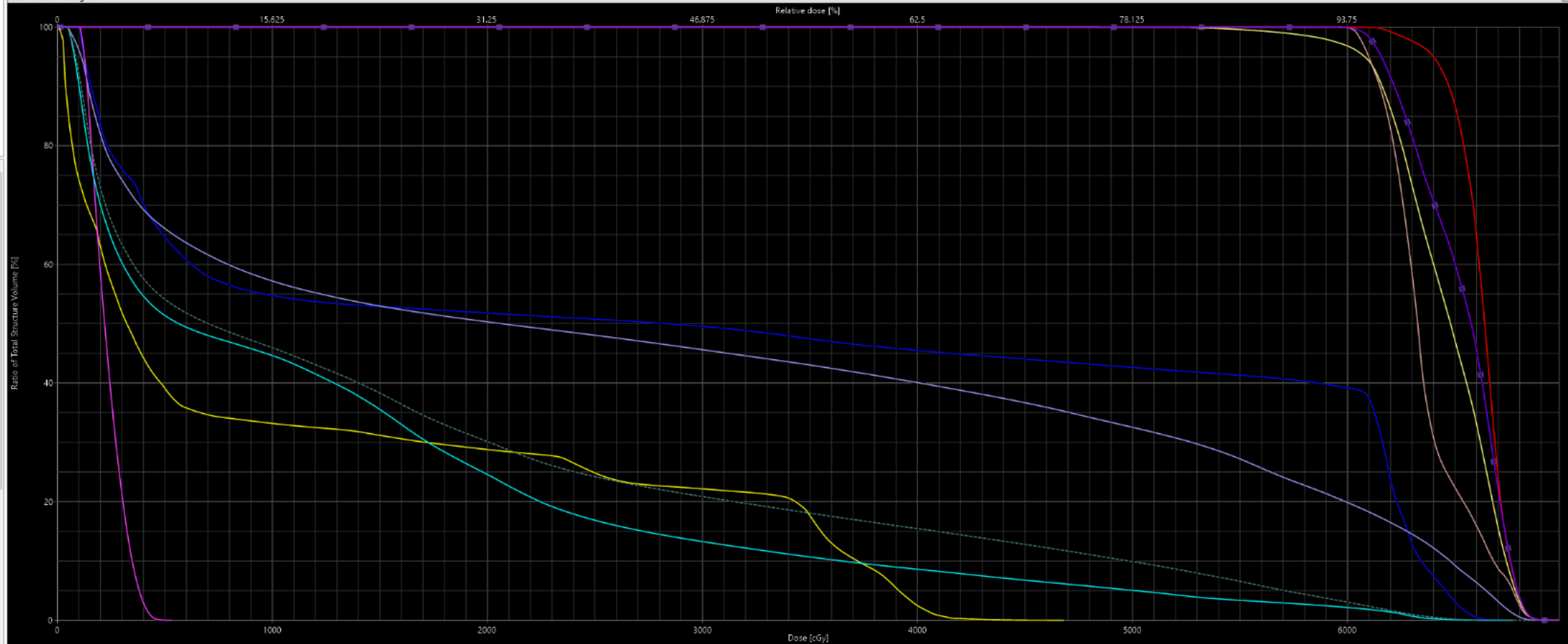
Field4 5-DRR (Live)

MLC

79

Field4 5-DRR (Live)

Dose Volume Histogram



Dose Reference Points Dose Statistics

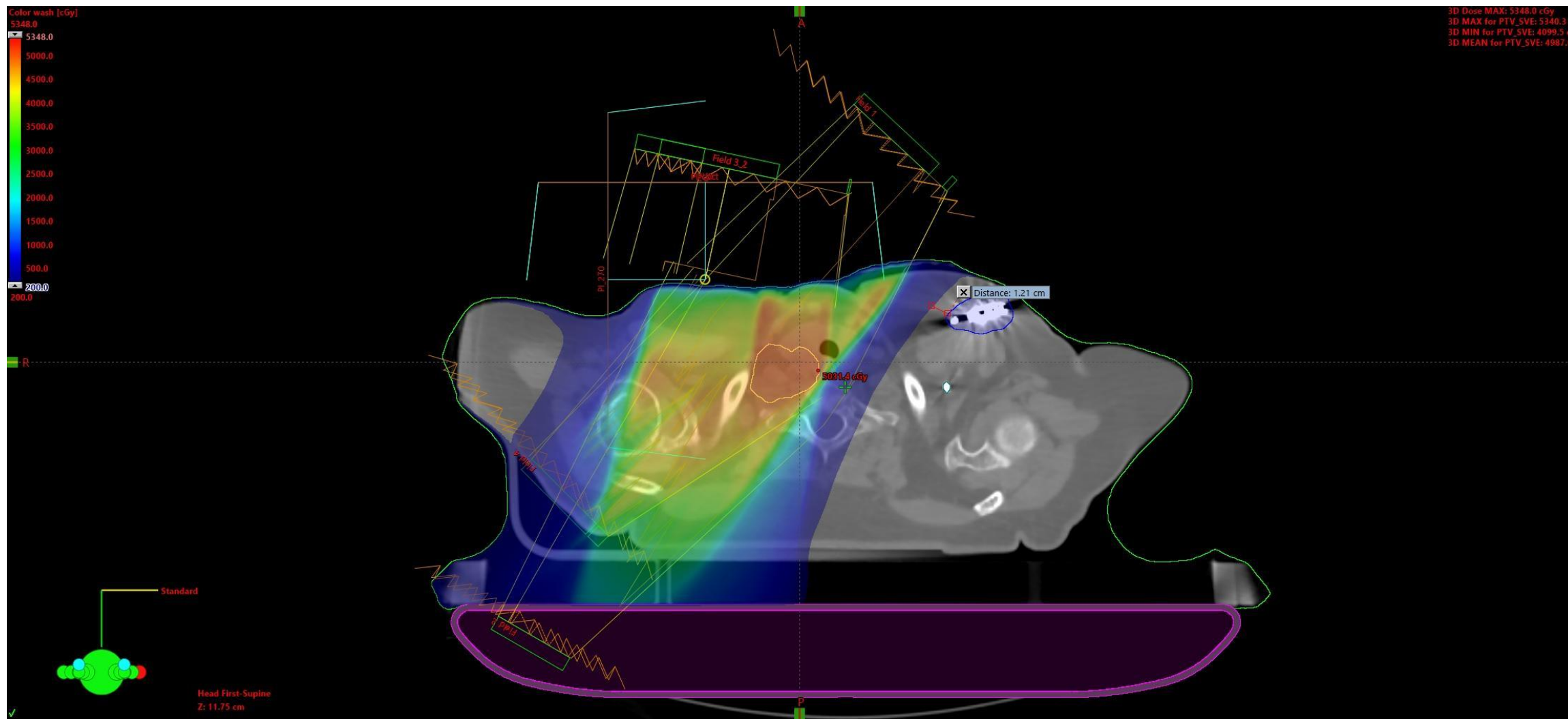
Show DVH	Structure	Approval Status	Plan	Course	Volume [cm ³]	Dose Cover [%]	Sampling Cover [%]	Min Dose [cGy]	Max Dose [cGy]	Mean Dose [cGy]	D5985.0% [%]	V95.0 [%]	V107.0 [%]	V107.0% [cm ³]	V5320.0cGy [%]	V5985.0cGy [%]	V5992.0cGy [%]	V6650.0cGy [%]
<input checked="" type="checkbox"/>	Lung_L	Approved	Plan_1	1	1720.1	100.0	100.0	35.3	6944.9	2876.0	0.0	18.6	0.1	1.3180	29.5	20.1	20.0	4.8
<input checked="" type="checkbox"/>	Lung_R	Approved	Plan_1	1	2523.3	100.0	100.0	43.2	6773.6	1331.9	0.0	1.9	0.0	0.0000	3.8	2.2	2.2	0.0
<input checked="" type="checkbox"/>	BODY	Approved	Plan_1	1	21699.8	100.0	100.2	1.0	6984.6	1137.3	0.0	4.1	0.0	6.6403	6.1	4.4	4.4	0.9
<input checked="" type="checkbox"/>	Esophagus	Approved	Plan_1	1	29.0	100.2	100.1	100.1	6723.9	3170.9	0.0	38.3	0.0	0.0000	41.8	39.3	39.3	0.1
<input checked="" type="checkbox"/>	SpinalCord	Approved	Plan_1	1	37.9	100.0	99.4	6.3	4685.6	1195.3	0.0	0.0	0.0	0.0000	0.0	0.0	0.0	0.0
<input checked="" type="checkbox"/>	Heart	Approved	Plan_1	1	363.5	100.0	100.0	101.0	535.7	232.4	0.0	0.0	0.0	0.0000	0.0	0.0	0.0	0.0
<input checked="" type="checkbox"/>	GTVp	Approved	Plan_1	1	83.5	100.0	100.0	6054.7	6944.7	6621.3	0.0	100.0	0.7	0.5707	100.0	100.0	100.0	44.8
<input checked="" type="checkbox"/>	gtvn	Approved	Plan_1	1	27.3	100.0	100.0	5954.0	6984.6	6366.0	0.0	96.5	0.6	0.1578	100.0	100.0	99.9	12.1
<input checked="" type="checkbox"/>	CTV_High	Approved	Plan_1	1	277.0	100.0	100.0	5604.9	6984.6	6523.2	0.0	99.0	0.6	1.7779	100.0	99.9	99.9	34.2
<input checked="" type="checkbox"/>	PTV_High	Approved	Plan_1	1	710.4	100.0	100.0	4273.5	6984.6	6453.5	0.0	95.0	0.6	4.2090	99.9	97.0	96.9	24.3
<input checked="" type="checkbox"/>	= (Lung_L OR Lung_R) S...	Approved	Plan_1	1	3946.6	100.0	100.0	35.3	6857.6	1619.8	1.5	1.5	1.5	1.0QNB	1.5	1.5	1.5	1.5

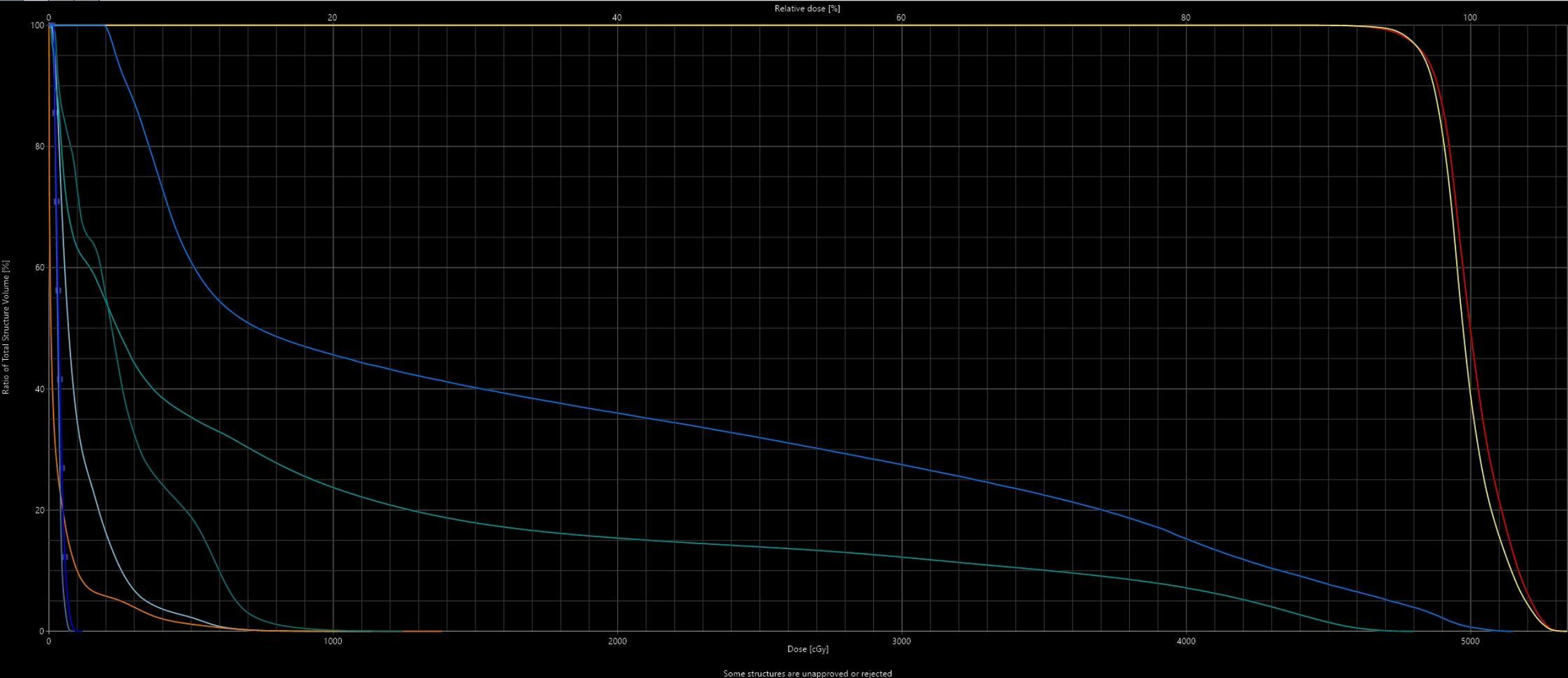
INTENSITY MODULATED RADIATION THERAPY - IMRT

- Konformalna radioterapijska tehnika – eskalacija doze na jasno definisani ciljni volumen i strm gradijent doze prema kritičnim strukturama
- Moguće je da u okviru volumena (tumora) doza varira (nije homogena), što se postiže modulacijom svakog snopa – npr simultani integrisani boost.
- Zasniva se na primeni više zračnih polja, podeljenih u segmentna polja
- Tokom svake frakcije kompjuterski kontrolisanim pomeranjem lamela MLC oblik zračnog polja se više puta sukcesivno ili kontinuirano dinamički menja



3D Dose MAX: 5348.0 cGy
3D MAX for PTV_SVE: 5340.3 cGy
3D MIN for PTV_SVE: 4099.5 cGy
3D MEAN for PTV_SVE: 4987.6 cGy





	b1A^2/E	Structure	IMRT_50Gy#	1	1013.2	100.0	100.0	1000.0	1000.0	2340.3	1081.0	2500.1	2530.2	88.8	38.1	0.0000	100.0
	b1W m1e2	Structure	IMRT_50Gy#	1	24.4	100.0	100.0	100.5	11.8	1542.3	500.0	140.8	141.5	0.0	0.0	0.0000	18.8
	Ezobymeduz	Structure	IMRT_50Gy#	1	10.2	100.0	100.0	100.0	101.0	2120.8	1110.3	1300.0	1010.0	4.0	0.1	0.0000	01.0
	b6A b1W	Structure	IMRT_50Gy#	1	41.3	100.0	100.0	88.0	12.0	118.3	31.1	13.0	12.2	0.0	0.0	0.0000	0.0
	r1ude	Structure	IMRT_50Gy#	1	5548.0	100.0	100.0	100.0	5.5	1805.3	821.8	1154.0	1120.1	0.0	0.0	0.0000	32.3
	H694	Structure	IMRT_50Gy#	1	224.1	100.0	100.0	100.0	1.2	1131.1	115.0	110.4	210.4	0.0	0.0	0.0000	5.3
	b9cewayer	Structure	IMRT_50Gy#	1	55.4	100.0	100.0	100.1	12.0	80.0	35.2	22.1	01.8	0.0	0.0	0.0000	0.0
	b1e92/L	Structure	IMRT_50Gy#	1	1102.8	100.0	100.0	100.0	0.0	1300.0	41.0	102.0	405.0	0.0	0.0	0.0000	1.5
	C1A m1e1o1e2kz	Structure	IMRT_50Gy#	1	144.4	100.0	100.0	100.0	1134.8	2340.3	2000.1	2500.1	2548.0	88.2	10.3	0.0000	100.0
show DVH	Structure	Structure	Structure	Structure	Volume [cm ³]	Dose cover [%]	Sampling cover [%]	Min dose [cGy]	Max dose [cGy]	Mean dose [cGy]	D1% cover [cGy]	D5% cover [cGy]	D10% cover [cGy]	D100% cover [cGy]	D100% cover [cm ³]	D200% cover [cGy]	
Hide	Dose	<input type="checkbox"/> Hide volume	<input type="checkbox"/> Hide structure	<input type="checkbox"/> Optimisation structure	Dose statistics	Reference points	Calculation models	Min sum									

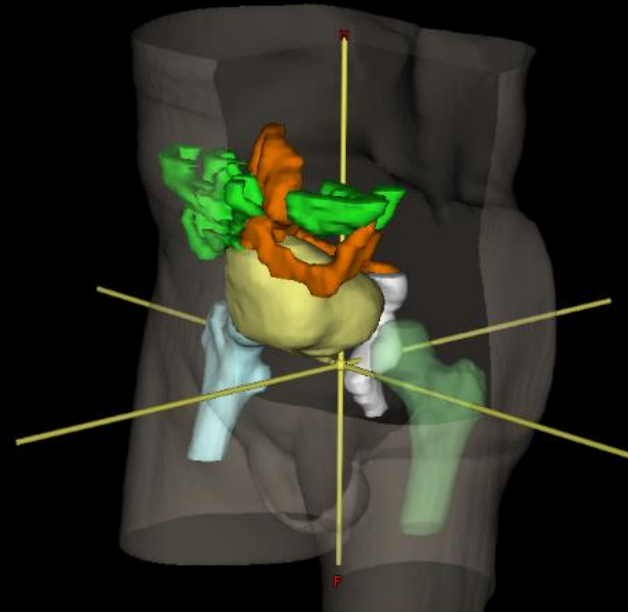
Volumetric Modulated Arc Therapy, VMAT

- Omogućava isporuku visoke doze na metu, odnosno tumor, u jednom ili pola luka.
- Obezbeđuje najveću homogenost distribucije doze.
- Doza se isporučuje na čitav ciljni volumen, a ne „slajs po slajs” kao što je to slučaj kod primene drugih tehnika.
- U poređenju sa IMRT, ima bolju pokrivenost mete i kvalitetniju zaštitu organa od rizika.
- Kraće trajanje tretmana, što direktno smanjuje mogućnost za interfrakcijsko pomeranje organa.
- Mana VMAT tehnike je ta što veći deo zdravog tkiva koji se nalazi u zračnoj regiji prima manju dozu.

Transversal - CT_1 - 4/6/2021 8:55 AM



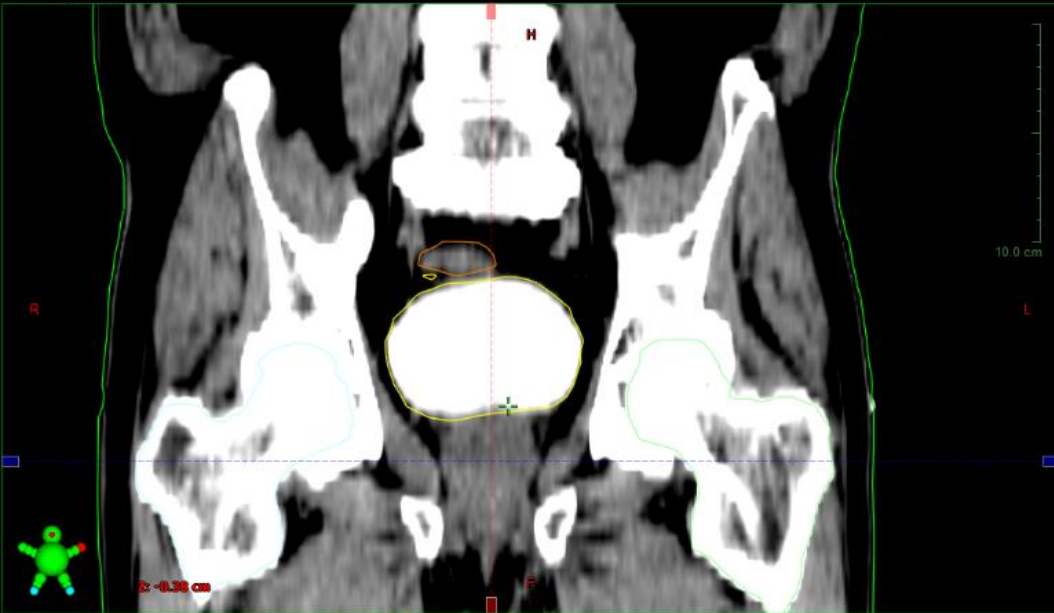
3D - CT_1 - 4/6/2021 8:55 AM



Drawing Tools

- Select Structures
- Draw Planar Contour
- Brush
- Eraser
- Draw Geometrical Shape
- Create or Edit Annotation
- Draw Volumetric Contour
- Transform Structure
- Deform Structure
- PET Subvolume Thresholding
- Image Thresholding
- Search Body
- Segmentation Wizard
- Flood Fill
- Margin for Structure
- Post Processing
- Extract Wall
- Crop Structure
- Boolean Operators
- Extend Segmentation
- Interpolate Structure
- Segment High Density Artifacts
- Clear Structure
- Move Marker or Isocenter Marker
- Edit Reference Points
- Draw Reference Line
- Calypso Beacon Detection

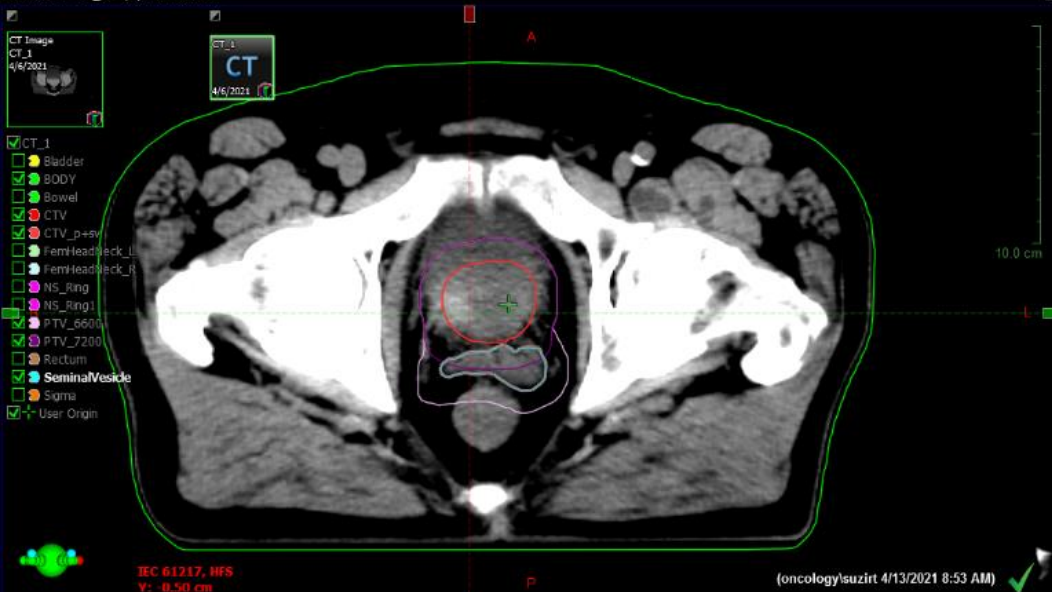
Frontal - CT_1 - 4/6/2021 8:55 AM



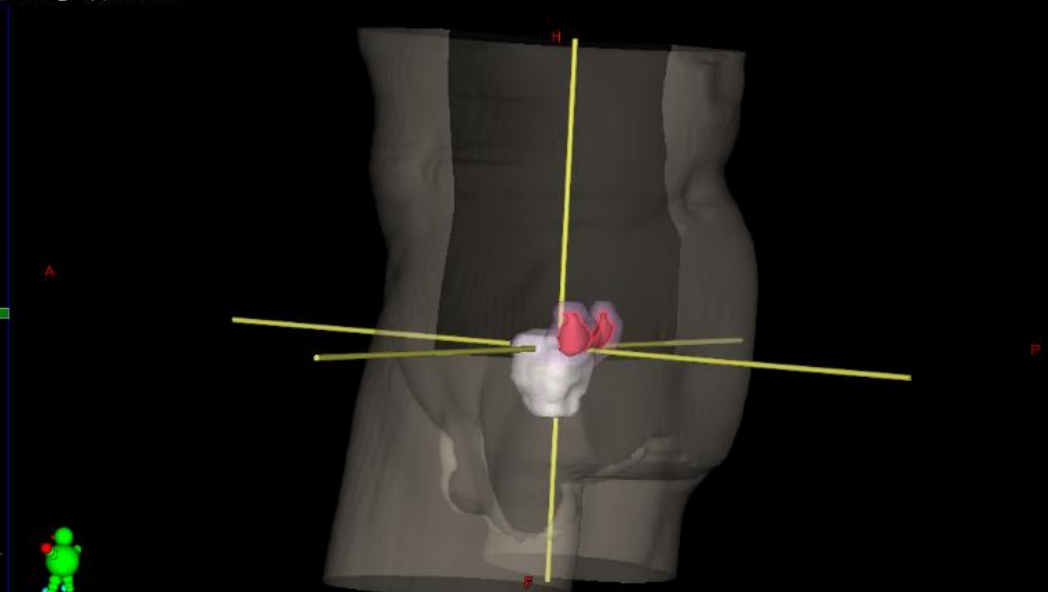
Sagittal - CT_1 - 4/6/2021 8:55 AM



Transverse - CT_1 - 4/6/2021 8:55 AM



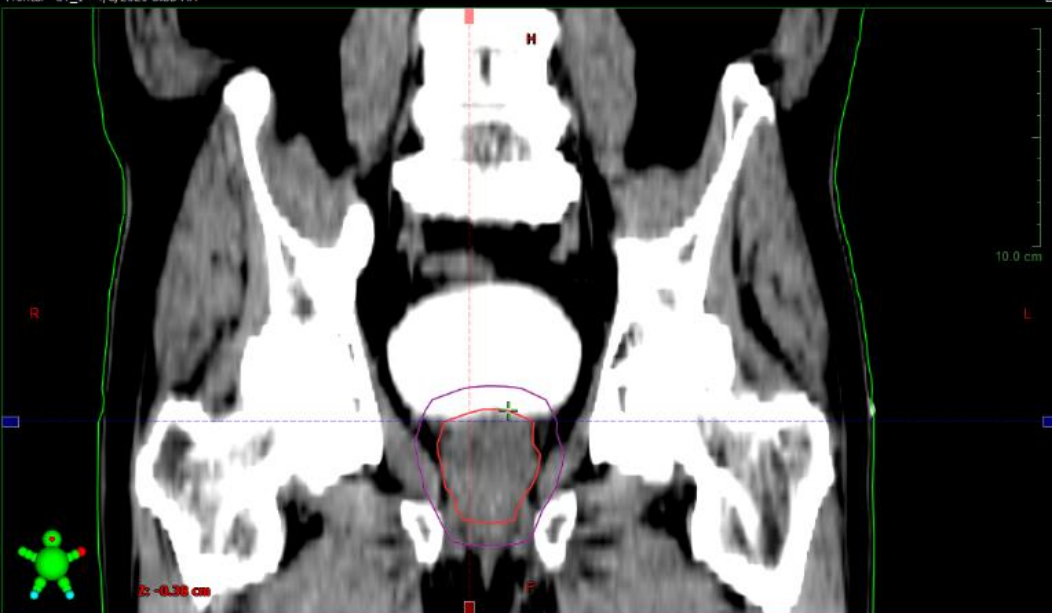
3D - CT_1 - 4/6/2021 8:55 AM



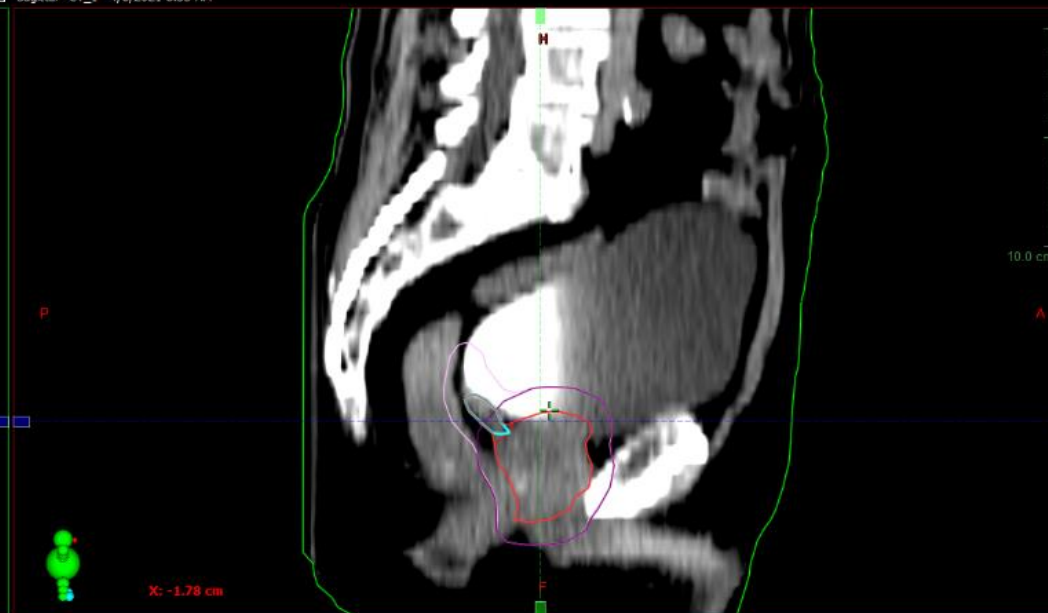
Drawing Tools

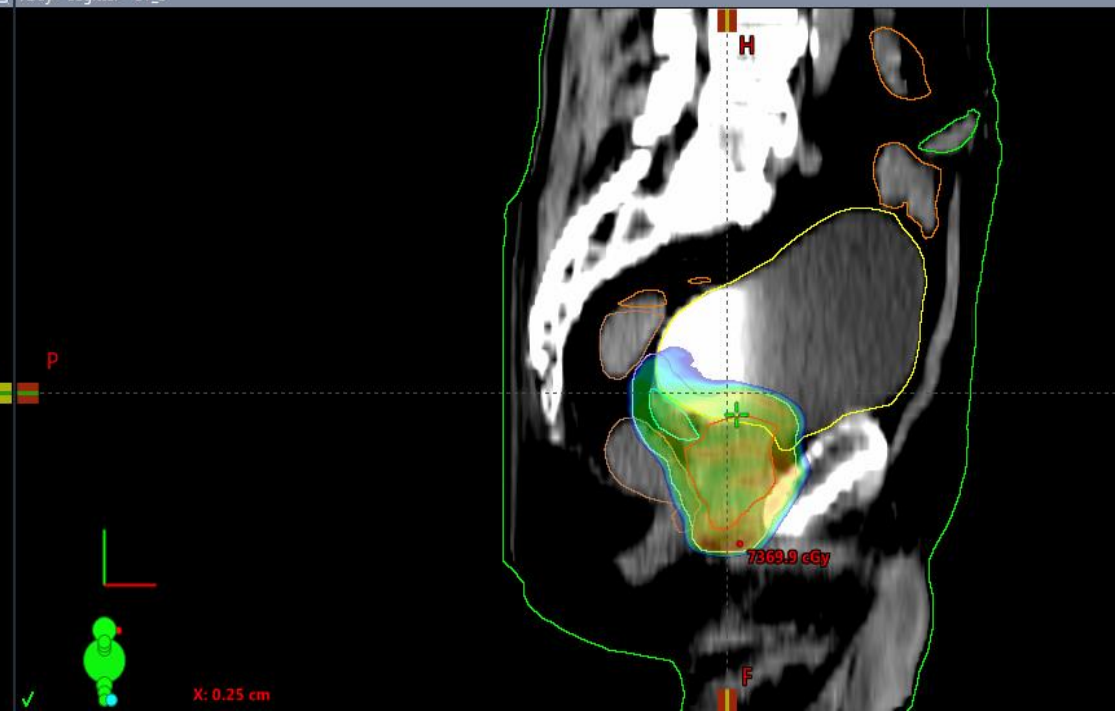
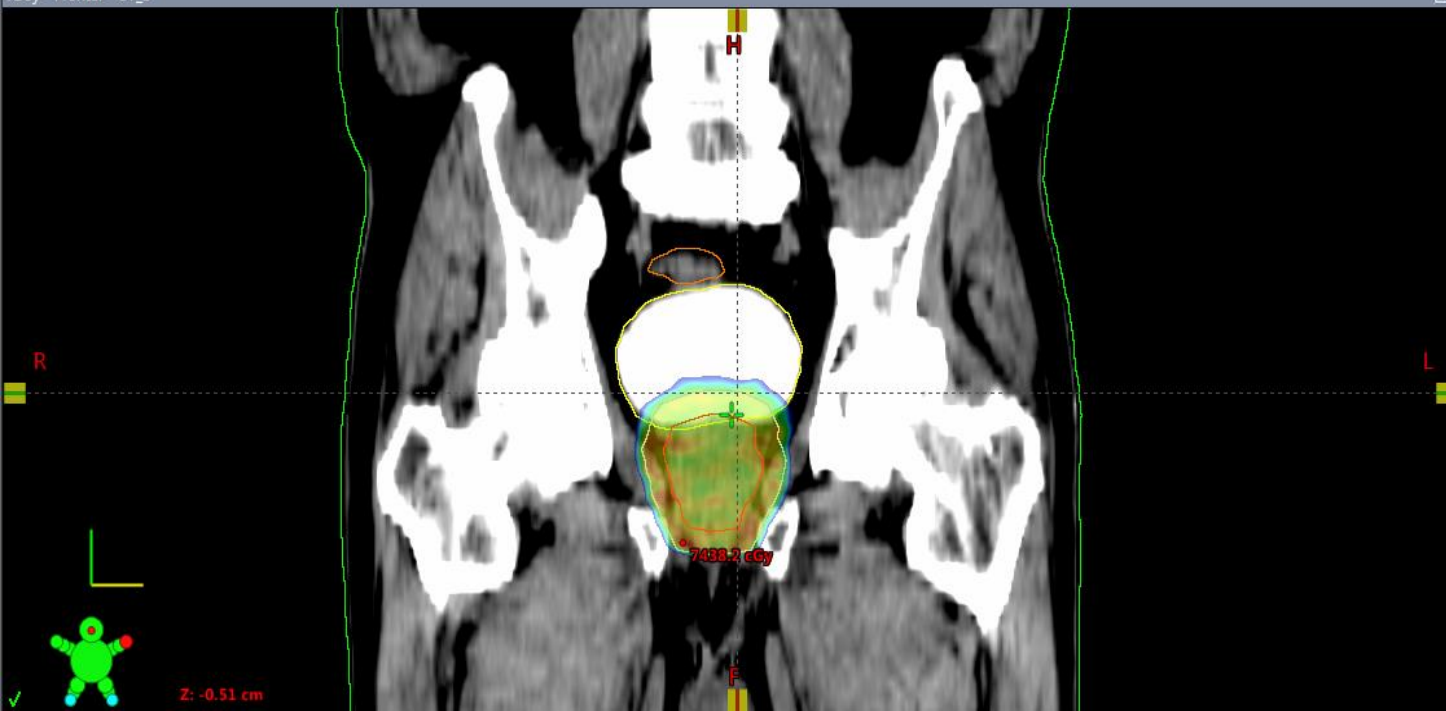
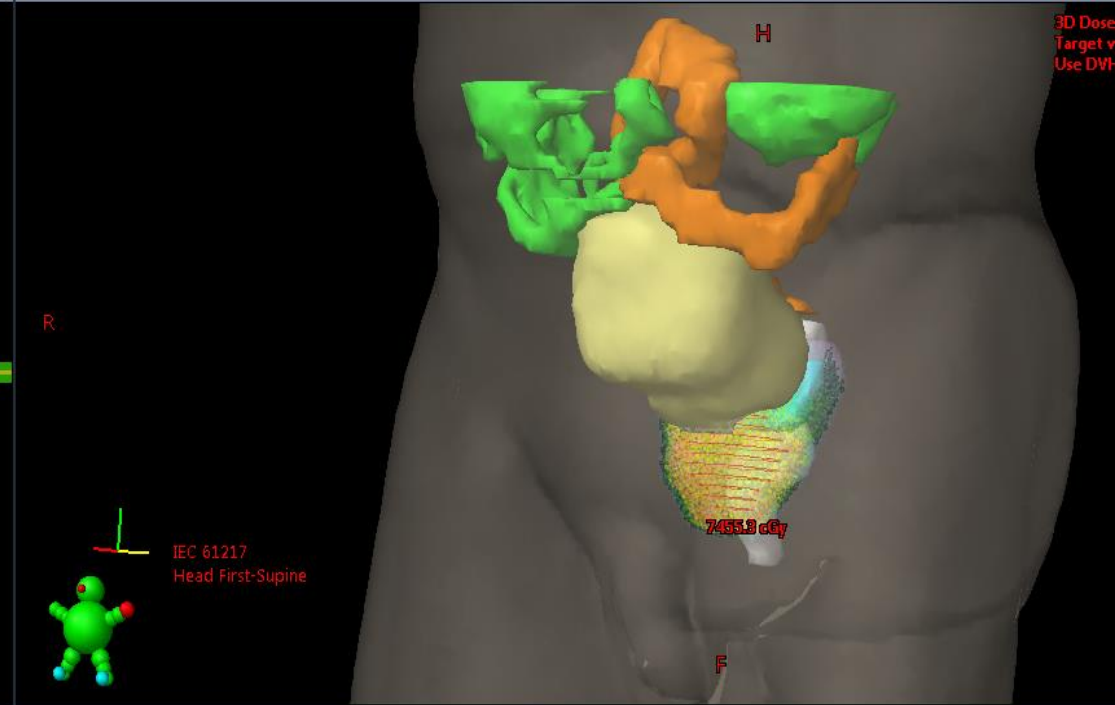
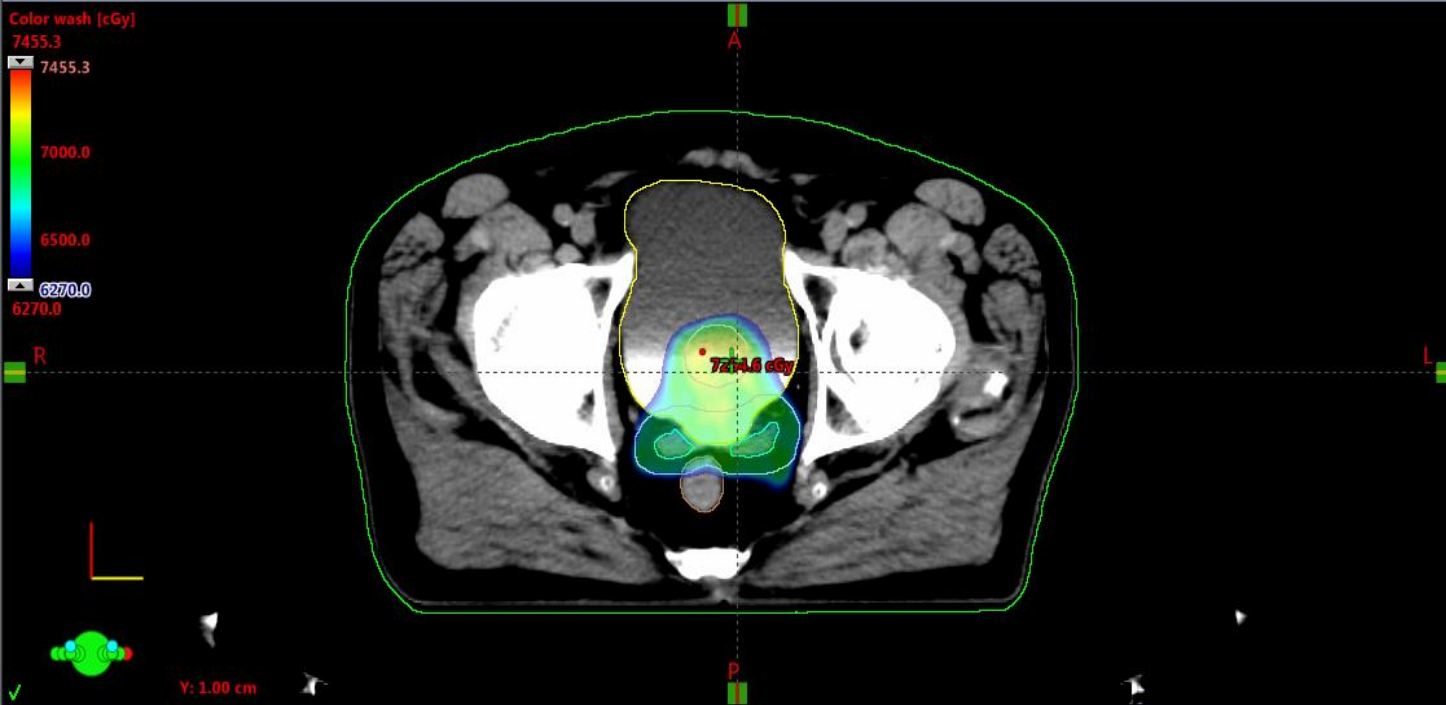
- Select Structures
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- Brush
- Eraser
- Draw Geometrical Shape
- Create or Edit Annotation
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- Transform Structure
- Deform Structure
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- Edit Reference Points
- Draw Reference Line
- Calypso Beacon Detection

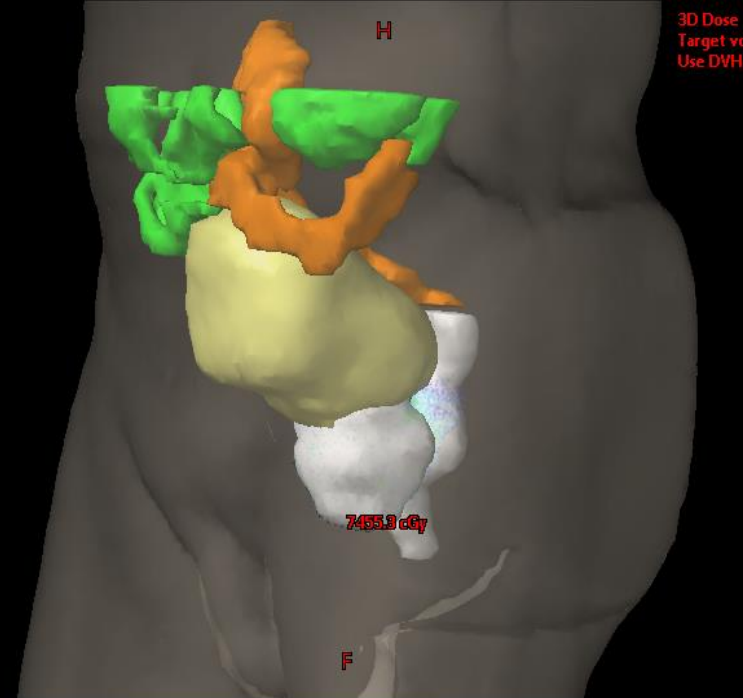
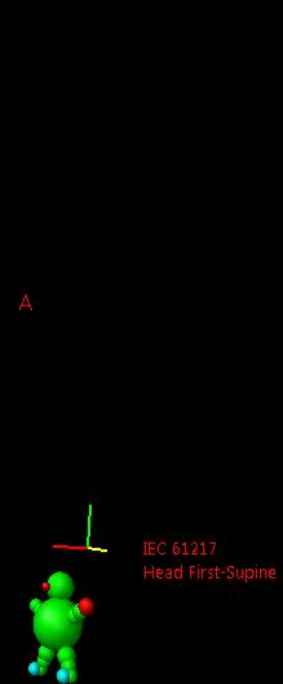
Frontal - CT_1 - 4/6/2021 8:55 AM



Sagittal - CT_1 - 4/6/2021 8:55 AM

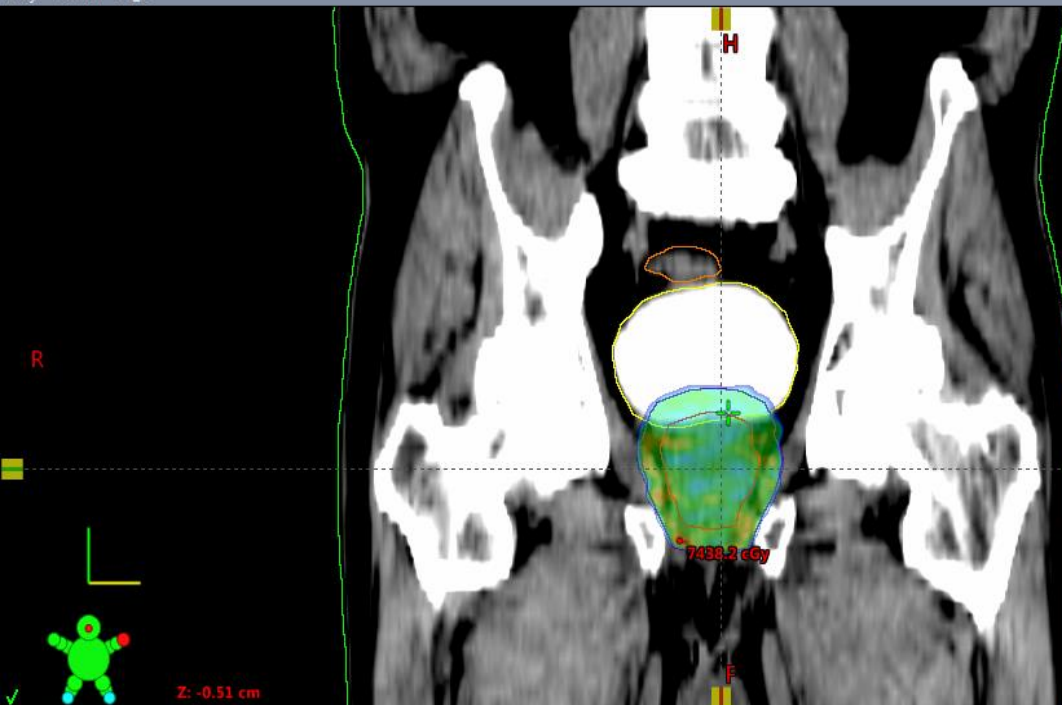


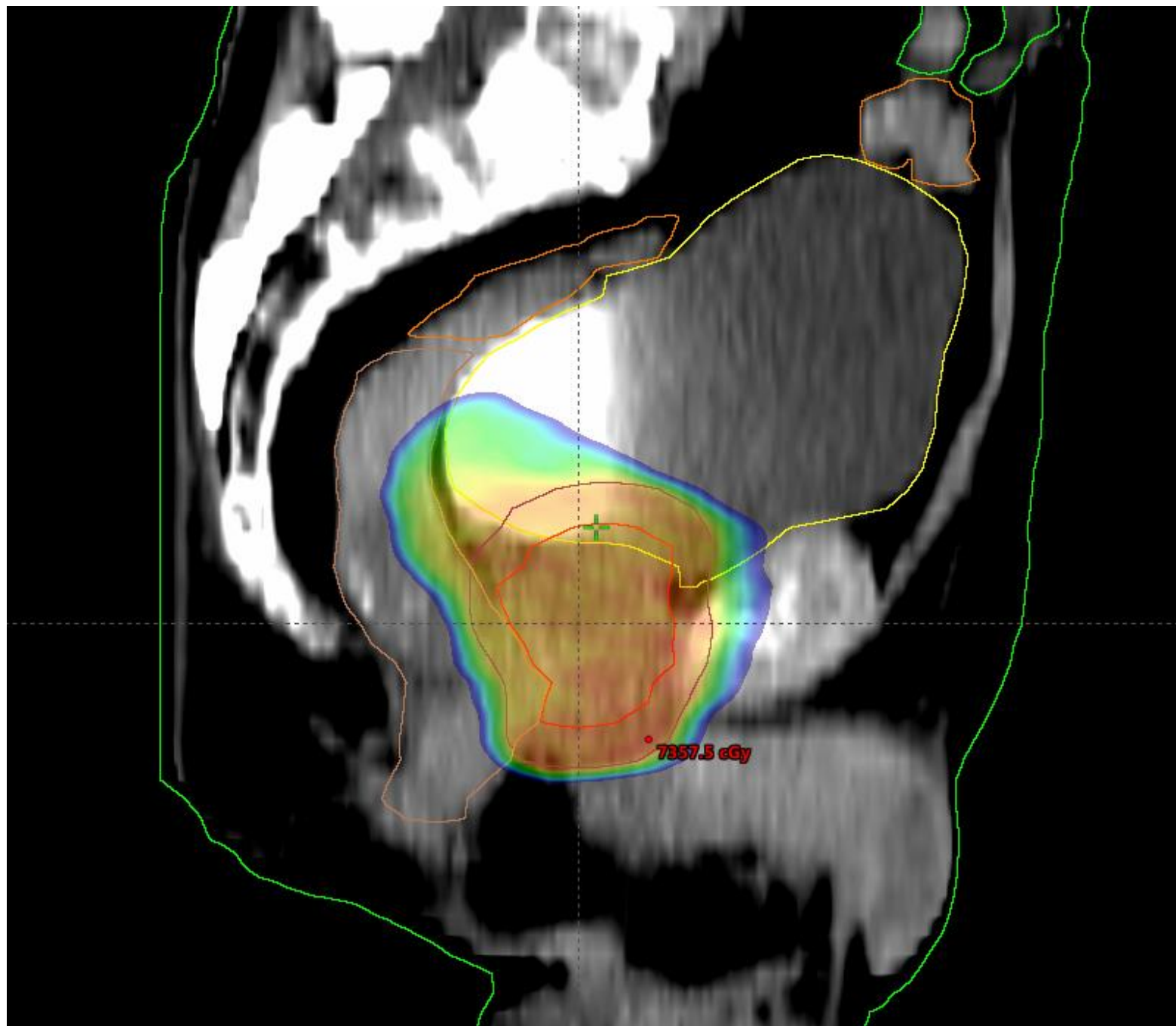




72Gy - Frontal - CT_1

72Gy - Sagittal - CT_1

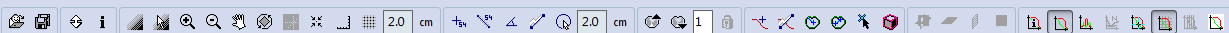




OAR constrains

Mokraćna bešika	V65 < 50% V70 < 35% V75 < 25% V80 < 15%
Sigmoidni kolon	V50 < 50% V60 < 35% V65 < 25% V70 < 20% V75 < 15%
Rektum	V50 < 50% V60 < 35% V65 < 25% V70 < 20% V75 < 15%
Creva	V45 < 195 cm ³ V15 < 120 cm ³
Femur	V40 < 40% V45 < 25% V50 < 10%

- Kang SW, Chung JB, Kim JS, Kim IA, Eom KY, Song C, Lee JW, Kim JY, Suh TS. Optimal planning strategy among various arc arrangements for prostate stereotactic body radiotherapy with volumetric modulated arc therapy technique. *Radiol Oncol.* 2017 Jan 15;51(1):112-120.

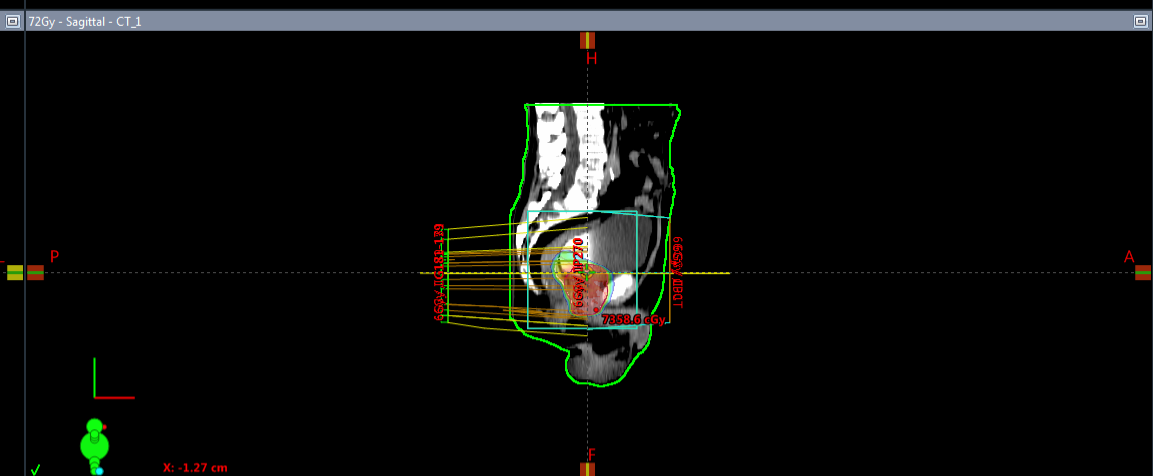
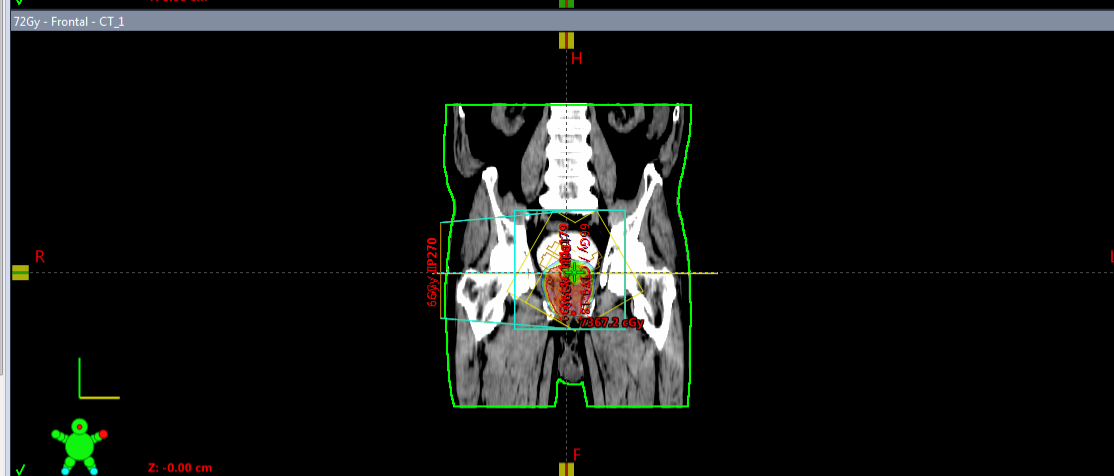
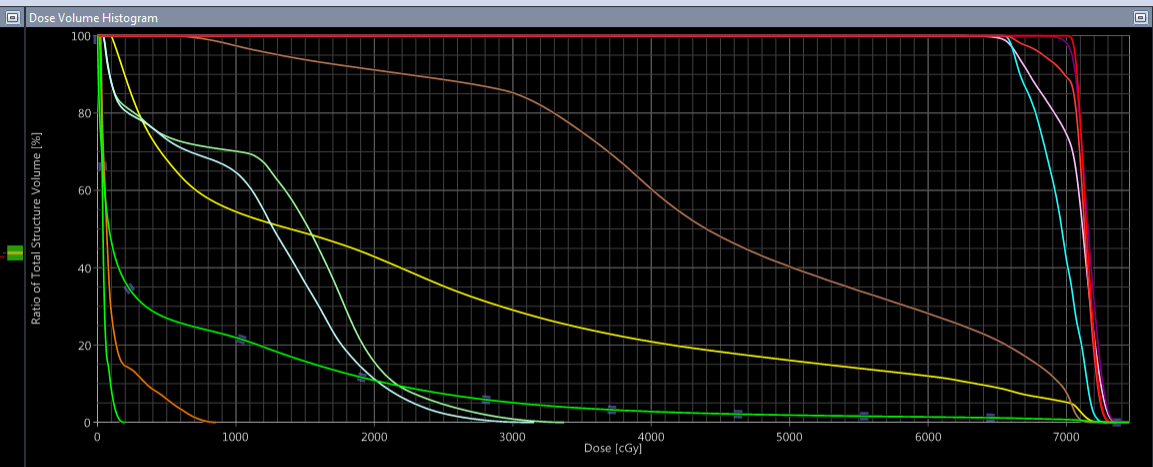
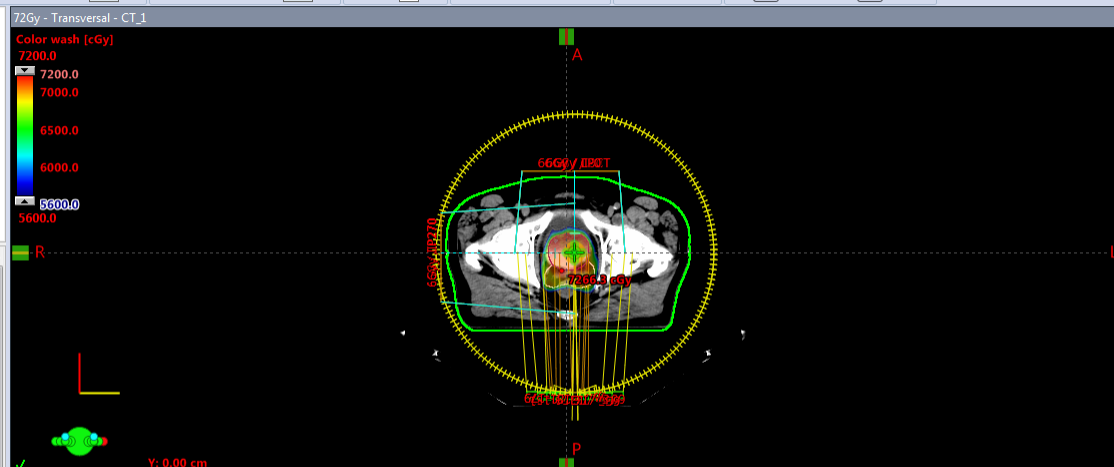


KaraVido010421

- 1
 - PD_6Gy
 - PD_66Gy
 - 72Gy
 - PTV66 : R0
 - 66Gy
 - PTV72 : R0
 - 6Gy

72Gy

- CT_1
 - Registered Images
 - CT_1
 - Bladder
 - BODY
 - Bowel
 - CTV
 - CTV_p+sv
 - FemHeadNeck_L
 - FemHeadNeck_R
 - NS_Ring
 - NS_Ring1
 - PTV_6600
 - PTV_7200
 - Rectum
 - SeminalVesicle
 - Sigma
 - User Origin
 - Reference Points
 - PTV_6600
 - PTV_7200
 - Verification
 - Verification1
 - Dose
 - 66Gy
 - Fields
 - Isocenter Group I
 - P0
 - P270
 - CBCT
 - G181-179
 - G179-181
 - 6Gy
 - Fields



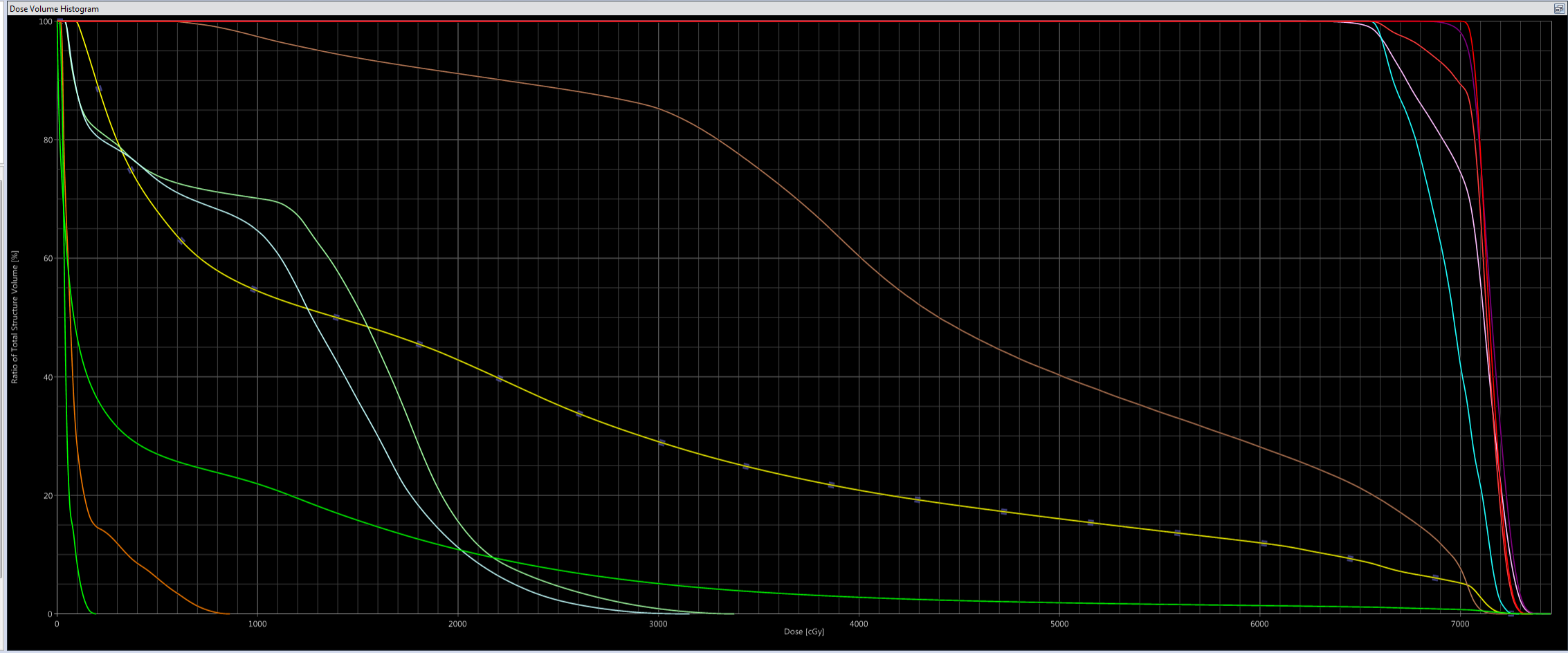
Fields	Dose	Reference Points	Dose Statistics	Plan Sum										
Show DVH	Structure	Approval Status	Plan	Course	Volume [cm ³]	Dose Cover.[%]	Sampling Cover.[%]	Min Dose [cGy]	Max Dose [cGy]	Mean Dose [cGy]				
<input checked="" type="checkbox"/>	BODY	Approved	72Gy	1	28289.4	100.0	100.0	100.1	0.0	7455.3	641.7			
<input checked="" type="checkbox"/>	Bladder	Approved	72Gy	1	709.0	100.0	100.0	100.0	91.5	7365.6	2229.9			
<input checked="" type="checkbox"/>	Bowel	Approved	72Gy	1	202.4	100.0	100.0	100.0	11.0	198.3	48.2			
<input checked="" type="checkbox"/>	CTV	Approved	72Gy	1	62.0	100.0	100.0	100.0	6992.7	7351.4	7149.1			
<input checked="" type="checkbox"/>	CTV_p+sv	Approved	72Gy	1	77.4	100.0	100.0	100.0	6534.5	7351.4	7110.4			
<input checked="" type="checkbox"/>	FemHeadNeck_L	Approved	72Gy	1	292.8	100.0	100.0	100.0	36.1	3381.7	1311.8			
<input checked="" type="checkbox"/>	FemHeadNeck_R	Approved	72Gy	1	289.6	100.0	100.0	100.0	38.2	3156.0	1155.8			
<input checked="" type="checkbox"/>	NS_Ring	Approved	72Gy	1										
<input checked="" type="checkbox"/>	NS_Ring1	Approved	72Gy	1	2500.9	100.0	100.0	100.0	128.5	7271.6	2781.2			
<input checked="" type="checkbox"/>	PTV_6600	Approved	72Gy	1	261.1	100.0	100.0	100.0	6007.9	7455.3	7059.8			
<input checked="" type="checkbox"/>	PTV_7200	Approved	72Gy	1	184.7	100.0	100.0	100.0	6732.3	7455.3	7158.5			
<input checked="" type="checkbox"/>	Rectum	Approved	72Gy	1	88.7	100.0	100.0	100.0	548.2	7236.5	4599.9			
<input checked="" type="checkbox"/>	SeminalVesicle	Approved	72Gy	1	14.2	100.0	100.0	100.1	6534.5	7294.2	6939.7			
<input checked="" type="checkbox"/>	Sigma	Approved	72Gy	1	197.3	100.0	100.0	100.0	17.3	865.8	123.2			

KaraVido010421

- 1
 - PD_6Gy
 - PD_66Gy
 - 72Gy
 - PTV66 : R0
 - 66Gy
 - PTV72 : R0
 - 6Gy

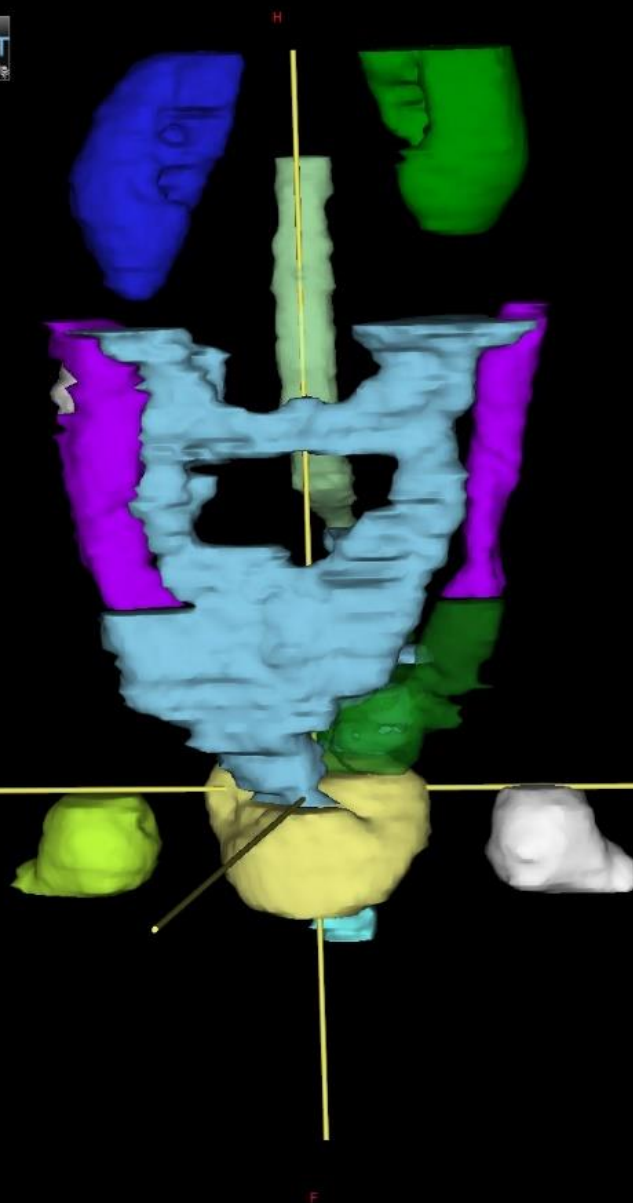
72Gy

- CT_1
 - Registered Images
 - CT_1
 - Bladder
 - BODY
 - Bowel
 - CTV
 - CTV_p+sv
 - FemHeadNeck_L
 - FemHeadNeck_R
 - NS_Ring
 - NS_Ring1
 - PTV_6600
 - PTV_7200
 - Rectum
 - SeminalVesicle
 - Sigma
 - User Origin
 - Reference Points
 - PTV_6600
 - PTV_7200
 - Verification
 - Verification1
 - Dose
 - 66Gy
 - Fields
 - Isocenter Group I
 - P0
 - P270
 - CBCT
 - G181-179
 - G179-181
 - 6Gy
 - Fields



Dose	Reference Points	Dose Statistics									
Show DVH	Structure	Approval Status	Plan	Course	Volume [cm ³]	Dose Cover. [%]	Sampling Cover. [%]	Min Dose [cGy]	Max Dose [cGy]	Mean Dose [cGy]	
<input checked="" type="checkbox"/>	BODY	Approved	72Gy	1	28289.4	100.0	100.1	0.0	7455.3	641.7	
<input checked="" type="checkbox"/>	Bladder	Approved	72Gy	1	709.0	100.0	100.0	91.5	7365.6	2229.9	
<input checked="" type="checkbox"/>	Bowel	Approved	72Gy	1	202.4	100.0	100.0	11.0	198.3	48.2	
<input checked="" type="checkbox"/>	CTV	Approved	72Gy	1	62.0	100.0	100.0	6992.7	7351.4	7149.1	
<input checked="" type="checkbox"/>	CTV_p+sv	Approved	72Gy	1	77.4	100.0	100.0	6534.5	7351.4	7110.4	
<input checked="" type="checkbox"/>	FemHeadNeck_L	Approved	72Gy	1	292.8	100.0	100.0	36.1	3381.7	1311.8	
<input checked="" type="checkbox"/>	FemHeadNeck_R	Approved	72Gy	1	289.6	100.0	100.0	38.2	3156.0	1155.8	
<input checked="" type="checkbox"/>	NS_Ring	Approved	72Gy	1							
<input checked="" type="checkbox"/>	NS_Ring1	Approved	72Gy	1	2500.9	100.0	100.0	128.5	7271.6	2781.2	
<input checked="" type="checkbox"/>	PTV_6600	Approved	72Gy	1	261.1	100.0	100.0	6007.9	7455.3	7059.8	
<input checked="" type="checkbox"/>	PTV_7200	Approved	72Gy	1	184.7	100.0	100.0	6732.3	7455.3	7158.5	
<input checked="" type="checkbox"/>	Rectum	Approved	72Gy	1	88.7	100.0	100.0	548.2	7236.5	4599.9	
<input checked="" type="checkbox"/>	SeminalVesicle	Approved	72Gy	1	14.2	100.0	100.1	6534.5	7294.2	6939.7	
<input checked="" type="checkbox"/>	Sigma	Approved	72Gy	1	197.3	100.0	100.0	17.3	865.8	123.2	

3D - CT_VadLoc2 - 3/11/2019 9:16 AM



Drawing Tools

Select Structures

- Draw Planar Contour
- Brush
- Eraser
- Draw Geometrical Shape
- Create or Edit Annotation
- Draw Volumetric Contour
- Transform Structure
- Deform Structure

PET Subvolume Thresholding

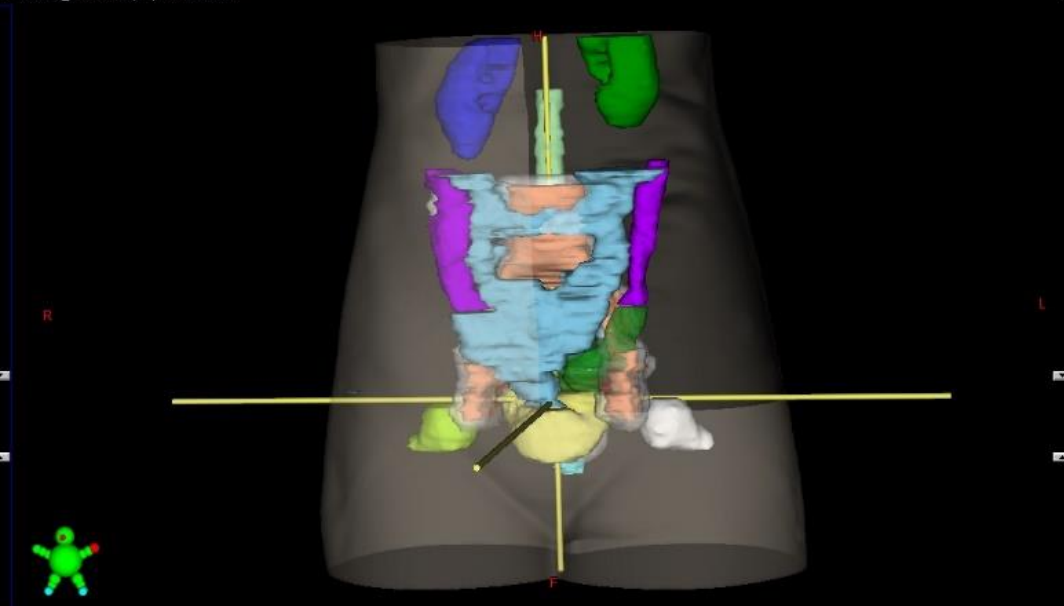
- Image Thresholding
- Search Body
- Segmentation Wizard
- Flood Fill
- Margin for Structure
- Post Processing
- Extract Wall
- Crop Structure
- Boolean Operators
- Extend Segmentation
- Interpolate Structure
- Segment High Density Artifacts
- Clear Structure

- Move Marker or Isocenter Marker
- Edit Reference Points
- Draw Reference Line
- Calypso Beacon Detection

Transversal - CT_VadLoc2 - 3/11/2019 9:16 AM



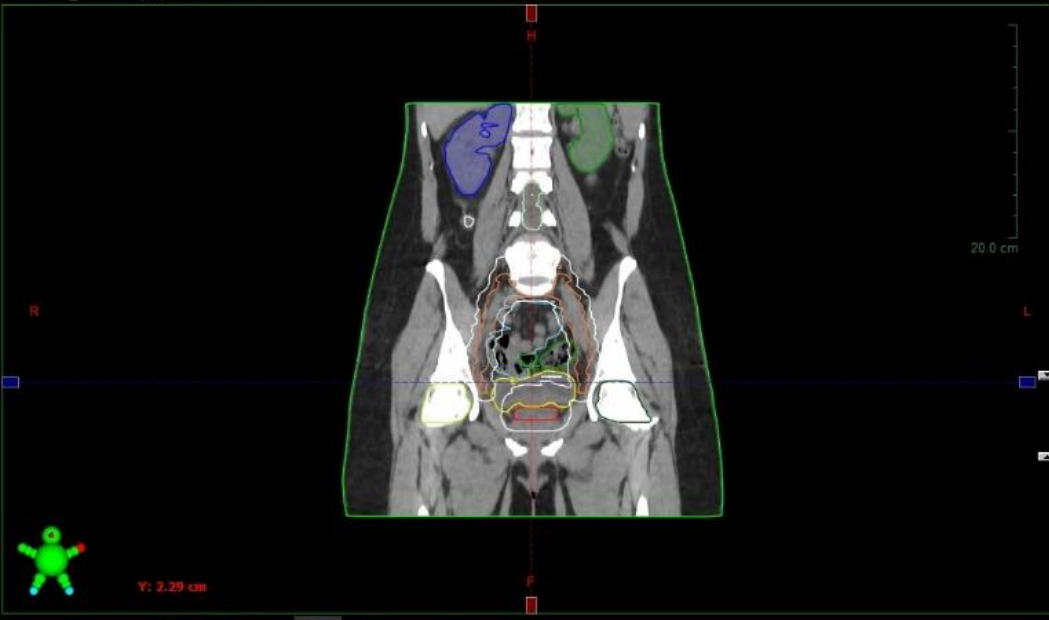
3D - CT_VadLoc2 - 3/11/2019 9:16 AM



Drawing Tools

- Select Structures
- Draw Planar Contour
- Brush
- Eraser
- Draw Geometrical Shape
- Create or Edit Annotation
- Draw Volumetric Contour
- Transform Structure
- Deform Structure
- PET Subvolume Thresholding
- Image Thresholding
- Search Body
- Segmentation Wizard
- Flood Fill
- Margin for Structure
- Post Processing
- Extract Wall
- Crop Structure
- Boolean Operators
- Extend Segmentation
- Interpolate Structure
- Segment High Density Artifacts
- Clear Structure
- Move Marker or Isocenter Marker
- Edit Reference Points
- Draw Reference Line
- Calypso Beacon Detection

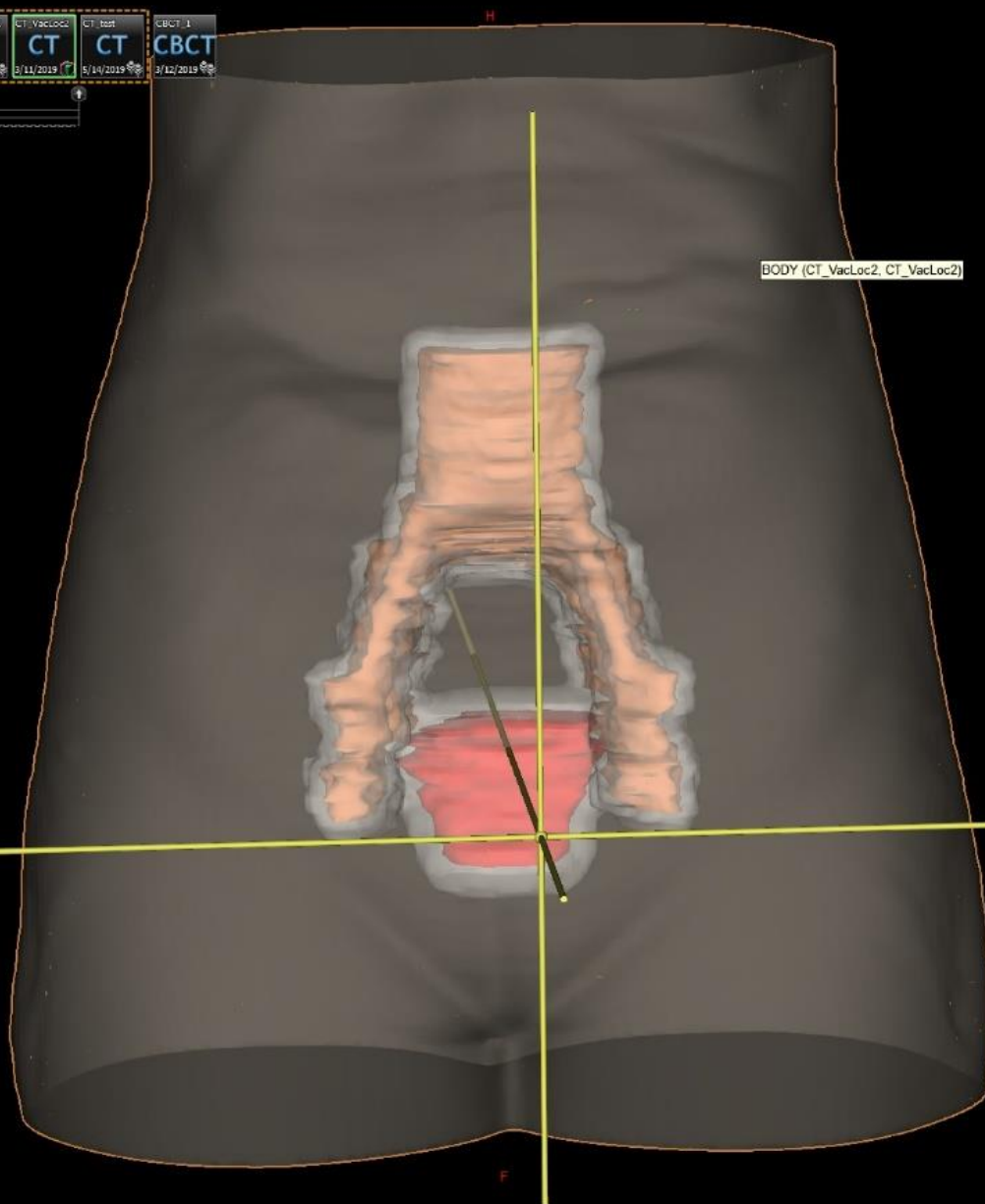
Frontal - CT_VadLoc2 - 3/11/2019 9:16 AM



Sagittal - CT_VadLoc2 - 3/11/2019 9:16 AM



3D - CT_VacLoc2 - 3/11/2019 9:16 AM



Drawing Tools

Select Structures

- Draw Planar Contour
- Brush
- Eraser
- Draw Geometrical Shape
- Create or Edit Annotation
- Draw Volumetric Contour
- Transform Structure
- Deform Structure

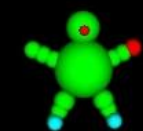
PET Subvolume Thresholding

Image Thresholding

- Search Body
- Segmentation Wizard
- Flood Fill
- Margin for Structure
- Post Processing
- Extract Wall
- Crop Structure
- Boolean Operators
- Extend Segmentation
- Interpolate Structure
- Segment High Density Artifacts
- Clear Structure

Move Marker or Isocenter Marker

- Edit Reference Points
- Draw Reference Line
- Calypso Beacon Detection





TRIIVA190225

C

PI1RA

PI1RA

CT_VacLoc2

Registered Images

CT_VacLoc2

Bladder

Colon

CouchInterior

CouchSurface

CTV_High

CTV_Intermediate

FemoralJoint_L

FemoralJoint_R

Kidney_L

Kidney_R

PTV def

Rectum

seroma

SmallBowel

SpinalCord

sygma

User Origin

Reference Points

PTV def

Dose

Fields

Isocenter Group 1

pi270

pi270-DRR (Live)

pi0

pi0-DRR (Live)

piCBCT

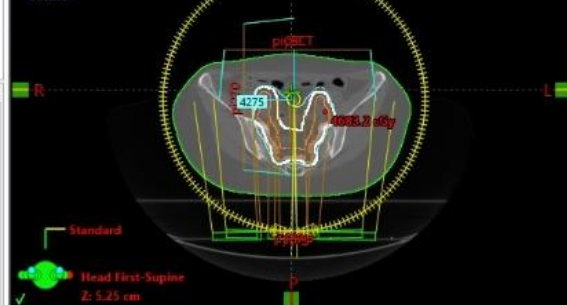
piCBCT-DRR (Live)

Field 2

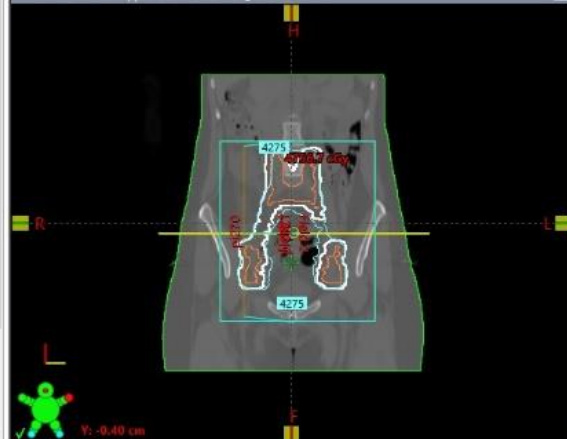
PI1RA - Treatment Approved - Transversal - CT_VacLoc2

Isodoses [cGy]
✓ 4815.0
4725.0
4500.0
4275.0
4050.0
✓ 4275.0
3800.0

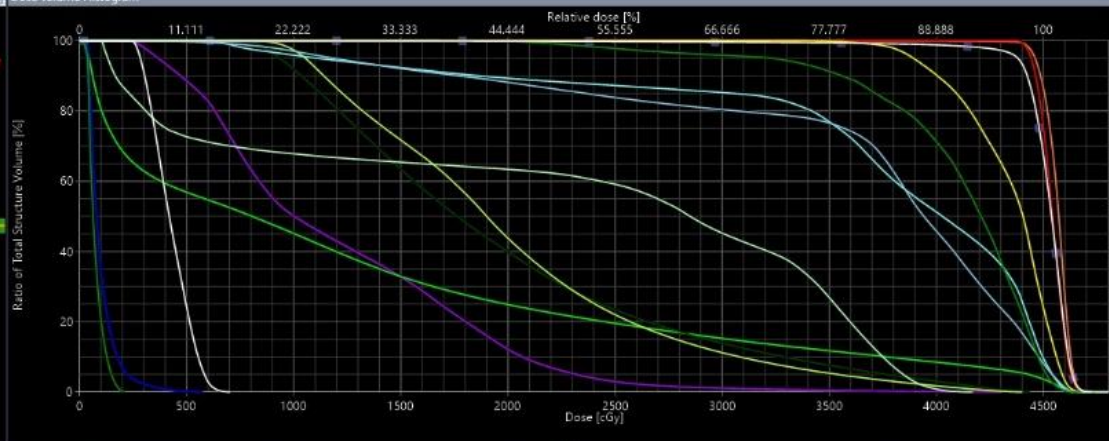
3D Dose MAX: 4808.1 cGy
3D MAX for PTV def: 4808.1 cGy
3D MIN for PTV def: 1332.0 cGy
3D MEAN for PTV def: 4512.3 cGy



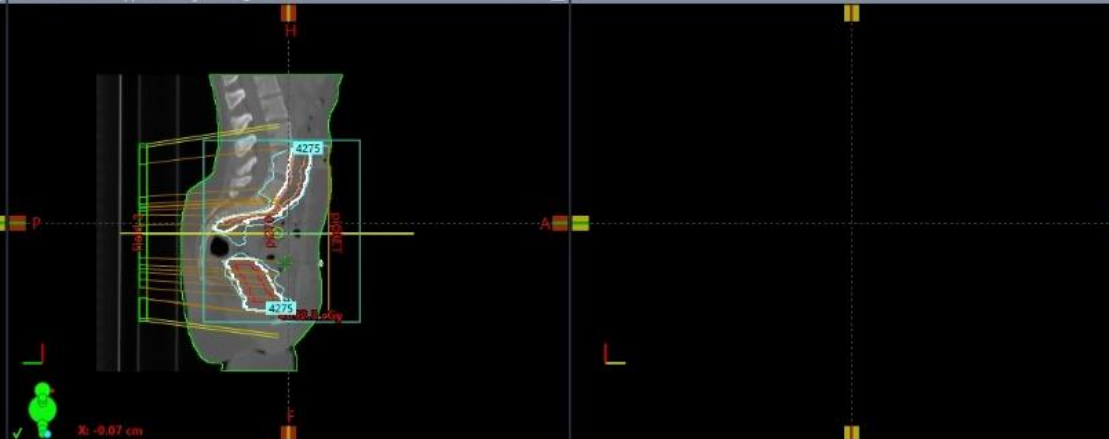
PI1RA - Treatment Approved - Frontal - CT_VacLoc2



Dose Volume Histogram



PI1RA - Treatment Approved - Sagittal - CT_VacLoc2



Fields Dose Reference Points Dose Statistics

Structure	Approval Status	Plan	Course	Volume [cm³]	Dose Cover [%]	Sampling Cover [%]	Min Dose [cGy]	Max Dose [cGy]	Mean Dose [cGy]
CTV_Intermediate	Approved	PI1RA	C	257.2	100.0	100.0	3499.8	4723.9	4562.7
CTV_High	Approved	PI1RA	C	57.0	100.0	100.0	4363.2	4731.2	4539.7
Colon	Approved	PI1RA	C	69.0	100.0	100.0	211.2	4309.5	1195.4
Bladder	Approved	PI1RA	C	81.7	100.0	100.0	3278.2	4724.5	4334.9
BODY	Approved	PI1RA	C	17716.9	100.0	100.0	9.6	4808.1	1294.2
FemoralJoint_L	Approved	PI1RA	C	42.5	100.0	100.0	759.6	4437.9	1966.9
FemoralJoint_R	Approved	PI1RA	C	43.1	100.0	100.0	782.3	4402.4	2012.0
Kidney_R	Approved	PI1RA	C	114.4	100.0	100.0	99.8	582.2	99.5
Rectum	Approved	PI1RA	C	36.1	100.0	100.0	592.7	4641.3	3706.6
SmallBowel	Approved	PI1RA	C	335.8	100.0	100.0	0.0	4703.3	3616.6
SpinalCord	Approved	PI1RA	C	34.3	100.0	100.0	102.2	4168.7	2252.3
sygma	Approved	PI1RA	C	117.9	100.0	100.0	1901.5	4677.4	4082.4
Kidney_L	Approved	PI1RA	C	84.7	100.0	100.0	99.8	216.8	74.0
seroma	Approved	PI1RA	C	37.1	100.0	100.0	242.5	707.5	425.2
PTV def	Approved	PI1RA	C	880.1	100.0	100.0	1332.0	4808.1	4512.3

Ready

User: dr Neda Milosavljevic

Group: Oncologist

Site: Main

CAP NUM: SCRL

1:05 PM

5/8/2020

Dose		Reference Points		Dose Statistics							
Show DVH	Structure	Approval Status	Plan	Course	Volume [cm³]	Dose Cover [%]	Sampling Cover [%]	Min Dose [%]	Max Dose [%]	Mean Dose [%]	
<input checked="" type="checkbox"/>	CTV_Intermediate	Approved	PI1RA	C	257.2	100.0	100.0	77.8	105.0	101.4	
<input checked="" type="checkbox"/>	CTV_High	Approved	PI1RA	C	57.0	100.0	100.0	97.0	105.1	100.9	
<input checked="" type="checkbox"/>	Colon	Approved	PI1RA	C	69.0	100.0	100.1	4.7	95.8	26.6	
<input checked="" type="checkbox"/>	Bladder	Approved	PI1RA	C	81.7	100.0	100.0	72.8	105.0	96.3	
<input checked="" type="checkbox"/>	BODY	Approved	PI1RA	C	17716.9	100.0	100.0	0.2	106.8	28.8	
<input checked="" type="checkbox"/>	FemoralJoint_L	Approved	PI1RA	C	42.5	100.0	100.0	16.9	98.6	43.7	
<input checked="" type="checkbox"/>	FemoralJoint_R	Approved	PI1RA	C	43.1	100.0	100.0	17.4	97.8	44.7	
<input checked="" type="checkbox"/>	Kidney_R	Approved	PI1RA	C	114.4	100.0	99.8	0.4	12.9	2.2	
<input checked="" type="checkbox"/>	Rectum	Approved	PI1RA	C	36.1	100.0	100.0	13.2	103.1	82.4	
<input checked="" type="checkbox"/>	SmallBowel	Approved	PI1RA	C	335.8	100.0	100.1	0.0	104.5	80.4	
<input checked="" type="checkbox"/>	SpinalCord	Approved	PI1RA	C	34.3	100.0	100.1	2.3	92.6	50.1	
<input checked="" type="checkbox"/>	Sigma	Approved	PI1RA	C	117.9	100.0	100.0	42.3	103.9	90.7	
<input checked="" type="checkbox"/>	Kidney_L	Approved	PI1RA	C	84.7	100.0	99.8	0.4	4.8	1.6	
<input checked="" type="checkbox"/>	Seroma	Approved	PI1RA	C	37.1	100.0	100.0	5.4	15.7	9.4	
<input checked="" type="checkbox"/>	PTV_def	Approved	PI1RA	C	880.1	100.0	100.0	29.6	106.8	100.3	



TRIIVA190225

C
PI1RA

PI1RA

CT_VacLoc2

Registered Images

CT_VacLoc2

Bladder

BODY

Colon

CouchInterior

CouchSurface

CTV_High

CTV_Intermediate

FemoralJoint_L

FemoralJoint_R

Kidney_L

Kidney_R

PTV def

Rectum

seroma

SmallBowel

SpinalCord

sygma

User Origin

Reference Points

PTV def

Dose

Fields

Isocenter Group 1

pi270

pi270-DRR (Live)

pi0

pi0-DRR (Live)

piCBCT

piCBCT-DRR (Live)

Field 2

PI1RA - Treatment Approved - Transversal - CT_VacLoc2

Color wash [%]

106.8

95.3

80.0

60.0

40.0

20.0

0.0

R

L

Standard

Head First-Supine

Z: -1.59 cm

Y: 1.65 cm

X: -0.67 cm

F

A

P

L

R

F

A

P

L

R

F

A

P

L

R

F

A

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TRIIVA190225

C

PI1RA

PI1RA

CT_VacLoc2

Registered Images

CT_VacLoc2

Bladder

BODY

Colon

CouchInterior

CouchSurface

CTV_High

CTV_Intermediate

FemoralJoint_L

FemoralJoint_R

Kidney_L

Kidney_R

PTV_def

Rectum

seroma

SmallBowel

SpinalCord

sygma

User Origin

Reference Points

PTV_def

Dose

Fields

Isocenter Group 1

pi270

pi270-DRR (Live)

pi0

pi0-DRR (Live)

piCBCT

piCBCT-DRR (Live)

Field 2

Field 2-DRR (Live)

MLC

Field 1

Field 1-DRR (Live)

MLC

MLC

MLC

MLC

MLC

MLC

MLC

MLC

MLC

MLC

MLC

PI1RA - Treatment Approved - Model View - CT_VacLoc2

Dose [%]

107.0

105.0

100.0

95.0

90.0

85.0

80.0

75.0

70.0

65.0

60.0

55.0

50.0

45.0

40.0

35.0

30.0

25.0

20.0

15.0

10.0

5.0

0.0

-5.0

-10.0

-15.0

-20.0

-25.0

-30.0

-35.0

-40.0

-45.0

-50.0

-55.0

-60.0

-65.0

-70.0

-75.0

-80.0

-85.0

-90.0

-95.0

-100.0

-105.0

-110.0

-115.0

-120.0

-125.0

-130.0

-135.0

-140.0

-145.0

-150.0

-155.0

-160.0

-165.0

-170.0

-175.0

-180.0

-185.0

-190.0

-195.0

-200.0

-205.0

-210.0

-215.0

-220.0

-225.0

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-235.0

-240.0

-245.0

-250.0

-255.0

-260.0

-265.0

-270.0

-275.0

-280.0

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-290.0

-295.0

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-335.0

-340.0

-345.0

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-355.0

-360.0

-365.0

-370.0

-375.0

-380.0

-385.0

-390.0

-395.0

-400.0

-405.0

-410.0

-415.0

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-425.0

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-435.0

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-450.0

-455.0

-460.0

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-475.0

-480.0

-485.0

-490.0

-495.0

-500.0

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-515.0

-520.0

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-535.0

-540.0

-545.0

-550.0

-555.0

-560.0

-565.0

-570.0

-575.0

-580.0

-585.0

-590.0

-595.0

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-605.0

-610.0

-615.0

-620.0

-625.0

-630.0

-635.0

-640.0

-645.0

-650.0

-655.0

-660.0

-665.0

-670.0

-675.0

-680.0

-685.0

-690.0

-695.0

-700.0

-705.0

-710.0

-715.0

-720.0

-725.0

-730.0

-735.0

-740.0

-745.0

-750.0

-755.0

-760.0

-765.0

-770.0

-775.0

-780.0

-785.0

-790.0

-795.0

-800.0

-805.0

-810.0

-815.0

-820.0

-825.0

-830.0

-835.0

-840.0

-845.0

-850.0

-855.0

-860.0

-865.0

-870.0

-875.0

-880.0

-885.0

-890.0

-895.0

-900.0

-905.0

-910.0

-915.0

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-925.0

-930.0

-935.0

-940.0

-945.0

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-960.0

-965.0

-970.0

-975.0

-980.0

-985.0

-990.0

-995.0

-1000.0

-1005.0

-1010.0

-1015.0

-1020.0

-1025.0

-1030.0

-1035.0

-1040.0

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-1065.0

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-1080.0

-1085.0

-1090.0

-1095.0

-1100.0

-1105.0

-1110.0

-1115.0

-1120.0

-1125.0

-1130.0

-1135.0

-1140.0

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-1150.0

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-1160.0

-1165.0

-1170.0

-1175.0

-1180.0

-1185.0

-1190.0

-1195.0

-1200.0

-1205.0

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-1370.0

-1375.0

-1380.



TRIIVA190225

C
PI1RA

PI1RA

CT_VacLoc2

Registered Images

CT_VacLoc2

Bladder

BODY

Colon

CouchInterior

CouchSurface

CTV_High

CTV_Intermediate

FemoralJoint_L

FemoralJoint_R

Kidney_L

Kidney_R

PTV def

Rectum

seroma

SmallBowel

SpinalCord

sygma

User Origin

Reference Points

PTV def

Dose

Fields

Isocenter Group 1

pi270

pi270-DRR (Live)

pi0

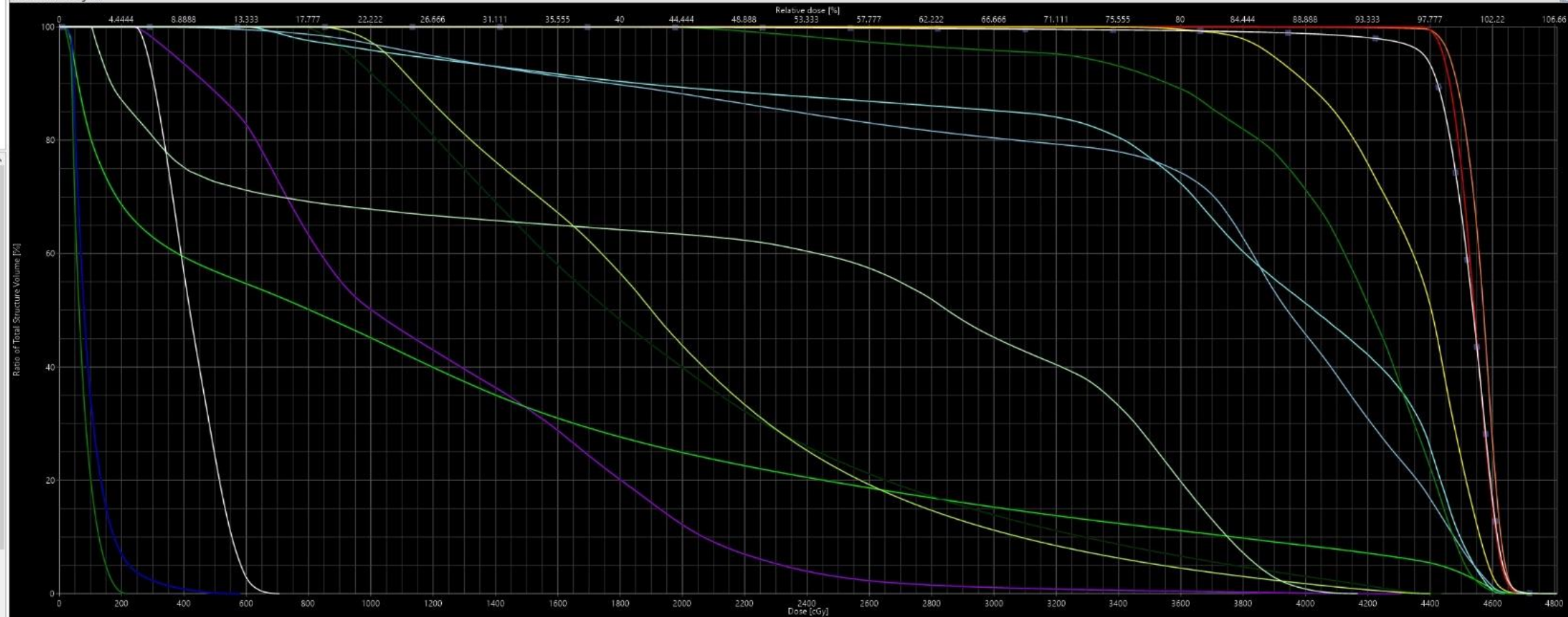
pi0-DRR (Live)

piCBCT

piCBCT-DRR (Live)

Field 2

Dose Volume Histogram



Dose Reference Points Dose Statistics

Show DVH	Structure	Approval Status	Plan	Course	Volume [cm ³]	Dose Cover [%]	Sampling Cover [%]	Min Dose [cGy]	Max Dose [cGy]	Mean Dose [cGy]	
<input checked="" type="checkbox"/>	CTV_Intermediate	Approved	PI1RA	C		257.2	100.0	100.0	3499.8	4723.9	4562.7
<input checked="" type="checkbox"/>	CTV_High	Approved	PI1RA	C		57.0	100.0	100.0	4363.2	4731.2	4539.7
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<input checked="" type="checkbox"/>	Bladder	Approved	PI1RA	C		81.7	100.0	100.0	3278.2	4724.5	4334.9
<input checked="" type="checkbox"/>	BODY	Approved	PI1RA	C		17716.9	100.0	100.0	9.6	4808.1	1294.2
<input checked="" type="checkbox"/>	FemoralJoint_L	Approved	PI1RA	C		42.5	100.0	100.0	759.6	4437.9	1966.9
<input checked="" type="checkbox"/>	FemoralJoint_R	Approved	PI1RA	C		43.1	100.0	100.0	782.3	4402.4	2012.0
<input checked="" type="checkbox"/>	Kidney_R	Approved	PI1RA	C		114.4	100.0	99.8	18.0	582.2	99.5
<input checked="" type="checkbox"/>	Rectum	Approved	PI1RA	C		36.1	100.0	100.0	592.7	4641.3	3706.6
<input checked="" type="checkbox"/>	SmallBowel	Approved	PI1RA	C		335.8	100.0	100.1	0.0	4703.3	3616.6
<input checked="" type="checkbox"/>	SpinalCord	Approved	PI1RA	C		34.3	100.0	100.1	102.2	4168.7	2252.3
<input checked="" type="checkbox"/>	sygma	Approved	PI1RA	C		117.9	100.0	100.0	1901.5	4677.4	4082.4
<input checked="" type="checkbox"/>	Kidney_L	Approved	PI1RA	C		84.7	100.0	99.8	16.6	216.8	74.0
<input checked="" type="checkbox"/>	seroma	Approved	PI1RA	C		37.1	100.0	100.0	242.5	707.5	425.2
<input checked="" type="checkbox"/>	PTV def	Approved	PI1RA	C		880.1	100.0	100.0	1332.0	4808.1	4512.3

Ready

User: dr Neda Milosavljevic

Group: Oncologist

Site: Main

CAP NUM: SCRL

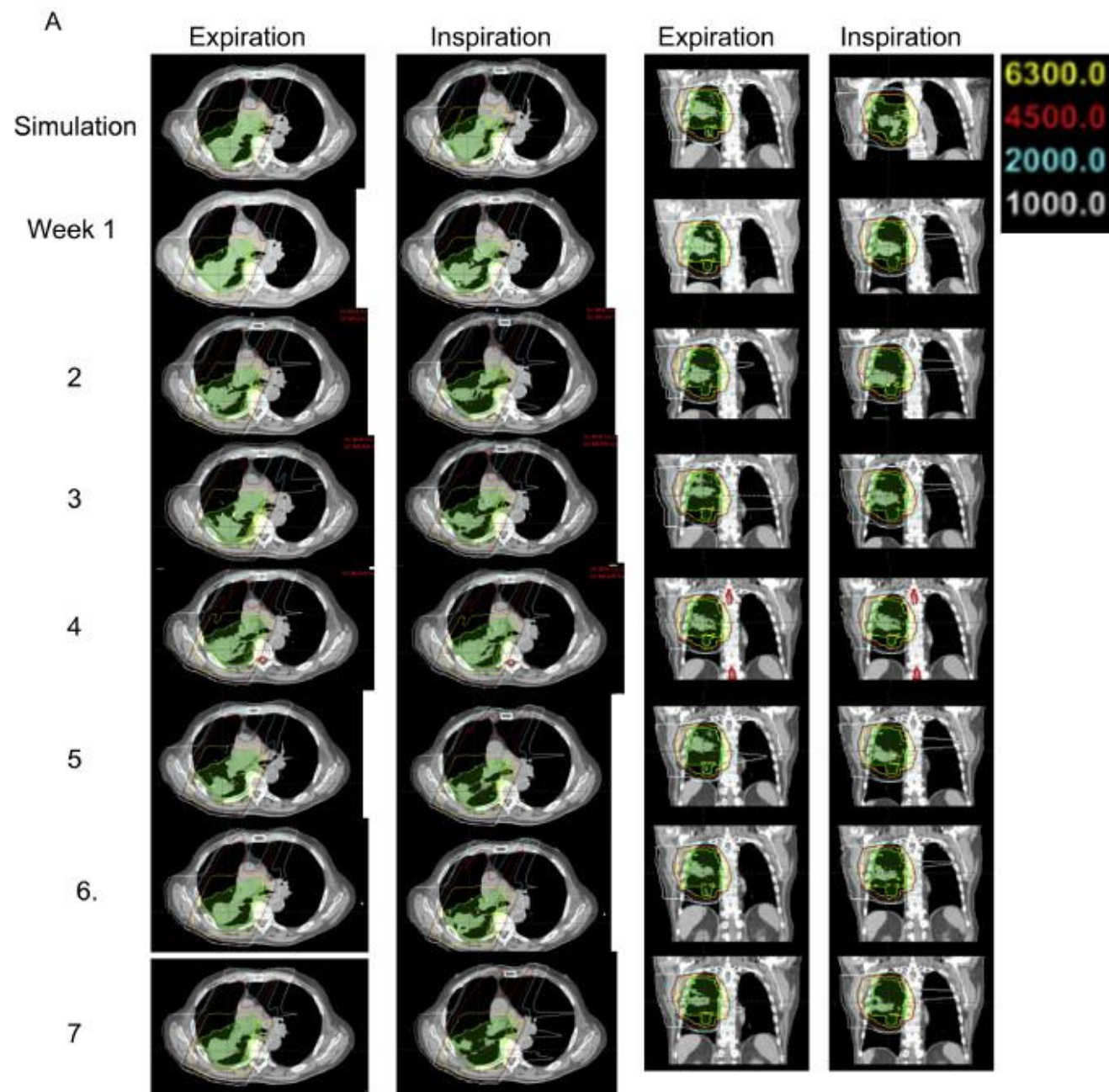
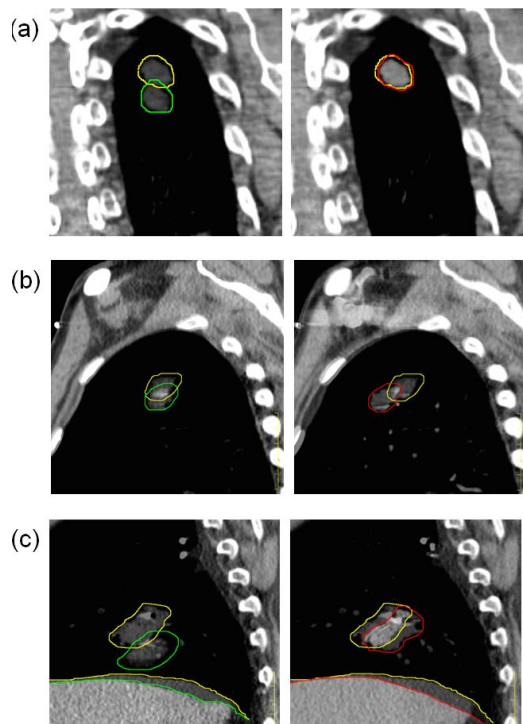
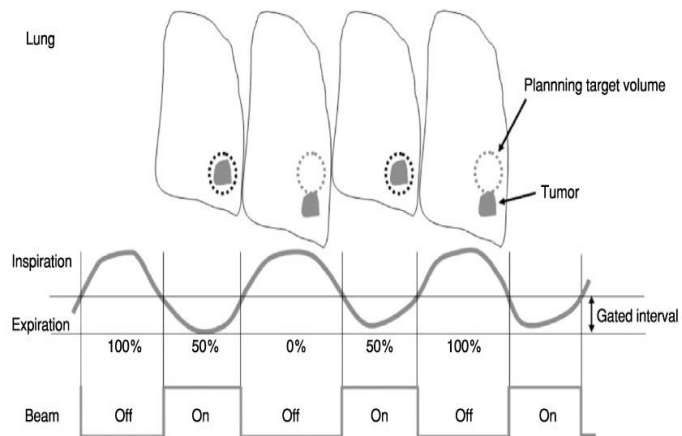
1:11 PM

5/8/2020

IMAGE GUIDED RADIOTHERAPY - IGRT

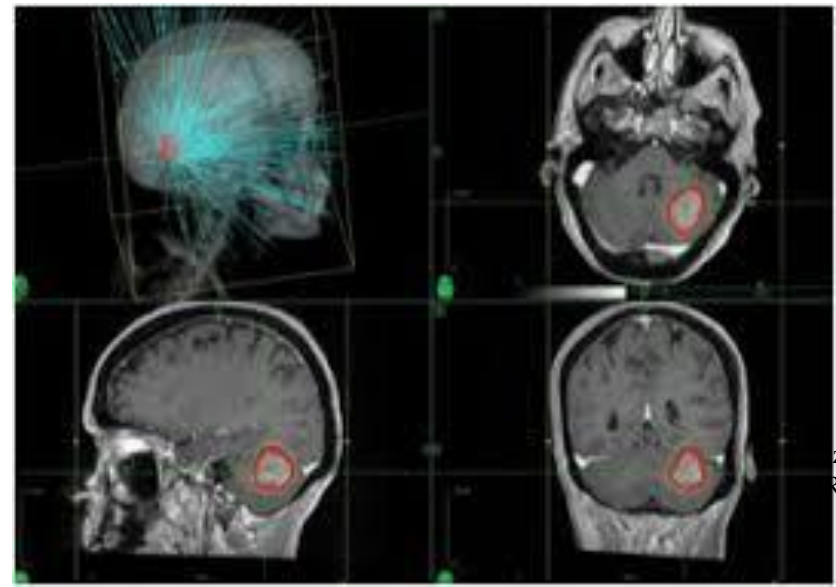
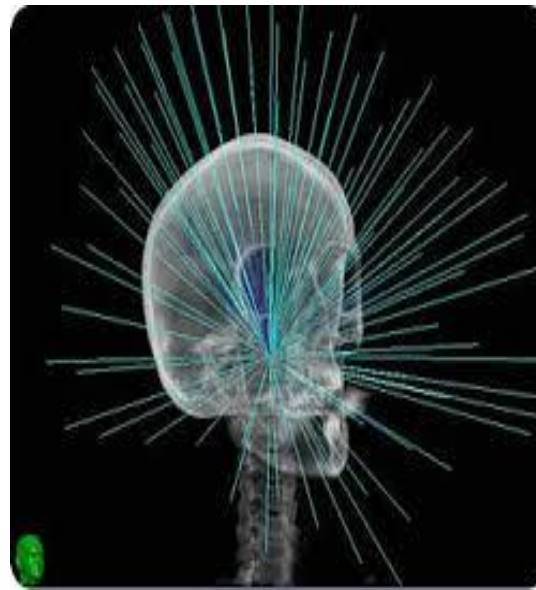
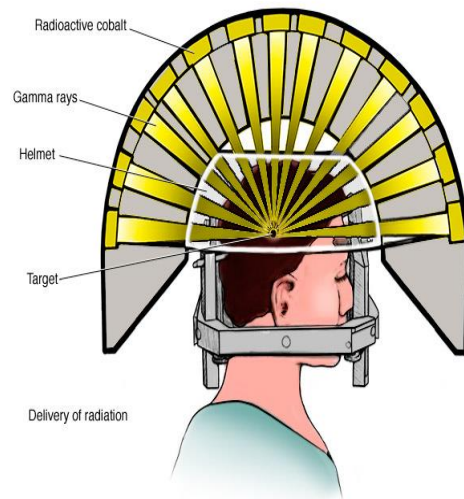
- Kontrola korektne lokalizacije pacijenta, ciljnih volumena, organa od rizika prilikom svake frakcije zračenja
- Uz pomoć UZ, KV-imaging ili cone-beam CT

- Dodatna preciznost svih navedenih tehnika se postiže primenom jedne od sledećih tehnika tretmana:
- **zadržavanje daha**
- **adaptivno disanje (respiratory gating)**
- **slobodno disanje**
- **Respiratory gating** je tehnika kojom se koristi fiducijalni marker na zidu grudnog koša koji uključuje CT ili linearni akcelerator u određenoj fazi respiracije. Ova tehnika podrazumeva da je eksterni marker respiracije u korelaciji sa unutrašnjim kretanjem tumora, što nije uvek slučaj, i može varirati iz dana u dan.
- Prve dve metode se koriste kod bolesnika kod kojih postoji velika ekskurzija tumora pri respiraciji.



STEREOTAKTIČNA RADIOTERAPIJA

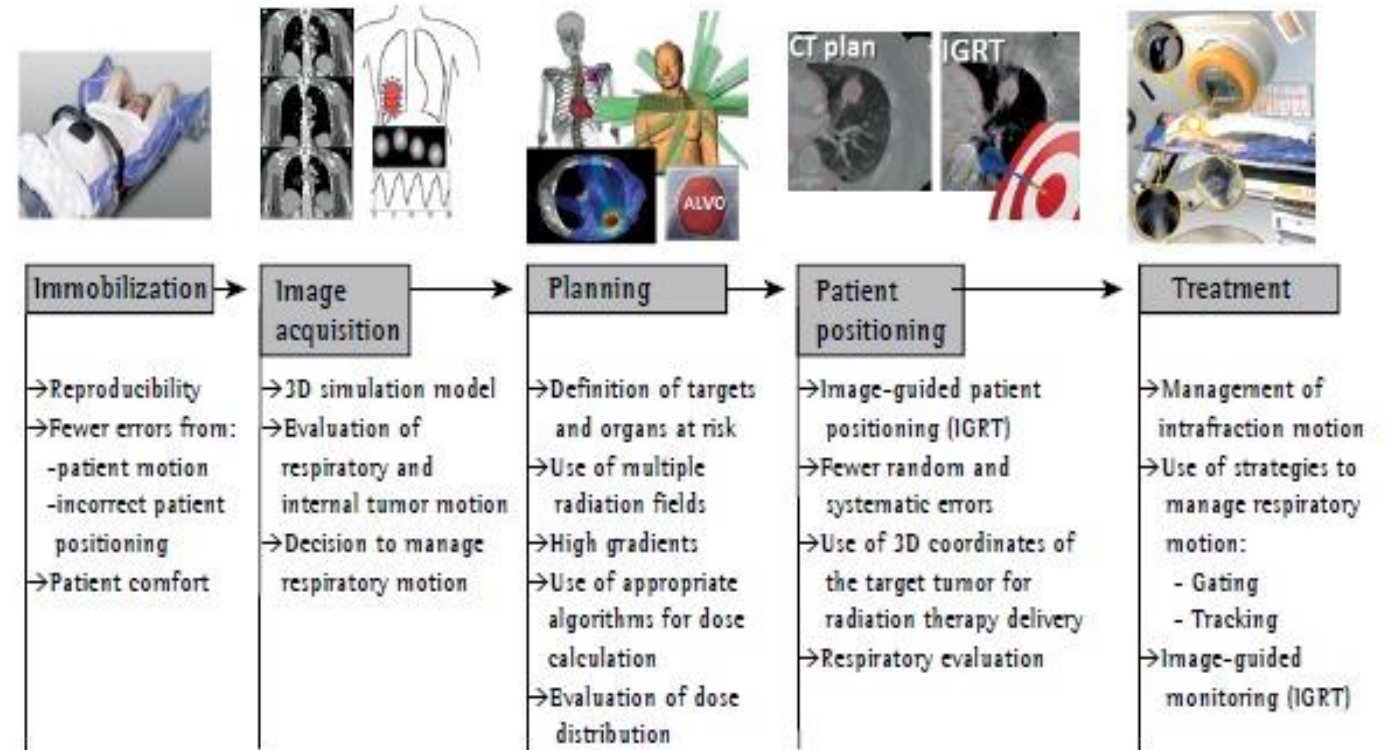
- Visoko fokusiran tretman na male, dobro definisane mete bilo u jednoj frakciji (20Gy), ili u 1-4 frakcije (6Gy, 7Gy, 8Gy)
- Najčešće kod solitarnih meta promena, reiradijacija



zvor: Mayo Clinic. SRS.
Radiosurgery.gr

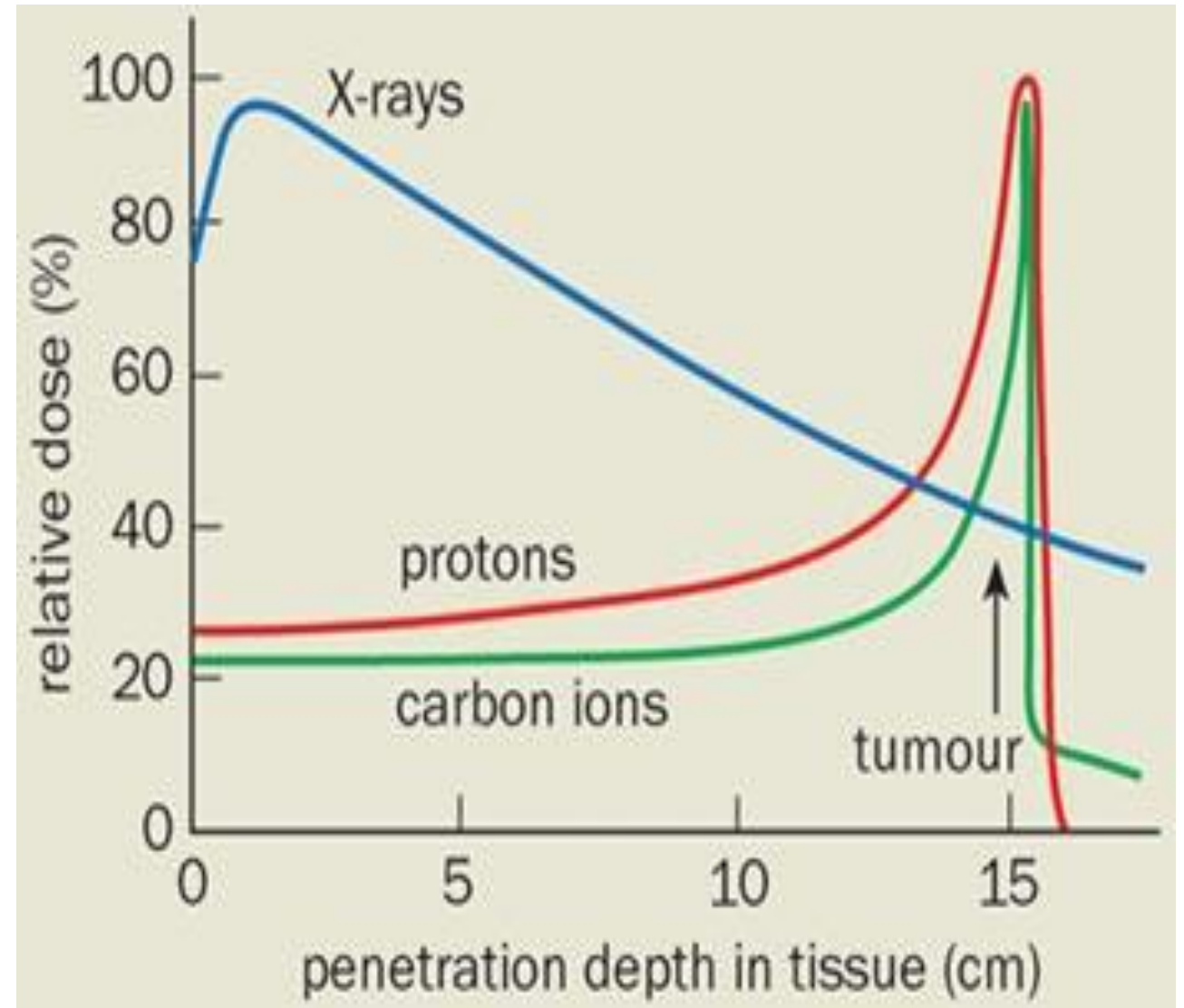
Stereotactic Body Radiotherapy, SBRT

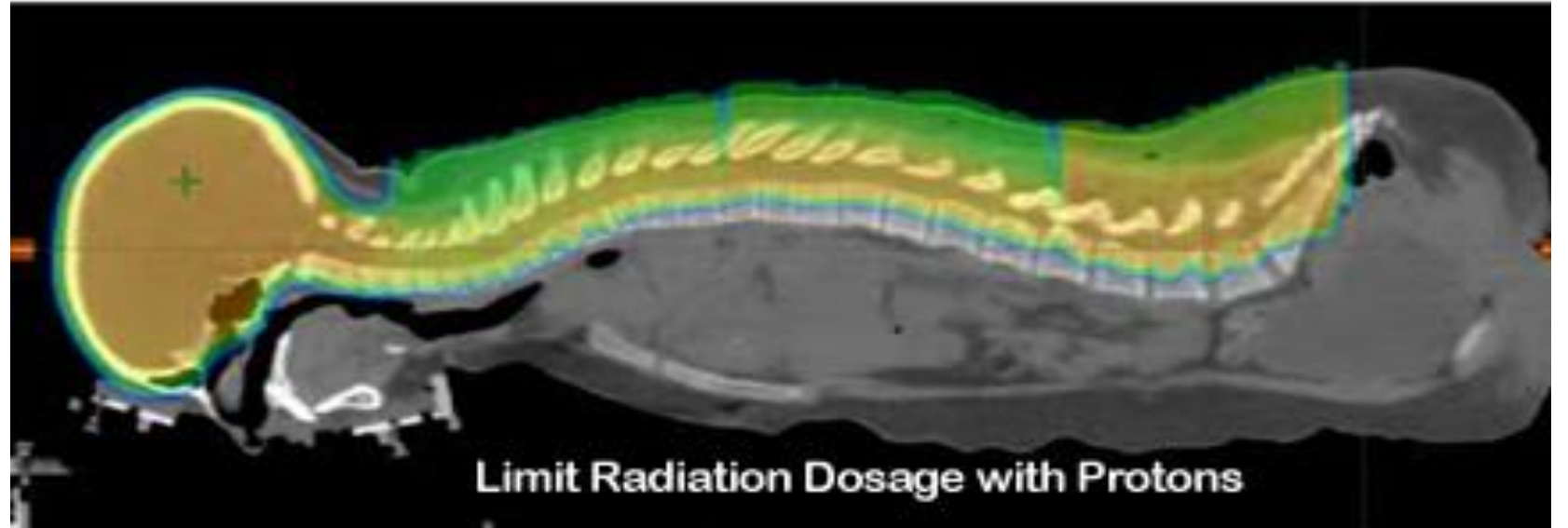
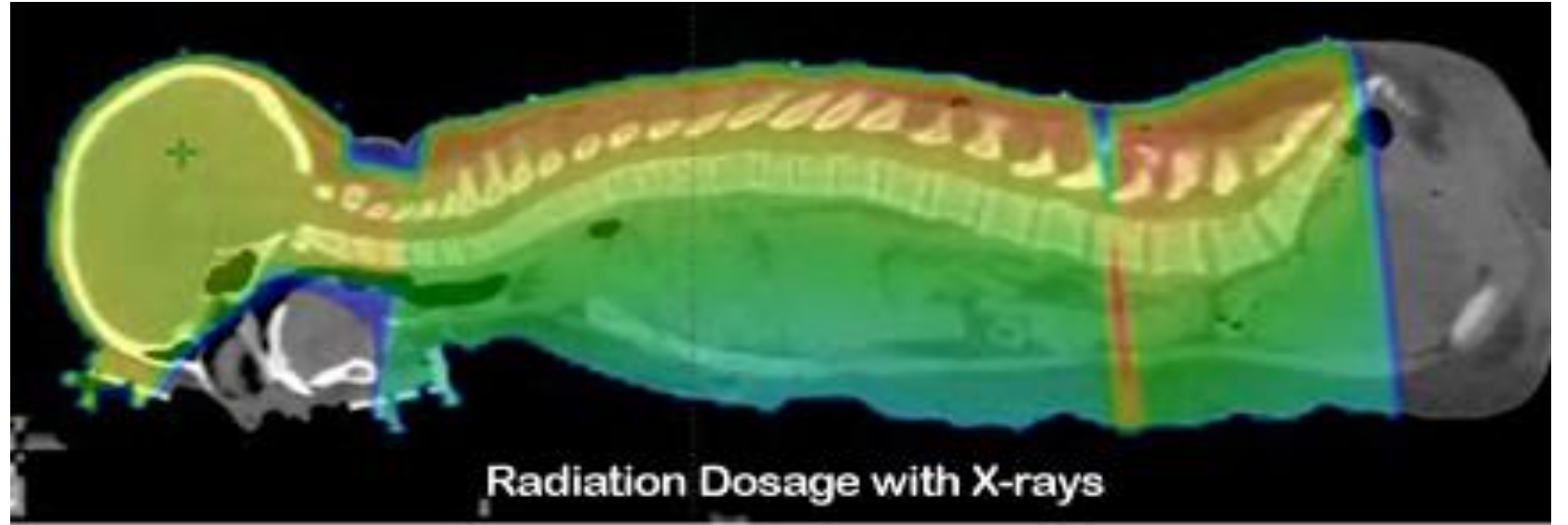
- Upotreba ablativnih doza koje se isporučuju u malom broju frakcija, I čija je biološki ekvivalentna doza (BED) >100 Gy.
- Prevenirati tumorsku repopulaciju, izaziva vaskularno oštećenje, apoptozu endotela, remodelovanje mikrovaskulature, indukuje imunski odgovor na tumor.



PROTONSKA TERAPIJA

- Karakteristična distribucije doze u ciljnom volumenu omogućava postizanje tumorske doze na određenoj dubini u tkivu uz poštedu normalnih struktura ispred i iza.
- Indikacije za zračenje tumora određenih lokalizacija – baza lobanje, CSI, retretman
- Nedostatak - cena mašine





INTRAOPERATIVE RADIOTHERAPY (IORT)

- Intraoperativna radioterapija (IORT) podrazumeva isporuku radioterapijske doze u jednoj frakciji direktno na ležište tumora tokom operativnog zahvata pre nego što tumorske ćelije imaju mogućnost da proliferišu u postoperativnom toku.
- tkivo je vaskularizovano, što povećava efikasnost RT.
- Radioterapija se sprovodi direktnom vizualizacijom ležišta tumora tokom hirurške intervencije.
- IORT smanjuje neželjene radijacione komplikacije na koži, srcu i plućima, eliminiše mogućnost da pacijent iz različitih razloga ne kompleтира preporučeni zračni tretman.
- Nedostatak IORT je što je definitivni Ph nalaz dostupan nakon sprovedene intervencije, te se ne mogu sa sigurnošću definisati resekcione margine – nedostatak na kome se poslednjih godina intenzivno radi, usavršavanjem tehnologije.
- Postoji više različitih tehnika iORT u zavisnosti od toga šta se koristi kao izvor zračenja, pa tako izvor mogu biti X zraci (Intrabeam)

- Ovaj sistem produkuje fotone niske energije (30- 50 KVp) sa brzim padom doze u tkivu i kao takav ne zahteva posebnu zaštitu u prostoriji (operacionoj sali) u kojoj se procedura izvodi.
- Ceo tretman traje između 20 i 45 minuta u zavisnosti od veličine operativne šupljine dijametra aplikatora i propisane doze.
- TARGIT (2000 pacijenata iz 28 centara) je pokazala da nema statistički značajne razlike u stopi lokalnog relapsa i radijacionoj toksičnosti i predstavlja nivo dokaza I za primenu IORT.

- Precizna lokalizacija ležišta tumora i ciljana isporuka visoke radioterapijske doze (20-25 Gy u 1 frakciji)
- Minimalno izlaganje okolnih zdravih struktura
- Mogućnost eskalacije doze (značajno veće od one koja može biti postignuta primenom transkutane zračne terapije)
- Mogućnost reiradijacije, posebno kod rekurentnih karcinoma
- IORT se može koristiti samostalno ili u kombinaciji sa transkutanom RT.
- Osim kod ranih karcinoma dojke IORT se može sprovoditi u većini intraabdominalnih tumora, rekurentnih kolorektalnih karcinoma, ginekoloških karcinoma, tumora mekih tkiva, te malignih tumora glave i vrata i pedijatrijskih tumora.

BRAHITERAPIJA

- Preciznim pozicioniranjem radioaktivnog izvora u neposrednoj blizini tumora (do 2 cm) moguće je aplikovanje visoke doze zračenja na ciljni volumen.
- Zbog strmog perifernog pada doze, zdravo tkivo u neposrednoj blizini, je manje ozračeno od tumora, pa je i njegovo oporavljanje lakše
- Volumna doza je manja od one u transkutanoj radioterapiji, pa su rizici za lokalno i sistemsko oštećenje organizma znatno manji.

Podela brahiterapije prema mestu aplikovanja izvora zračenja

- Površinska (kontaktna) brahiterapija izvodi se dovođenjem izvora u neposrednu blizinu, za zračenje tumora lokalizovanih na koži i vidljivim sluzokožama.
- Intrakavitarna (intraluminarna/endoluminalna) uvođenjem radioizotopa u prirodne tjelesne šupljine pomoću vodiča/aplikatora.
- Intersticijalna brahiterapija gdje se izvori zračenja uvode direktno u tumor, kroz šuplje vodiče u obliku igala, koje se zabađaju u tumorsko tkivo ili ubacivanjem radioaktivnih zrnaca u tumor.

