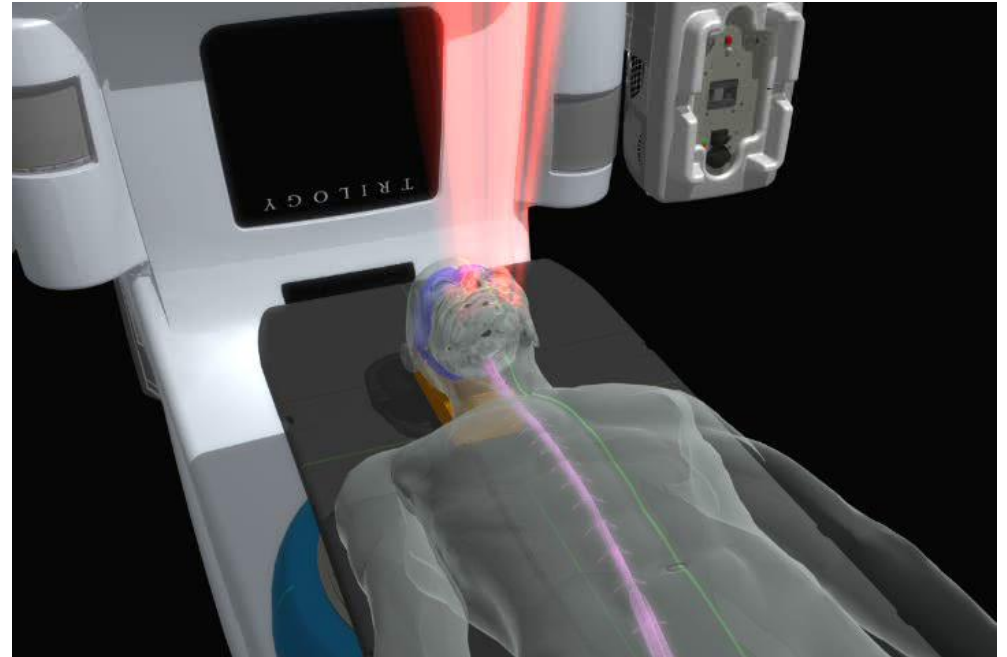


AK IMRT - Neuruppin

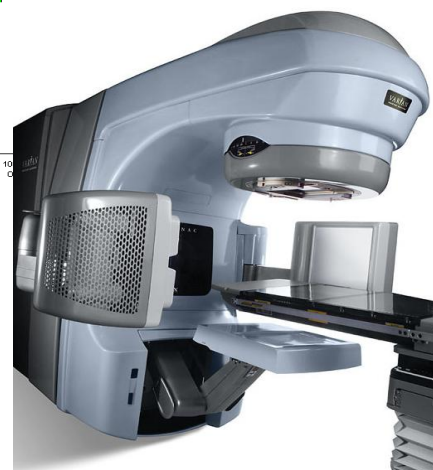
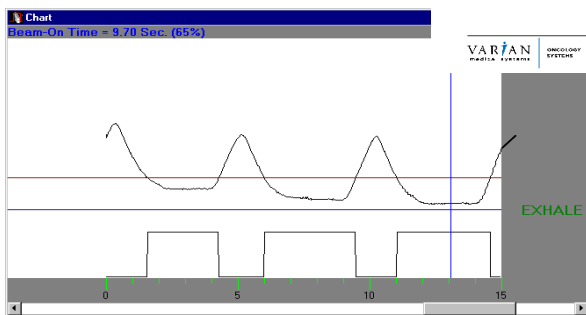
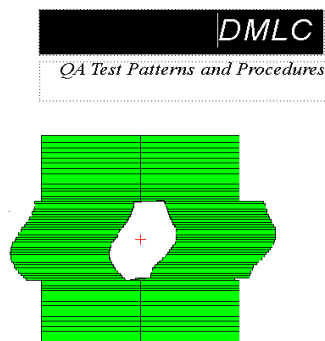
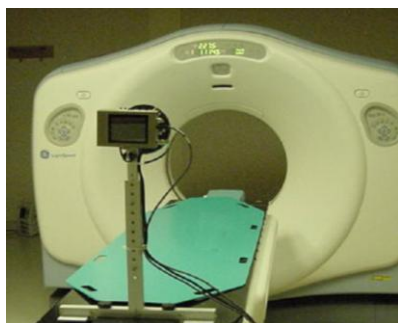
**RAPID ARC
IMRT in einer Rotation**



Daniel Weber, Varian Medical Systems

... heutige Bestrahlungstechniken

3D / IMRT / Tomo / IGRT / Partikel...



Ziele...

- Entwicklung einer Bestrahlungsplanungs- und Bestrahlungseinheit welche:
 - IMRT signifikant schneller abstrahlen kann als ein konvent. Bestrahlungsgerät
 - Dosisverteilung in gleicher Qualität wie Tomotherapy- & konvent. IMRT-Systeme dies liefern
 - einen optimalen Bestrahlungsplan in kürzester Zeit umsetzen können

Voraussetzung Netzwerk: Insellösungen / Integration ??

Simulation & Verification:

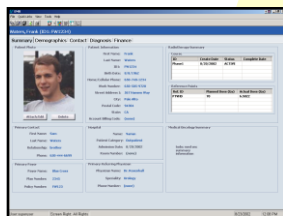


Treatment Console &
Portal Imaging

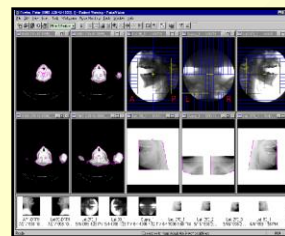


R&V – System

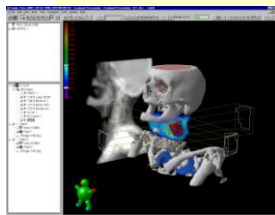
- Patient Manager
- Time Planner
- RT Chart
- Activity Capture
- Document Manager
- Reports Author...



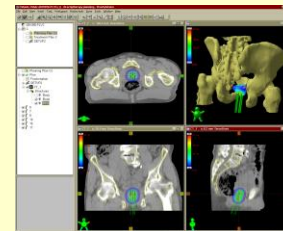
Review Station



Prescription, CT-Simulation,
Planning System



Brachytherapy Planning:



... zwingend → kompl. Systemintegration

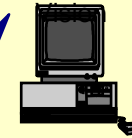
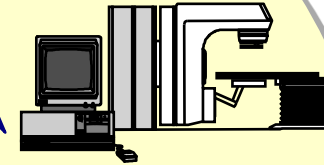
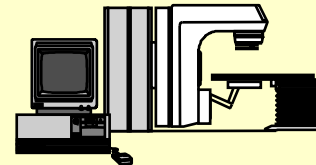
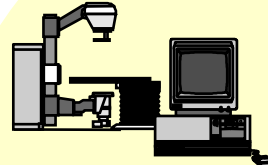
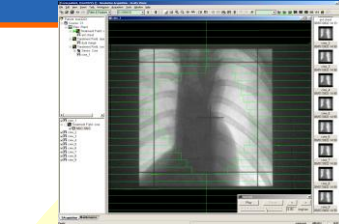
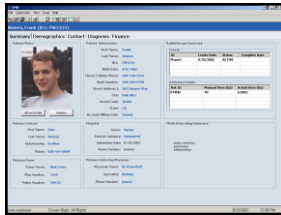
Simulation & Verification: SIMULIX / DICOMRT

Treatment:

4D Integrated Treatment Console &
VARIAN - IGRT / DART

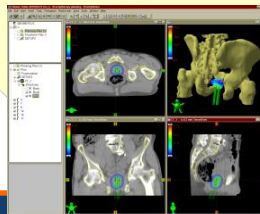
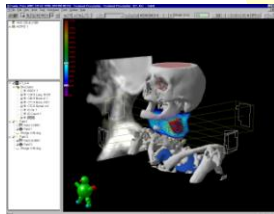
Data & Process Management:

- Patient Manager
- Time Planner
- RT Chart
- Activity Capture
- MedOncology
- Document Manager
- Reports Author



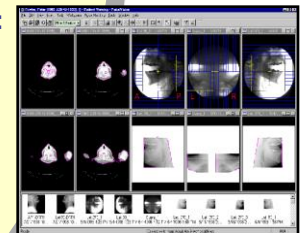
Prescription, CT-Simulation, Planning:

IMRT / SomaVision - Eclipse - Helios



Brachytherapy
Planning:
BrachyVision

Imaging & Review:



VARIAN-ARIA
System DB

DICOM, HL-7, RTP-X, Import/Export, ...

Ziele... → die Lösung

- Entwicklung einer Bestrahlungsplanungs- und Bestrahlungseinheit welche:
 - IMRT singnifikant schneller abstrahlen kann als ein konvent. Bestrahlungsgerät
 - Dosisverteilung in gleicher Qualität wie Tomotherapy- & konvent. IMRT-Systeme dies liefern
 - einen optimalen Bestrahlungsplan in kürzester Zeit umsetzen können



Volumetric Modulated
Arc Therapy

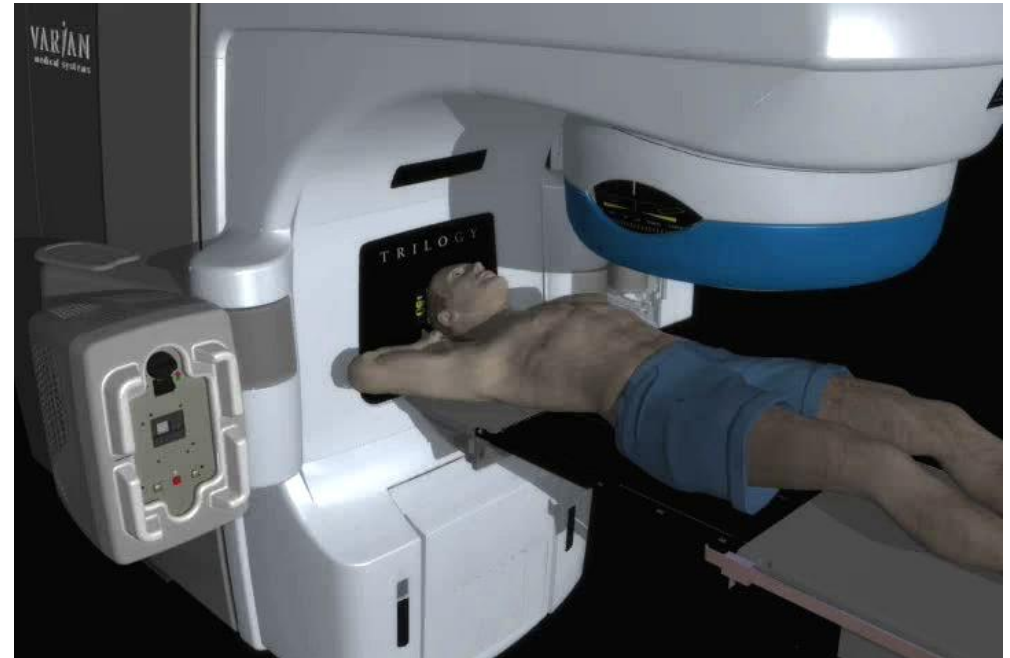
IMRT in einer Gantry-
Drehung

Varian Medical Systems



RAPID ARC - VMAT in einer Gantrydrehung

- **eine einzige 360° Gantry Rotation**
- **Vollfeld - cone beam**
- **Grenzwerte**
 - MLC motion - max. 5 mm/ deg
 - Dosisrate - maximum
 - Dosisrate - Modulation



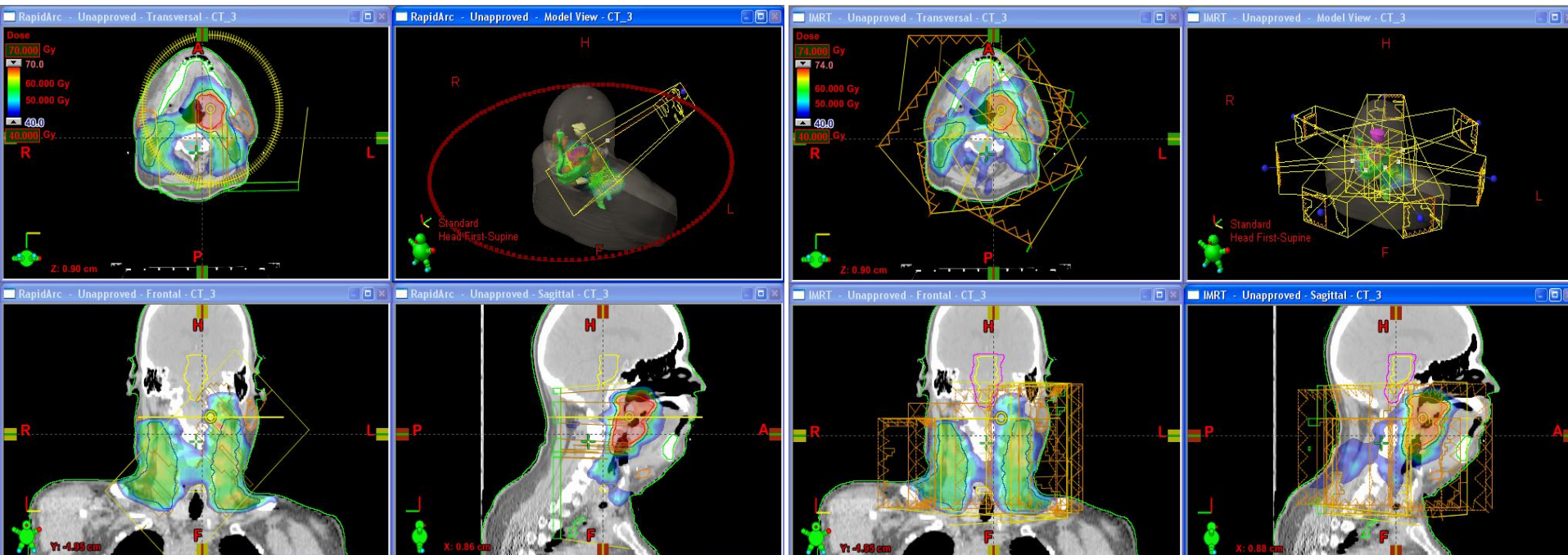
RapidArc - 2+2!

- 2 min Imaging & Repositioning
- 2 min Treatment
 - Less than 600 MU/ 2Gy
 - Variable gantry speed
 - Variable dose rate
 - Inter-digitating MLC
 - Dynamic MLC



RapidArc - IMRT Quality

- Highly efficient with MU and time



RapidArc
Single arc IMRT

496 MU

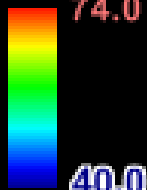
Conventional
7-field IMRT

1685 MU

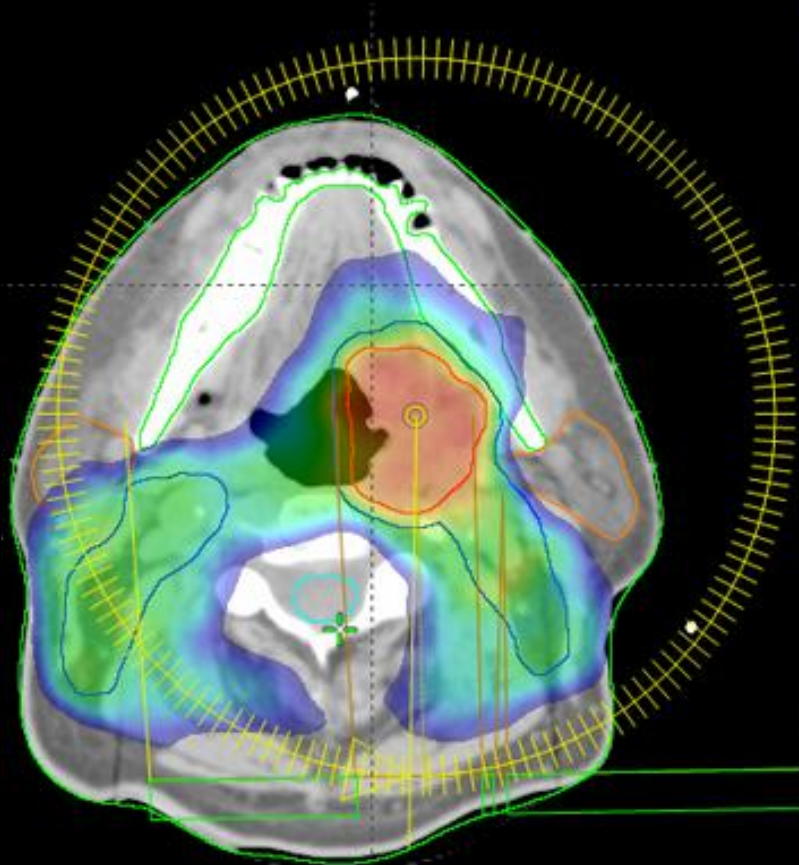
RapidArc - IMRT Quality

Dose Gy

74.0

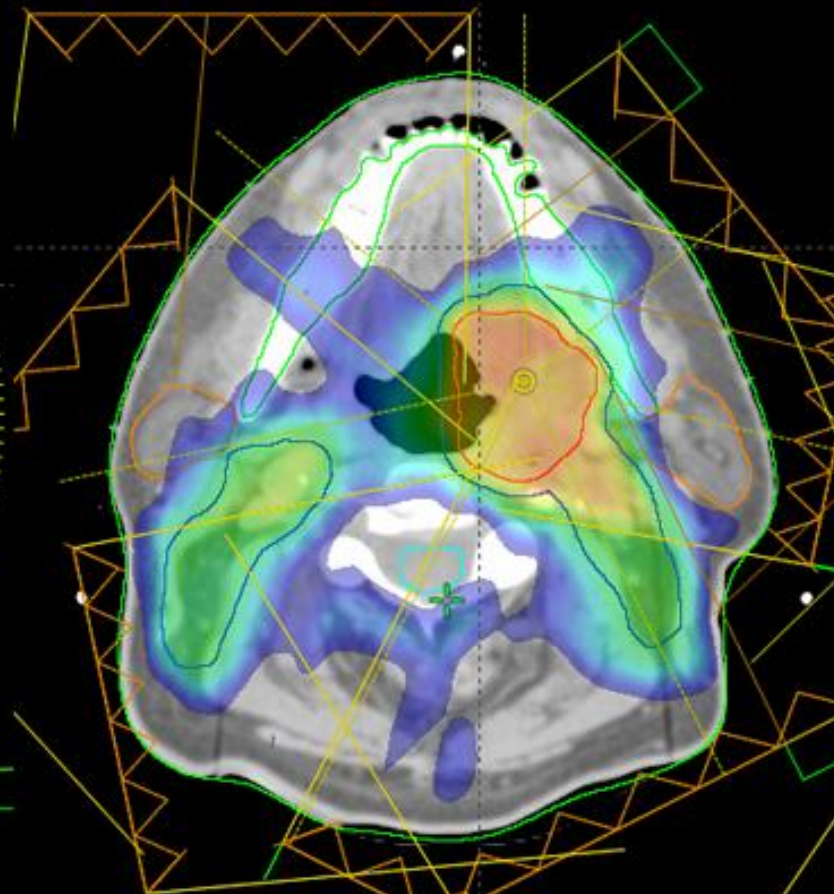


40.0



RapidArc
Single arc IMRT

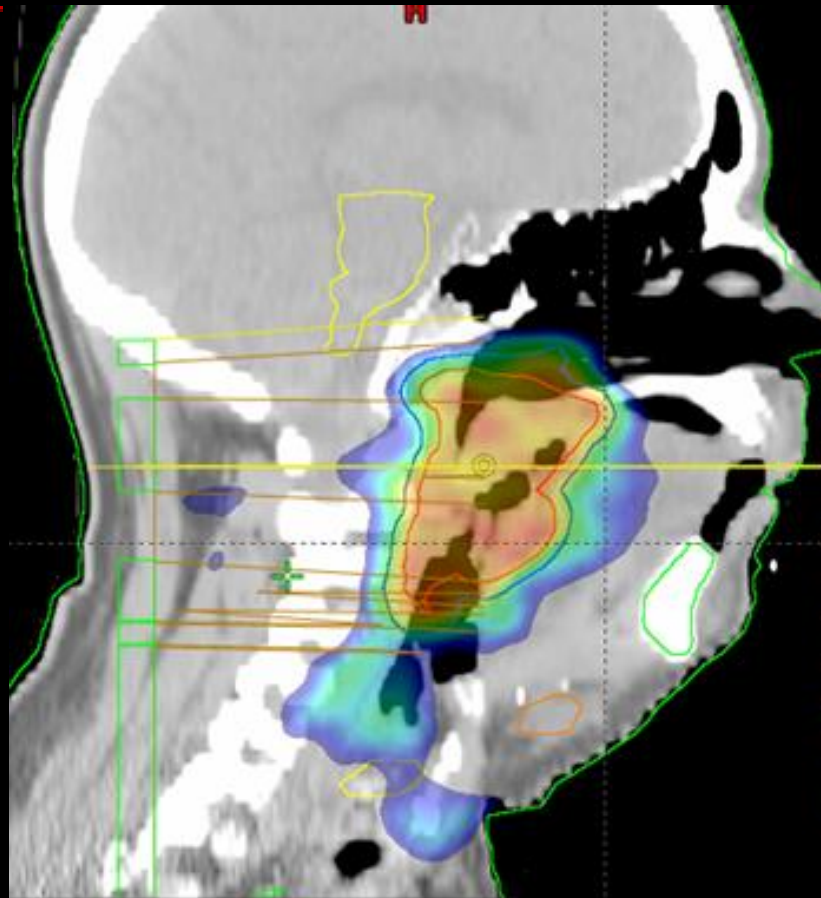
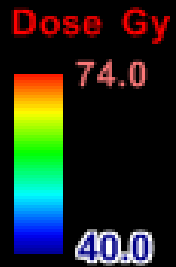
496 MU



Conventional
7-field IMRT

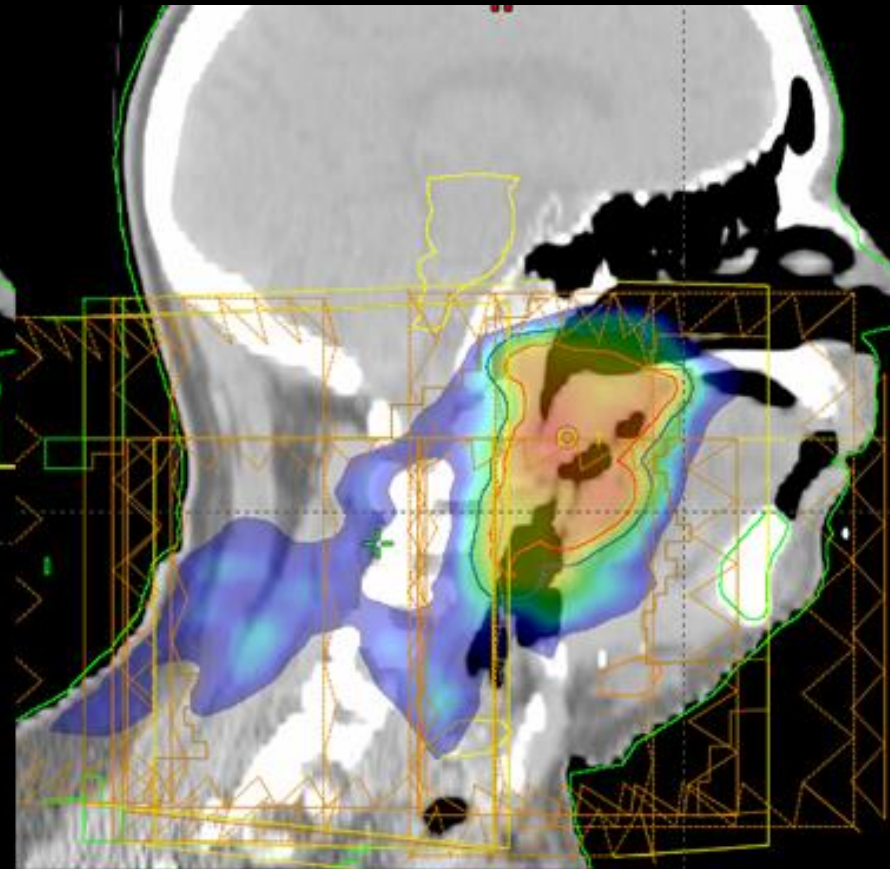
1685 MU

RapidArc - IMRT Quality



RapidArc
Single arc IMRT

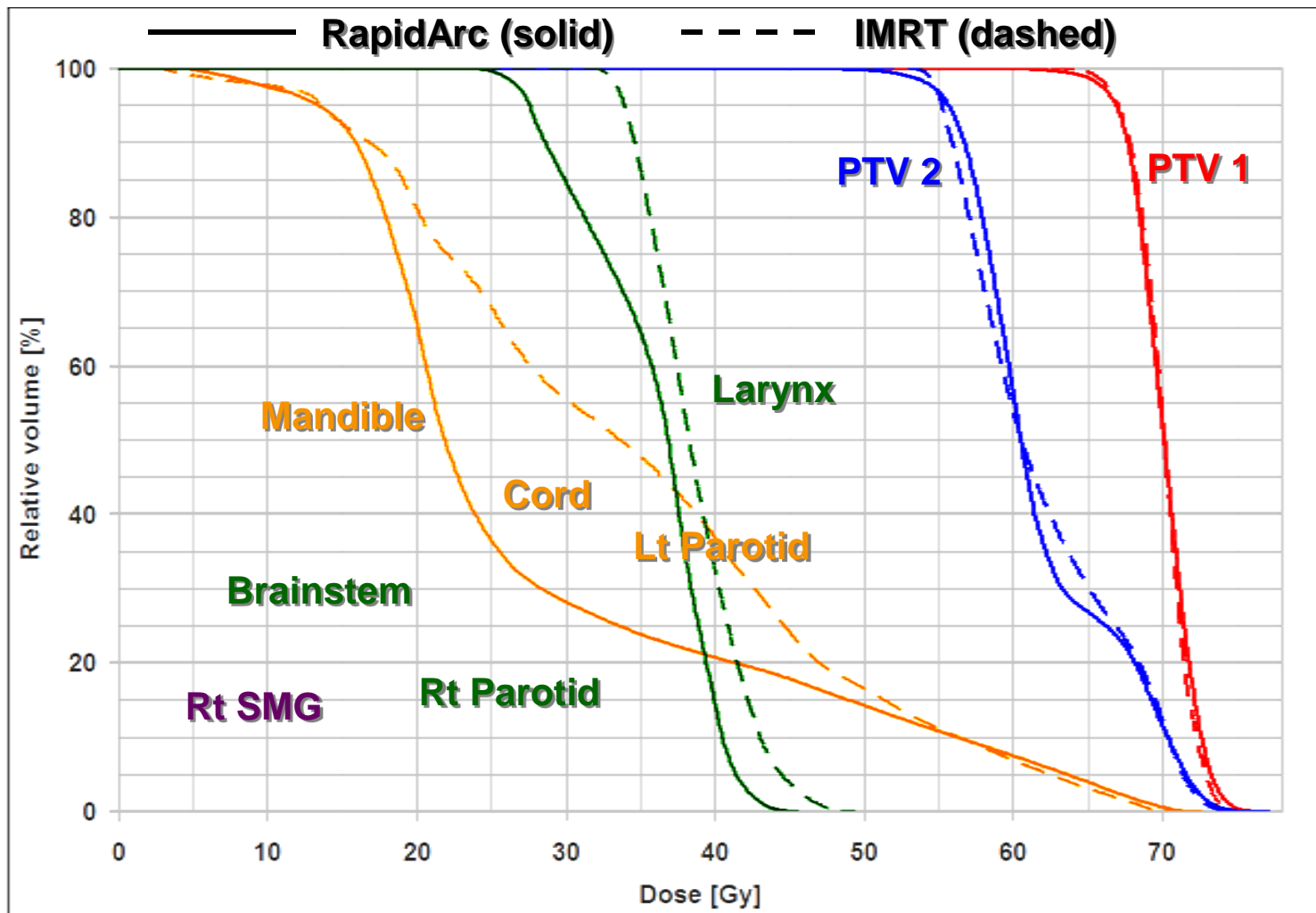
496 MU



Conventional
7-field IMRT

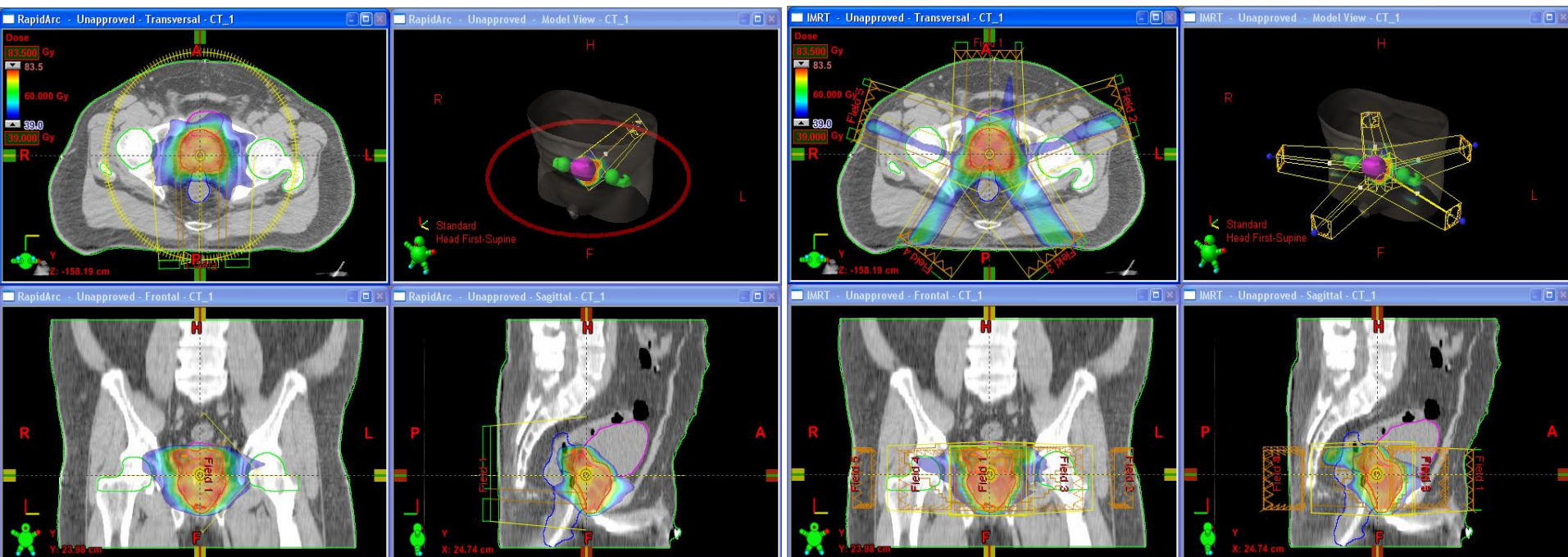
1685 MU

RapidArc - IMRT Quality



RapidArc - IMRT Quality

- Highly efficient with MU and time



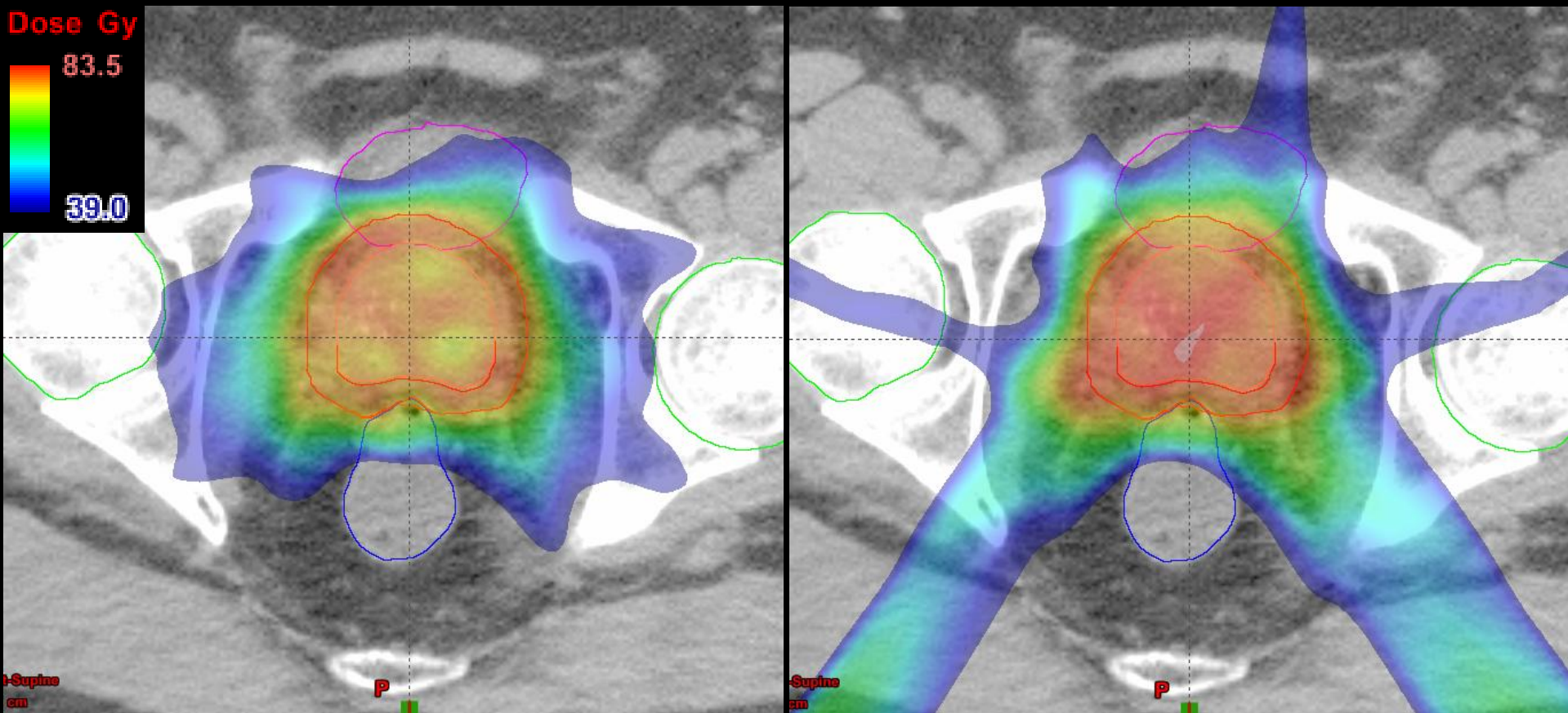
RapidArc
Single arc IMRT

603 MU

Conventional
7-field IMRT

915 MU

RapidArc - IMRT Quality



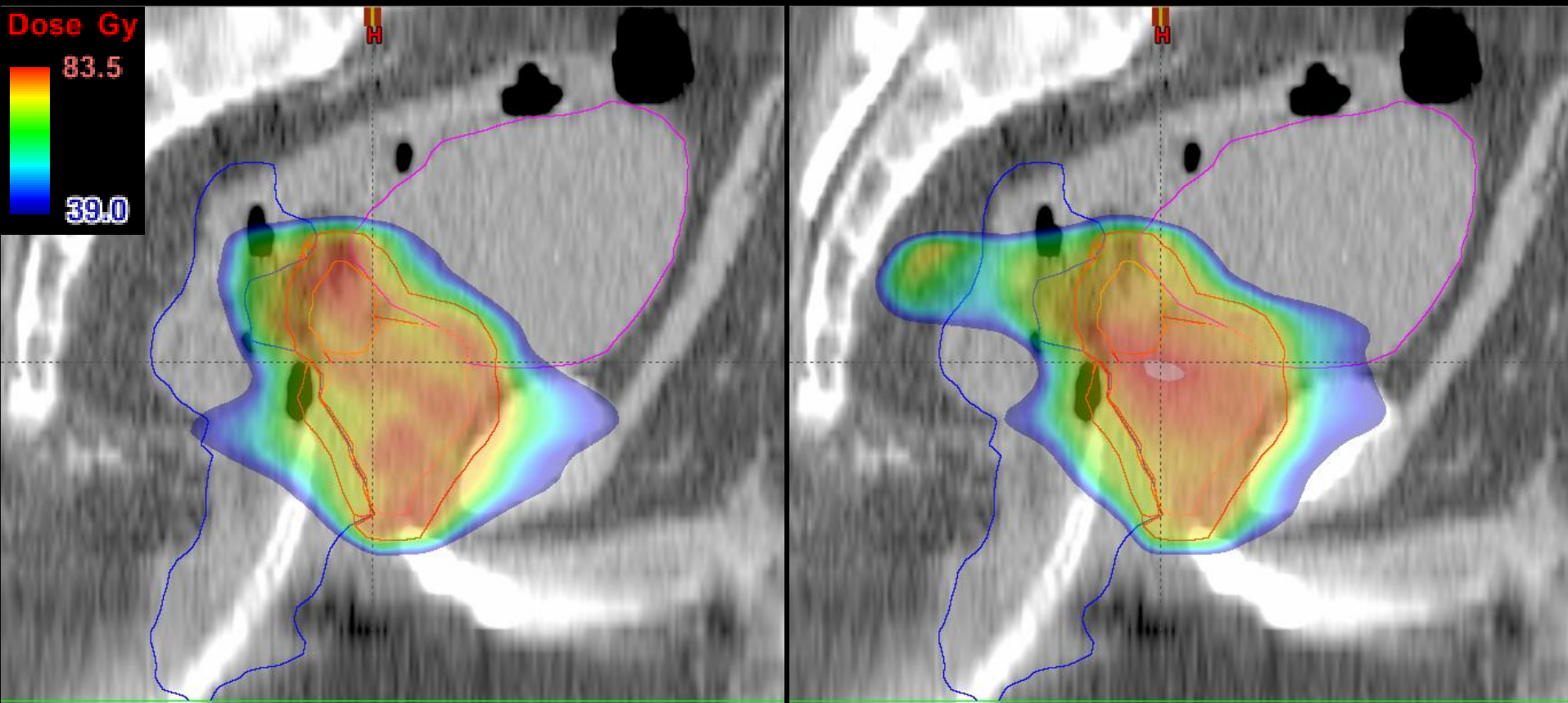
RapidArc
Single arc IMRT

603 MU

Conventional
7-field IMRT

915 MU

RapidArc - IMRT Quality



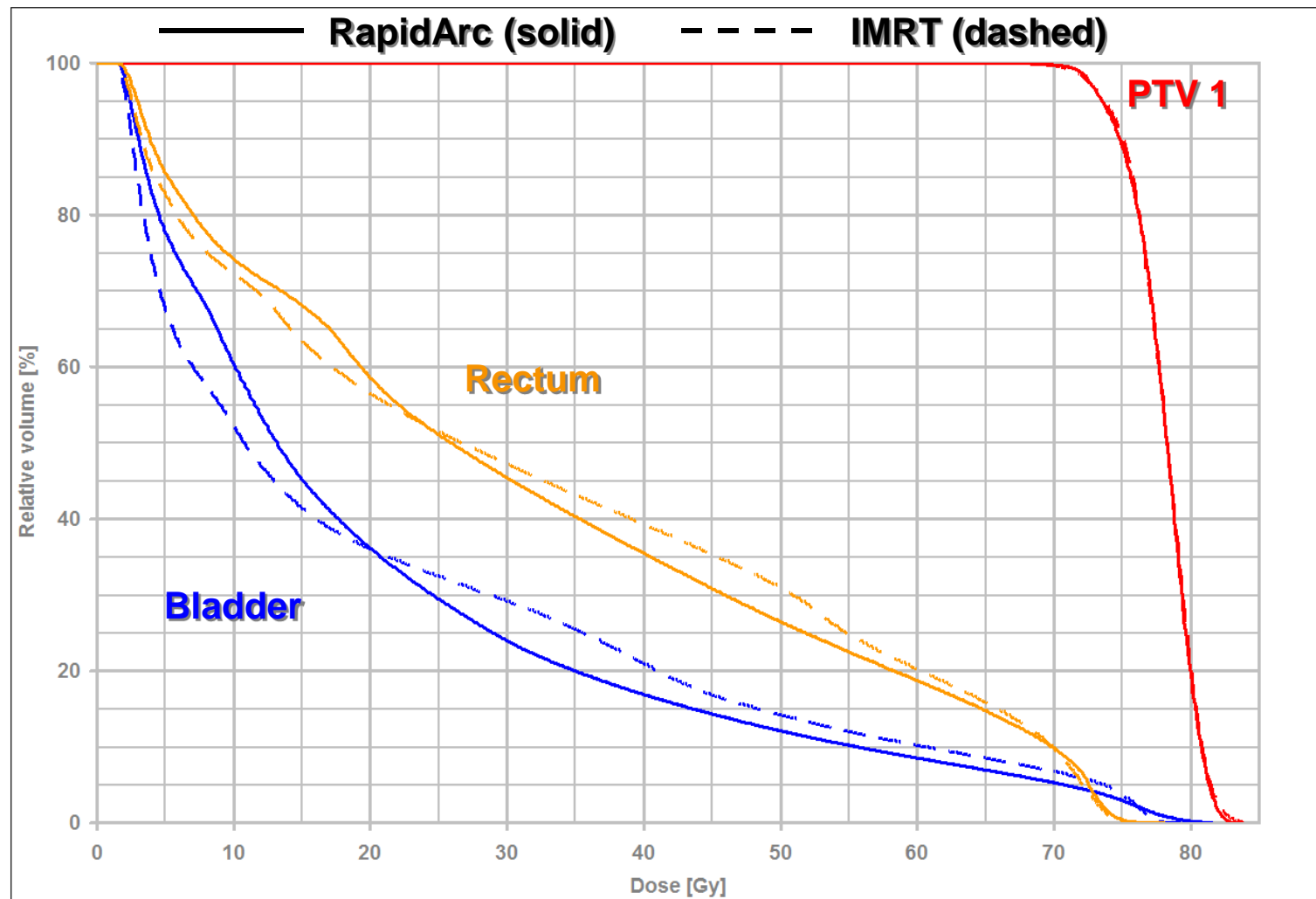
RapidArc
Single arc IMRT

603 MU

Conventional
7-field IMRT

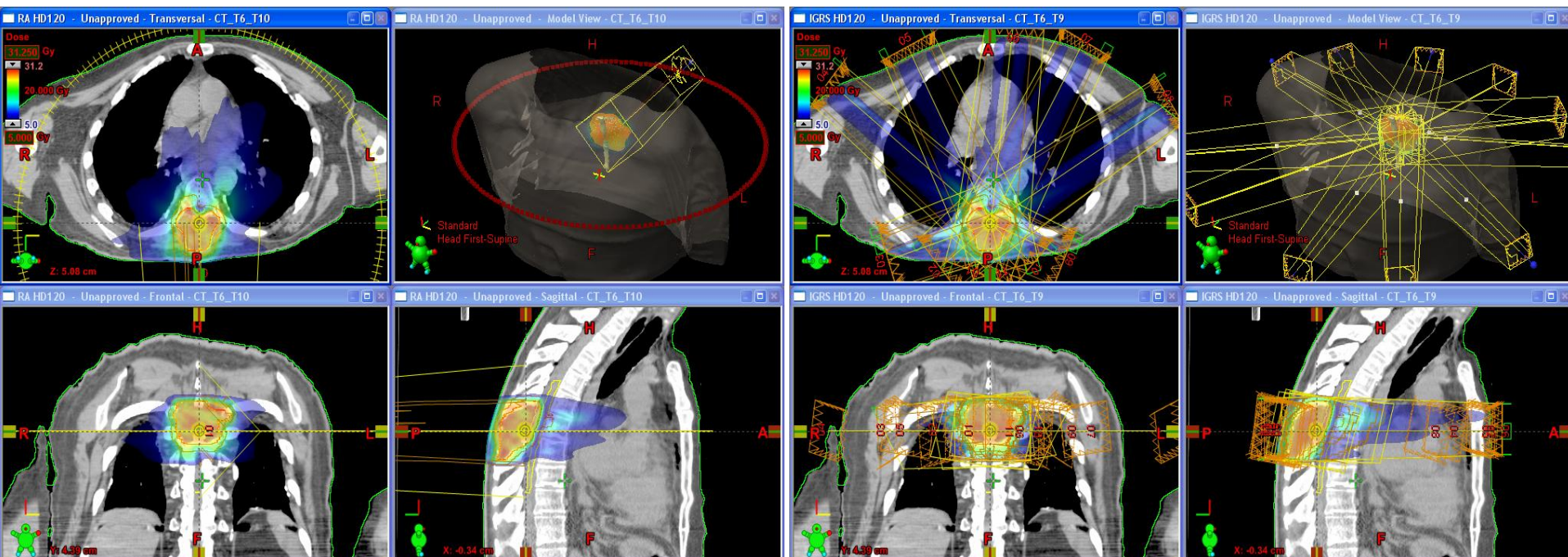
915 MU

RapidArc - IMRT Quality



RapidArc - IMRT Quality

- Highly efficient with MU and time



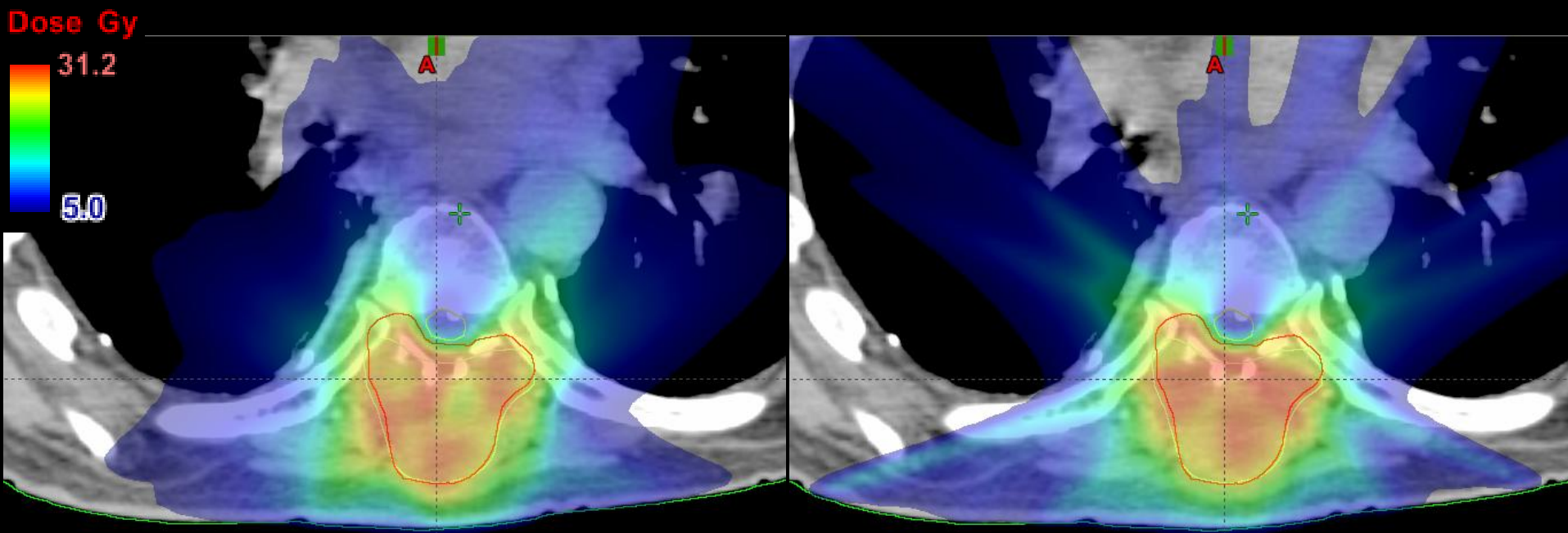
RapidArc
Single arc IMRT

2174 MU

Conventional
7-field IMRT

3072 MU

RapidArc - IMRT Quality



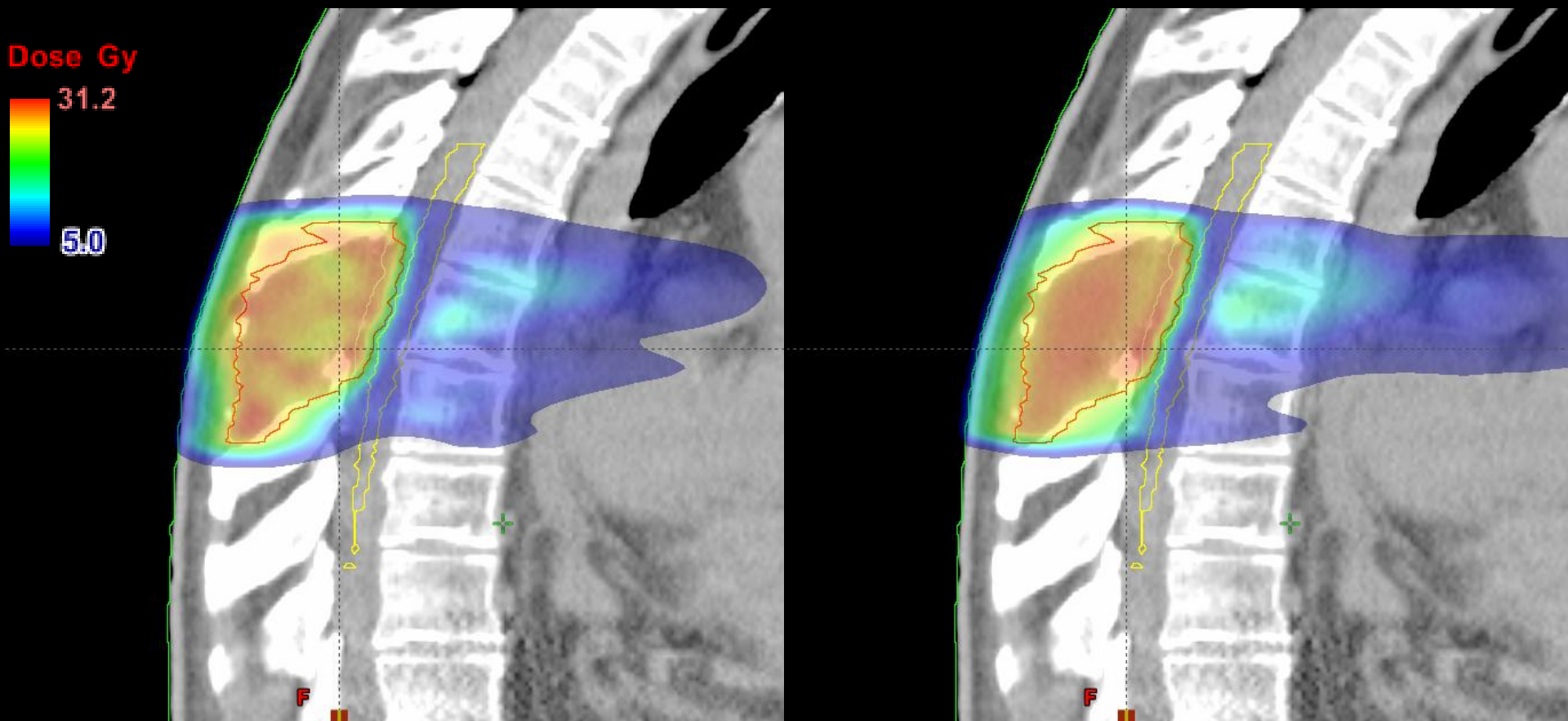
RapidArc
Single arc IMRT

2174 MU

Conventional
7-field IMRT

3072 MU

RapidArc - IMRT Quality



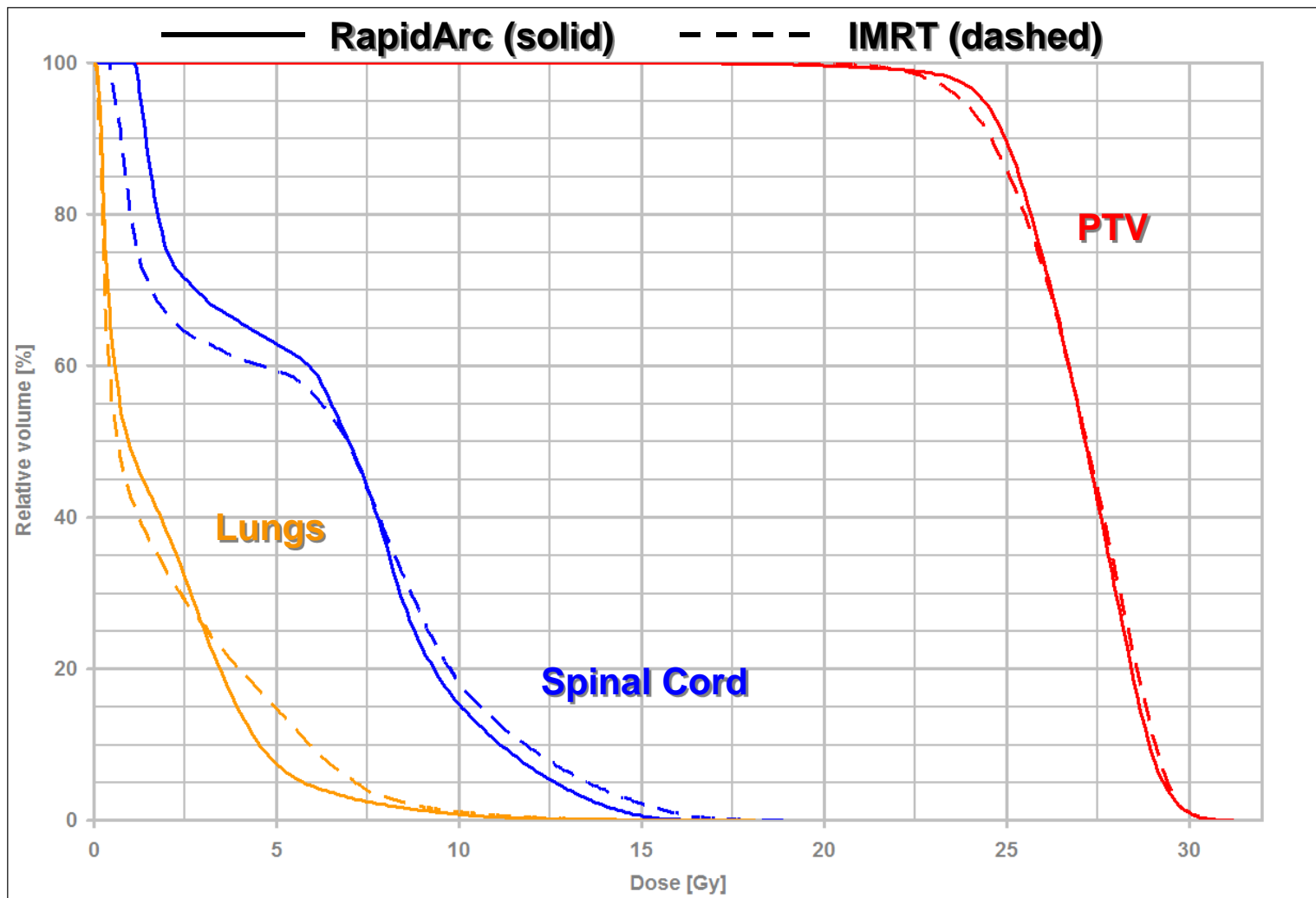
RapidArc
Single arc IMRT

2147 MU

Conventional
7-field IMRT

3072 MU

RapidArc - IMRT Quality

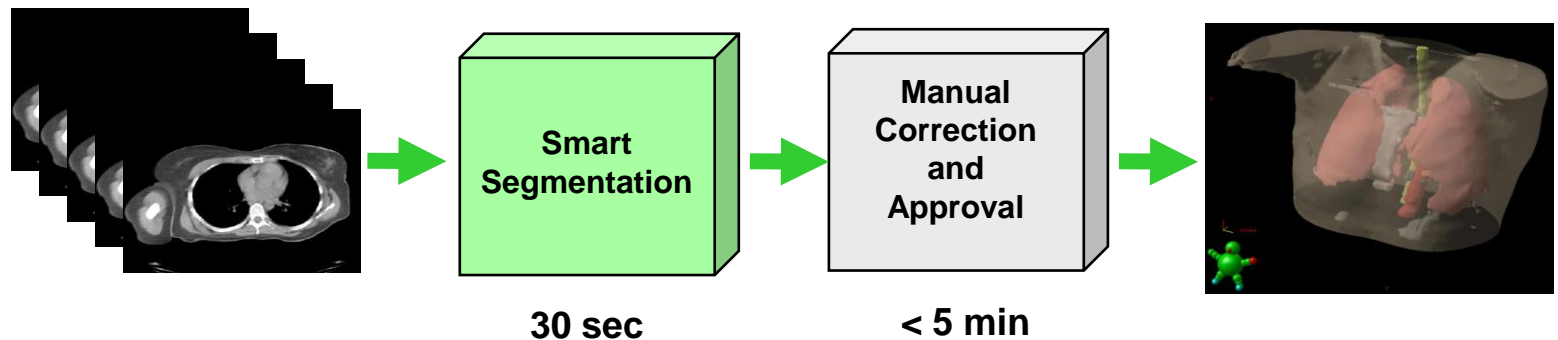


RAPID ARC - Bestrahlungsplanung mit Eclipse

- 'Normaler' IMRT-Planungsprozess
- Arc Optimierung
- Plan Verifikation
- Add. Features

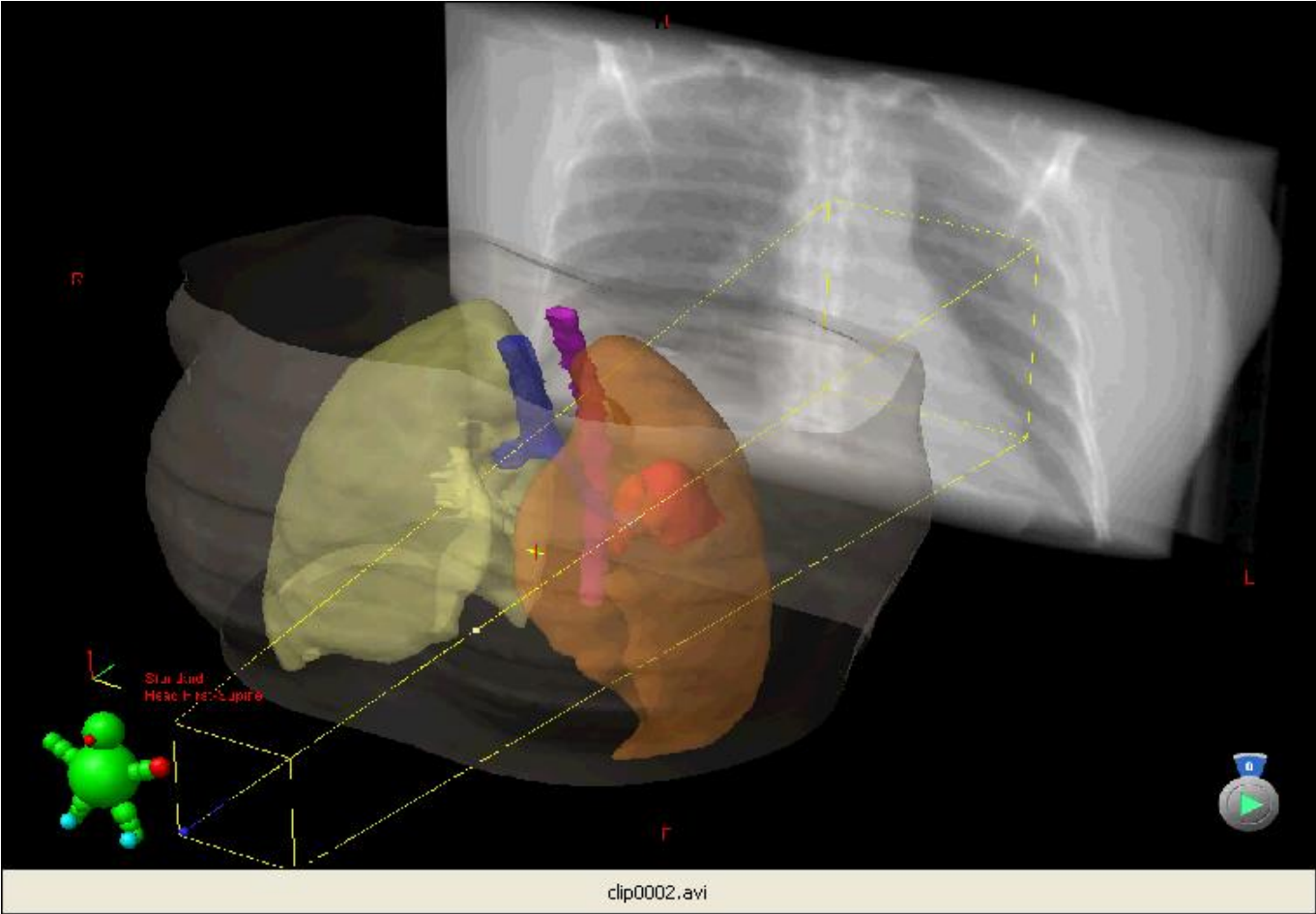
Eclipse Feature → Auto-Segmentierung

- Kompl. Konturing in weniger als 5 Minuten

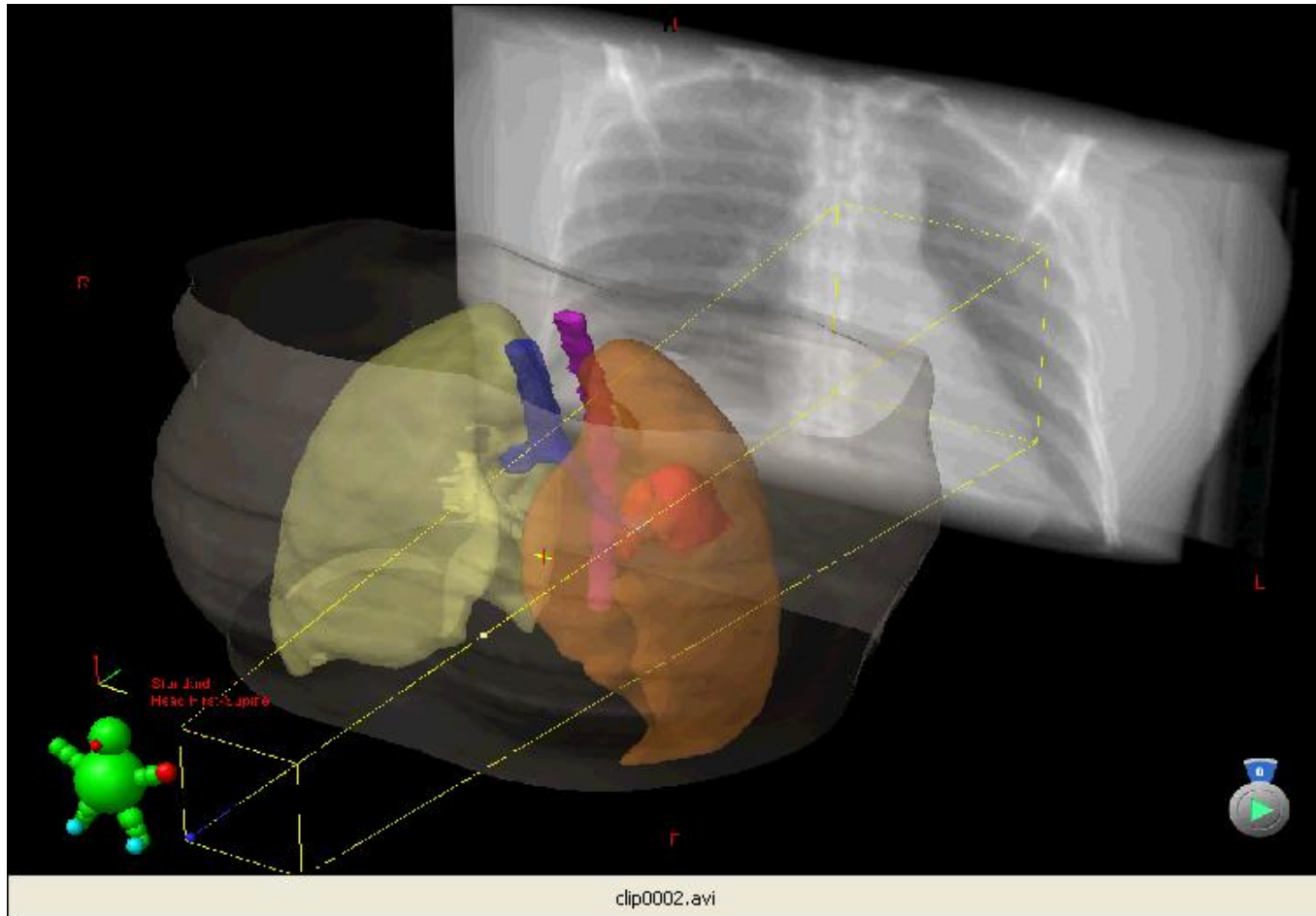


- vollautomatisch
- effektive tools zur Korrektur

Bsp: 'Smart Segmentation'



'Smart Segmentation' mit 4D Darstellung



Eclipse 8.1 Beam Angle Optimierung

- Neue Darstellung des Patienten im 'Helios-Fenster'

Beam Angle Optimization

Structures and Objectives

Use Normal Tissue Objective Priority: 150 Normal Tissue Objective Parameters...

	Volume [cc]	Points	Resolution [mm]
<input checked="" type="checkbox"/> BODY	18626	183956	4.50
<input checked="" type="checkbox"/> Femur Head r	63	2109	3.00
<input checked="" type="checkbox"/> Femur head l	57	2000	2.95
<input checked="" type="checkbox"/> PTV	158	5257	3.00
<input checked="" type="checkbox"/> Prostate	78	2609	3.00
<input checked="" type="checkbox"/> Rectum	84	2807	3.00
<input checked="" type="checkbox"/> Rectum dorsal	52	2000	2.87
<input checked="" type="checkbox"/> bladder	464	15462	3.00

Add Upper Objective Add Lower Objective Delete

Dose Volume Histogram

Calculation Options

Global optimization: 0/71 fields left

Coplanar

Local optimization:

Simplex

Min number of fields: 5

Max number of fields: 9

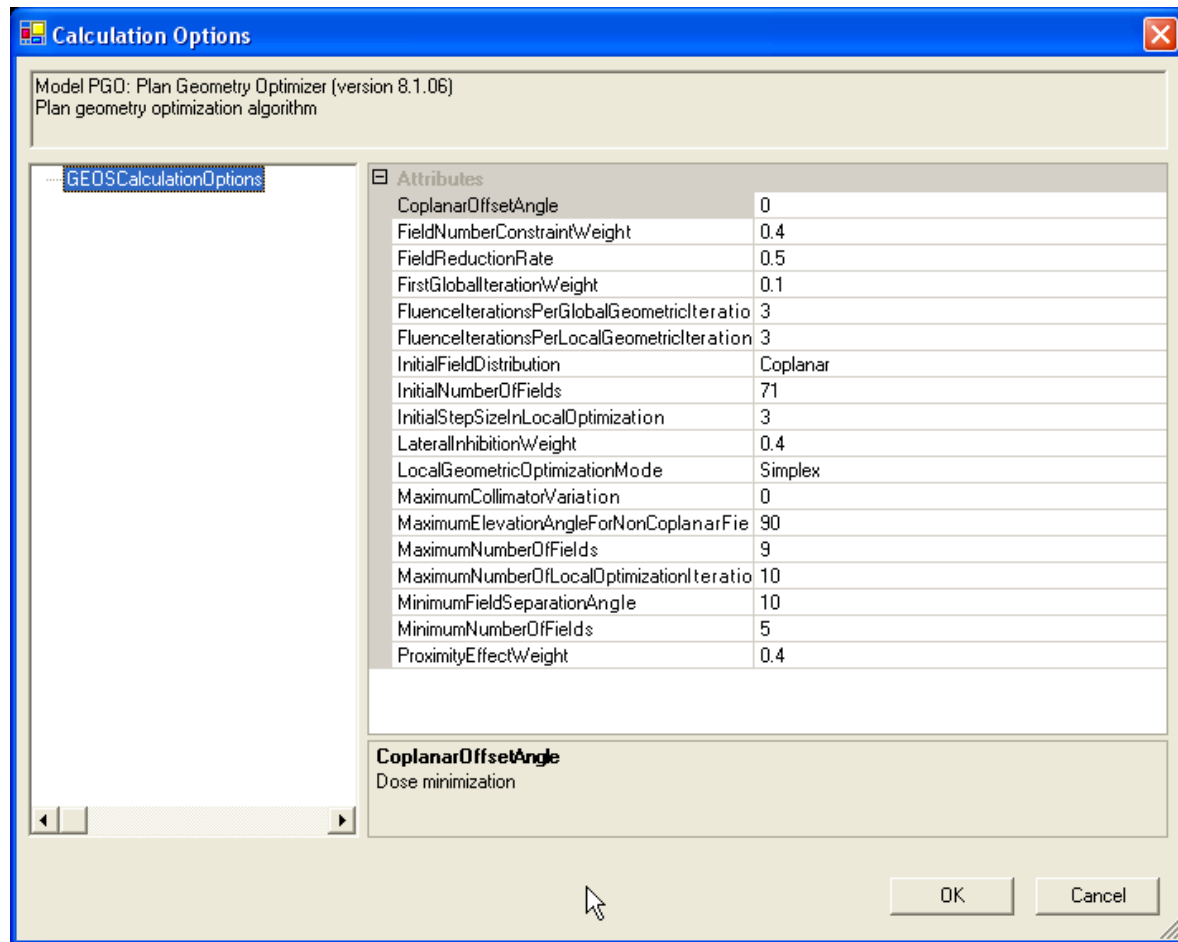
Optimize

Calculation Options... OK Cancel Apply

The screenshot shows the Eclipse 8.1 Beam Angle Optimization interface. The 'Structures and Objectives' table lists various anatomical structures and their associated optimization parameters. The 'Dose Volume Histogram' is currently empty. The 'Calculation Options' section shows the optimization settings, including the number of fields left (0/71) and the number of fields to optimize (5 to 9). The 3D visualization at the bottom shows the patient's head and neck region with beam paths overlaid in green.

Eclipse 8.1 Beam Angle Optimization

- Berechnungsoptionen für PGO (Plan Geometry Optimizer)



Eclipse 8.1 Beam Angle Optimierung

- Beamdarstellung für globale Optimierung

Structures and Objectives

Structure	Type	Volume [cc]	Points	Resolution [mm]	Priority
BODY		18628	57574	10.00	
Femur Head r		63	3285	3.00	
Femur head l		57	3131	2.95	
PTV		158	9912	3.00	
	Upper	Volume [%]: 0.0	Dose [Gy]: 71.0	Priority: 50	
	Lower	Volume [%]: 100.0	Dose [Gy]: 69.0	Priority: 50	
Prostate		78	4280	3.00	
	Upper	Volume [%]: 0.0	Dose [Gy]: 70.7	Priority: 50	
	Lower	Volume [%]: 100.0	Dose [Gy]: 68.8	Priority: 50	
Rectum		84	4848	3.00	
	Upper	Volume [%]: 14.1	Dose [Gy]: 55.1	Priority: 50	
	Upper	Volume [%]: 3.8	Dose [Gy]: 67.9	Priority: 50	
Rectum dorsal		52	3650	2.87	
bladder		464	20876	3.00	
	Upper	Volume [%]: 6.6	Dose [Gy]: 64.8	Priority: 50	
	Upper	Volume [%]: 44.0	Dose [Gy]: 32.2	Priority: 50	

Dose Volume Histogram

Volume [%] vs. Dose [Gy]

Calculation Options

Global optimization: Performing GLOBAL optimization... 38/71 fields left

Local optimization: Simplex

Min number of fields: 5

Max number of fields: 9

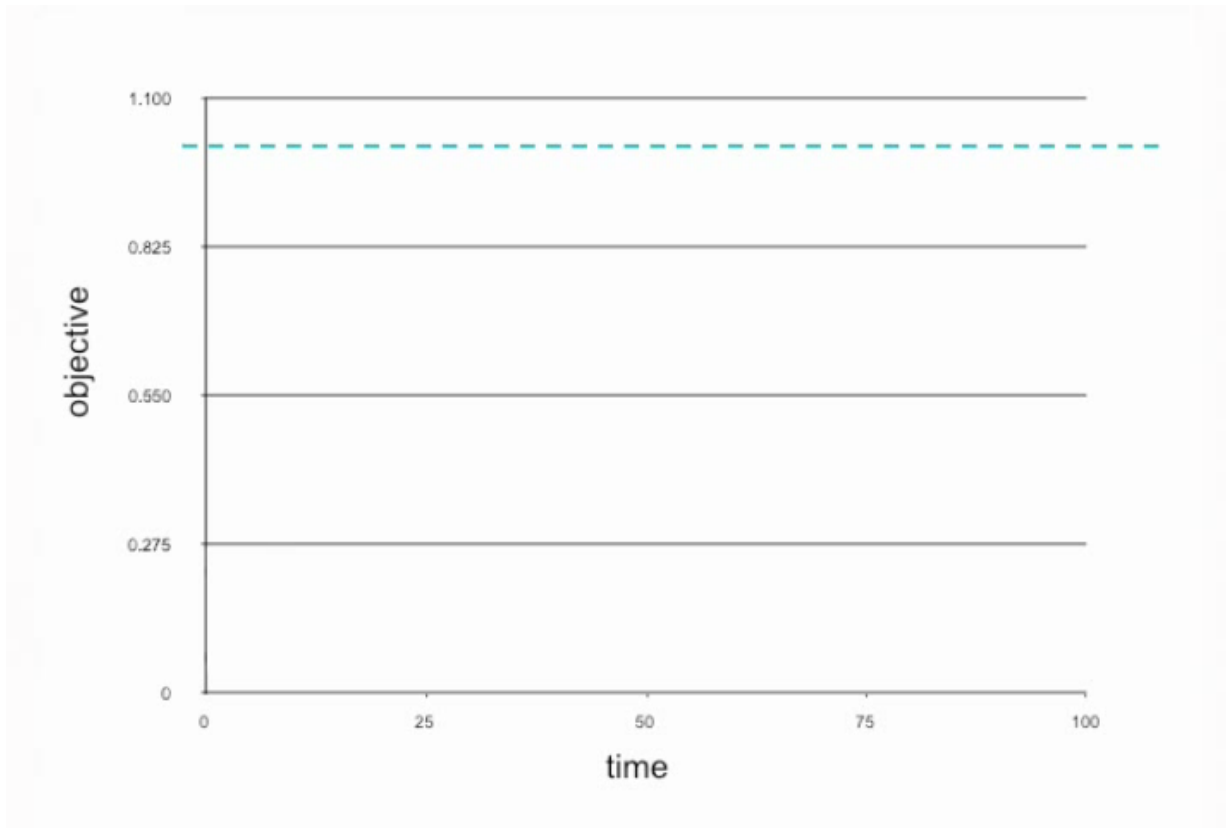
Optimizing ... 0h 1m 29s

Optimize

Calculation Options... OK Cancel Apply

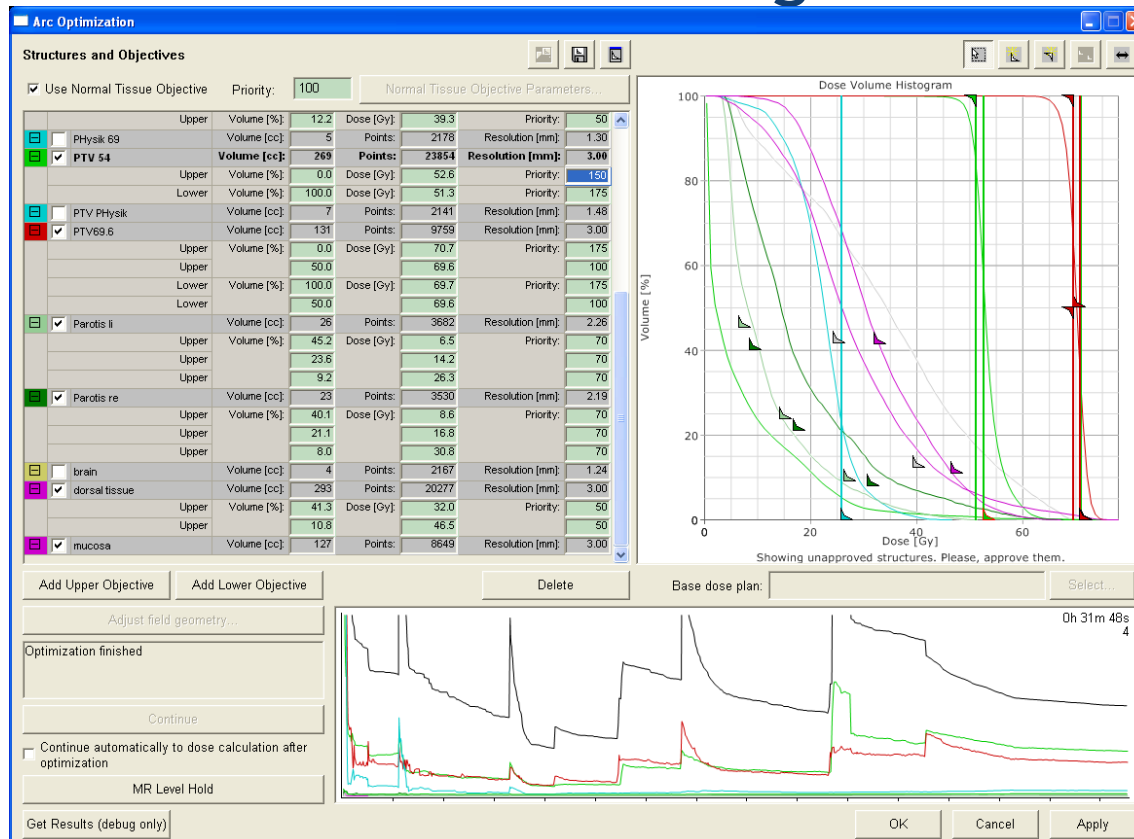
RapidArc Planning for Eclipse

- Progressive sampling in optimization



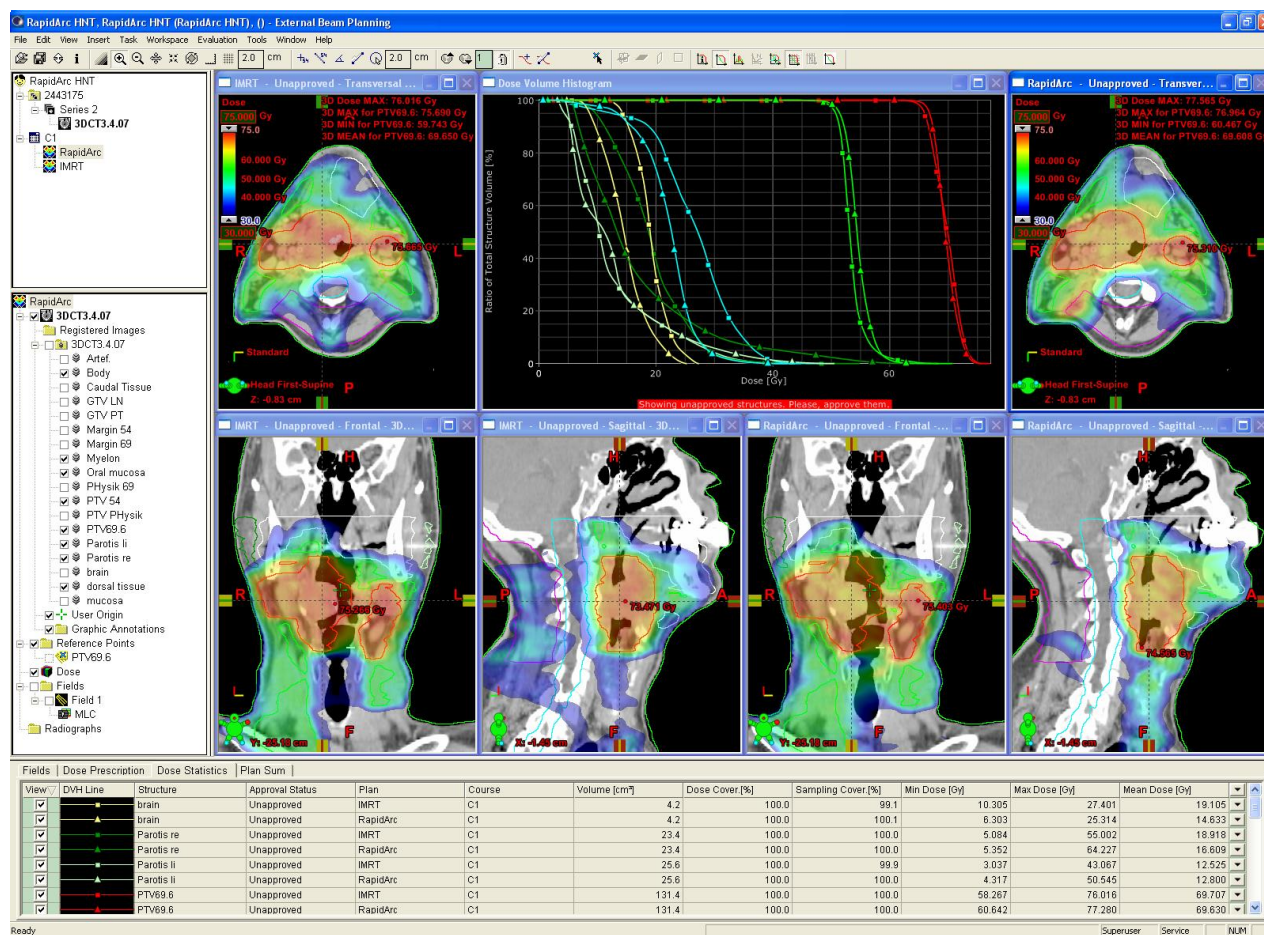
RapidArc Optimierung

■ Autostart der Dosisberechnung

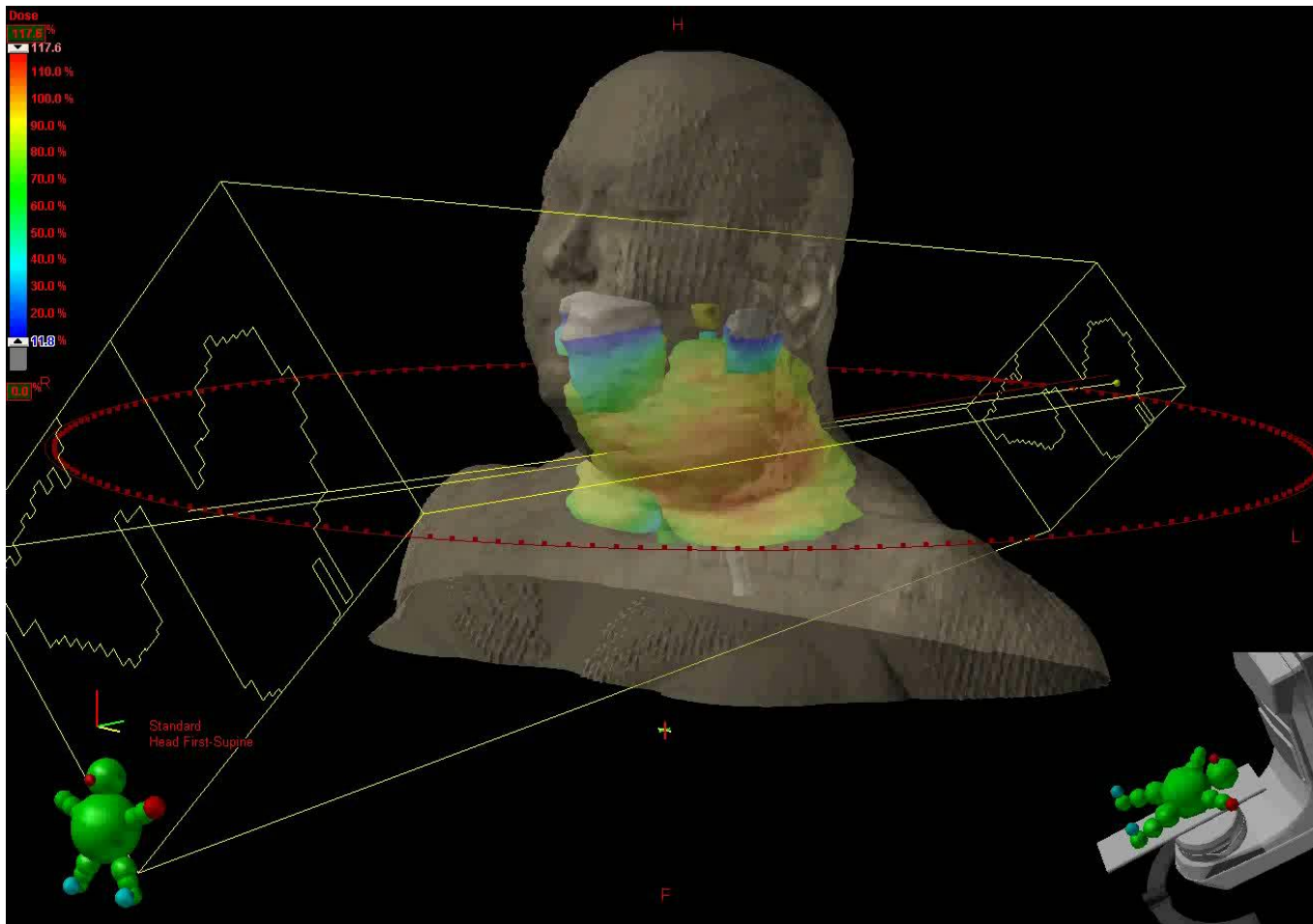


RapidArc Beispiel

- HNT
- RapidArc ▲
- IMRT ■
- RapidArc
- 662 MU
- IMRT
- >1000 MU



Geschwindigkeit - 2-8 mal schneller



Arc
Optimierung
in Eclipse TPS

The Importance of Treatment Time

In vitro study of cell survival following dynamic MLC intensity-modulated radiation therapy dose delivery^{a)}

Vitali Moiseenko^{b)} and Cheryl Duzenli

Vancouver Cancer Centre, British Columbia Cancer Agency, 600 West 10th Avenue, Vancouver, British Columbia V5Z 4E6, Canada, and Department of Physics and Astronomy, University of British Columbia, 6224 Agricultural Road, Vancouver, British Columbia V6T 1Z1, Canada

Ralph E. Durand

BCCA Cancer Research Centre, 675 West 10th Avenue, Vancouver, British Columbia V5Z 1L3, Canada

(Received 23 October 2006; revised 9 January 2007; accepted for publication 6 February 2007; published 28 March 2007)

The possibility of reduced cell kill following intensity-modulated radiation therapy (IMRT) compared to conventional radiation therapy has been debated in the literature. This potential reduction in cell kill relates to prolonged treatment times typical of IMRT dose delivery and consequently increased repair of sublethal lesions. While there is some theoretical support to this reduction in cell kill published in the literature, direct experimental evidence specific to IMRT dose delivery patterns is lacking. In this study we present cell survival data for three cell lines: Chinese hamster V79 fibroblasts, human cervical carcinoma, SiHa and colon adenocarcinoma, WiDr. Cell survival was obtained for 2.1 Gy delivered as acute dose with parallel-opposed pair (POP), irradiation time 75 s, which served as a reference; regular seven-field IMRT, irradiation time 5 min; and IMRT with a break for multiple leaf collimator (MLC) re-initialization after three fields were delivered, irradiation time 10 min. An actual seven-field dynamic MLC IMRT plan for a head and neck patient was used. The IMRT plan was generated for a Varian EX or iX linear accelerator with 120 leaf Millennium MLC. Survival data were also collected for doses 1×, 2×, 3×, 4×, and 5× 2.1 Gy to

**Innovative Systemlösungen
für die Strahlentherapie
aus einer Hand**

**Vielen Dank
für Ihre Aufmerksamkeit**

