

# Clinical benefits using MapRT for extracranial non-coplanar treatment planning – implementation in clinical routine and first results

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Gemeinsam fürs Leben.

# Disclosures

Department for radiooncology and radiotherapy of Klinikum Darmstadt GmbH has a research agreement with VisionRT

This presentation is honored by VisionRT.

# MapRT at Klinikum Darmstadt

## Overview:

- **how MapRT is used in our department**
- advantages in dose distribution in non-coplanar treatment with MapRT
- clinical implementation of non coplanar treatment
- summary and next steps

# MapRT at Klinikum Darmstadt

8 Select Patient Review Setup Clearance Map NOT FOR CLINICAL USE physik

Plan Name: NNiere li, ISO (mm) [30.0, 42.0, -75.0] (01/11/2024 09:27:08) Continue to Clearance Map

Select Patient Surface

Surface Name	Captured
20241030 112805	30/10/2024 12:28:05

Select Treatment Room

01. TrueBeam- no H&N extension	[EDGE] TrueBeam	IGRT Exact
02. TrueBeam - with H&N ext.	TrueBeam	IGRT Exact H&N ext
03. Elektronen (e=6)	[EDGE] TrueBeam (e=6)	IGRT Exact
04. Elektronen (e=10)	[EDGE] TrueBeam (e=10)	IGRT Exact
04. Elektronen (e=15)	[EDGE] TrueBeam (e=15)	IGRT Exact
06. Elektronen (e=20)	[EDGE] TrueBeam (e=20)	IGRT Exact
07. Elektronen (e=25)	[EDGE] TrueBeam (e=25)	IGRT Exact
08. TrueBeam (img=50cm)	[EDGE] TrueBeam (img=50)	IGRT Exact



# MapRT at Klinikum Darmstadt

MapRT interface showing patient setup and treatment parameters.

Navigation: Select Patient | Review Setup | **Clearance Map** | NOT FOR CLINICAL USE | physik

Isocenter (cm): X (R-L) 3, Y (I-S) -7.5, Z (P-A) 4.2  
Couch Buffer (cm) 4, Patient Buffer (cm) 4

Couch Shift (cm): X 0, Y 0, Z 0

Buttons: [Data](#) [Report](#)

Patient:  NNiere li

Status	#	ID	Type	Gantry	Couch	Direction	
<input checked="" type="checkbox"/>	1	Field 1	Arc	330° to 179°	0°	CW	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	2	Field 2	Arc	179° to 330°	0°	CC	<input checked="" type="checkbox"/>

01. TrueBeam - no H&N extension



# MapRT at Klinikum Darmstadt

MapRT interface showing patient setup and treatment parameters.

**NOT FOR CLINICAL USE**

physik ▾

Select Patient Review Setup Clearance Map

Isocenter (cm) X (R-L) 2 Y (L-S) -7.5 Z (P-A) 4.2 Couch Buffer (cm) 4 Patient Buffer (cm) 4

Couch Shift (cm) X 0 Y 0 Z 0

Download Data Report

NNiere li NC

Status	#	ID	Type	Gantry	Couch	Direction	✓
✓	1	Field 3	Arc	330° to 179°	345°	CW	✓
✓	2	Field 2	Arc	179° to 330°	11°	CC	✓
✓	3	Field 1	Arc	181° to 179°	0°	CW	✓

Gantry Angle (°)

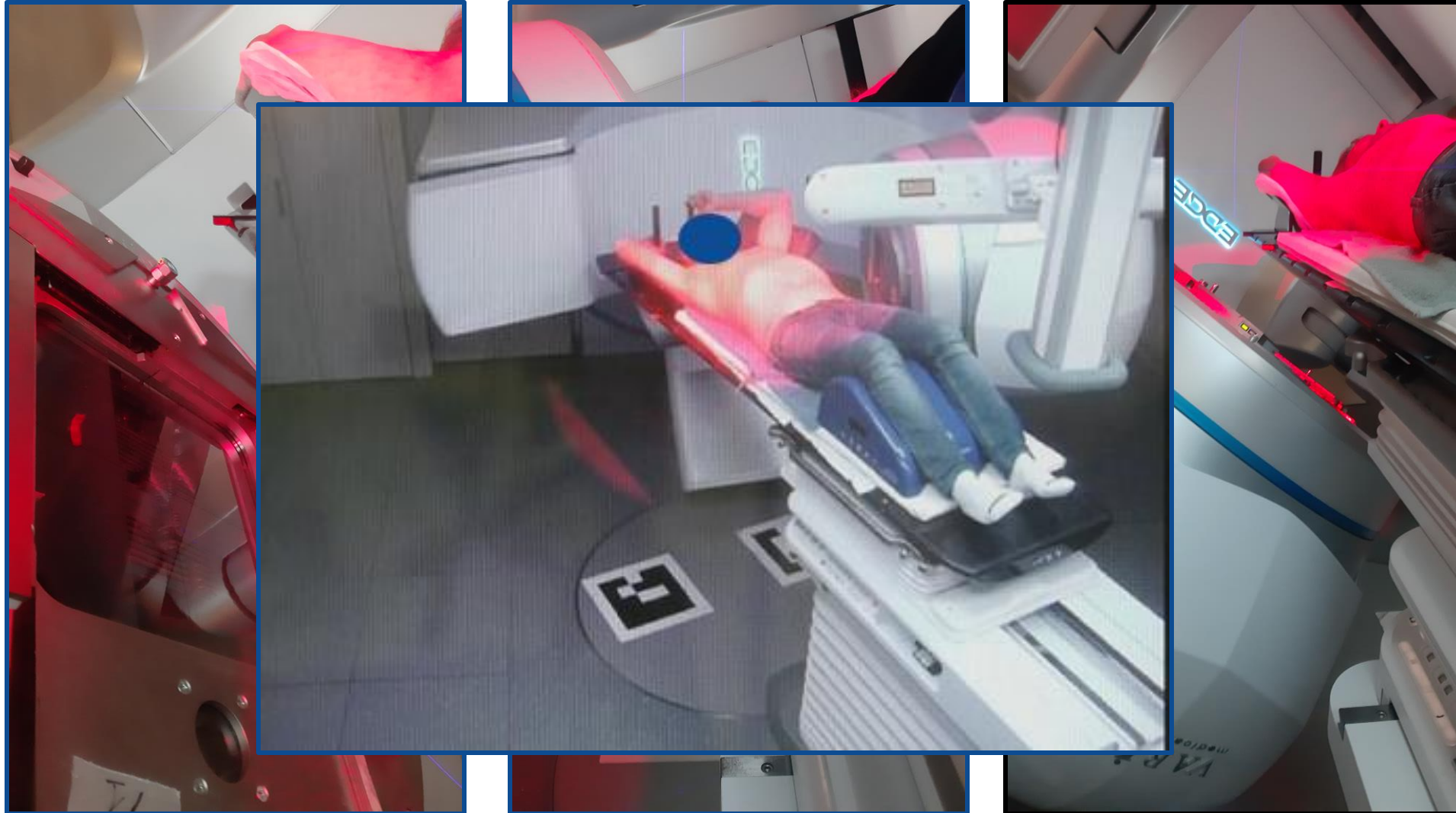
Couch Angle (°)

C:0° G:0°

Couch Angle (°) 0 Gantry Angle (°)

01. TrueBeam- no H&N extension

# Influence of couch and patient buffer



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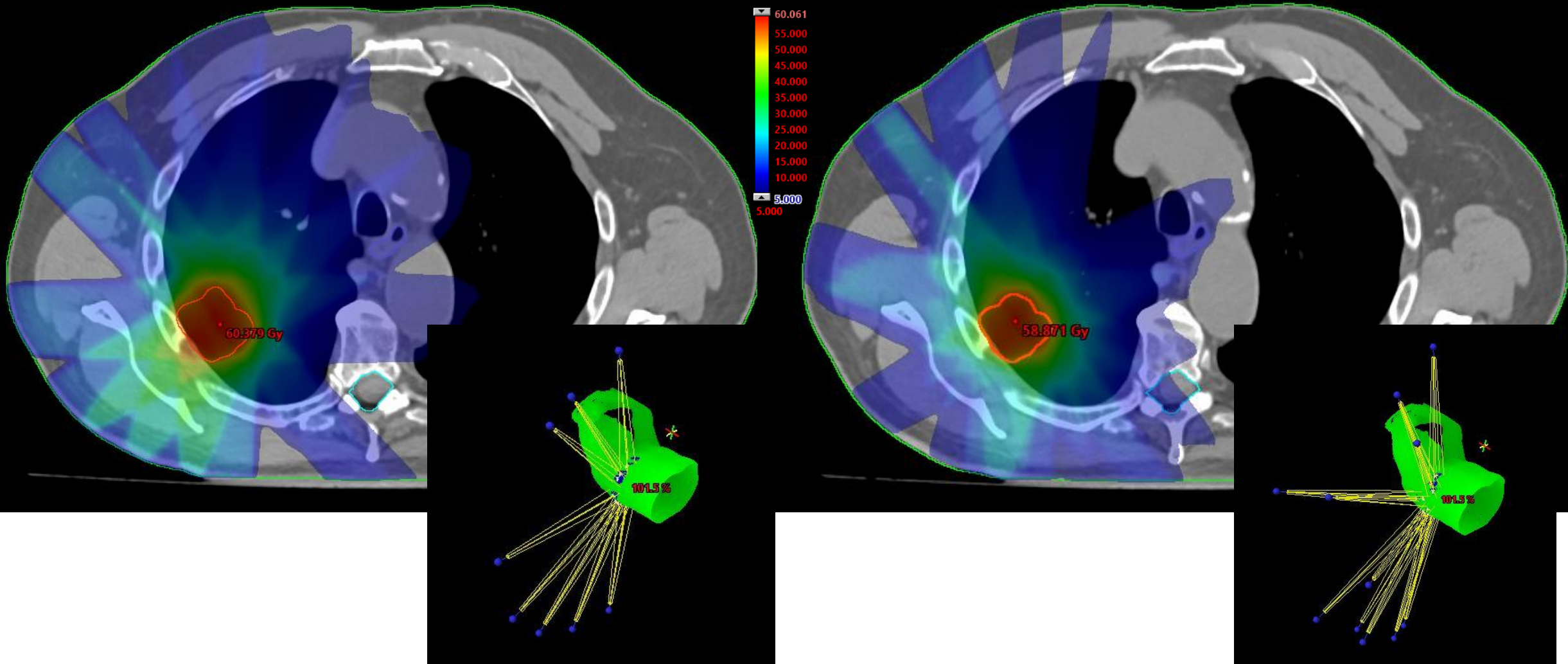


# plan optimization using non-coplanar fields – SBRT lung

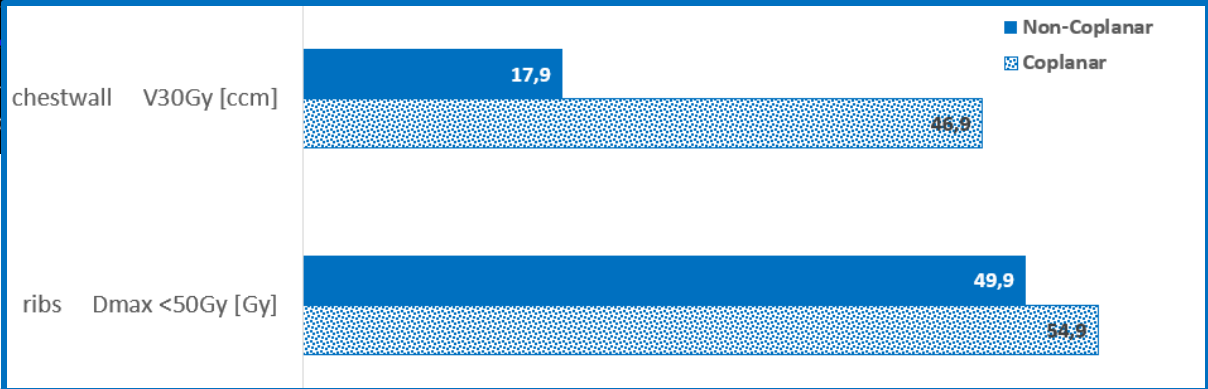
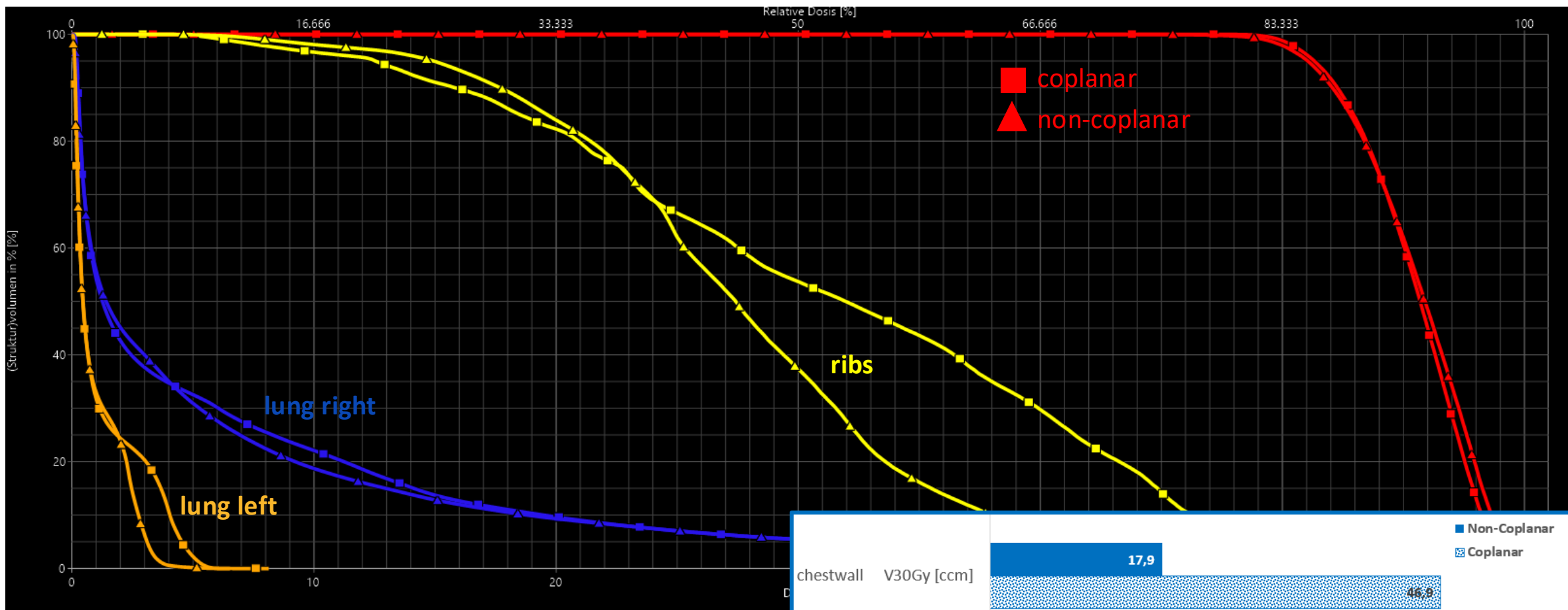
8 fixed fields coplanar

prescription: 4\*12Gy [80%]

12 fixed fields - 7 non-coplanar



# plan optimization using non-coplanar fields – SBRT lung

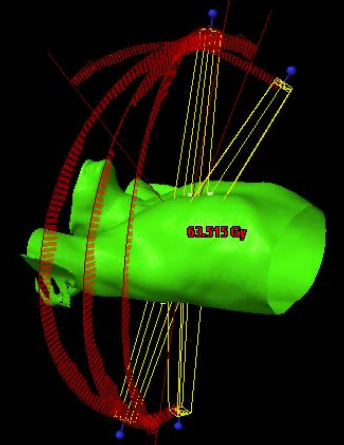
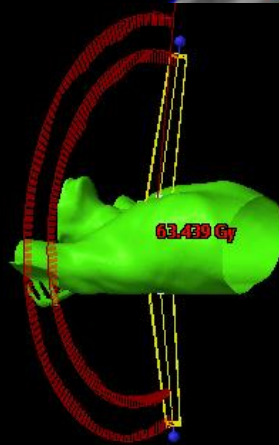
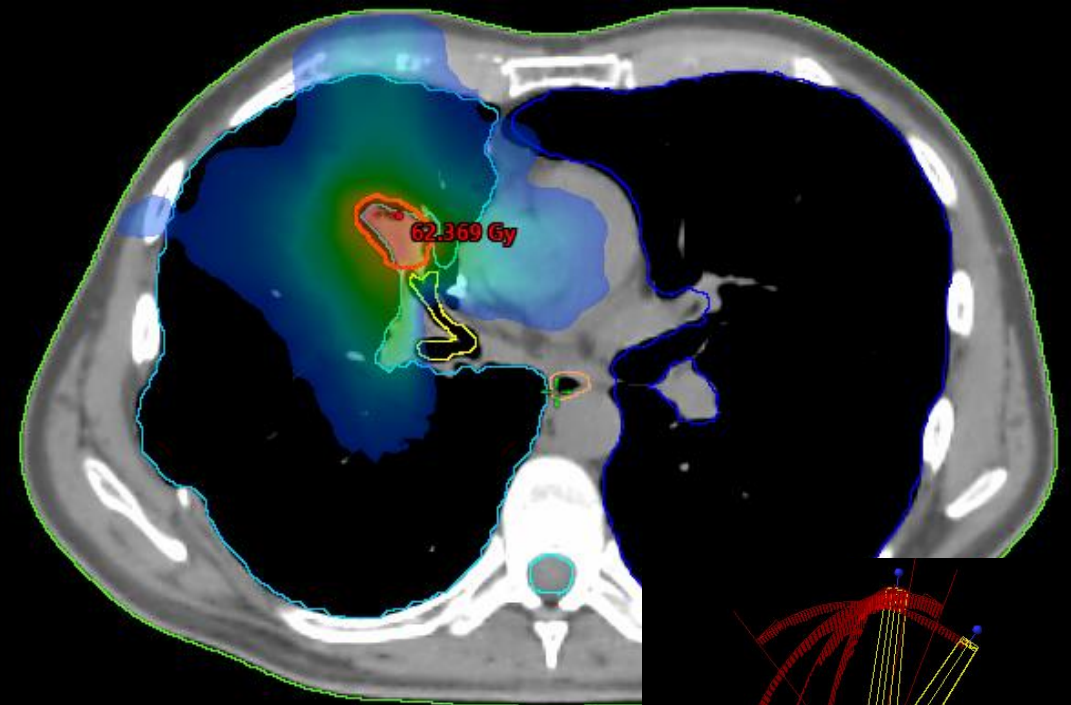
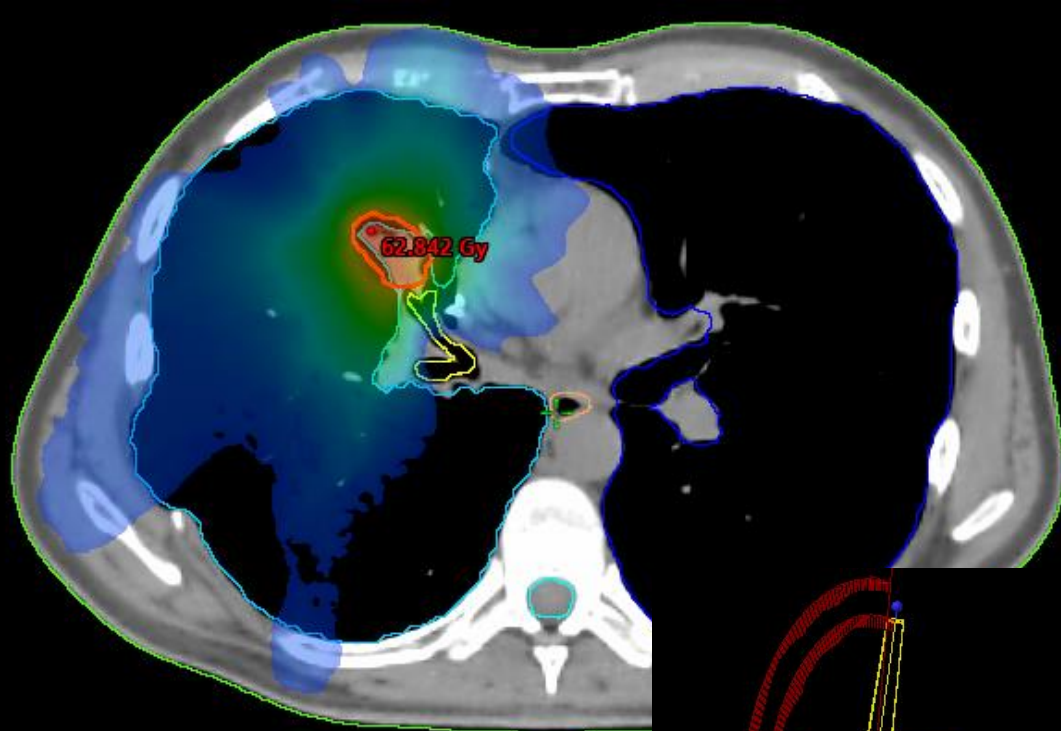


# plan optimization using non-coplanar fields – SBRT lung

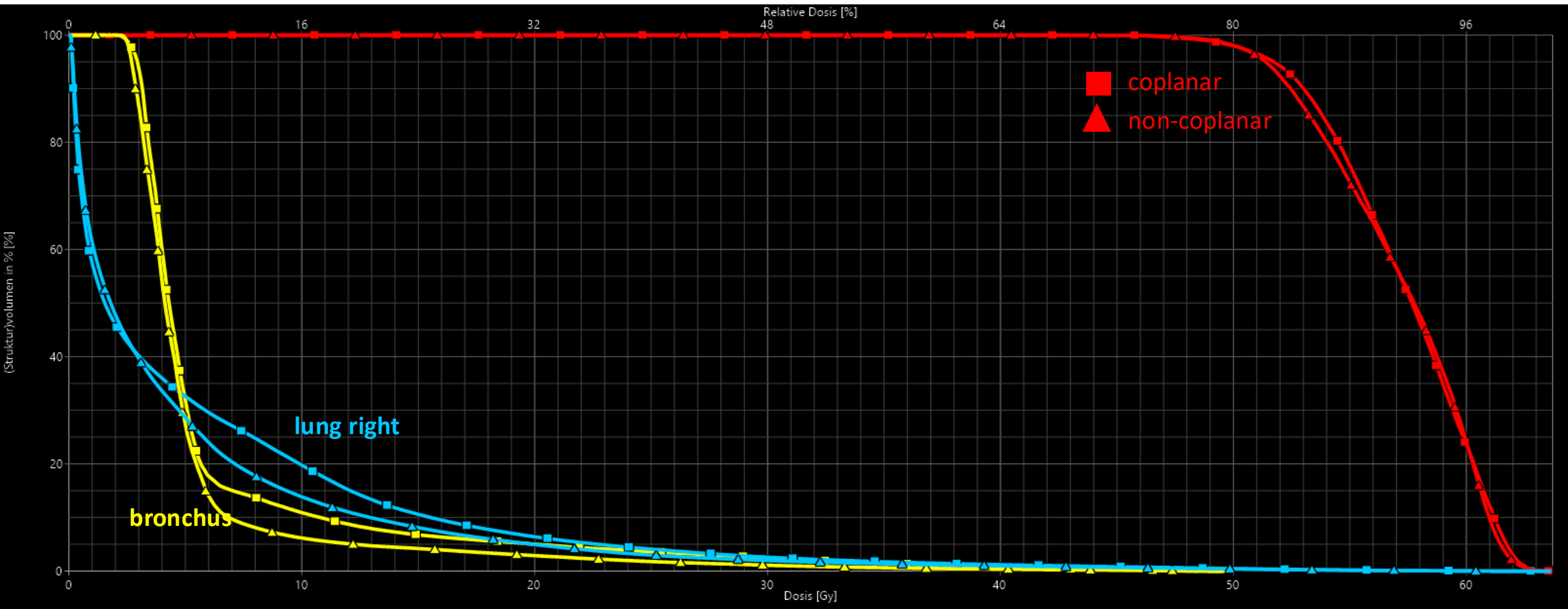
2 VMAT fields– coplanar

prescription: 10\*5,0Gy (80%)

4 VMAT fields – 3 non-coplanar



# plan optimization using non-coplanar fields – SBRT lung



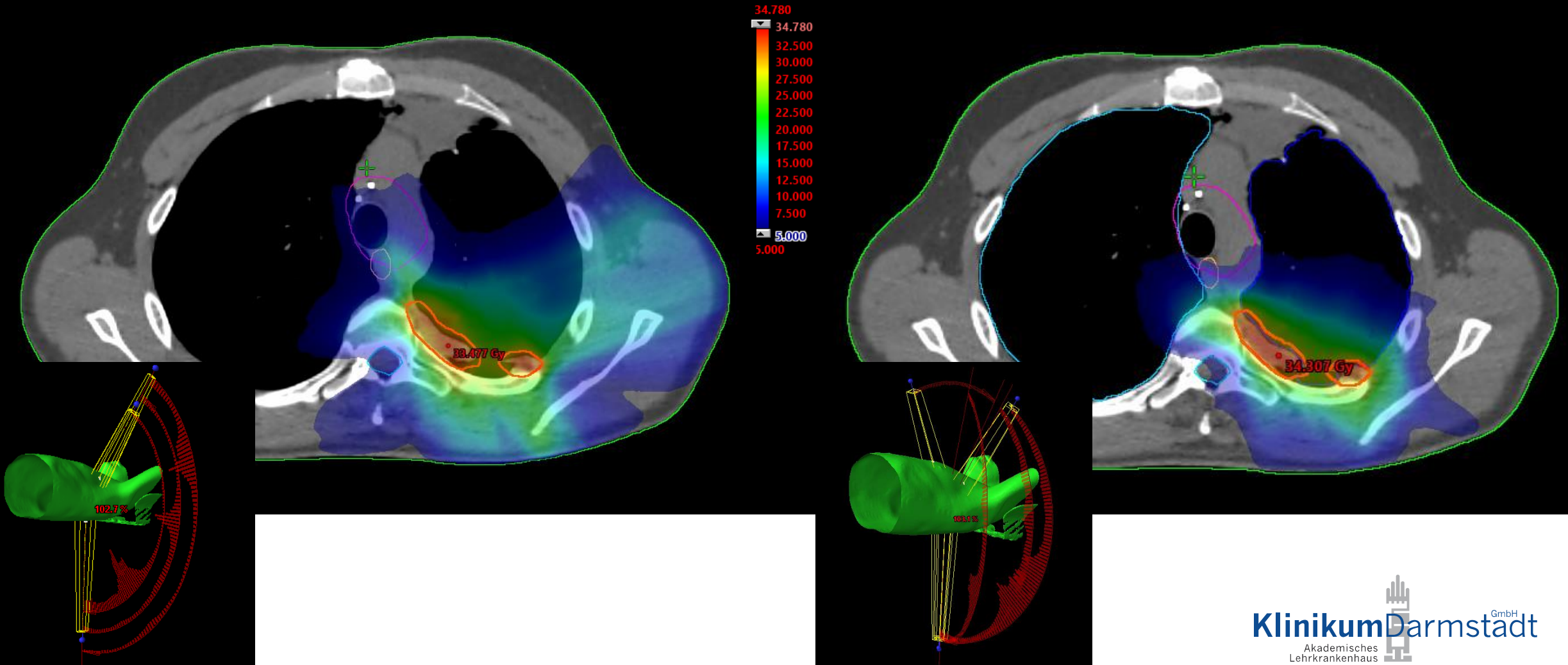


# plan optimization using non-coplanar fields – metastasis of a thymoma

3 VMAT fields– coplanar

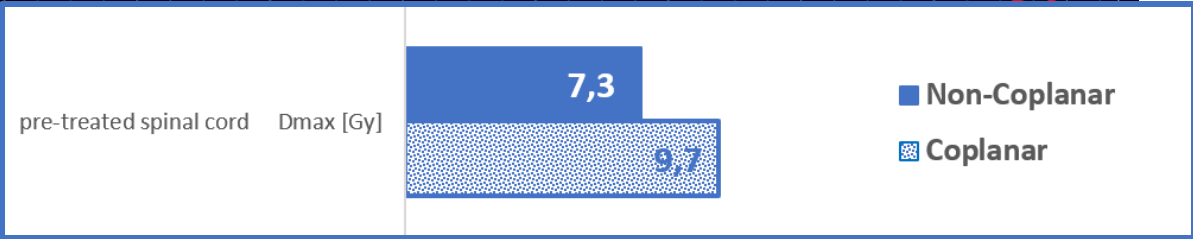
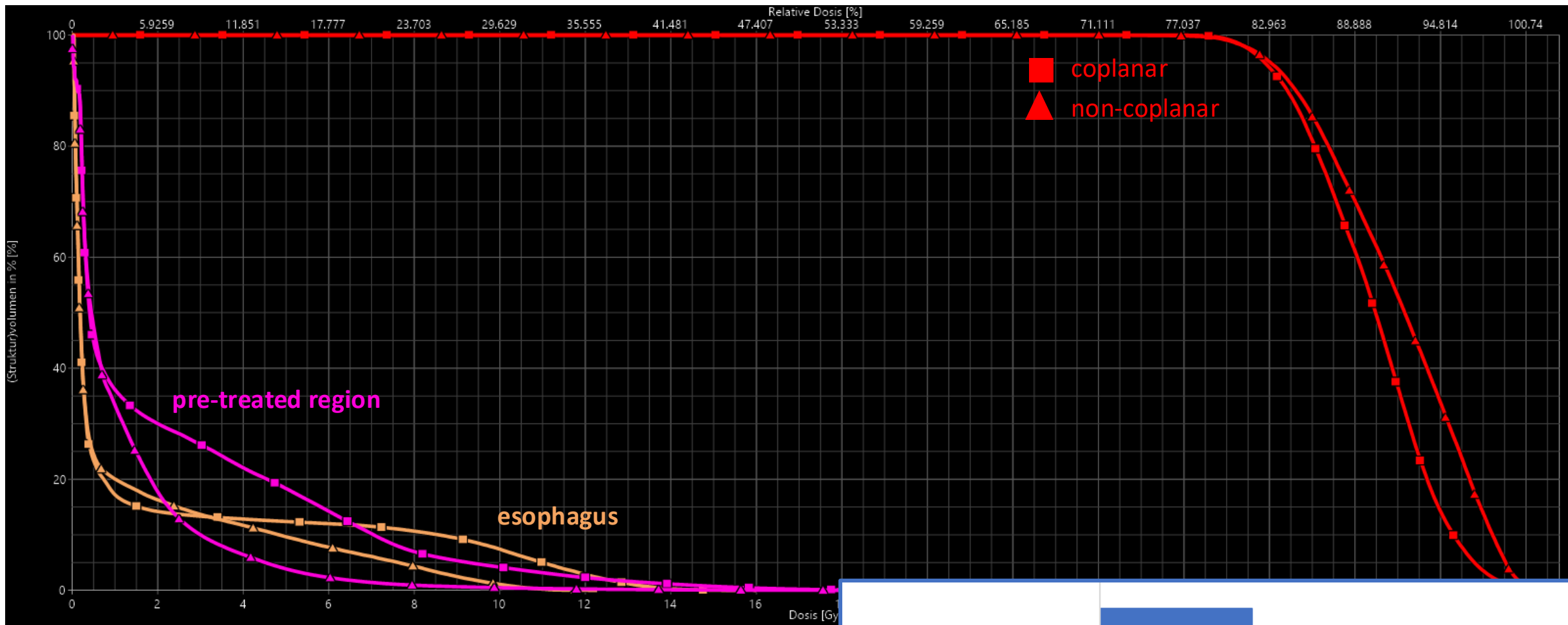
prescription: 3\*9,0Gy (80%)

4 VMAT fields – 3 non-coplanar





# plan optimization using non-coplanar fields – metastasis of a thymoma

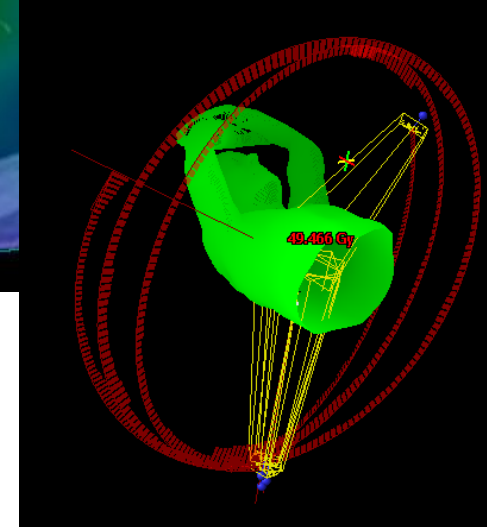
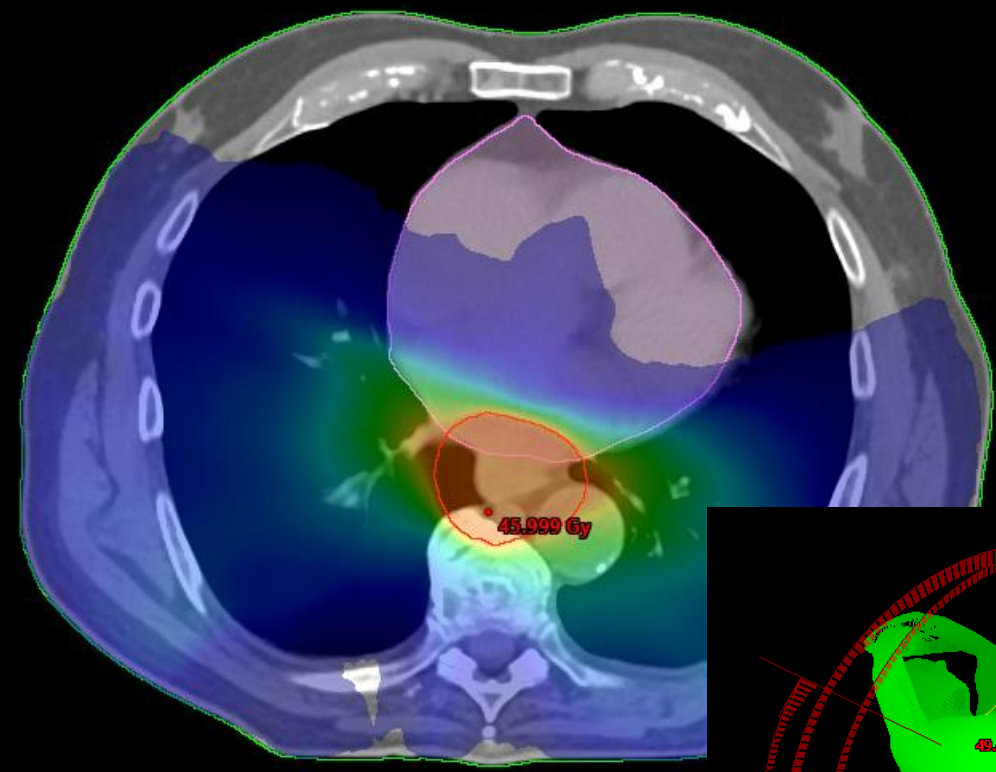
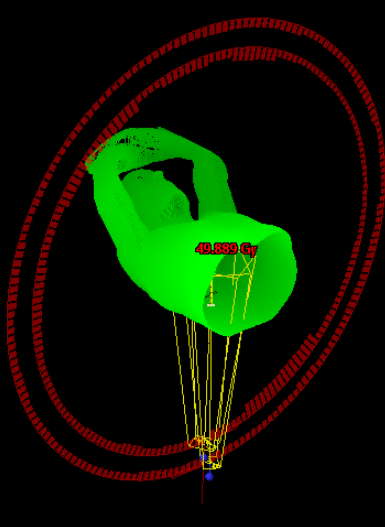
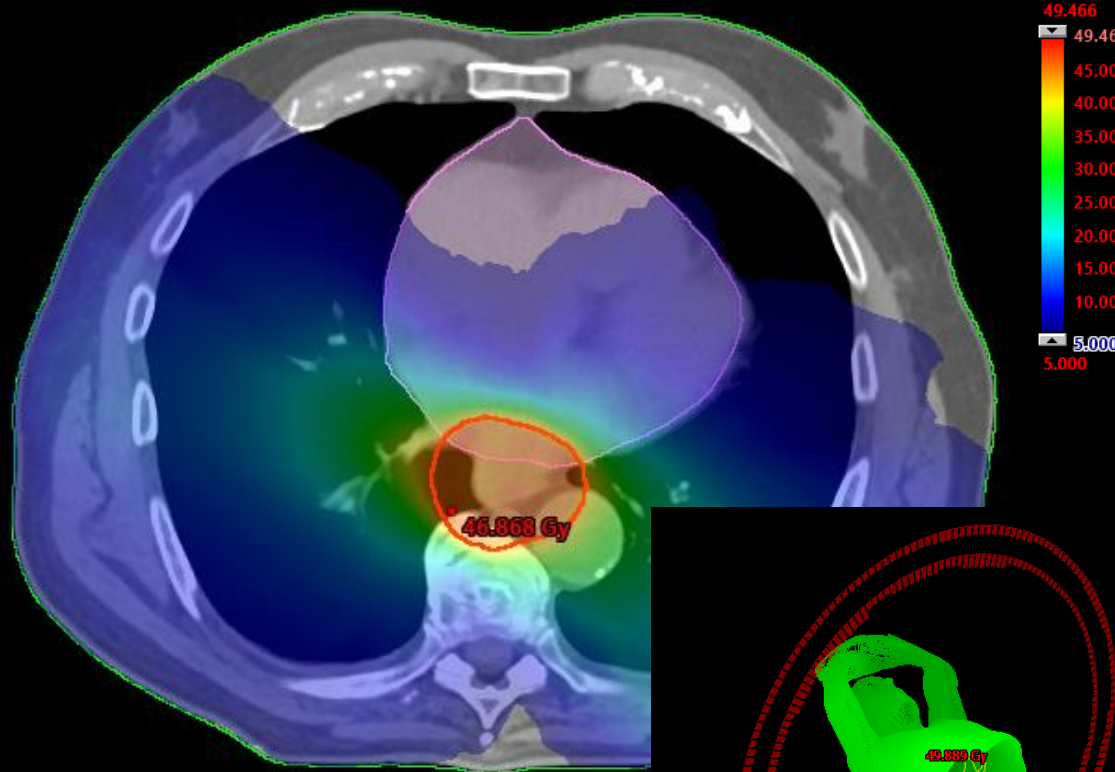


# plan optimization using non-coplanar fields – esophagus

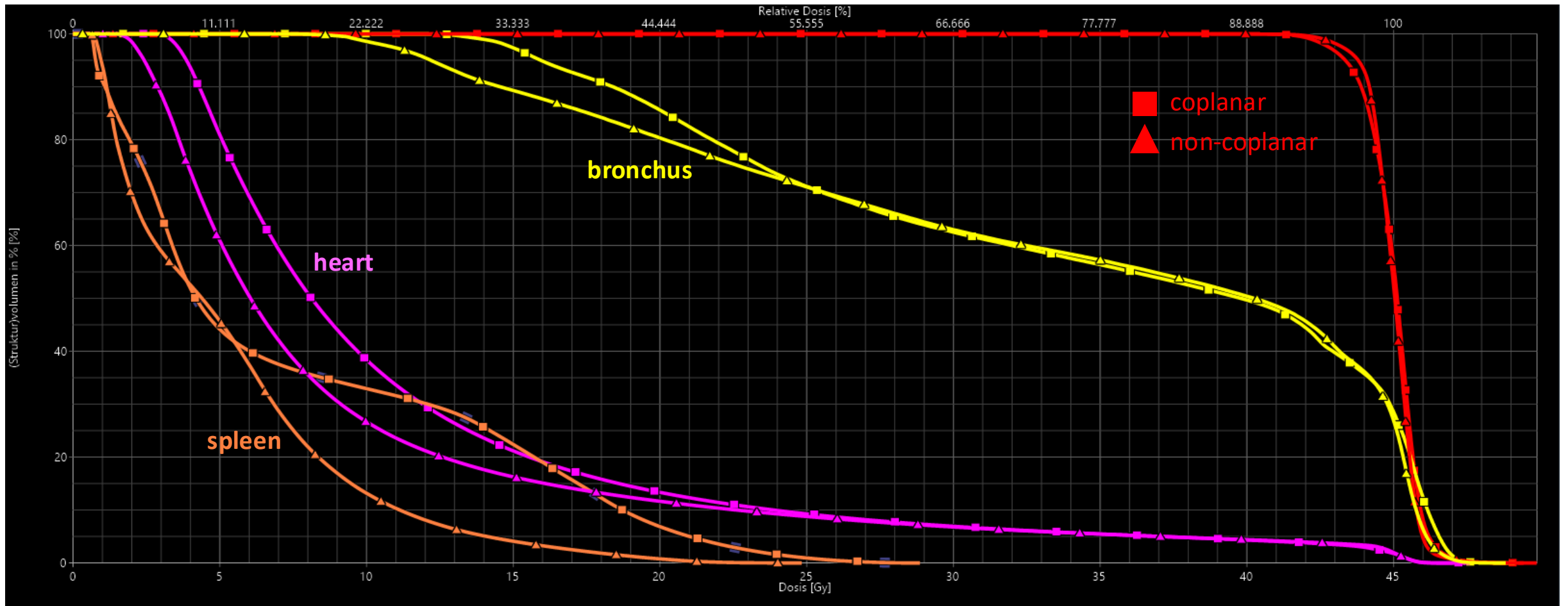
2 VMAT fields – coplanar

prescription: 25\*1,8Gy

4 VMAT fields – 4 non-coplanar



# plan optimization using non-coplanar fields – esophagus

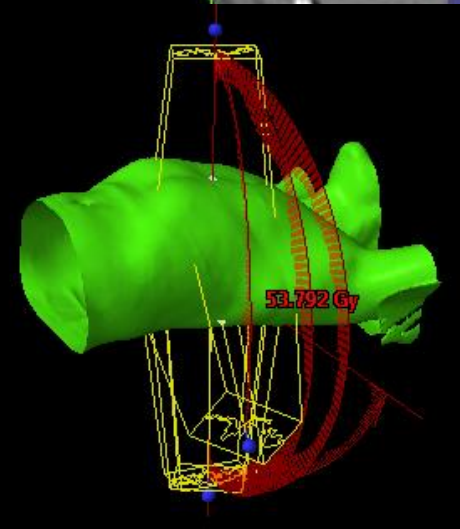
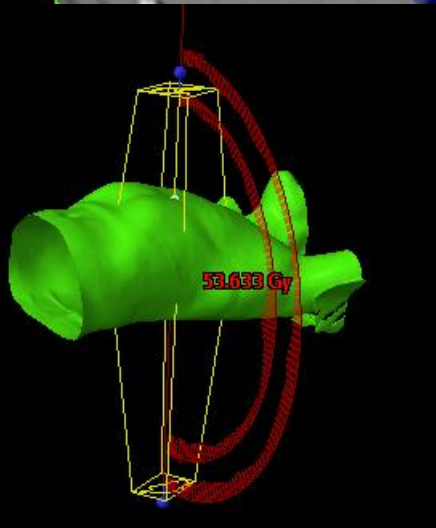
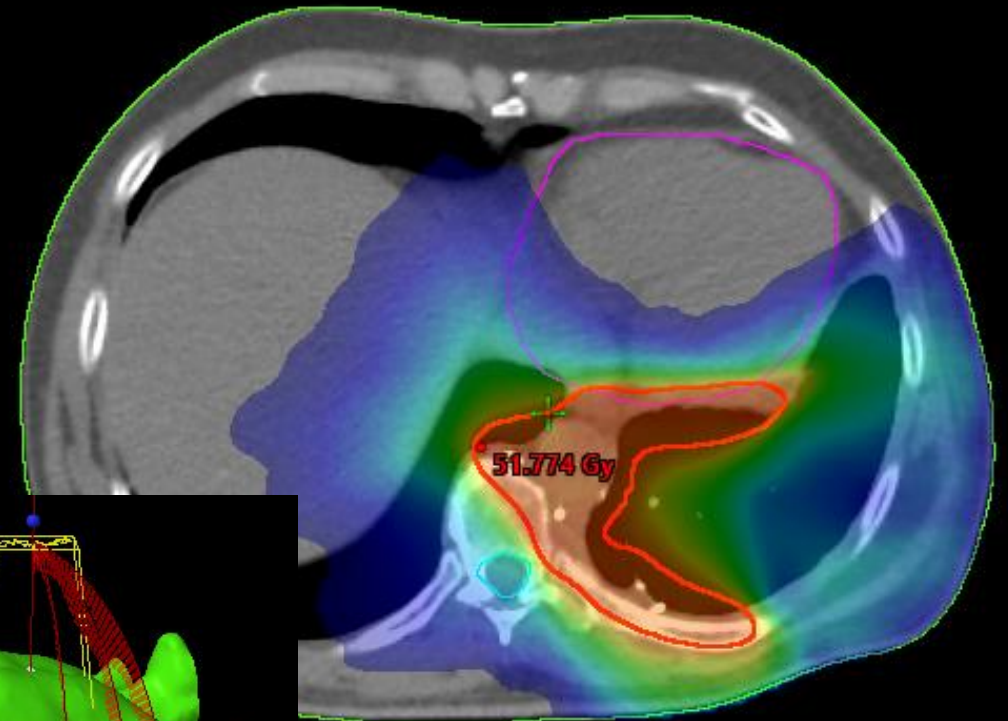
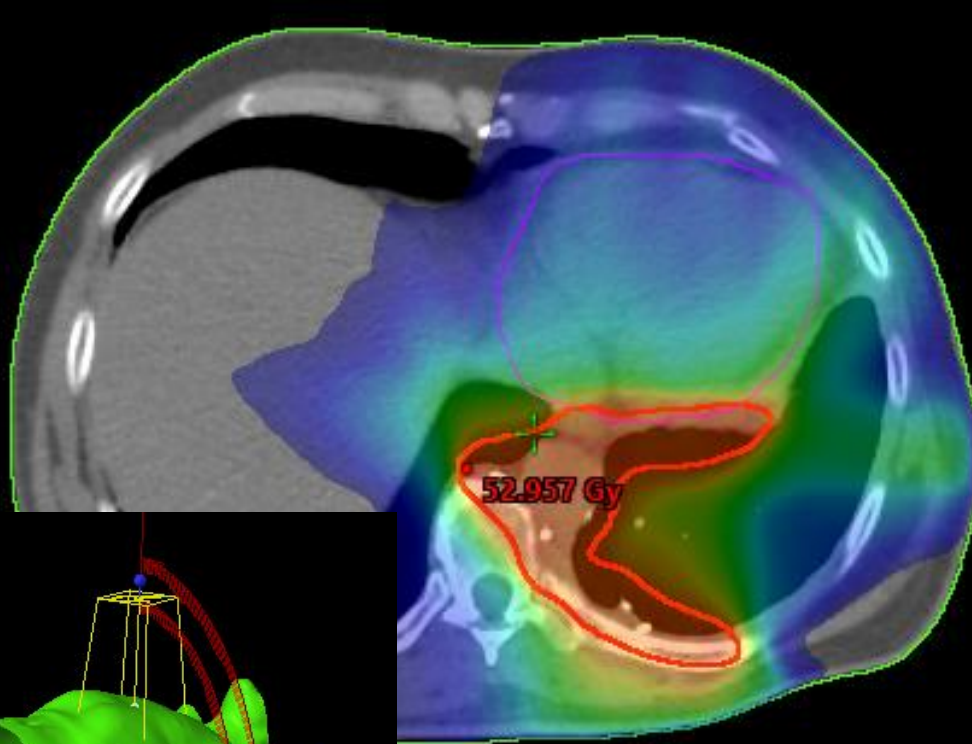


# plan optimization using non-coplanar fields – desmoid

2 VMAT fields– coplanar

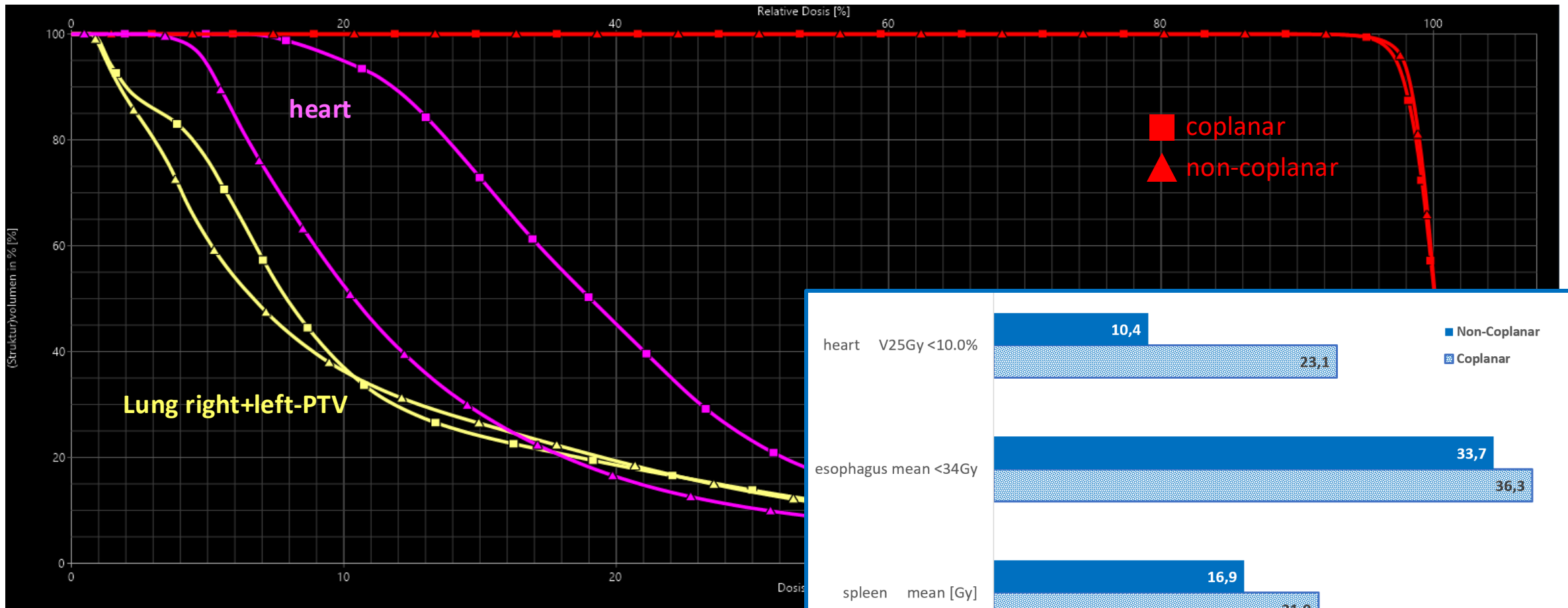
prescription: 25\*2Gy

4 VMAT fields – 3 non-coplanar





# plan optimization using non-coplanar fields – desmoid



Organ	Parameter	Non-Coplanar	Coplanar
heart	V25Gy <10.0%	10,4	23,1
esophagus	mean <34Gy	33,7	36,3
spleen	mean [Gy]	16,9	21,9
spinal cord	Dmax [Gy]	36,8	40,1

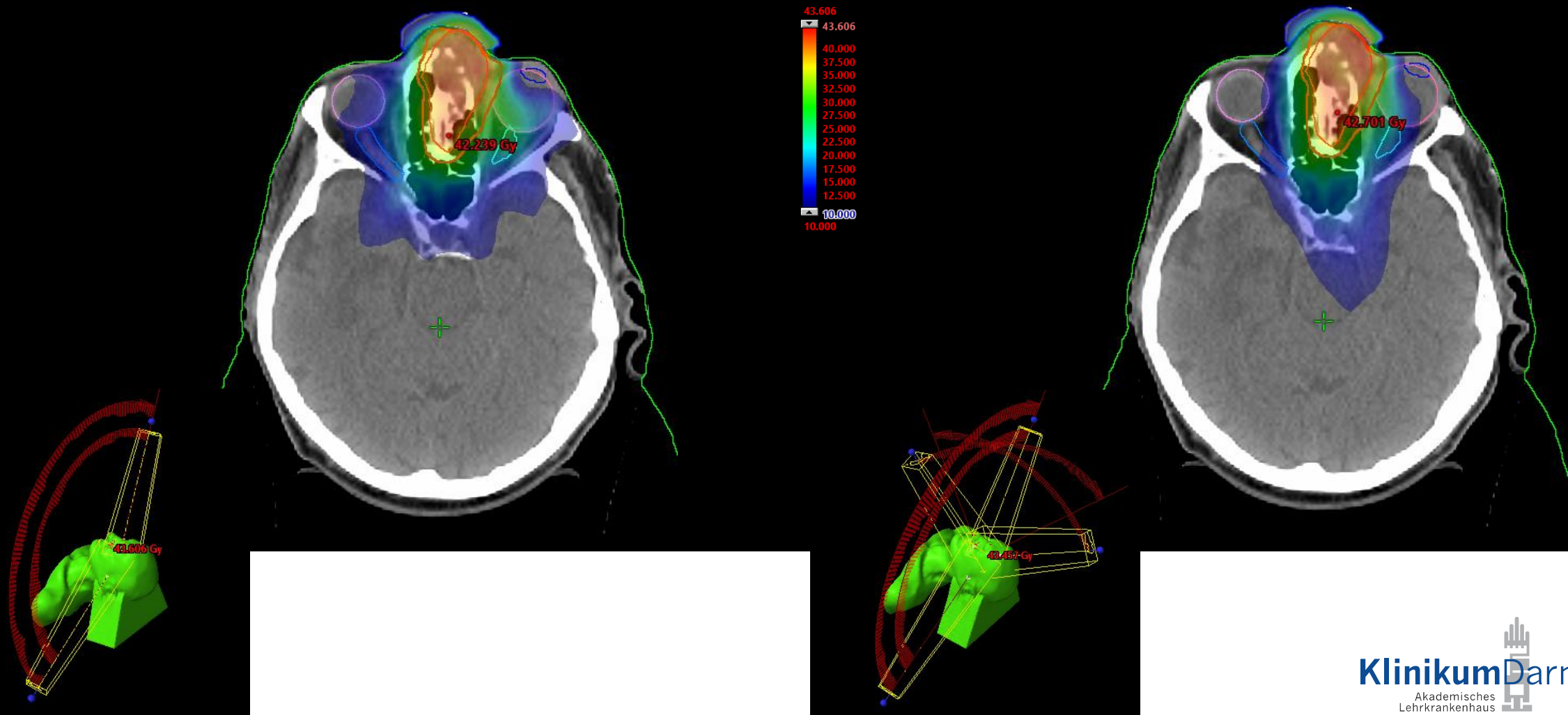


# plan optimization using non-coplanar fields – nose

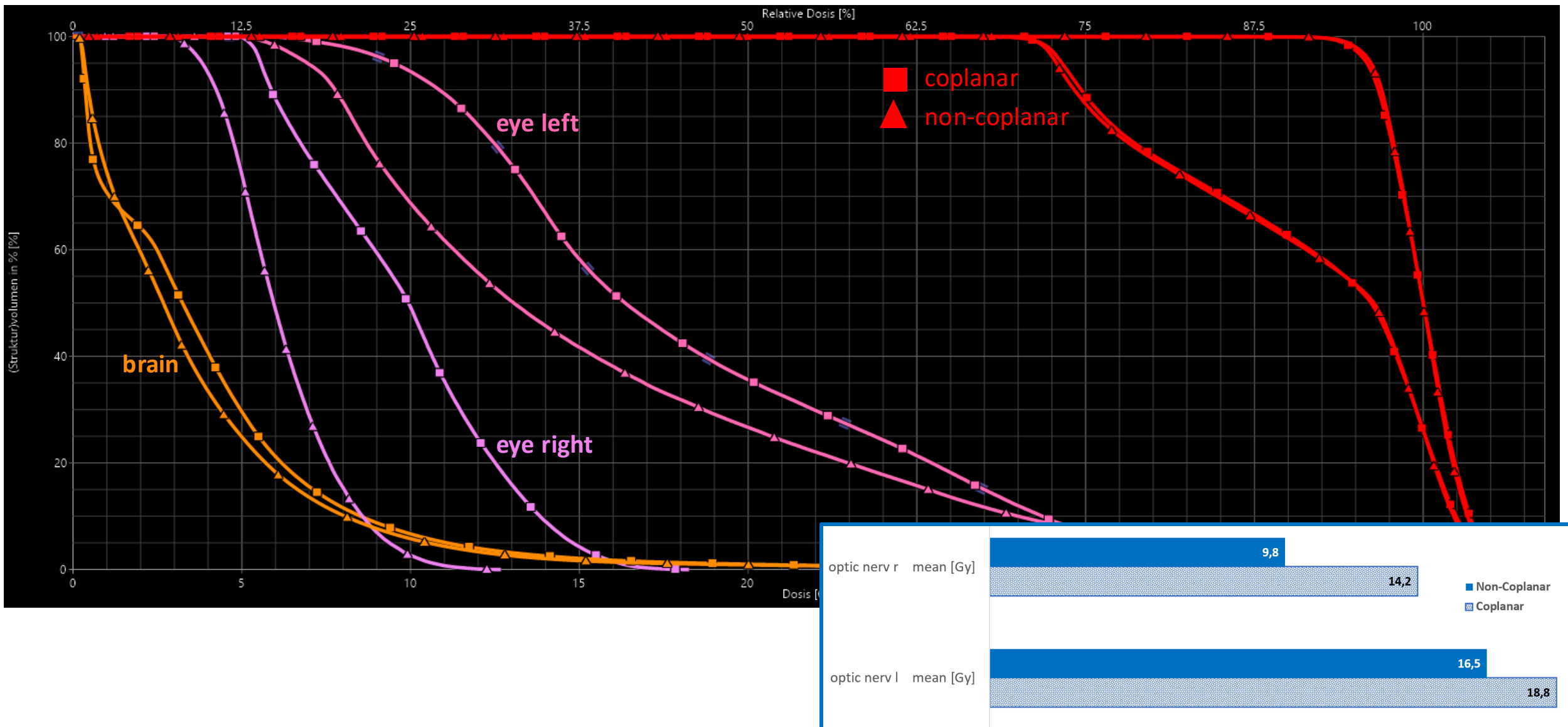
2 VMAT fields– coplanar

prescription: 10\*4,0/3,0Gy

4 VMAT fields – 2 non-coplanar



# plan optimization using non-coplanar fields – nose

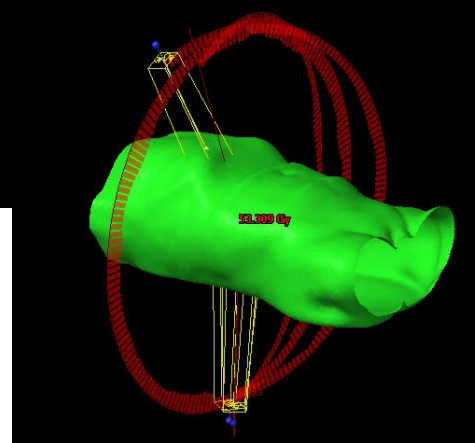
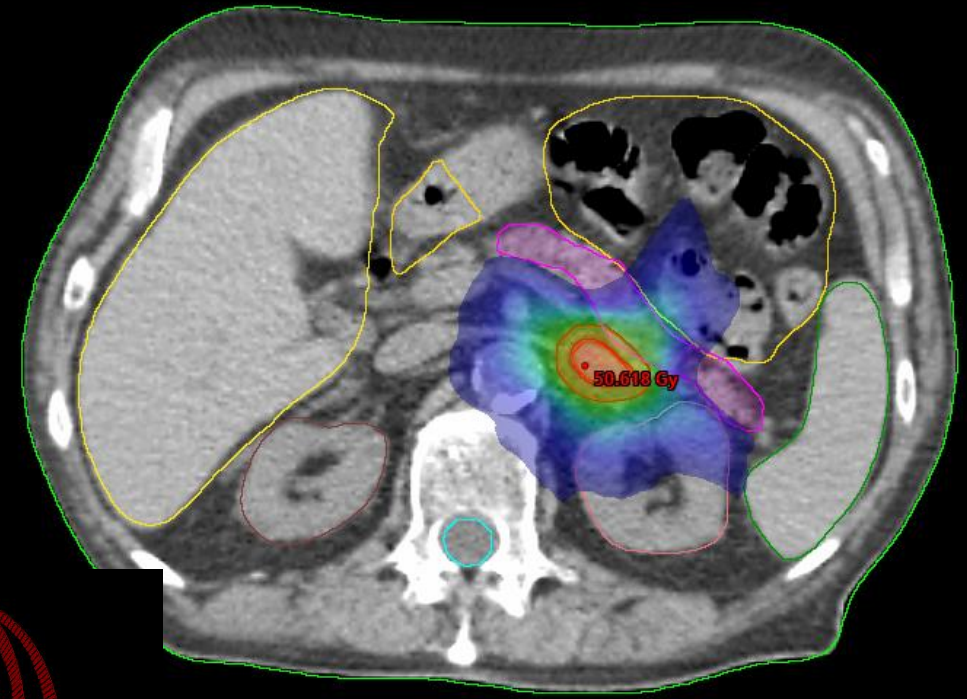
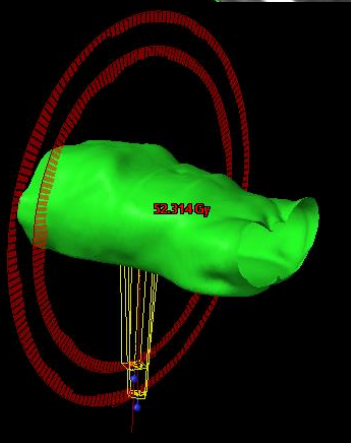
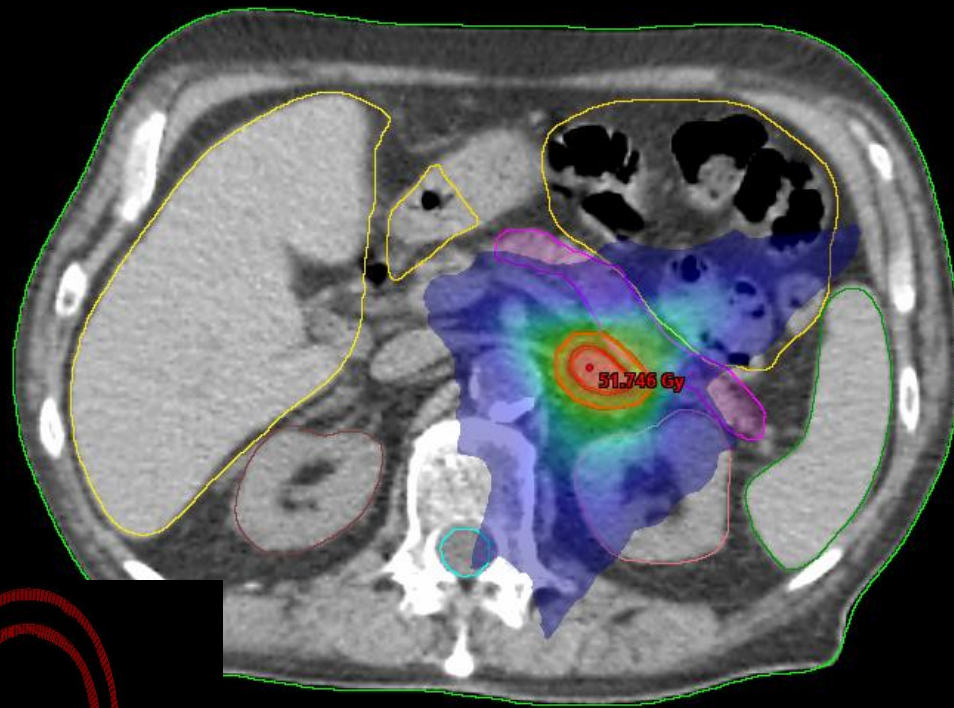


# plan optimization using non-coplanar fields – adrenal gland

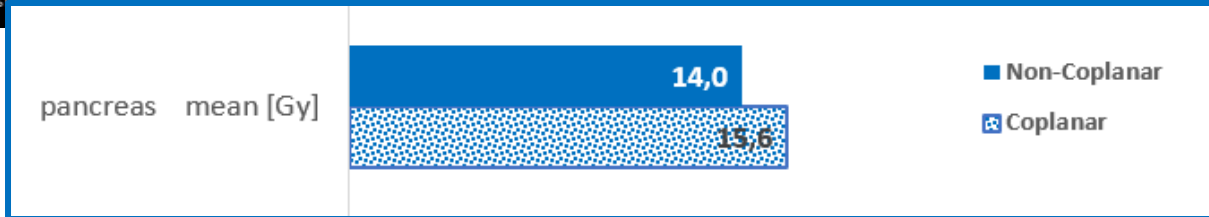
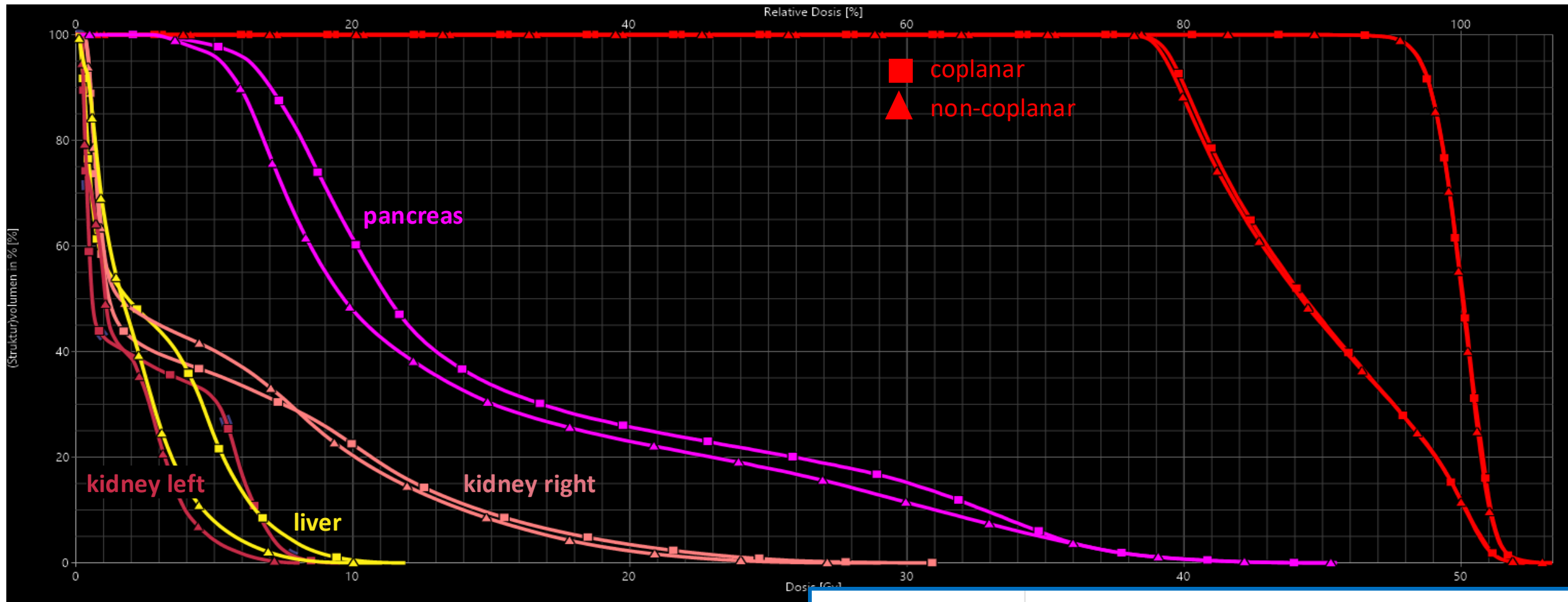
2 VMAT fields– coplanar

prescription: 10\*5,0/4,0Gy

3 VMAT fields – 2 non-coplanar



# plan optimization using non-coplanar fields – adrenal gland



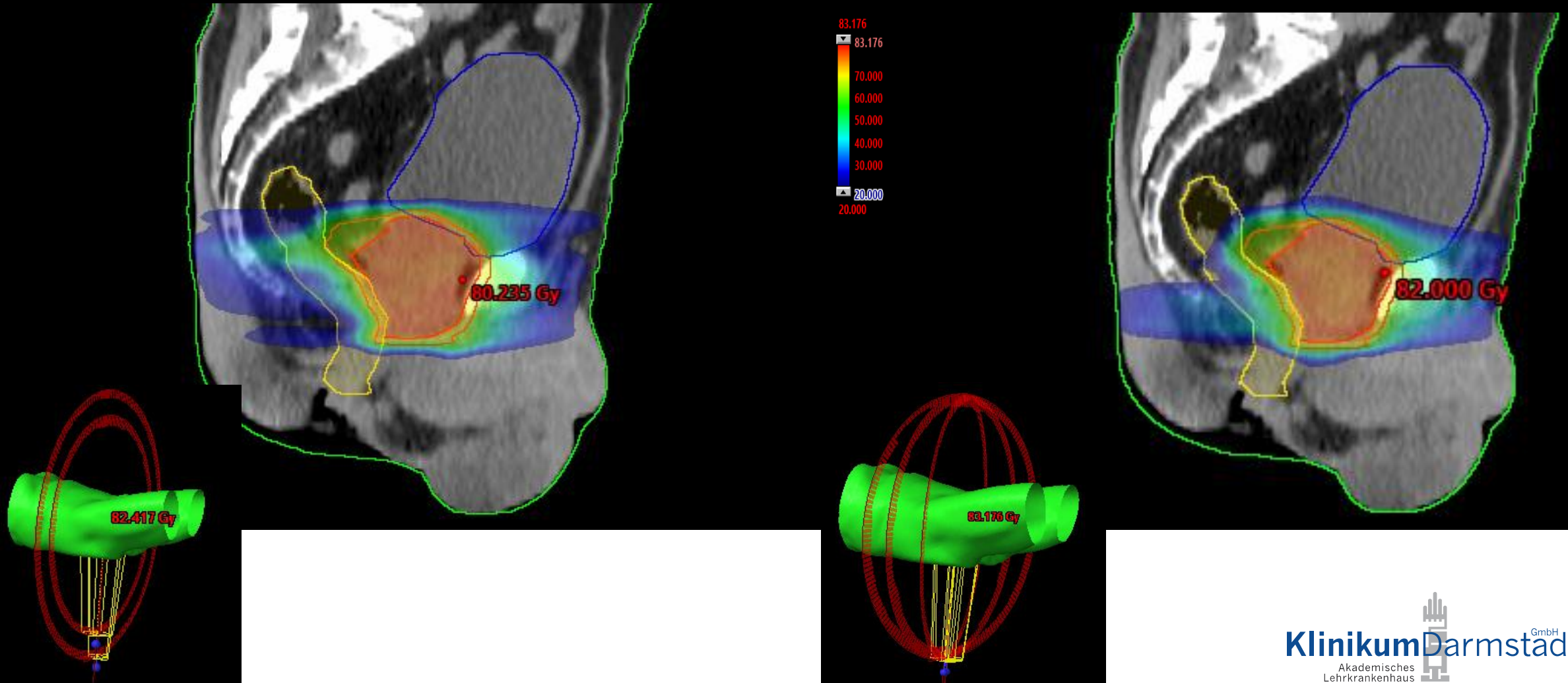


# plan optimization using non-coplanar fields – prostate

2 VMAT fields– coplanar

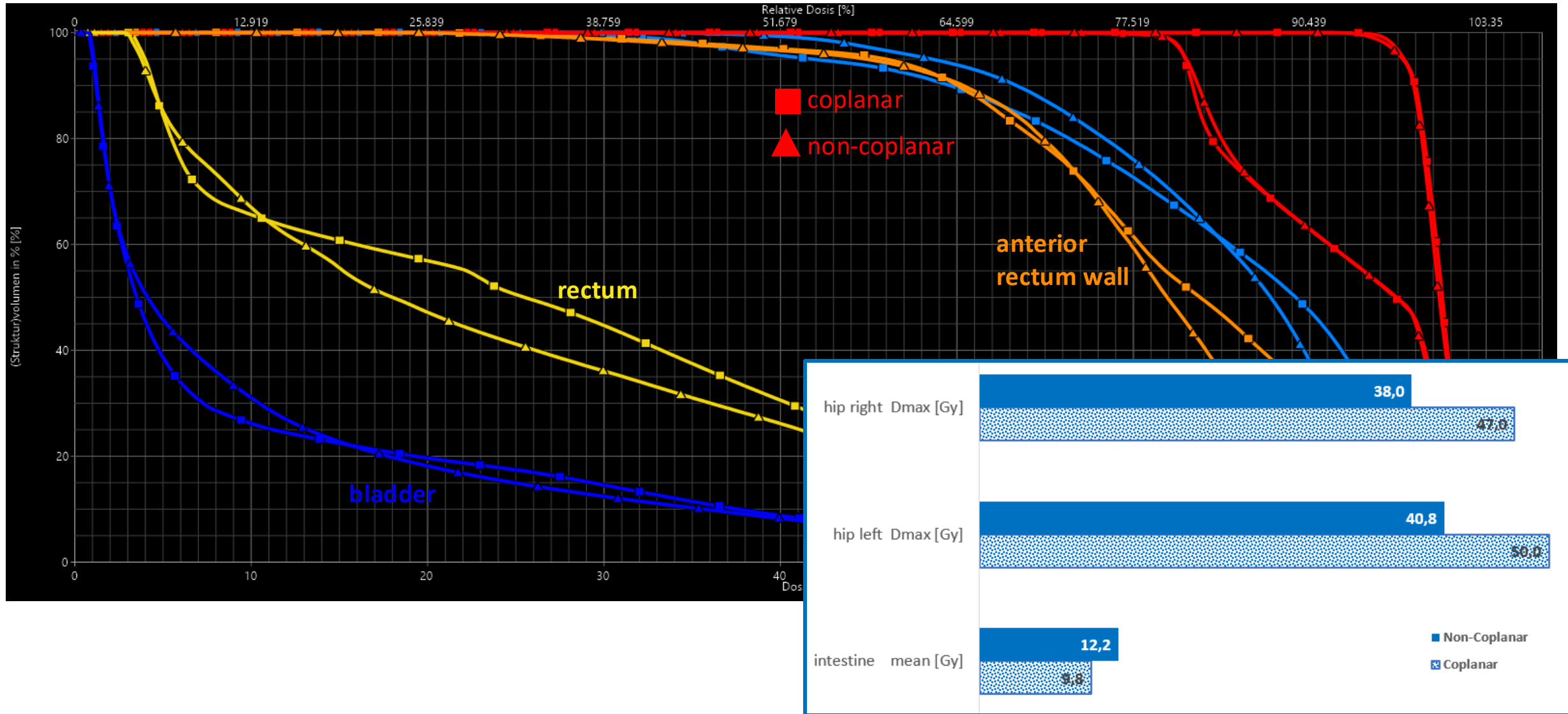
prescription: 36\*2,15/1,8Gy

3 VMAT fields – 3 non-coplanar

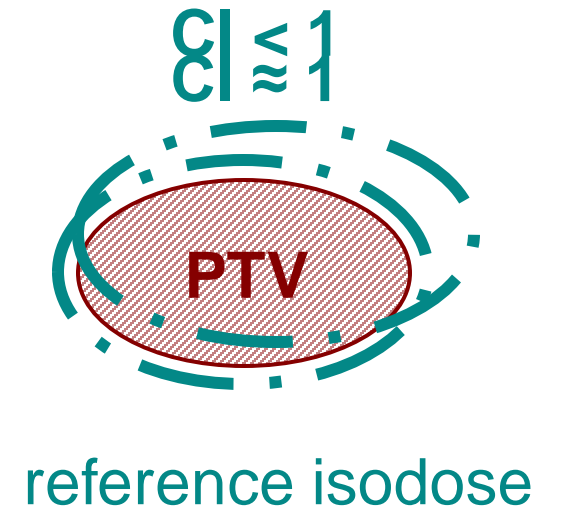
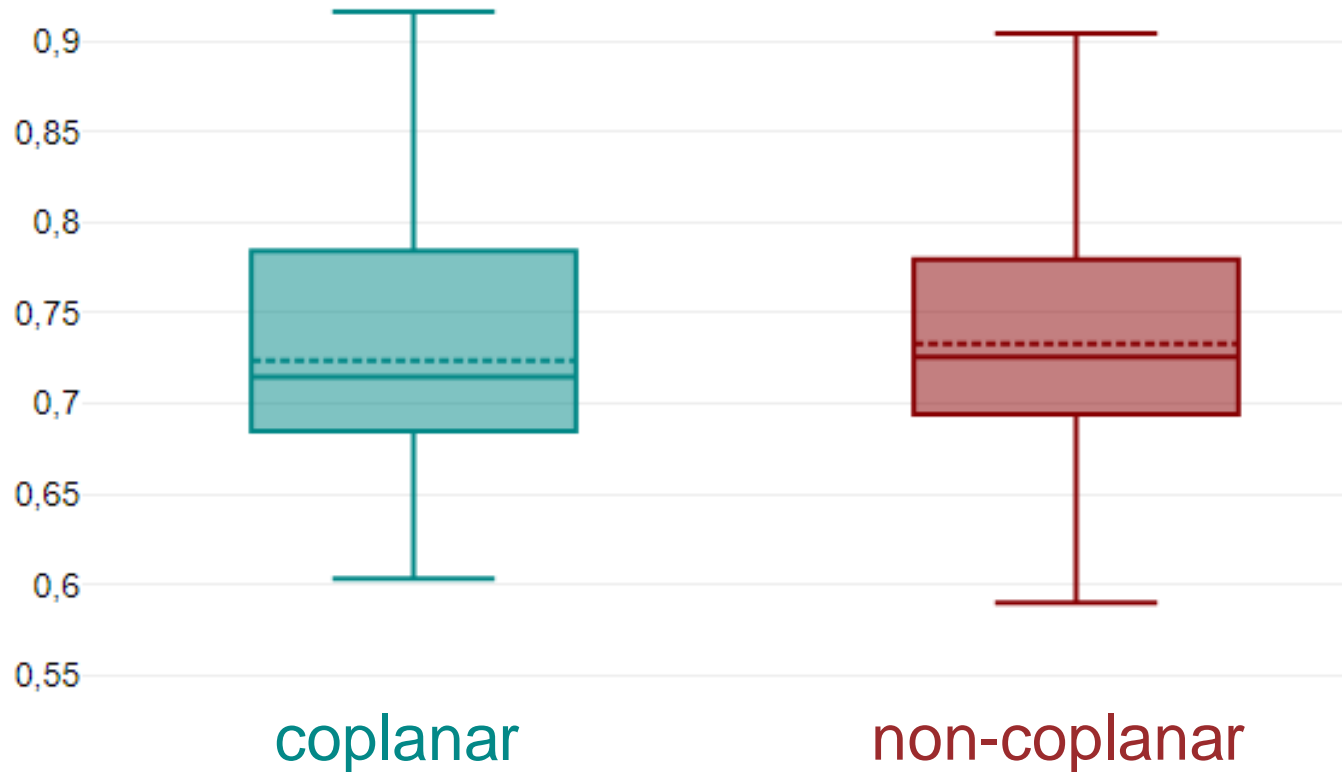




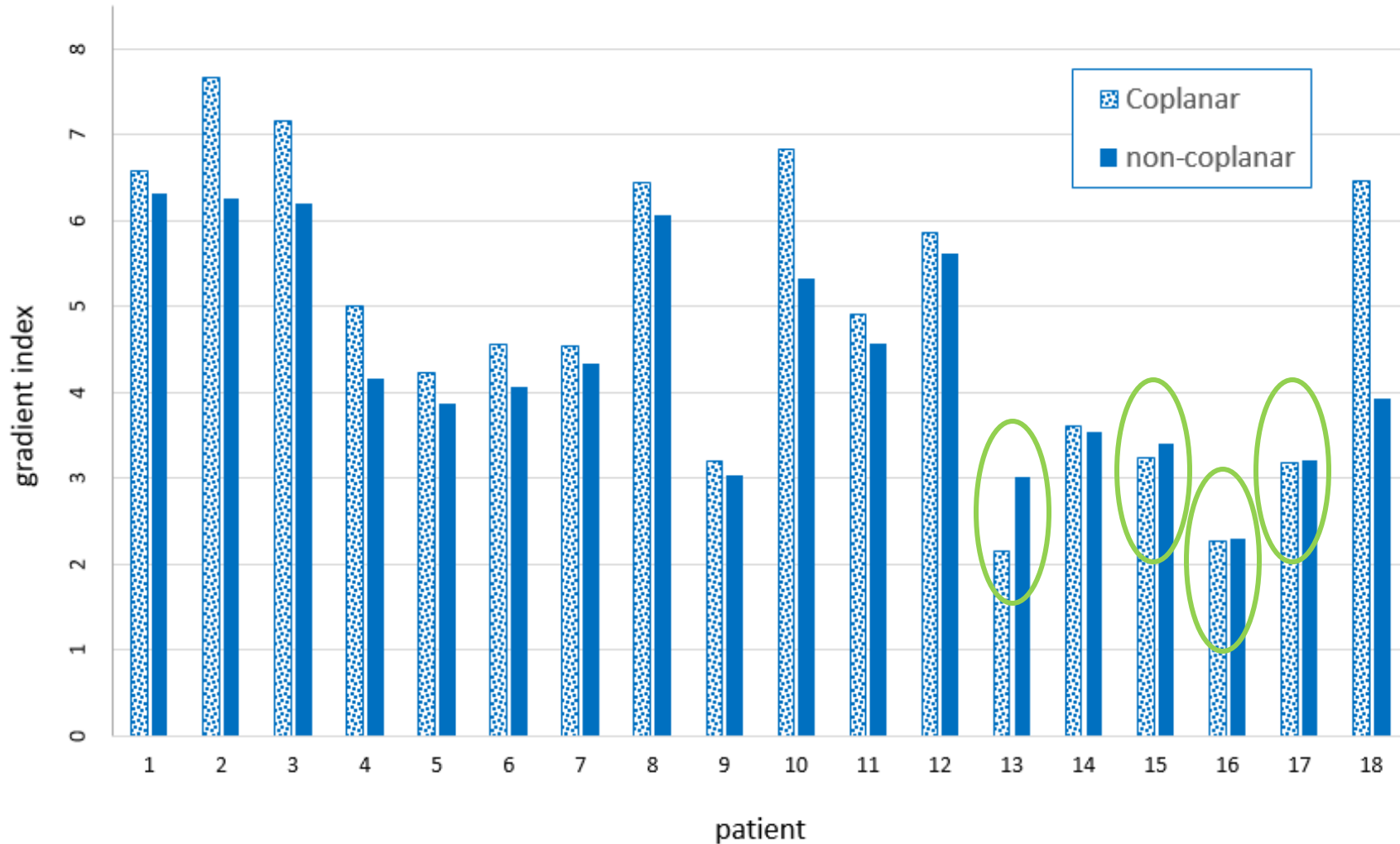
# plan optimization using non-coplanar fields – prostate



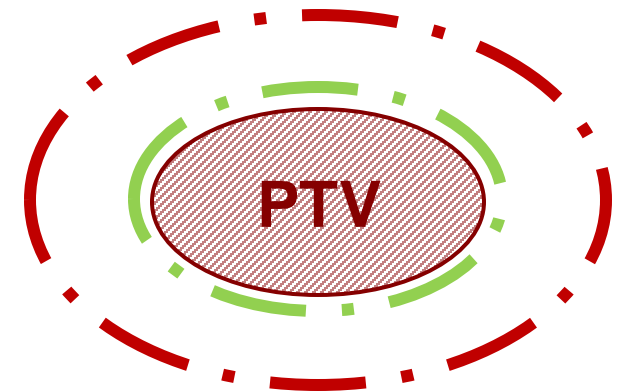
# change in Conformity Index CI in lung SBRT Cases



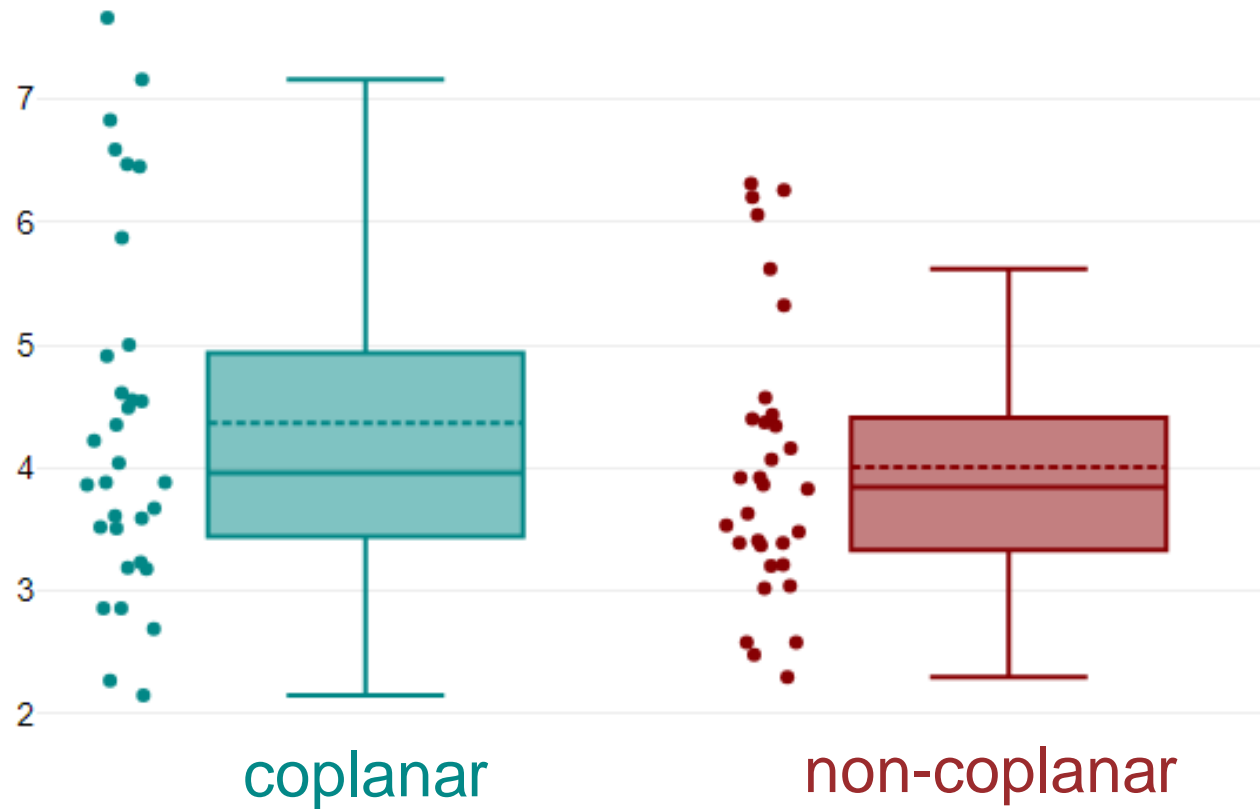
# change in Gradient Index GI in lung SBRT Cases



$$GI = \frac{\text{50\% isodose}}{\text{reference isodose}}$$

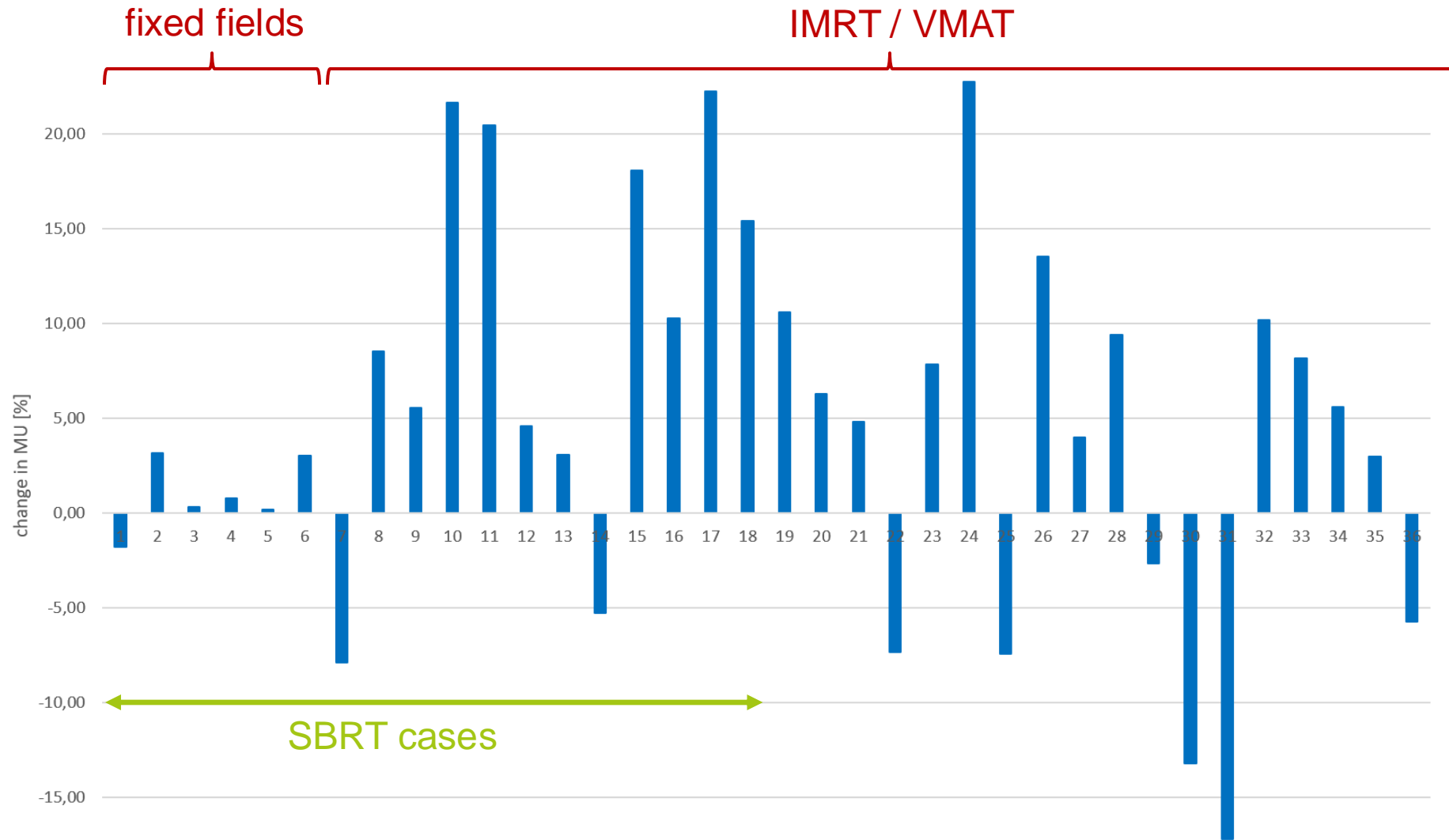


# change in Gradient Index GI in all cases





# change of Monitor Units from coplanar to non-coplanar technique



# MapRT at Klinikum Darmstadt

## Overview:

- how MapRT is used in our department
- advantages in dose distribution in non-coplanar treatment with MapRT
- **clinical implementation of non coplanar treatment**
- summary and next steps

# starting patient treatment using non-coplanar fields

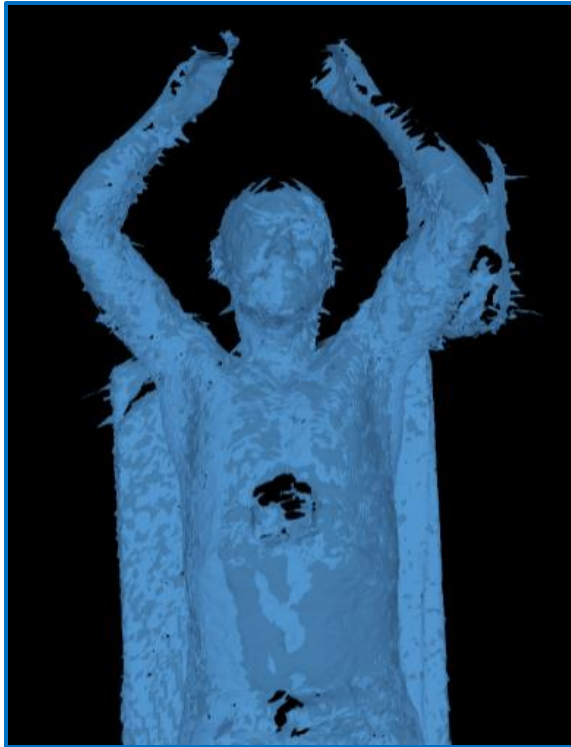
Non coplanare Bestrahlung Planung und EE		Klinikum Darmstadt Akademisches Lehrkrankenhaus	
ID: _____	Patientenname: _____		
<b>CT-Planung:</b>	Zielvolumen: _____		
Lagerungshilfsmittel:	Position craniale Bar: _____		
Armhalterung:	Stifte: _____	Position: _____	Keil: _____
Prostep:	Position: _____		
Maskenhalterung:	Stufenhalter Pos: _____	Keil: _____	
	Handgriffe: _____		
<b>Bestrahlungsplanung:</b>	Planung durchgeführt von: _____		
Planname: _____	Buffer Couch: _____ cm	Buffer Gantry: _____	
<b>Planfreigabe:</b>	Endgültiger Plan in _____		
<b>Ersteinstellung:</b>	FF: _____		
AlignRT ROI OK?	Ja <input type="checkbox"/>	Nein <input type="checkbox"/>	
<b>Zuständige MTRA:</b>	_____		
<b>MTRA-Einweisung:</b>	Durchgeführt: <input type="checkbox"/>	Nein (sind bereits eingewiesen) <input type="checkbox"/>	
<b>Dry Run:</b>		Ja	Nein
Feld1:	Gantry: _____ Couch _____	Dry run OK? <input type="checkbox"/>	<input type="checkbox"/>
Feld2:	Gantry: _____ Couch _____	Dry run OK? <input type="checkbox"/>	<input type="checkbox"/>
Feld3:	Gantry: _____ Couch _____	Dry run OK? <input type="checkbox"/>	<input type="checkbox"/>
Feld4:	Gantry: _____ Couch _____	Dry run OK? <input type="checkbox"/>	<input type="checkbox"/>
Feld5:	Gantry: _____ Couch _____	Dry run OK? <input type="checkbox"/>	<input type="checkbox"/>
<b>Abweichungen bei Bildgebung:</b>			
> 1cm; 1°	Nein <input type="checkbox"/>	Ja <input type="checkbox"/> -> erneuten Dry Run durchführen	
> 0,5cm vrt /lat oder 0,5° rot	Nein <input type="checkbox"/>	Ja <input type="checkbox"/> -> erneuten Dry Run für kritischste Felder durchführen	
DokuID: Formular_Planung_EE_240429.doc	Stand: 29.04.2024 Die aktuell gültige Version dieses Formulars ist im Intranet verfügbar.	Abteilung: Hie Ersteller: Hie 1 von 1	

Non coplanare Bestrahlung Vorgehen bei jeder Fraktion		Klinikum Darmstadt Akademisches Lehrkrankenhaus	
ID: _____	Patientenname: _____		
<b>Diese Schritte bei jeder Fraktion durchführen:</b>			
1. Patientenlagerung mittels AlignRT			
2. Trockenlauf durchführen für folgende Felder:			
Couch: _____	Gantry rotieren von _____ bis _____	Wenn ok, Gantry auf _____	
Couch: _____	Gantry rotieren von _____ bis _____	Wenn ok, Gantry auf _____	
Couch: _____	Gantry rotieren von _____ bis _____	Wenn ok, Gantry auf _____	
Couch: _____	Gantry rotieren von _____ bis _____	Wenn ok, Gantry auf _____	
3. Couch wieder auf 0°			
4. Bestrahlungsraum verlassen			
5. Bildgebung geplant? Ja → Punkt 6 Nein → Punkt 7			
6. CBCT (ggfs. mit Tischzeiger) durchführen			
7. Ergebnis des CBCT auswerten:			
Rotationsfehler größer 2°?	Ja → Punkt 8	Nein → Punkt 12	
8. In den Bestrahlungsraum gehen			
9. Erneuter Trockenlauf für das kritischste Feld:			
Couch: _____	Gantry rotieren von _____ bis _____	Wenn ok, Gantry auf _____	
Bei Kollisionsgefahr bitte Physik rufen !			
10. Couch wieder auf 0°			
11. Bestrahlungsraum verlassen			
12. Bestrahlung <b>in der vorgegebenen Reihenfolge</b> starten. Auf keinen Fall ändern!			
13. Bestrahlungsfelder mit Couch-Drehung:			
In den Raum gehen: 1. Couch auf vorgegebene Position			
2. Gantry auf vorgegebene Position			
14. Raum verlassen und Feld bestrahlen			
DokuID: Formular_Planung_EE_V2_240723.doc	Stand: 23.07.2024 Die aktuell gültige Version dieses Formulars ist im Intranet verfügbar.	Abteilung: Hie Ersteller: Hie 2 von 2	

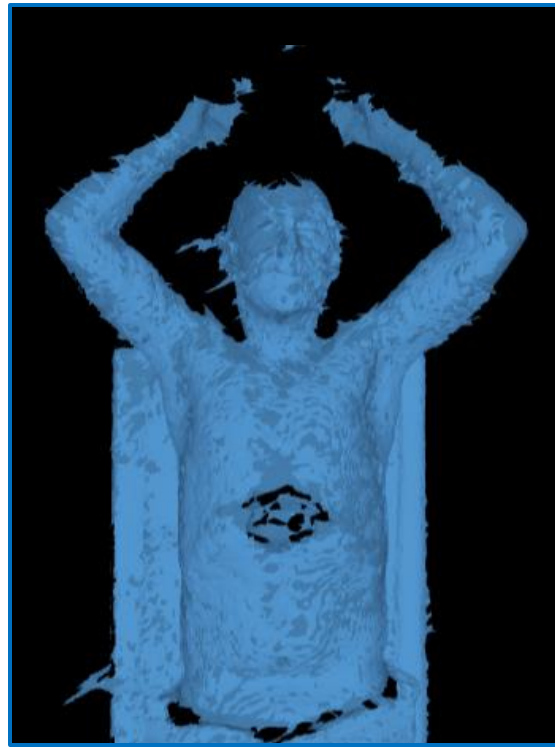
first treatment

subsequent fractions

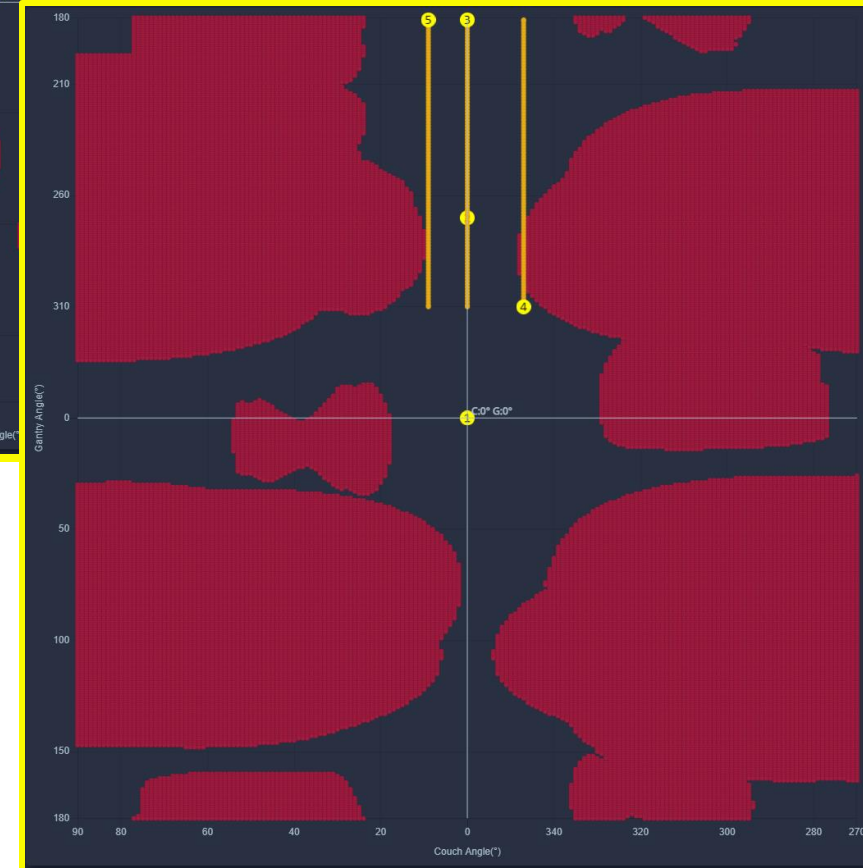
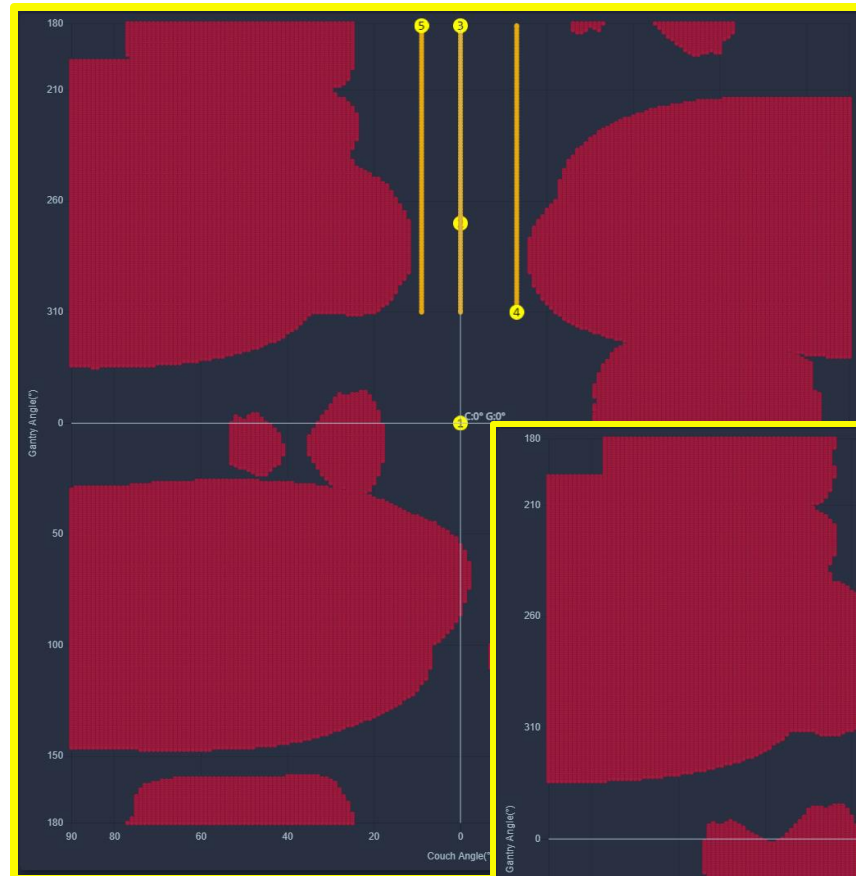
# Results 1: Influence of patient positioning



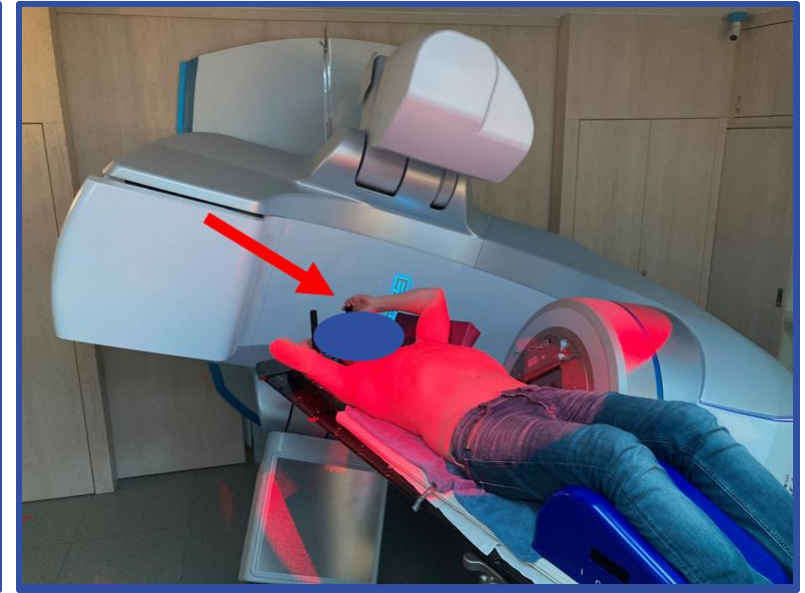
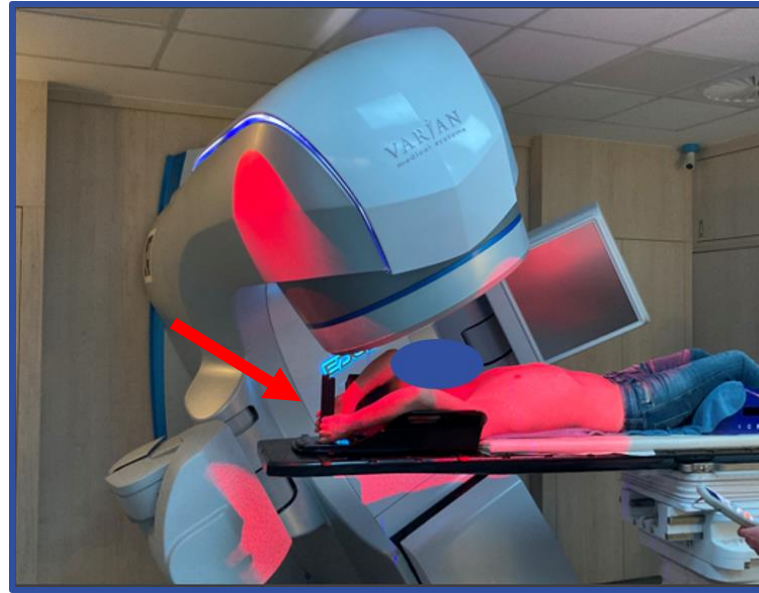
05.04.2024



17.07.2024

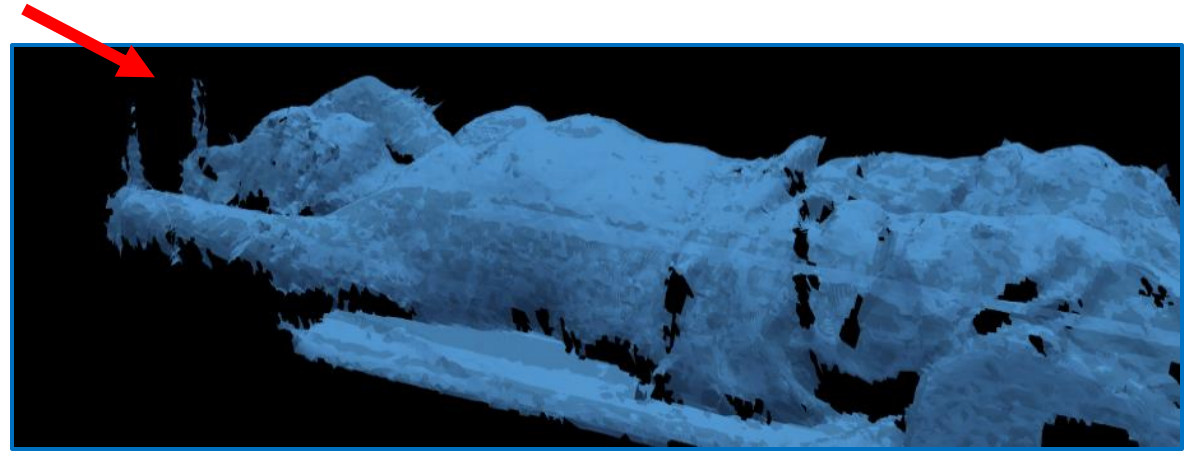


## Results 2: Influence of patient positioning

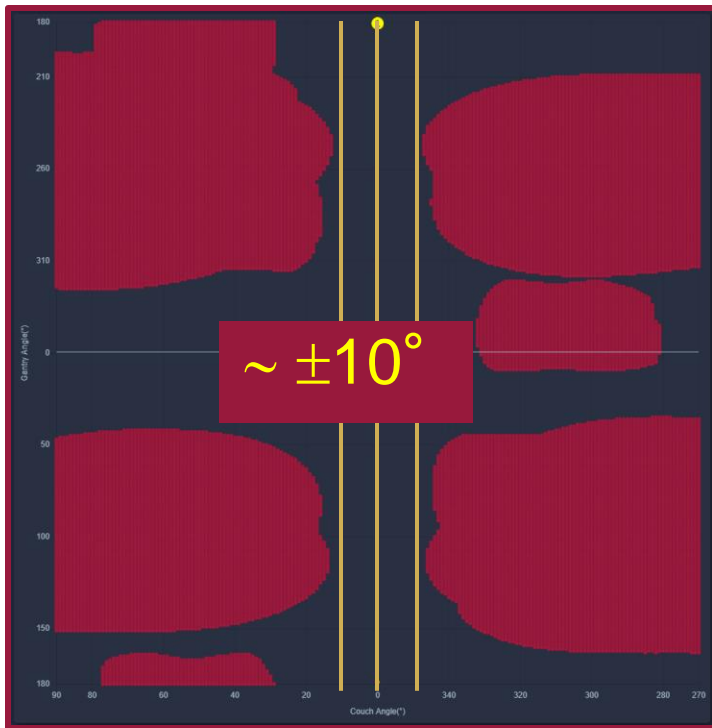
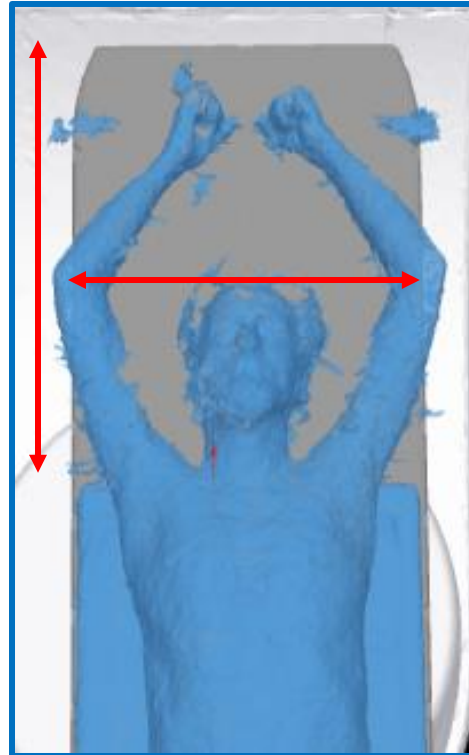




# Results 3: Influence of positioning aid



# Results 4: Influence of positioning aid



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## Summary

- better results in less time in plan calculation
- increased safety during treatment of non-coplanar fields
- treatment time is only slightly longer
- positioning of the patients and used positioning aid influence the possible couch deflection

**„More freedom, better plans.....better outcome, less side effects“**

## Next steps

- allow couch movements from outside
- reduce couch and patient buffer from 4cm to 3cm

# Thank you for your interest ....

## ....and many thanks to my team:

Jana Kouptsidis

Iliyana Nikolova-Rezaie

Stephan Böck, Noel Goethals, Agnieszka Jasko, Eugen Kara

Stefanie Trappen, Franziska Leist, Dr. Martin Silber, Martin Brauns