

Use of MapRT to optimise noncoplanar planning for head and neck patients

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Conflict of Interest

- Member of the SGRT community clearance mapping consortium

Background

- ① Overview of MapRT
- ② Rationale for study
- ③ Results and Conclusion

Background

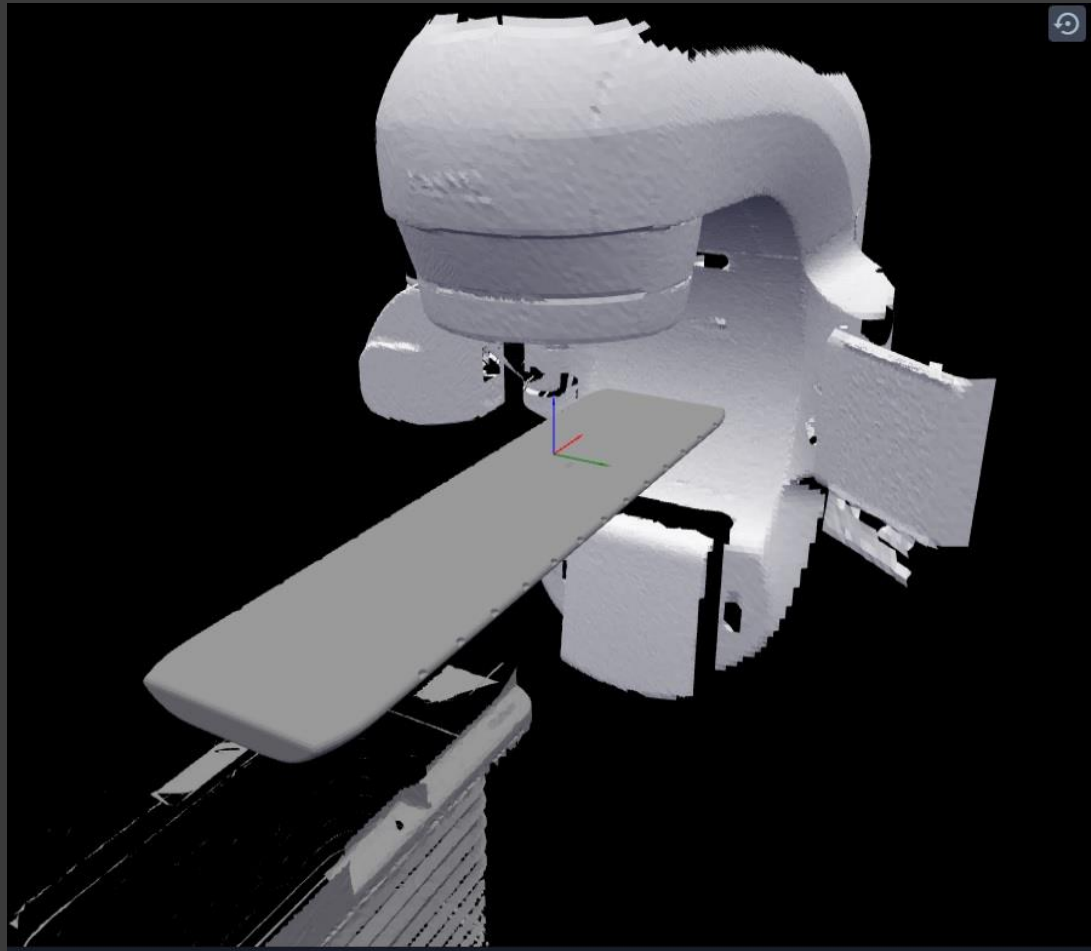
● MapRT

- Uses camera to capture entire patient surface, along with any immobilisation/support accessories
- Enables manipulation of isocentre, gantry and couch on virtual linac
- Improves plan optimisation while avoiding collision

Map RT Workflow

- ⦿ Pre/during CT Scan
 - Check for collision
 - Optimise patient position
- ⦿ During Planning
 - Improve dose distribution with non coplanar
- ⦿ Before treatment
 - Avoid dry runs and replans

Virtual linac



Patient surface

Plan Name: preview, ISO (mm) [0.0, 0.0, 0.0] (21/11/2023 14:58:20) Continue to Clearance Map

Select Patient Surface

Surface Name	Captured
20230418 164237	20/06/2023 09:09:46

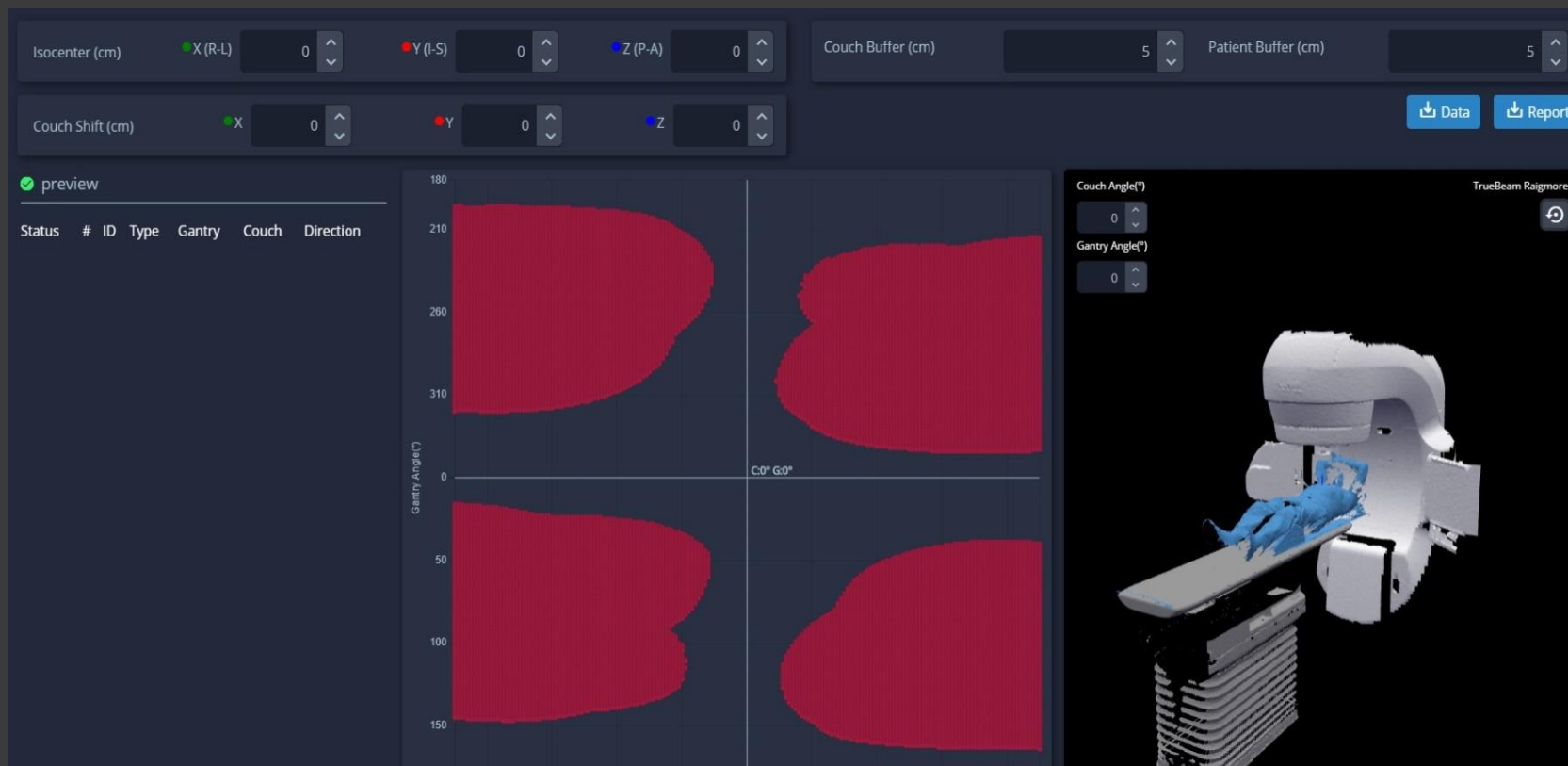
Select Treatment Room

Room Name	Treatment Machine	Couch
TrueBeam H&N Extension	[Truebeam] TrueBeam LIDAR	Varian with CIVCO H&N extension
TrueBeam Raigmore	[Truebeam] TrueBeam LIDAR	TrueBeam LIDAR



The image shows a 3D visualization of a patient surface scan. A patient is lying on a treatment couch, which is positioned in front of a TrueBeam H&N Extension machine. The patient's surface is highlighted in blue, indicating the scanned area. The machine is shown in a semi-transparent white color, revealing its internal components. The background is black, making the white machine and blue patient stand out. In the top right corner of the visualization, there is a label 'TrueBeam H&N Extension' and a refresh icon.

Clearance Map



Workflow - Software in action

Isocenter (cm) X (R-L) 0 Y (I-S) 0 Z (P-A) 0 Couch Buffer (cm) 5 Patient Buffer (cm) 5

Couch Shift (cm) X 0 Y 0 Z 0 [Data](#) [Report](#)

preview

Status	#	ID	Type	Gantry	Couch	Direction
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RECORDED WITH SCREENCAST MATIC

Couch Angle(°) 0 Gantry Angle(°) 0

Workflow - Software in action

Isocenter (cm) X (R-L) 0.05 Y (I-S) 2 Z (P-A) 10.94 Couch Buffer (cm) 5 Patient Buffer (cm) 5

Couch Shift (cm) X 0 Y -35 Z 0

[Data](#) [Report](#)

VTB/23/205

Status	#	ID	Type	Gantry	Couch	Direct
✓	1	1	Arc CWr	250° to 40°	10°	CW
✓	2	2	Arc CCWr	40° to 250°	10°	CC
✓	3	3	Arc CWI	320° to 110°	350°	CW
✓	4	4	Arc CCWI	110° to 320°	350°	CC
✓	5	Ant ISO	Static	0°	0°	--
✓	6	RLat	Static	270°	0°	--

RECORDED WITH SCREENCAST MATIC

Couch Angle(°) 10 Gantry Angle(°) 40

TrueBeam H&N Extension

Optimising non-coplanar H&N

- ⦿ Shoulder positioning issues
 - ?Shell not rigid
 - Patient compliance
 - Change between CT/treatment
 - Unable to visualise shoulder position
 - Shoulderless masks allow use of AlignRT/postural video
- ⦿ Poor dosimetry
 - Aware of it due to IVD

Optimising non-coplanar H&N

- ⦿ Shoulder positioning issues
 - Immobilise shoulders better
 - *Or*
 - Remove them from the equation
 - Partial arcs or couch kicks

- ⦿ Poor dosimetry
 - New machine parameter class solution
 - Current dosimetric class solution

Optimising non-coplanar H&N

- ⦿ Not aiming to get the best possible plan
- ⦿ A clinically acceptable plan that has more accurate delivery > one good on screen but not in reality
- ⦿ Aware of time limitations on linac
- ⦿ Need to be able to do IVD

Optimising non-coplanar H&N

- ⦿ Retrospective study
- ⦿ Replan with couch kicks
 - Easier to get machine class solution than partial arcs
 - Not significantly extra time on linac
- ⦿ Compare plans dosimetrically
- ⦿ Calculate on CBCT to compare actual treatment of each technique

Optimising non-coplanar H&N



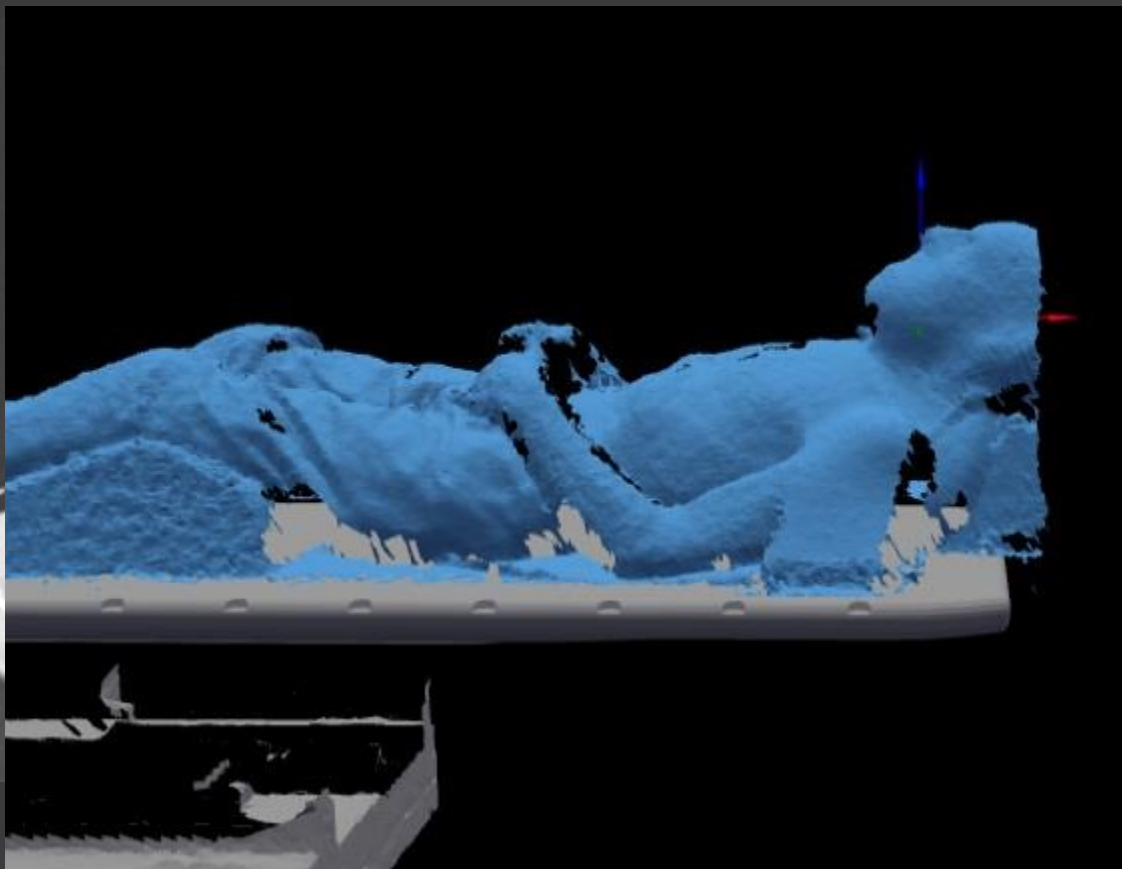
Optimising non-coplanar H&N

Plan dose: noncopop12 (CT 1)
Clinical: Collapsed Cone v5.7
Position: 18.07 2.00 -8.55 cm
CT: -1001 HU
Dose: 0.00 Gy

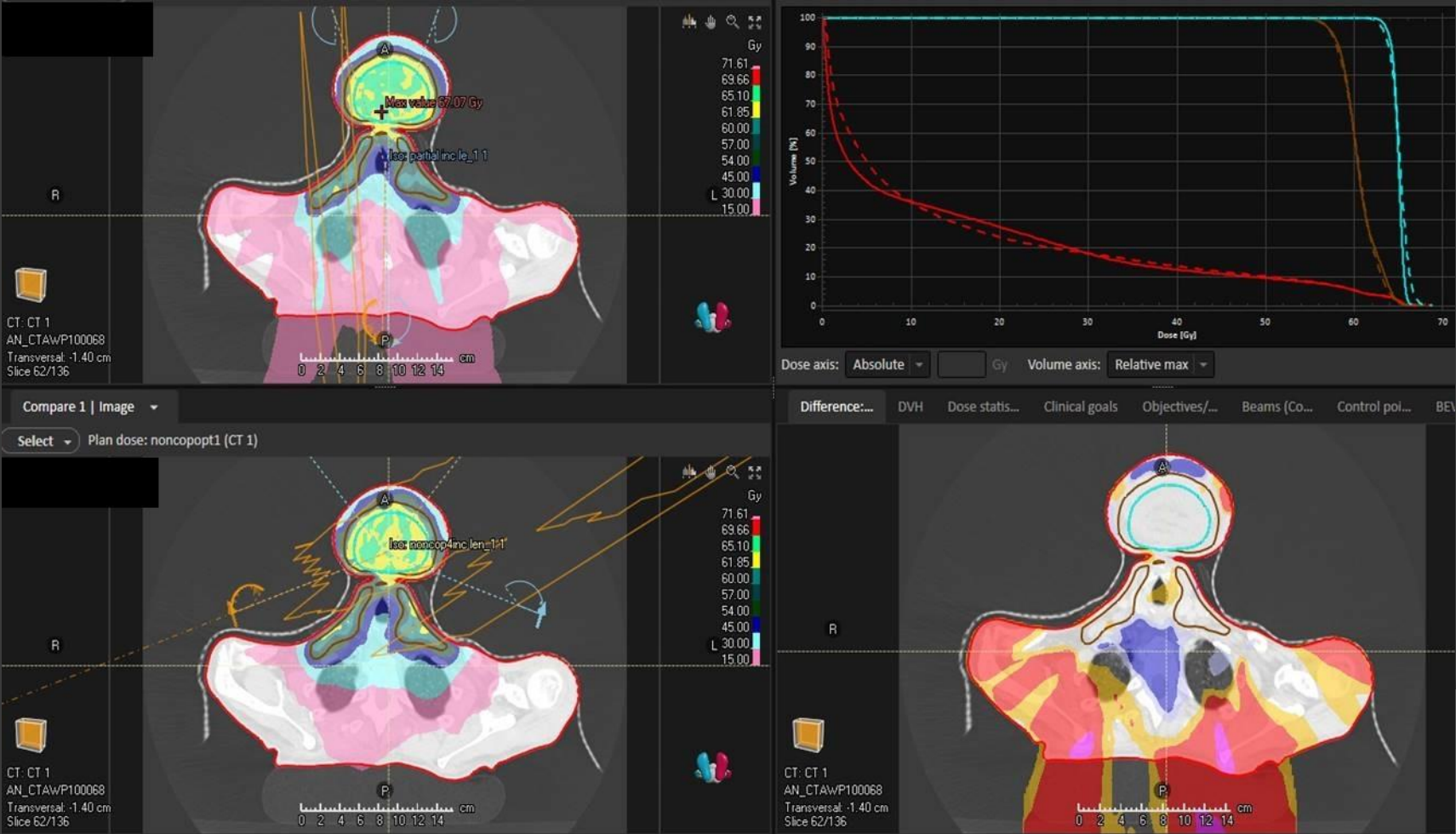
R



CT: CT 1
AN_CTAWP100068
Transverse: 2.00 cm
Slice 79/136



Current use – Optimising non-coplanar H&N



Results

- ⦿ Qualitative analysis (retro and prospective)
 - DVH/dose stats analysis
 - Visual inspection of isodoses
- ⦿ Problems on treatment for those planned prospectively

Results

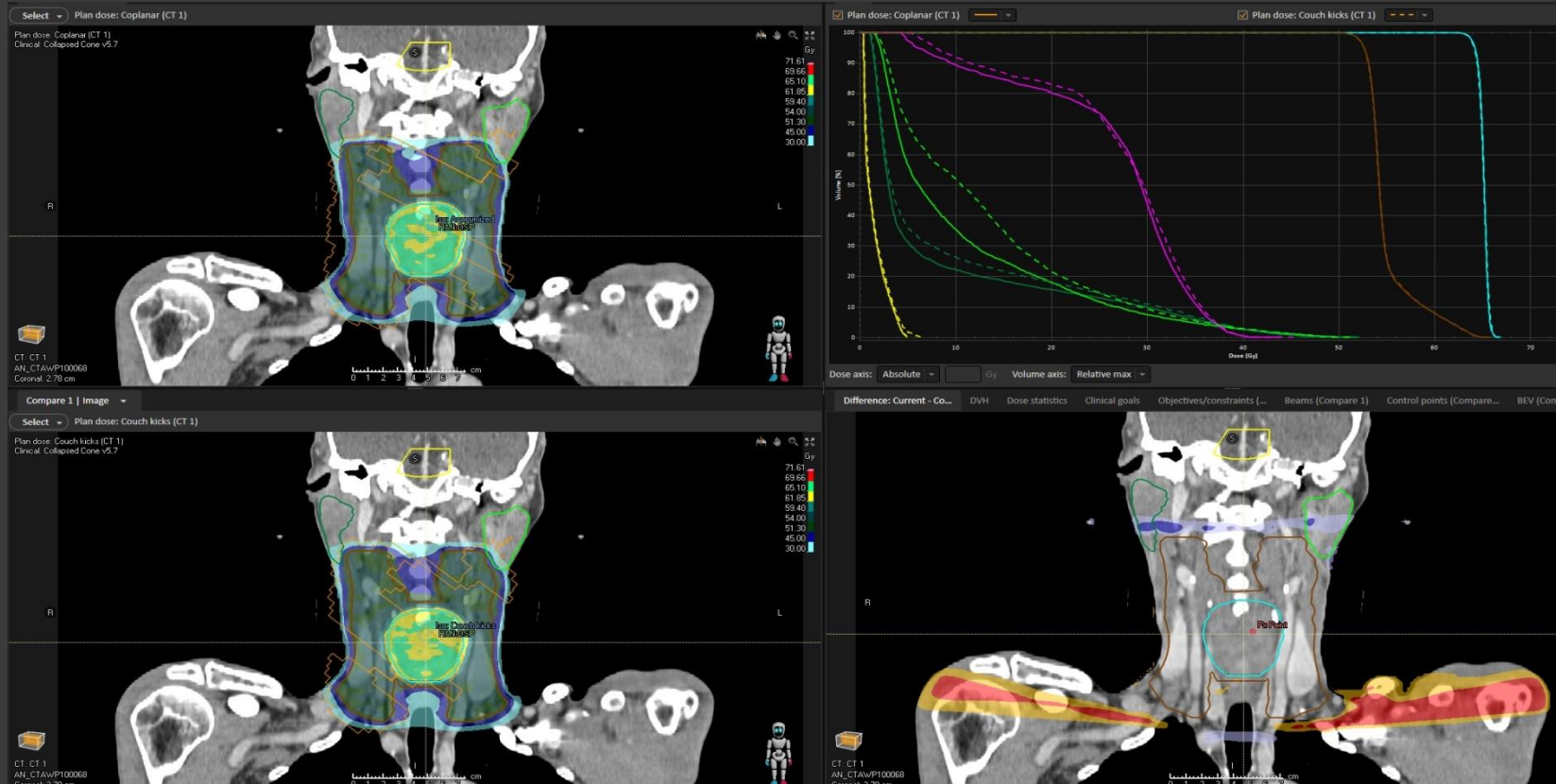
- ⦿ Class solution for machine parameters obtained
 - $GA = 181 - 40$; CA 10 (CW and CCW)
 - $GA = 320 - 179$; CA 350 (CW and CCW)
- ⦿ Current dosimetric class solution works
 - Minor tweaks found during planning will improve

Results

- ⦿ **ALL** plans with couch kicks were dosimetrically better when calculated on CBCT
- ⦿ No problems with *plans* for those treated
 - Replans due to weight loss
 - One needed replan with full shell due to stridor meaning he couldn't keep still

Results

Primary PTV
L Parotid
Spinal Cord
Nodal PTV
R Parotid
Brainstem

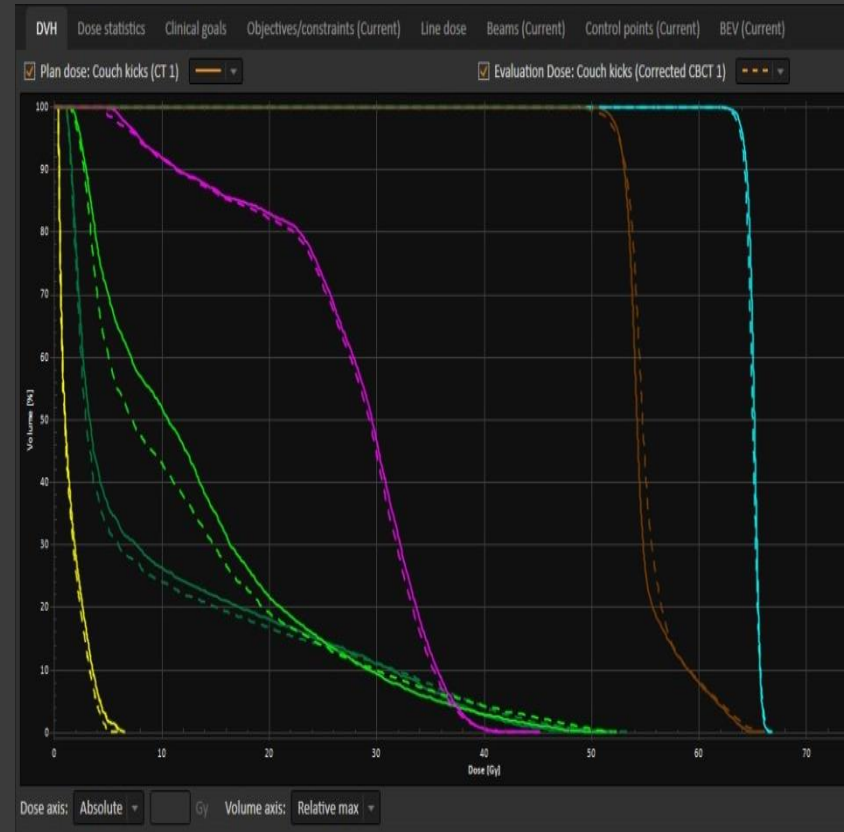
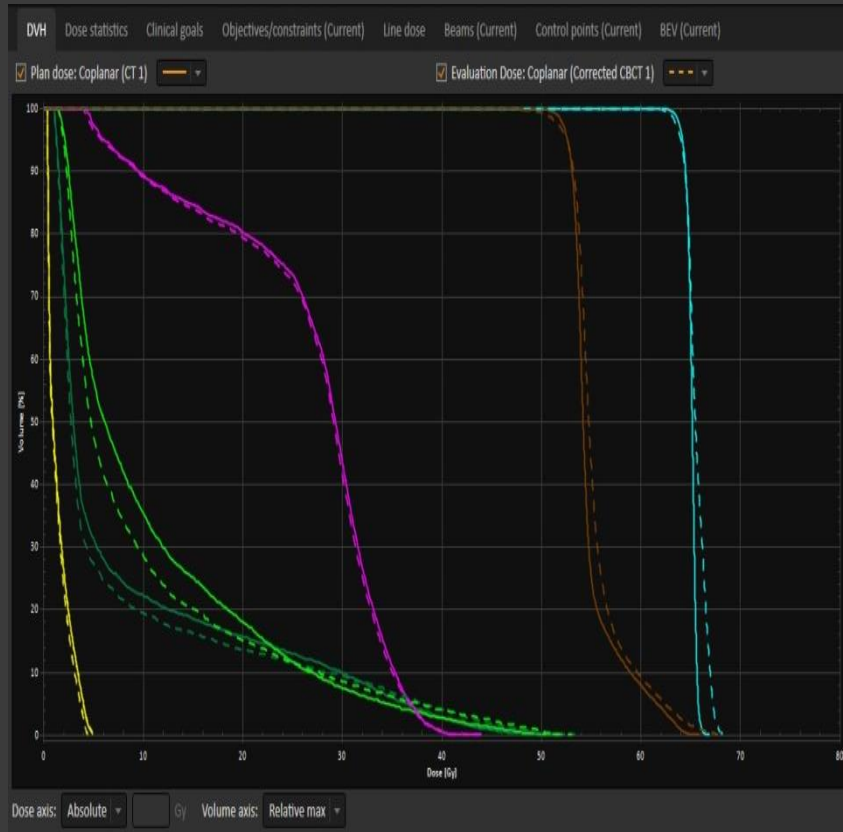


Coplanar

Couch kicks

Results

Primary PTV Nodal PTV
L Parotid R Parotid
Spinal Cord Brainstem

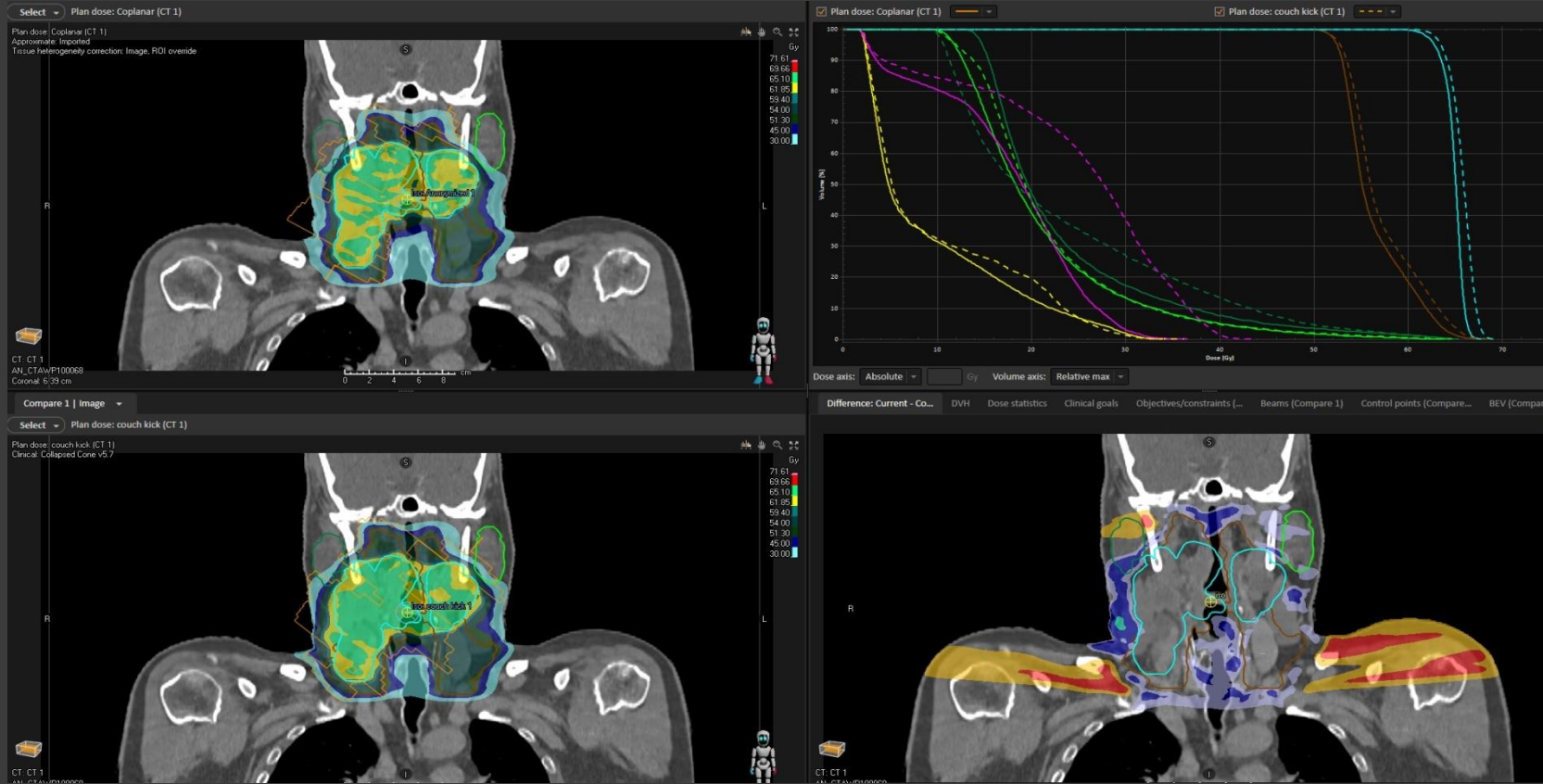


Coplanar

Couch kicks

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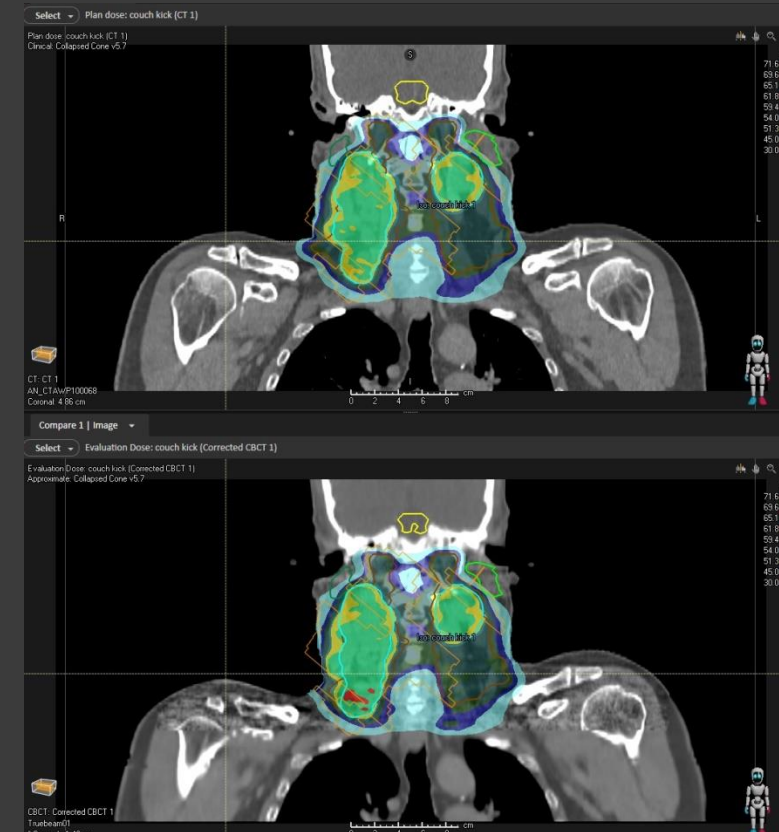
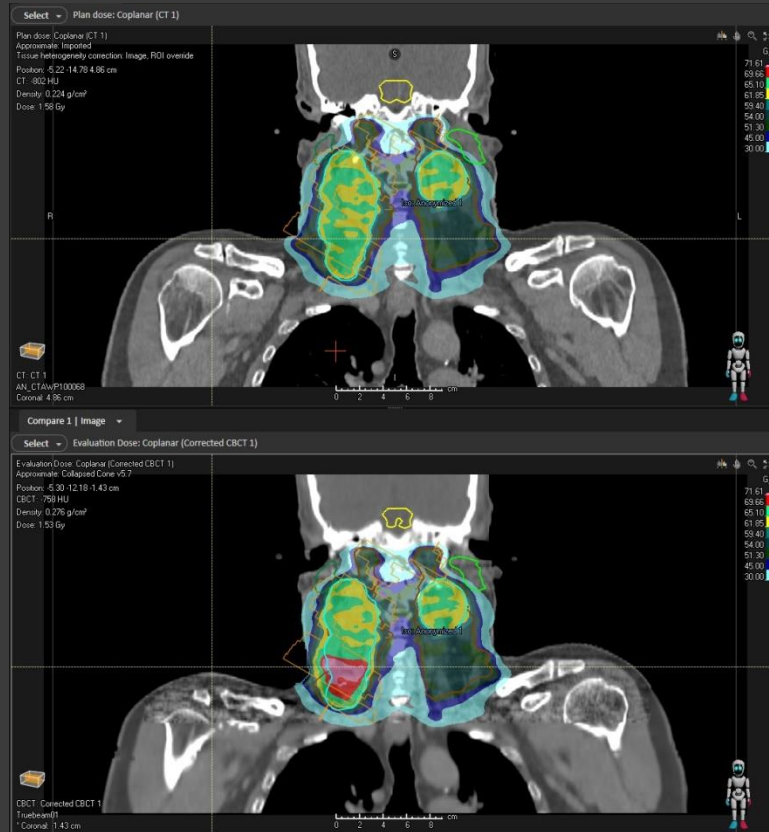


Coplanar

Couch kicks

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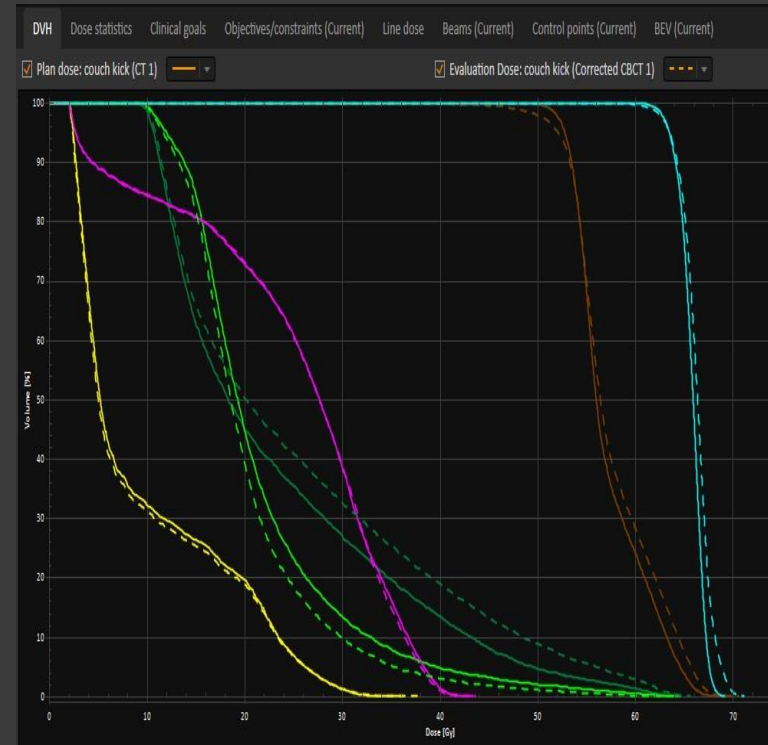
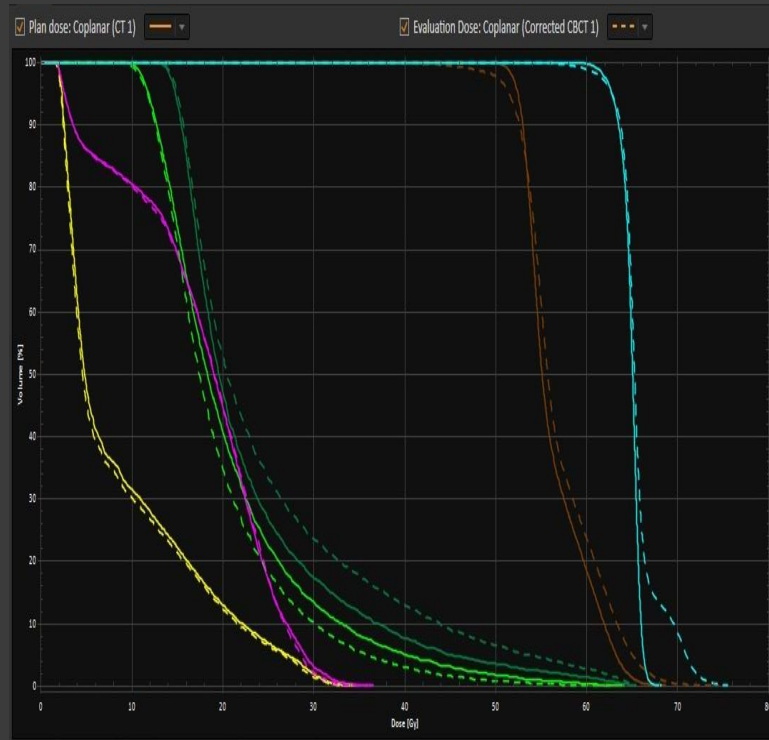


Coplanar

Couch kicks

Results

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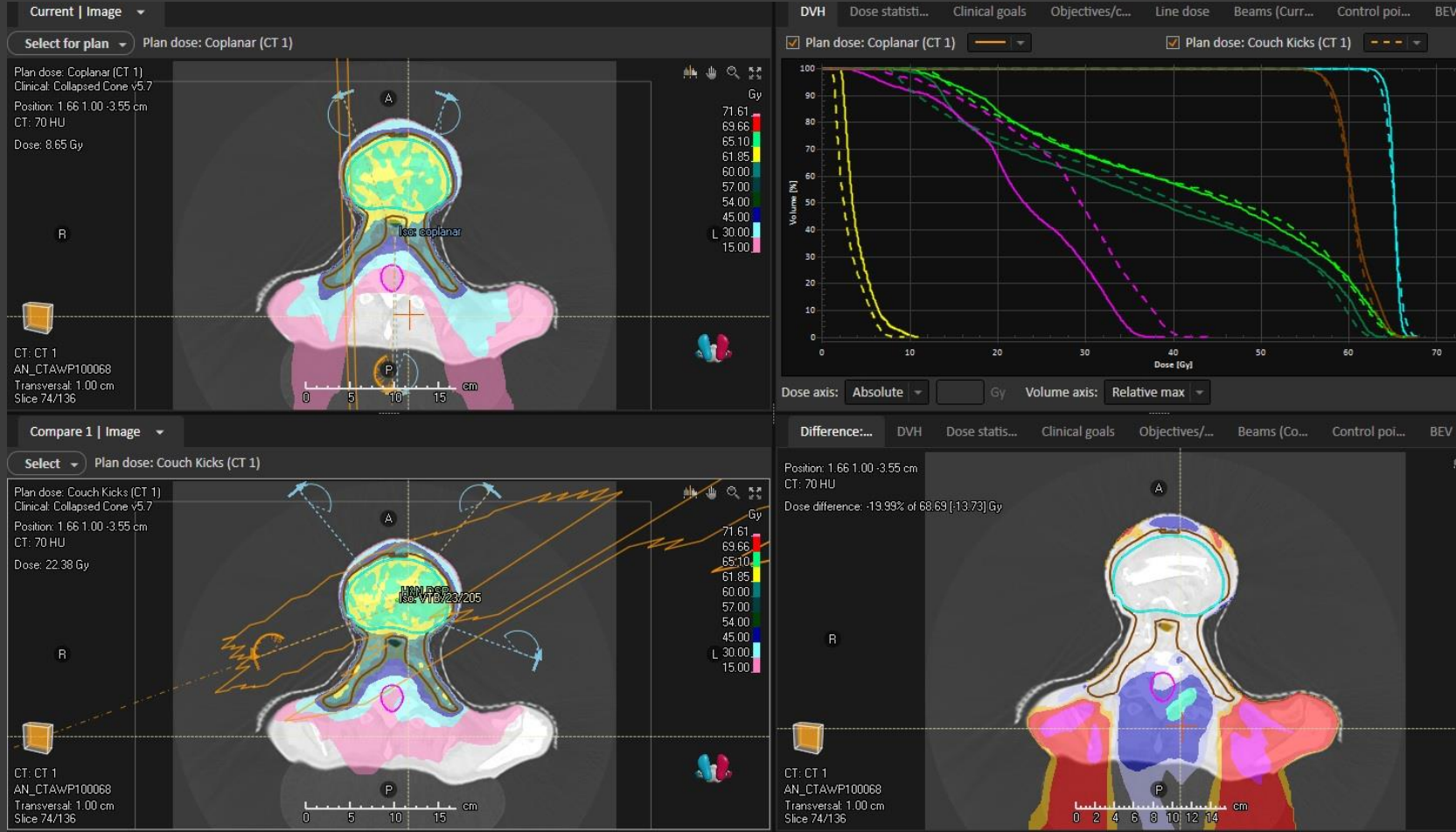


Coplanar

Couch kicks

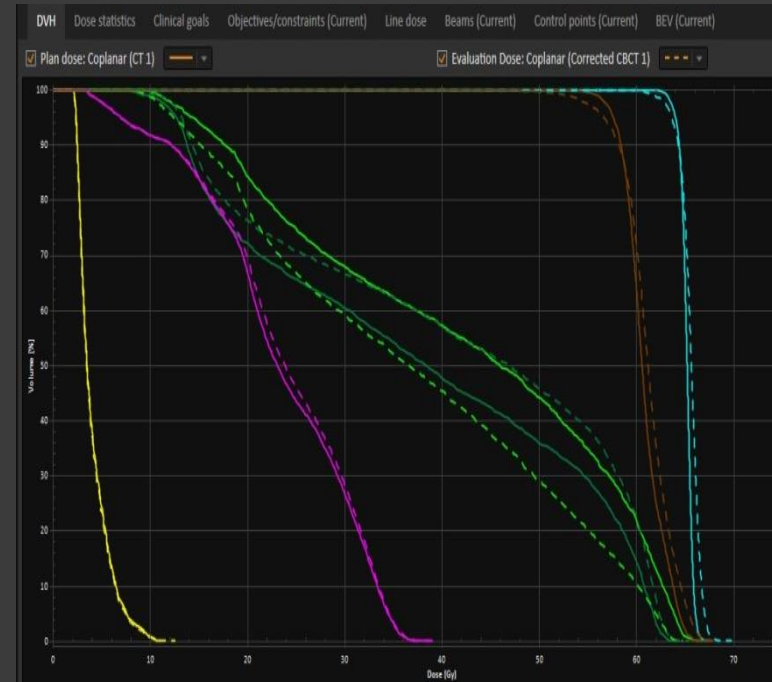
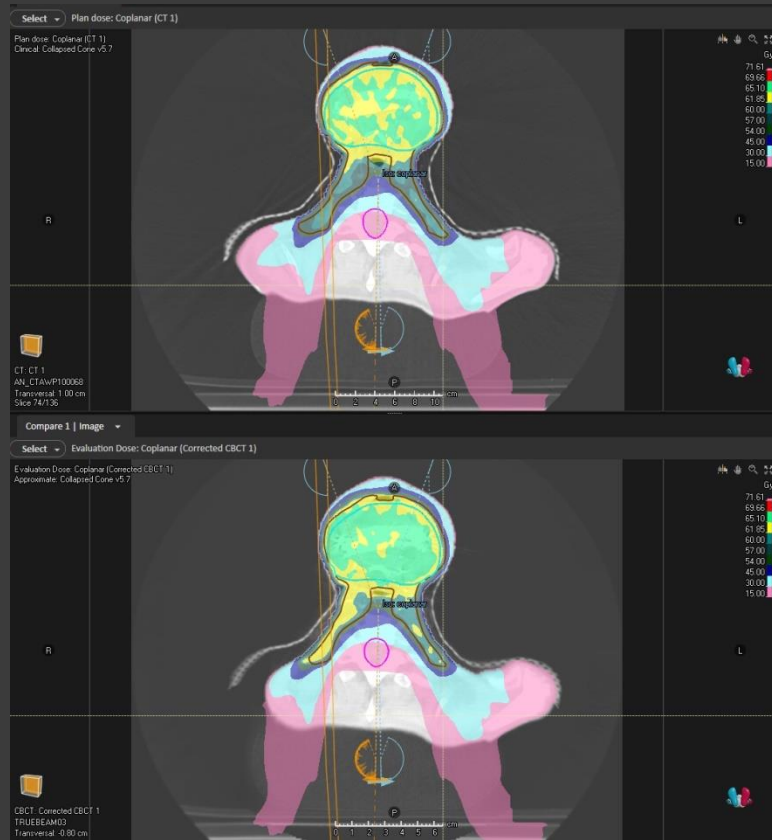
Results

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Results

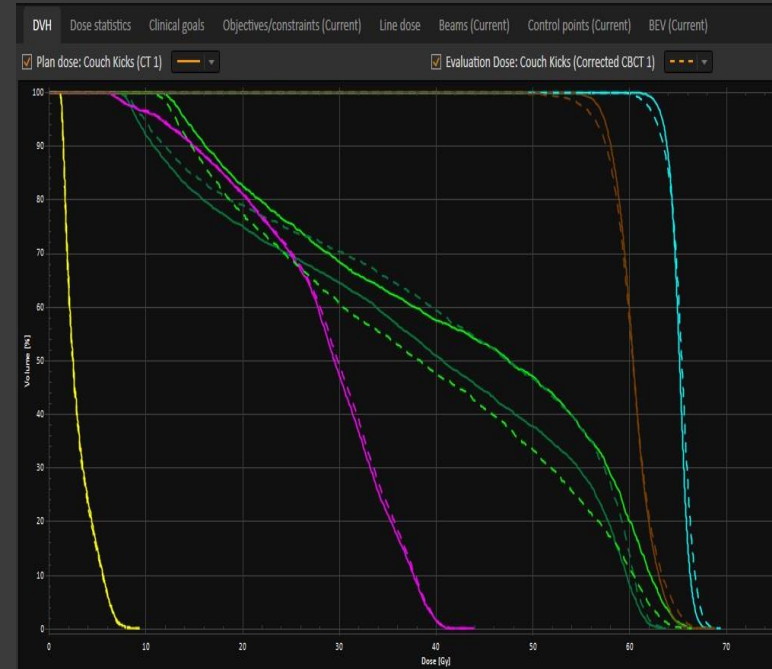
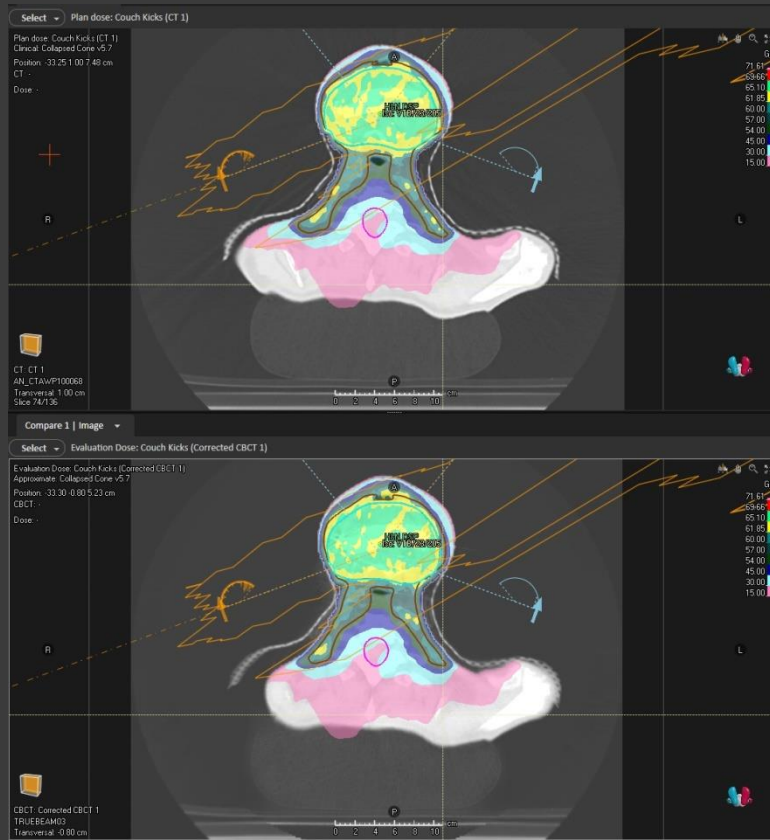
Primary PTV Nodal PTV
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Results

Primary PTV
L Parotid
Spinal Cord

Nodal PTV
R Parotid
Brainstem



Conclusion

- ⦿ Planning with couch kicks gives clinically comparable plan to coplanar **AND improved reliability of treatment**
- ⦿ No significant time implication
 - Planning
 - Treatment
- ⦿ MapRT instrumental in developing class solution
 - Can be used to adapt on patient-by-patient basis as required
 - **May give us confidence to move couch from outside room**

Future work

- Staff training
- Put technique into practice for all H&N patients
- Implement shoulderless/faceless masks

Acknowledgements

- Vision RT
- Radiotherapy colleagues
 - Laura Hammond
 - Robin Taylor
 - Daniel Leach