TREATMENT PLANNING CONSIDERATIONS FOR STEREOTACTIC ABLATIVE BODY RADIOTHERAPY TO MULTIPLE SITES

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Overview

SABR at Royal Surrey County Hospital (RSCH):

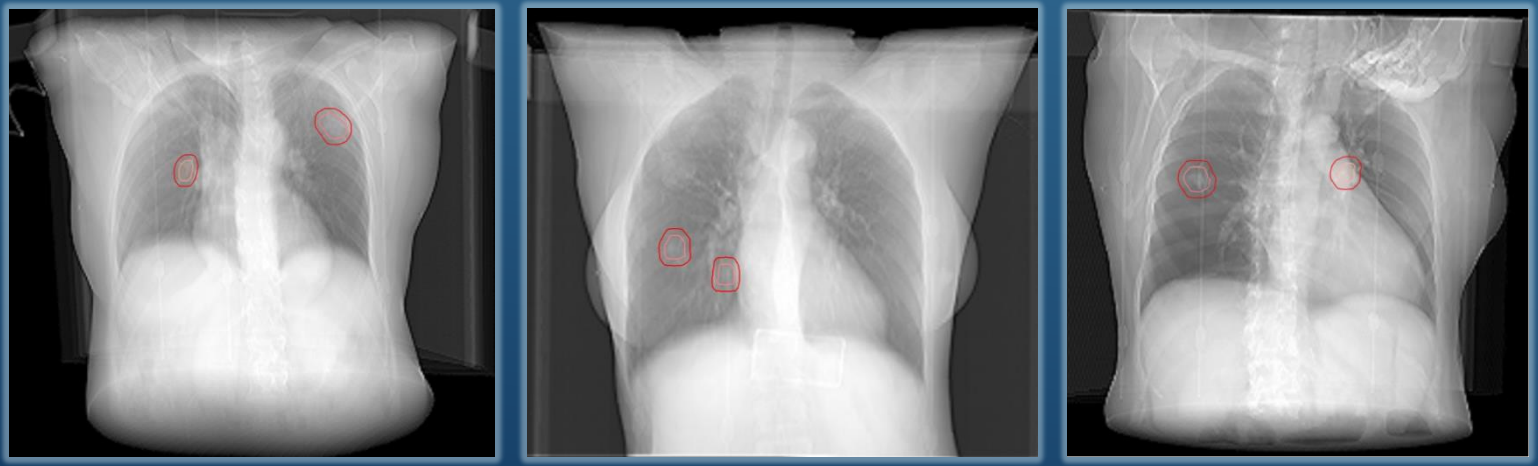
- January 2012 – 1st SABR lung patient treated
- 186 SABR lung patients treated to date
- 2015 - RSCH approved as a centre to deliver extra-cranial SABR treatments to oligometastic disease under CtE programme
- 2016 Treated first CtE spine and nodal sites

SABR at RSCH

- 4DCT or 3D scan depending on treatment site
- Rapid Arc planned using:
  - Eclipse V13.6
  - 6MV for chest, 10MV FFF for other body sites
  - Normalised 100% covers 95% of the target volume
  - 3, 5 or 8 fractions, dose prescribed dependant on site
- Treatment delivery on Truebeam 2.5 STX

Planning Multiple Lung and/or Nodal Sites

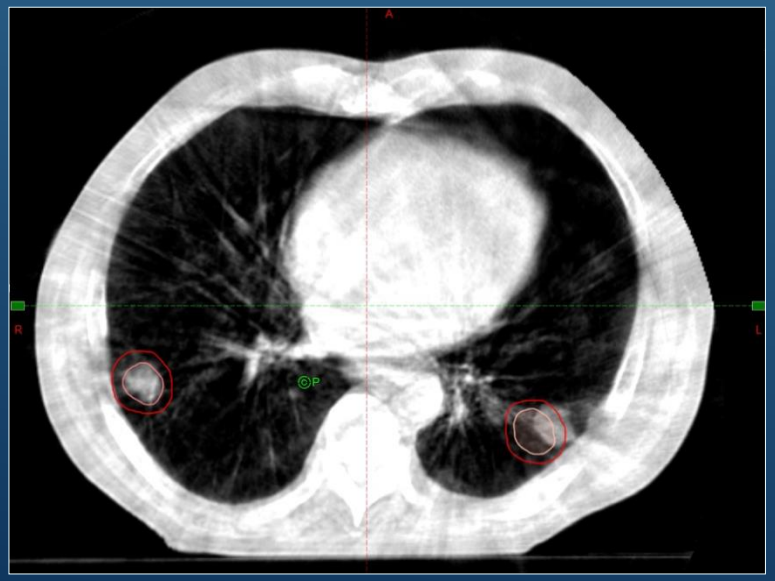
- Need to consider locations of lesions relative to each other:



- Contribution of dose from one plan to another?

Planning Multiple Lung and/or Nodal Sites

- Dosimetric impact if relative position of volumes changes when imaged on treatment?



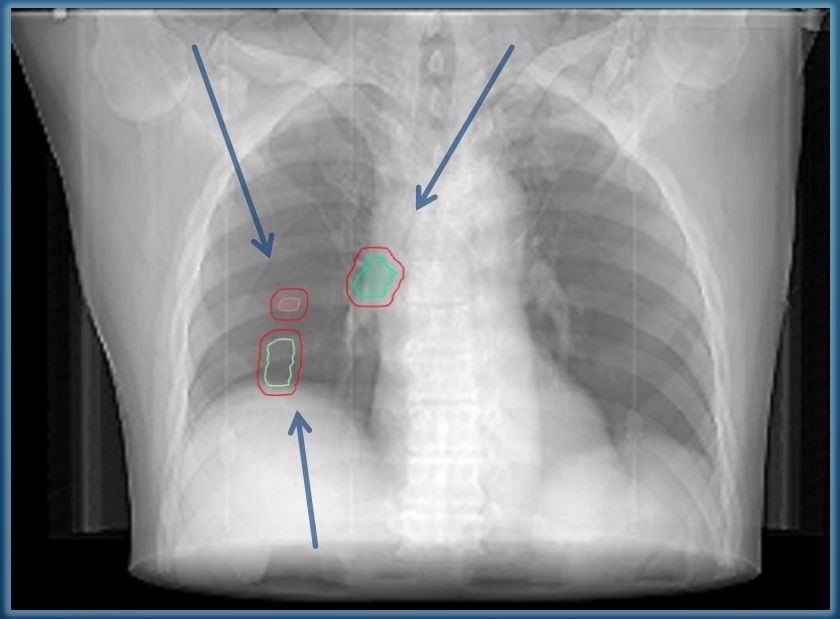
Case Study – 3 Volumes

- Male, 63 years old
- Primary Renal Cancer
- SABR to 3 sites :
  - R Upper Lung (RUL)
  - R Lower Lung (RLL)
  - R Hilar Lymph Node

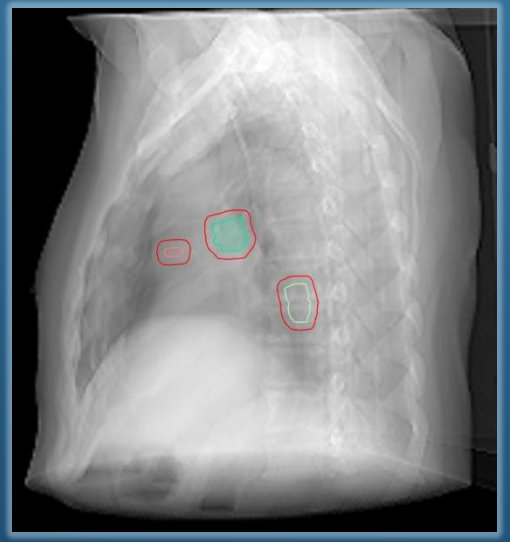
Case Study - Volumes

RUL
54Gy in 3fr

Node
36Gy in 3fr



RLL
55Gy in 5fr



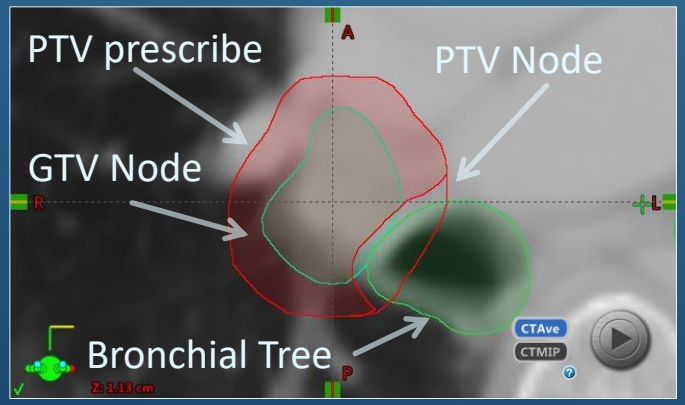
	ITV Vol(cc)	PTV Vol (cc)
RUL	0.5	4.5
RLL	3.4	13.6
Node	4.1	16.2

Case Study - Planning

- 3 Volumes all seen on same CT scan
- 3 Volumes ‘close’ to each other
- Node PTV overlap with Bronchial Tree
- Different prescriptions and number of fractions
- How to take into account dose contribution from one plan to the others?

Case Study - Planning Volume 1 (Node)

- Node PTV overlaps with Bronchial Tree → PTV prescribe created (Node PTV cropped 0.2cm from Bronchial Tree)
- Node planned first as compromise required to keep bronchial tree within tolerance
- Normalised 100% covers 95% of target (PTV Prescribe)



Case Study - Planning Volume 2 (RUL)

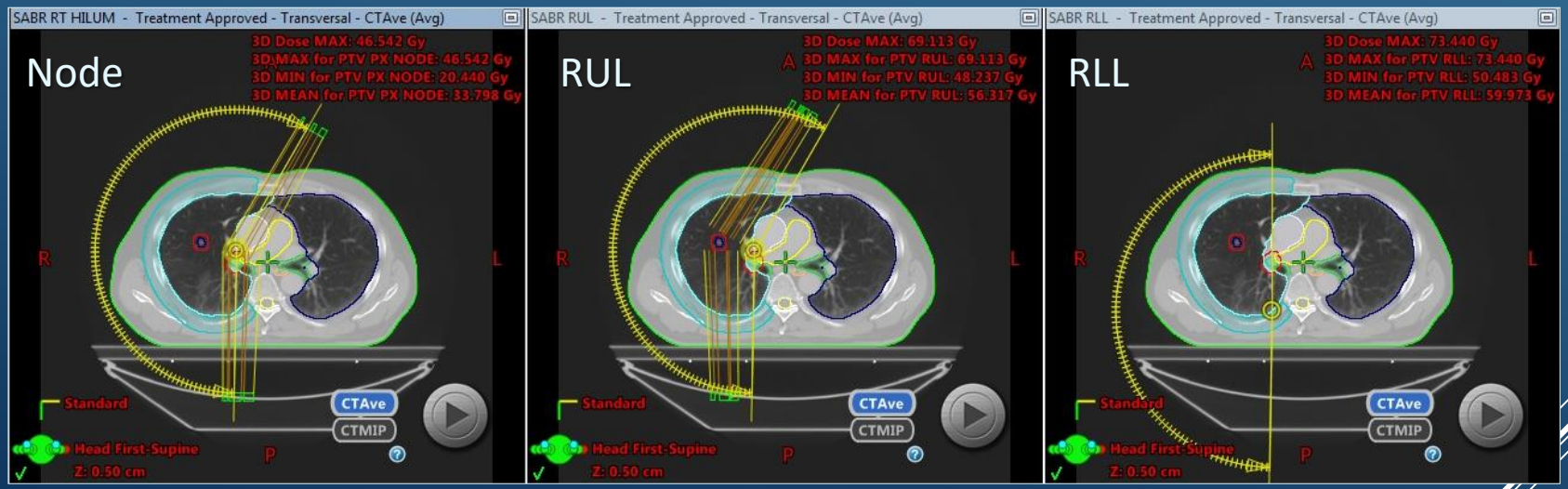
- Same number of fraction as Node
- Same isocentre position as Node plan used
- Use Node plan as Base Dose Plan
- No normalisation applied
- Revisit Node plan using RUL plan as Base Dose Plan
- Use Plansum (RUL and Node) to normalise both PTVs and assess coverage

Case Study - Planning Volume 3 (RLL)

- Different isocentre
- Use plansum of all three plans to:
  - Normalise all PTVs so that 95% covers 100% of volume
  - Check OAR doses (including bronchial tree)
- BUT RLL is 5 fractions

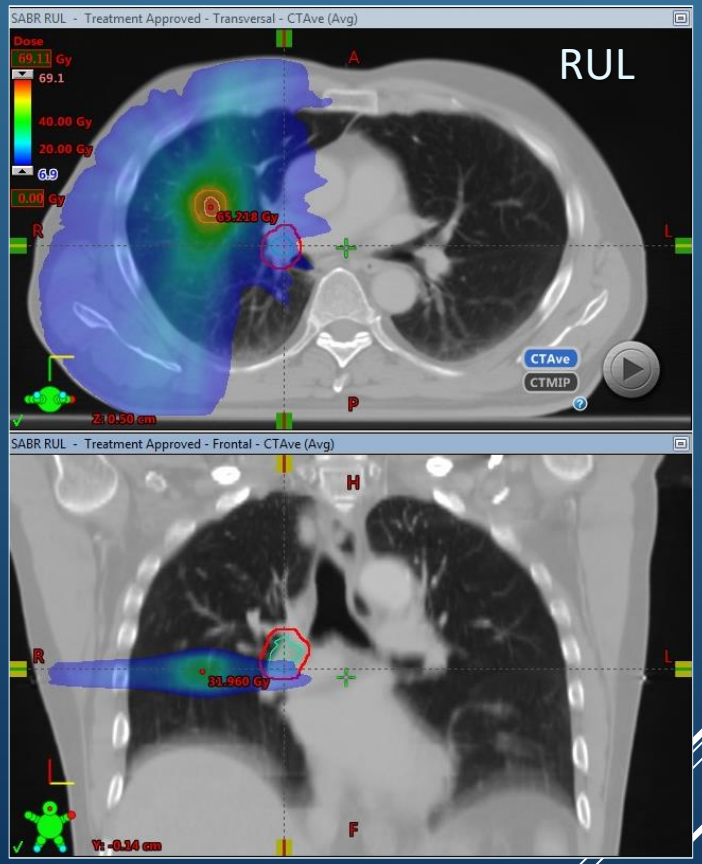
Case Study – Plan Set Up

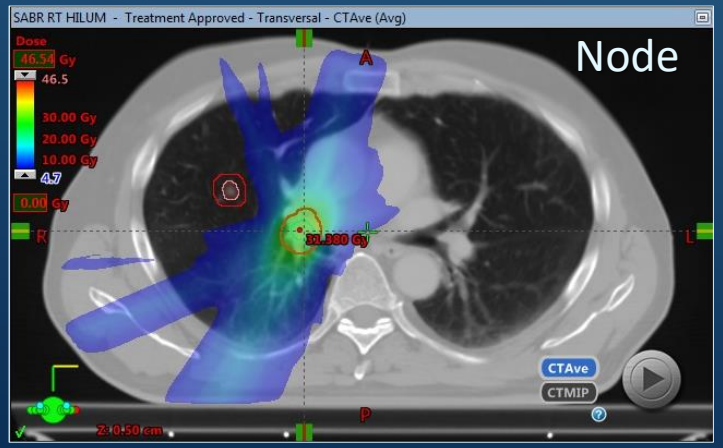
- 3 plans → 2 partial arcs used for each volume



Case Study – Dose distribution

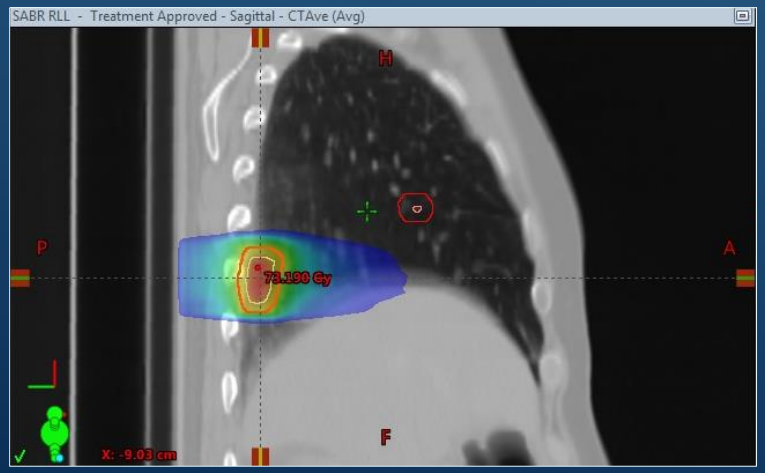
- Individual plans showing dose colourwash overlap from RUL and Node plans

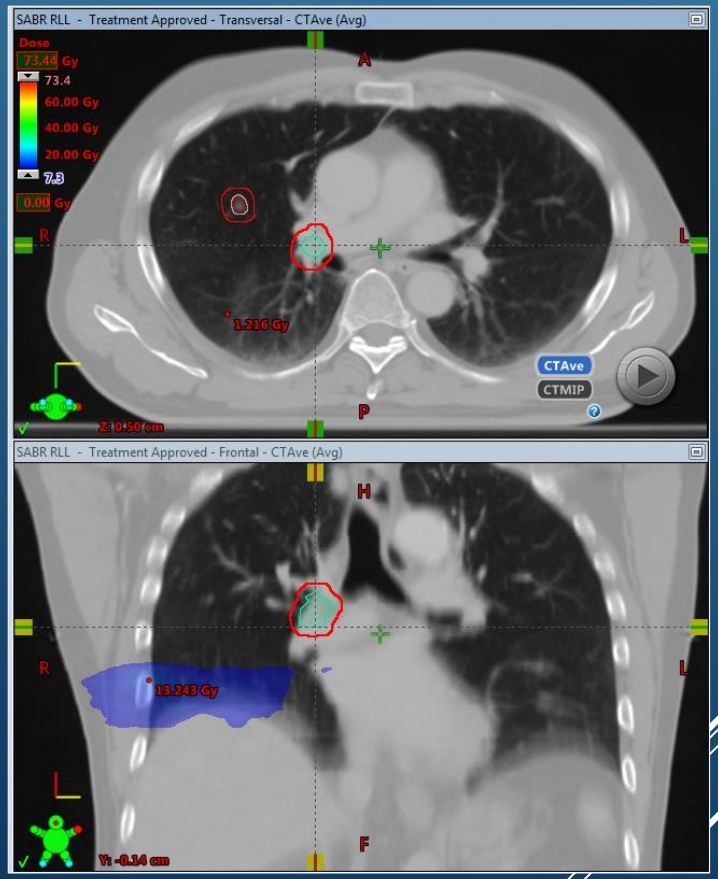




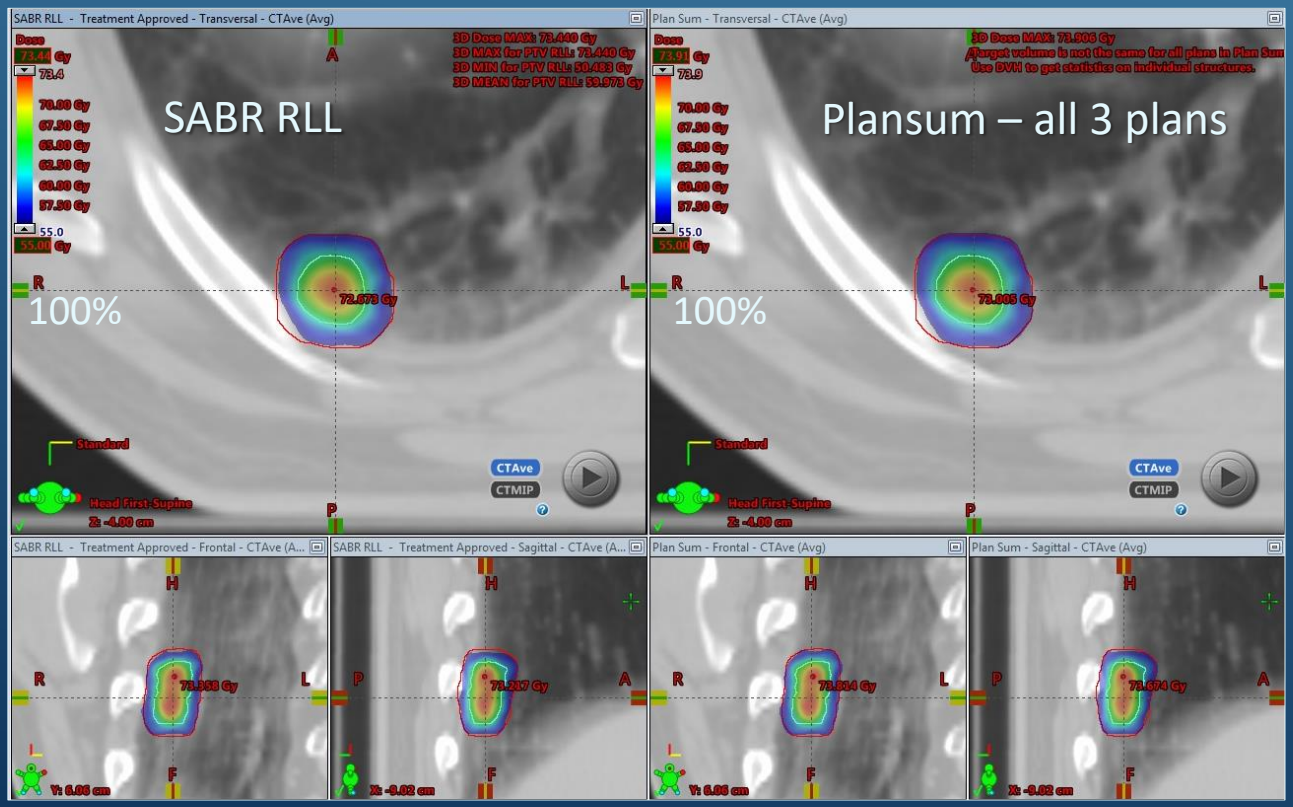
Case Study – Dose Distribution

- RLL – no direct overlap with other volumes
  - Mean dose to RUL = 2.5Gy
  - Mean dose to Node = 0.3Gy



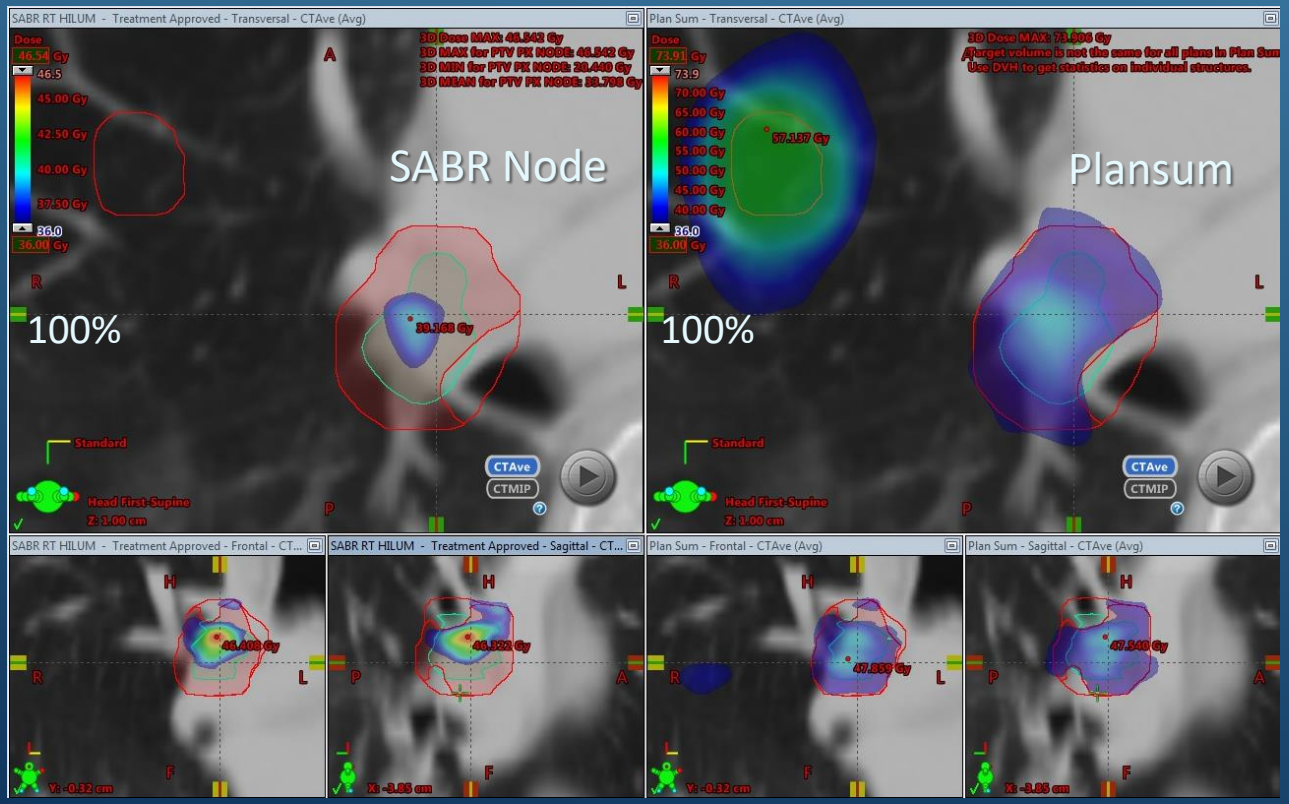


Case Study – Dose Distribution RLL



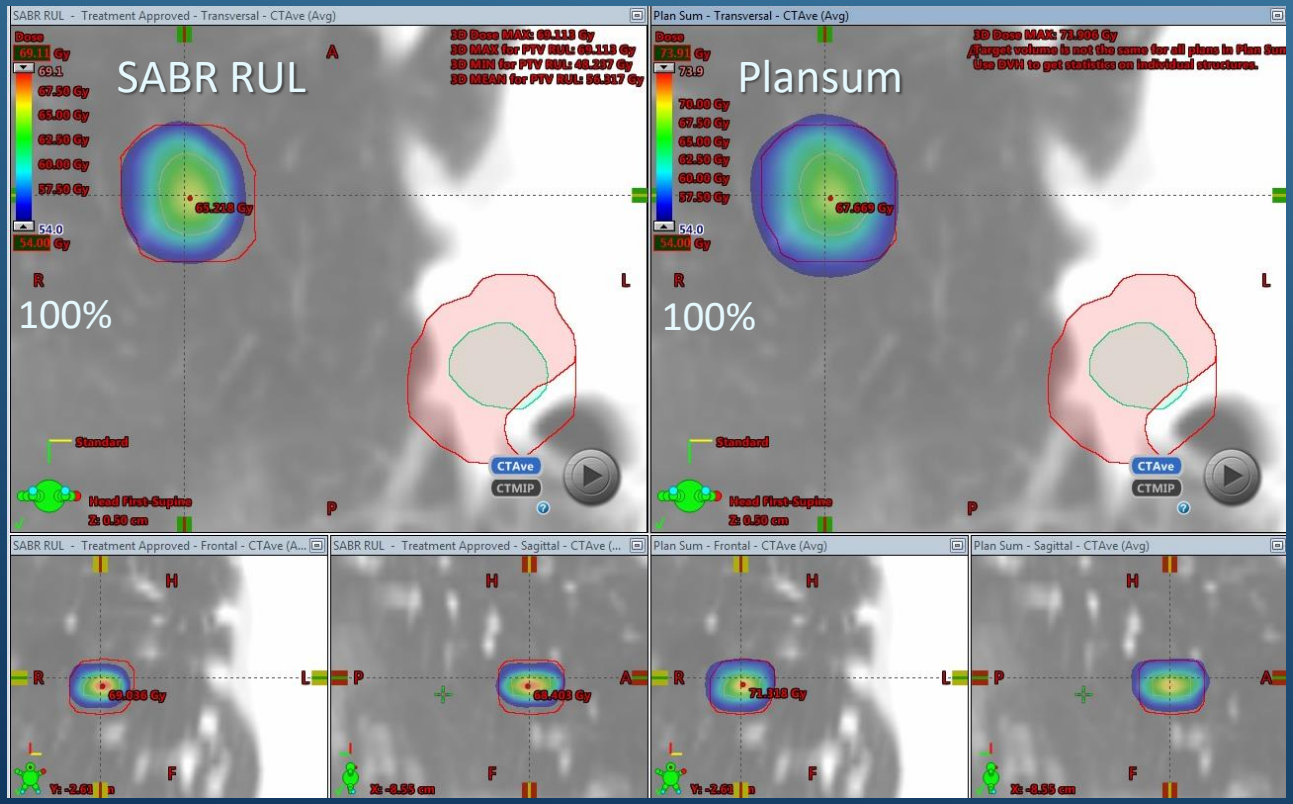
Plansum does not take into account that RLL is delivered in 5 fractions(RUL and Node are 3 fractions)

Case Study – Dose Distribution Node



Mean dose contribution from RUL plan to Node GTV = 4.0Gy

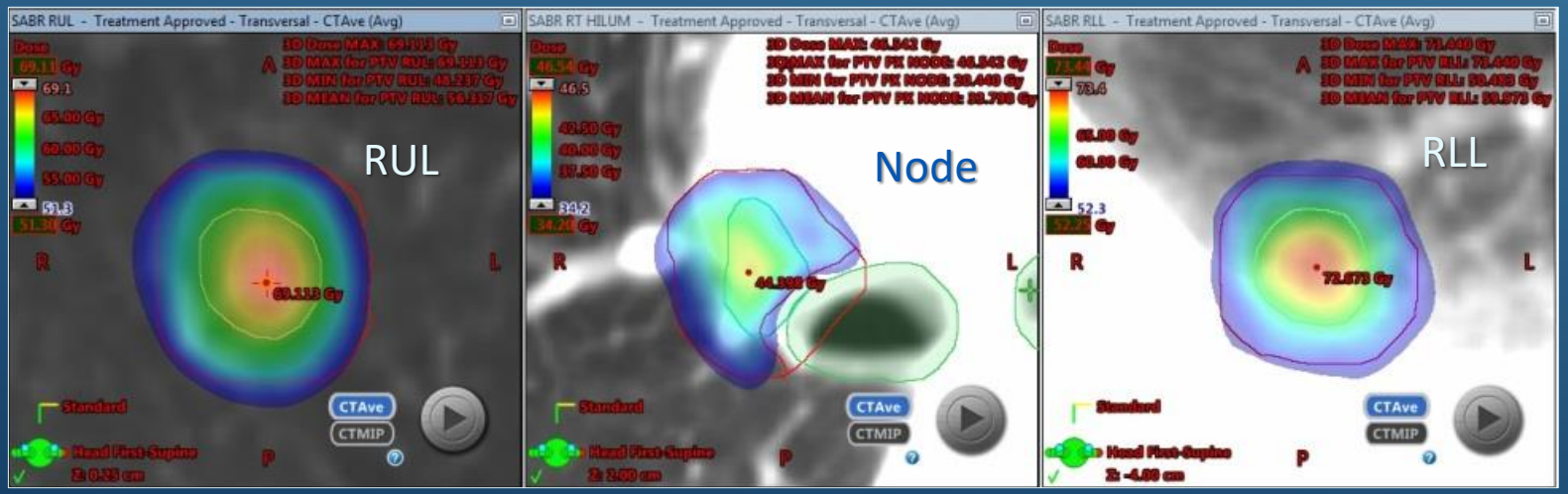
Case Study – Dose Distribution RUL



Mean dose contribution from Node plan to RUL ITV = 1.5Gy

Case Study – Dose Distribution

Final dose distribution (showing coverage by 95%):



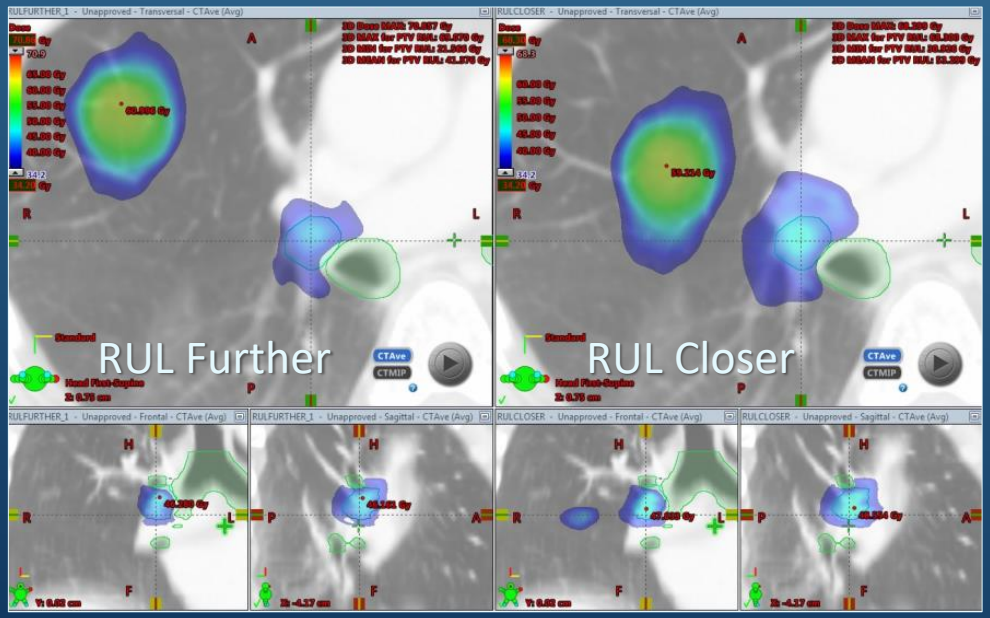
Node shows compromise required to keep Bronchial Tree in tolerance

Set Up Error and Dosimetric Impact

- Use Case Study as an example using Node and RUL plans
- What is the dosimetric impact if the relative distance between the RUL and Node differs on treatment?
- ITV/GTV to PTV margin = 0.5cm. Assume RUL and Node are 1cm closer/further from each other
- Assume position of bronchial tree relative to Node is fixed

Set Up Error and Dosimetric Impact

- Simulate by shifting isocentre on planning scan and recalculating plan



- Assess impact on dosimetry

Set Up Error and Dosimetric Impact

- If the RUL is delivered ‘closer’ to the Node is the bronchial tree still in tolerance?
- If the RUL is delivered ‘further’ away from the Node is the Node GTV dosimetry still acceptable?

Contribution of:	Mean Dose
RUL Plan to Node GTV	7.3%
Node Plan to RUL ITV	4.4%

Set Up Error and Dosimetric Impact

Bronchial Tree tolerances for 3 fractions:

	Optimal	Mandatory
DMax (0.5cc)	<30Gy	<32Gy

Doses achieved:

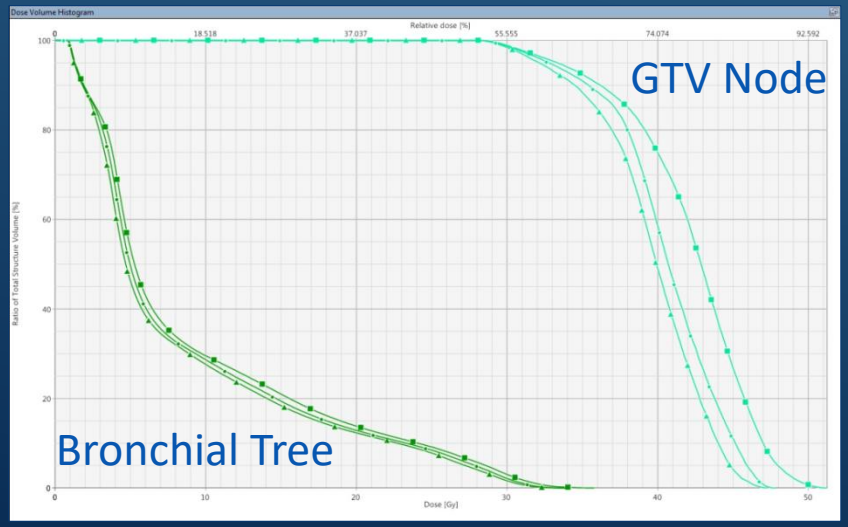
	Planned	RUL Closer
Dmax (0.5cc)	30.8Gy	31.6Gy

Still in tolerance

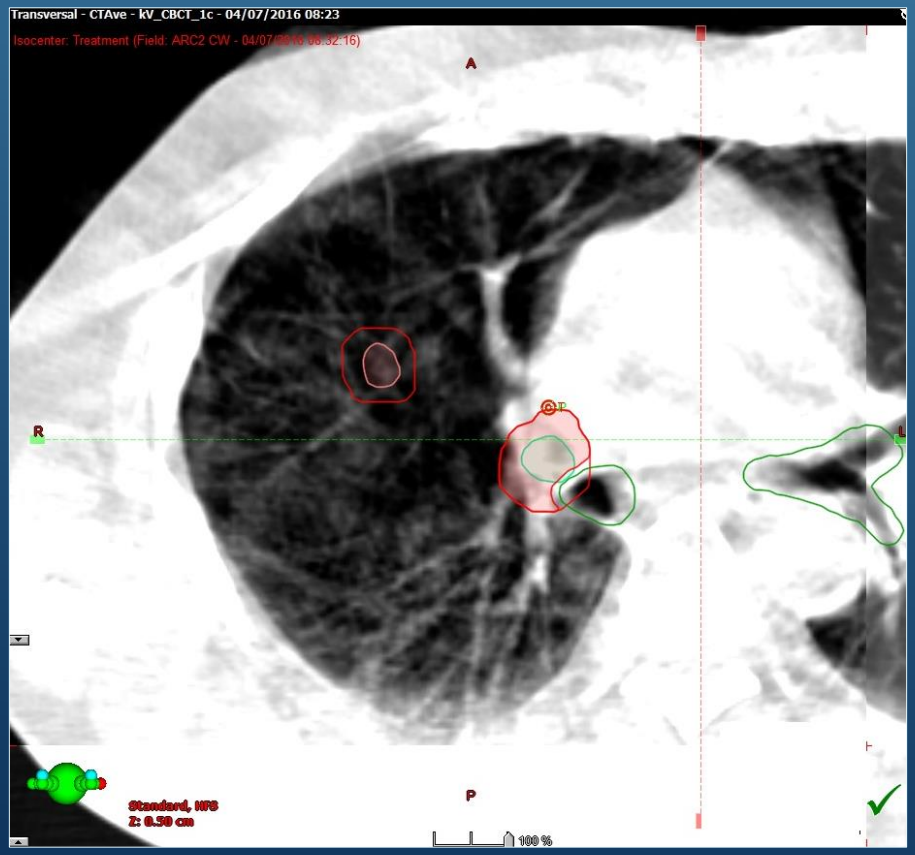
Set Up Error and Dosimetric Impact

- GTV Node Dose stats:

GTV Node	Min	Max	Mean
Planned	78.3%	132.8%	112.5%
RUL Further	78.1%	131.1%	110.0%
RUL Closer	78.9%	142.2%	117.2%



Set Up Error and Dosimetric Impact



CBCT acquired on treatment

Conclusions (1)

- Each case has its own challenges
- Discuss approach to planning on patient specific basis
- Plan Set up:
  - Are single or multiple plans required?
    - Single plan is quicker to plan & quicker to treat
  - Are single or multiple isocentres required?
    - Single isocentre reduces imaging requirements

Conclusions (2)

- Do we need to take into account dose contribution of plans to each other?
- How do we approach this in terms of:
  - Normalisation
  - OAR tolerances
- If ‘Plan 1’ contributes to the dosimetry of ‘Volume 2’ aim to achieve a homogeneous dose distribution across the ‘Volume 2’
- Be wary of dosimetry for plans for different numbers of fractions

Acknowledgements

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Thank you

Any Questions?