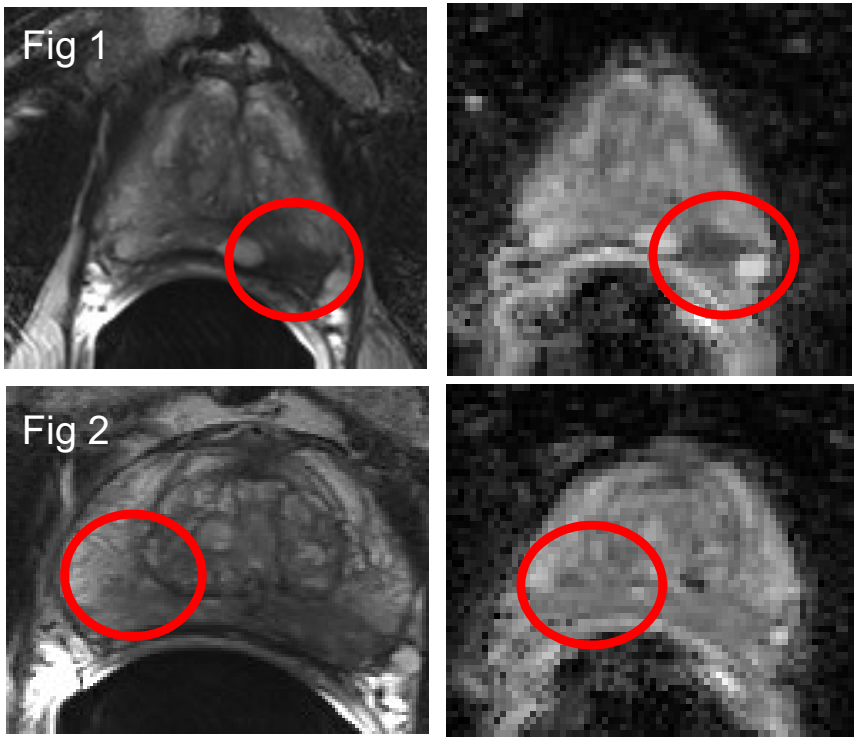
POTEN-C Trial: Neurovascular Sparing Arm Patient Example #1

Last updated 8/28/2018

Case Evaluation and Choice of Side to Spare

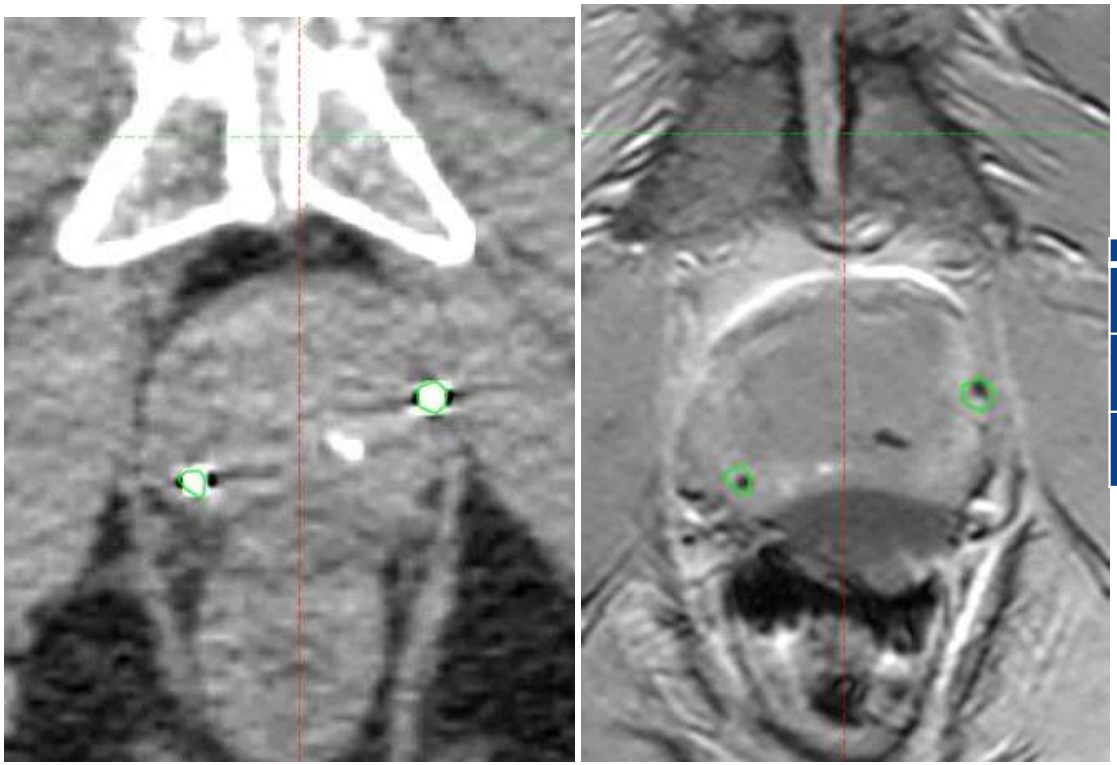
- iPSA <5 Gleason Grade 6 >50% cores (1/6 right, 6/6 left) in young patient opting for treatment
- mpMRI 3T w/ endorectal coil
  - PIRADS v2 score 4 dominant lesion on left mid PZ (Fig 1)
  - v2 score 3 right mid lesion of unclear significance and >5mm from right sided neurovascular bundle (NVB)
  - Concordant w/ bx result
- Elected trial w/ intent to spare right NVB, internal pudendal arteries and penile bulb/corpora cavernosa
- Patient then underwent SpaceOAR/fiducial placement with subsequent randomization to NE-sparing arm ***PT BLINDED TO THIS***



General Steps in Contouring Neurovascular Sparing Arm

- Choose side to spare (right in this patient, as right sided MR lesion equivocal and >5mm to NVB)
- Fusion of MRI/CT (if not using MR only planning) using fiducials/FSGPR sequence, pitch alignment
- Contouring CTV (prostate) on MR as guidance for CT delineation of CTV
- Contouring of normal structures, with focus on NVB, IPAs, penile bulb/corpus cavernosum to reflect location on CT (may require differing registration to MRI) and **NOT** overlapping with CTV prostate.
- *Shaping5mm* structure is a 5mm expansion on combination of right NVB, penile bulb/CC, and IPA
- PTV1_30Gy will be a 3mm expansion on CTV, excluding the right sided NVB, IPA and penile bulb/CC (0mm margin in areas)
- PTV2_SAbR (40 or 45Gy) will be PTV1_30Gy, excluding the *Shaping5mm* structure above.

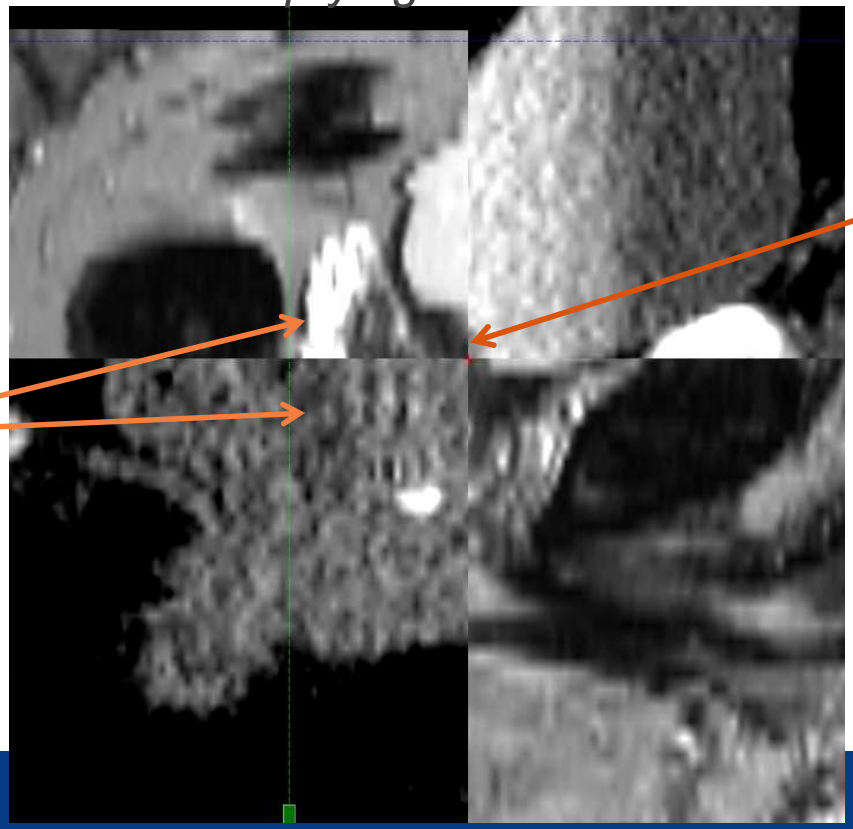
Case 1 Neurovascular Sparing MRI Registration – Fiducial Alignment (can also use hemorrahge products!)



Pulse sequence	Plane	Slice thickness; FOV	Duration
Localizer	Axial and sagittal	10mm; 400 mm	30 sec
T2WI FSE	Axial	3 mm; 180 mm	6-7 min
T1WI SPGR	Axial	3 mm; 180 mm	3-4 min

Case 1 Neurovascular Sparing MRI Registration – Pitch Alignment

Check for differences in pitch if can't get a solid fiducial match (can have ok fiducial alignment but offset in pitch can throw off relationship of gland to normal structures, including neurovascular elements, demonstrating importance of reproducible bladder fill/rectal emptying maneuvers at treatment)

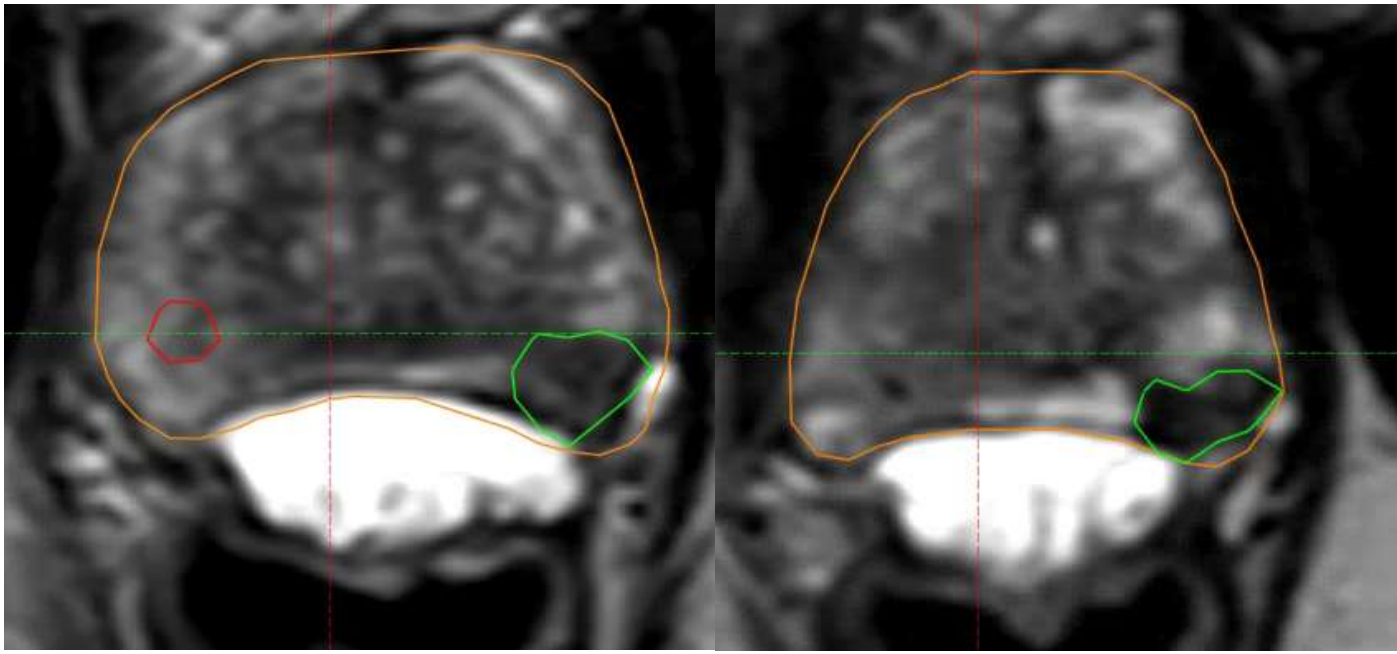


Spacer gel and SV's lined up on sagittal

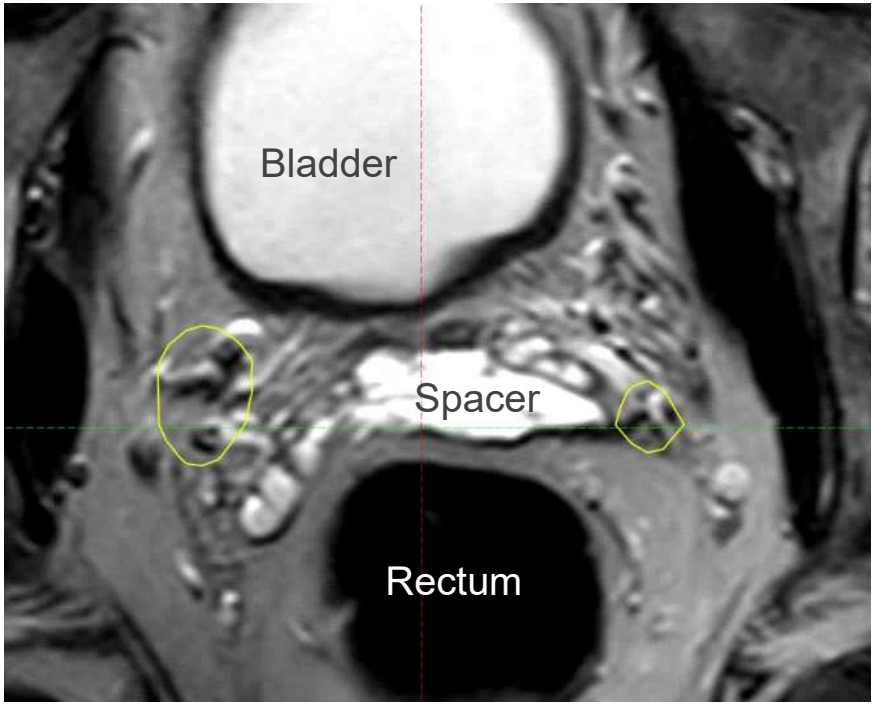
Bladder interface w/ prostate can also be a good area to align pitch of CT/MRI

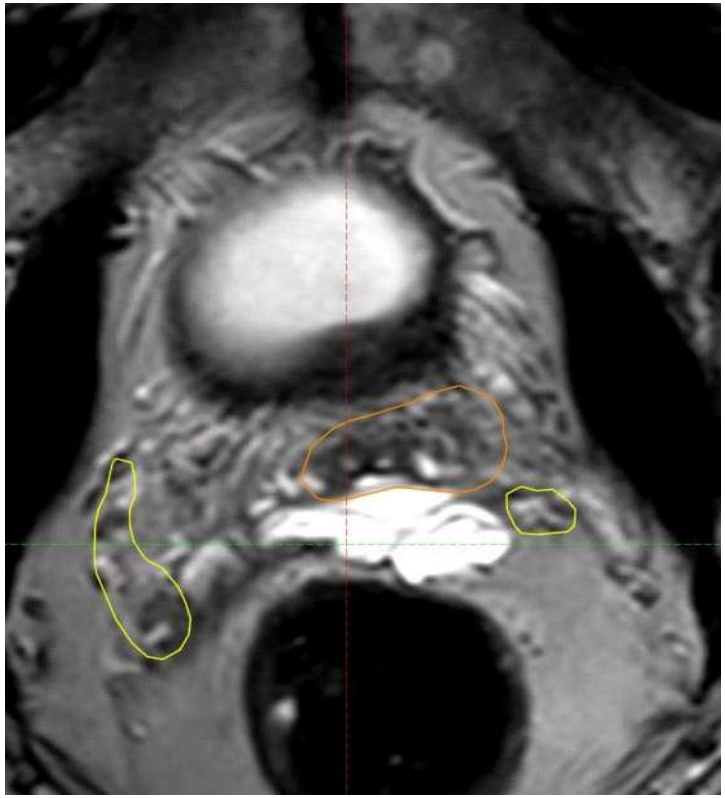
Case 1 NV Sparing – CTV Delineation (orange)

- CTV (orange) relies on MR fusion to be tight on prostate especially in area of right NVB to spare, whereas more liberty can be taken on left where dominant lesion (green) was in contact w/ capsue. The indeterminate right sided lesion is noted (red) to check for a minimum coverage out of safety.



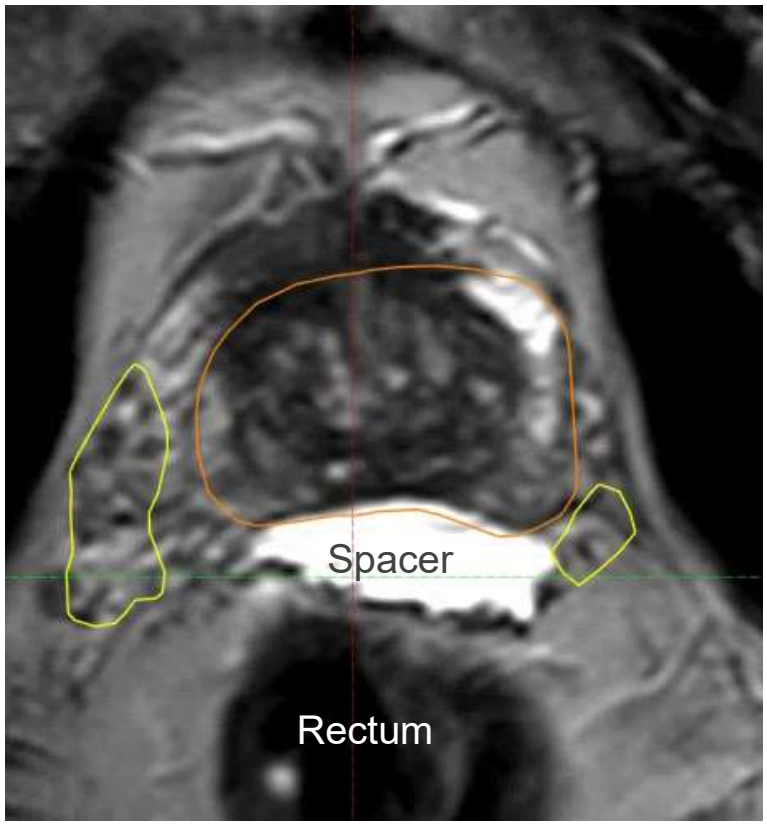
Case 1 NV sparing - Neurovascular Bundle (yellow, above base)

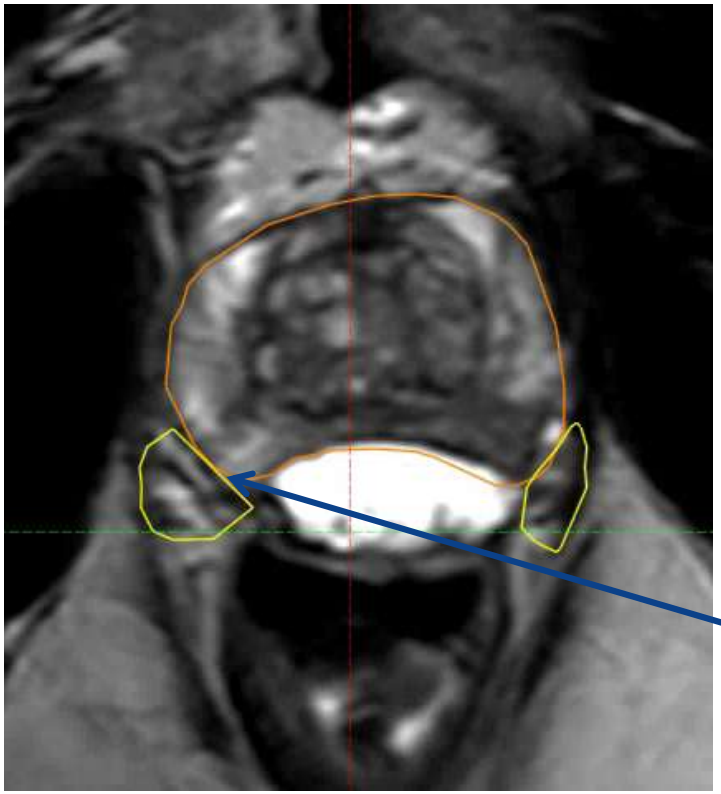




CTV- orange

Case 1 NV sparing - Neurovascular Bundle (yellow, base-mid)

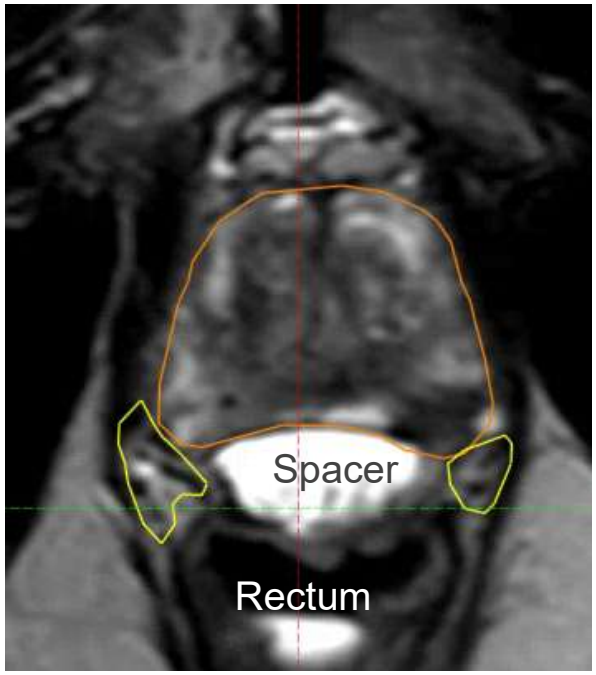


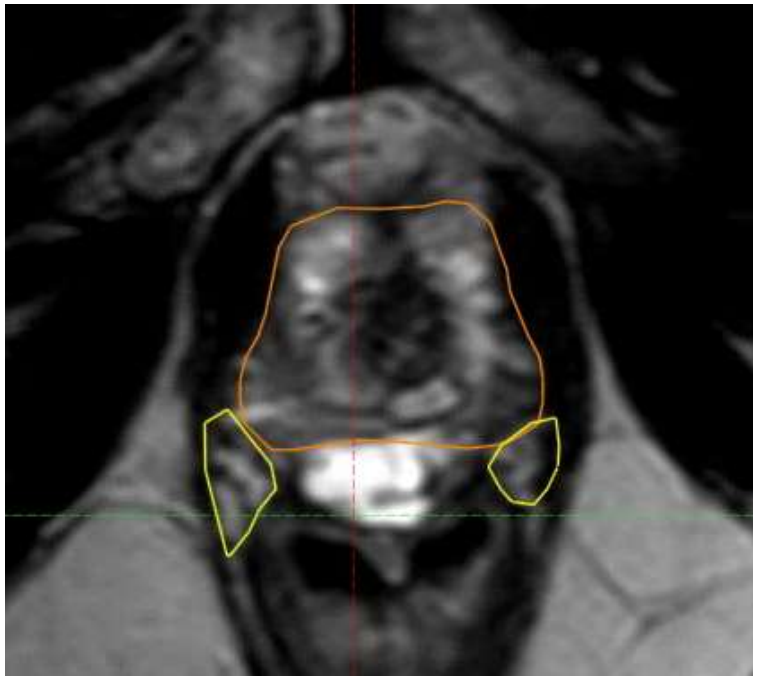


CTV- orange

No CTV-NVB overlap allowed; favor CTV if not clear

Case 1 NV sparing - Neurovascular Bundle (yellow, mid-apex)

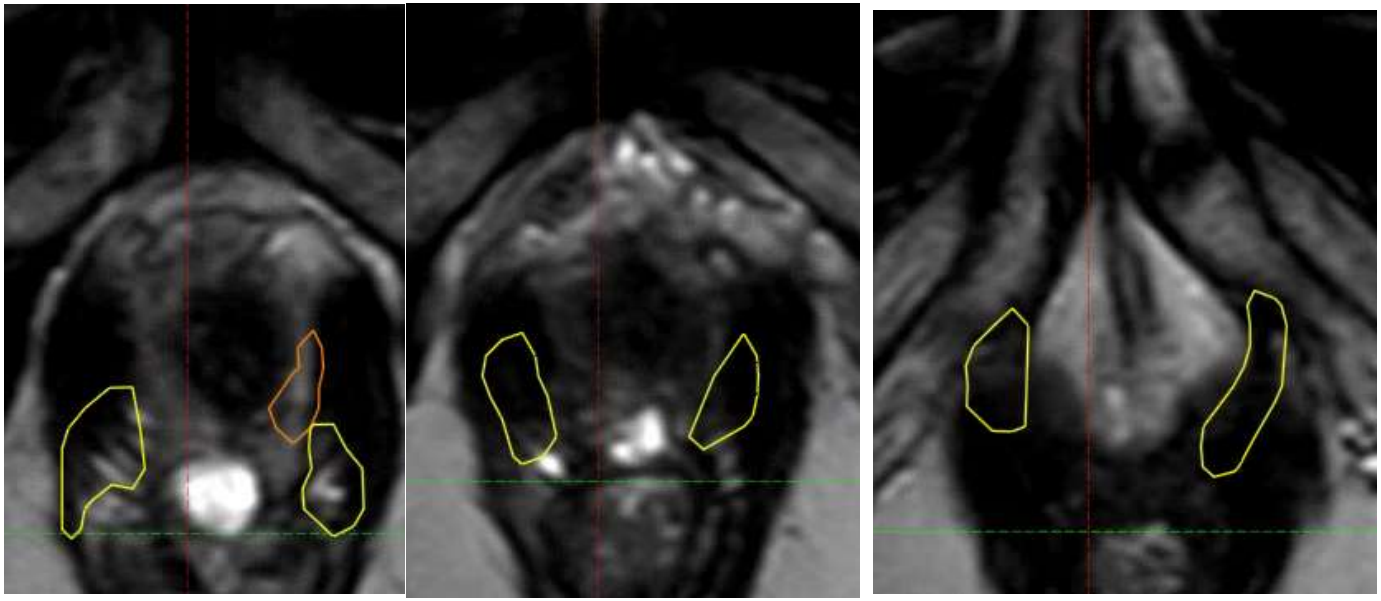




CTV- orange

Case 1 NV sparing - Neurovascular Bundle (yellow, apex to bulb)

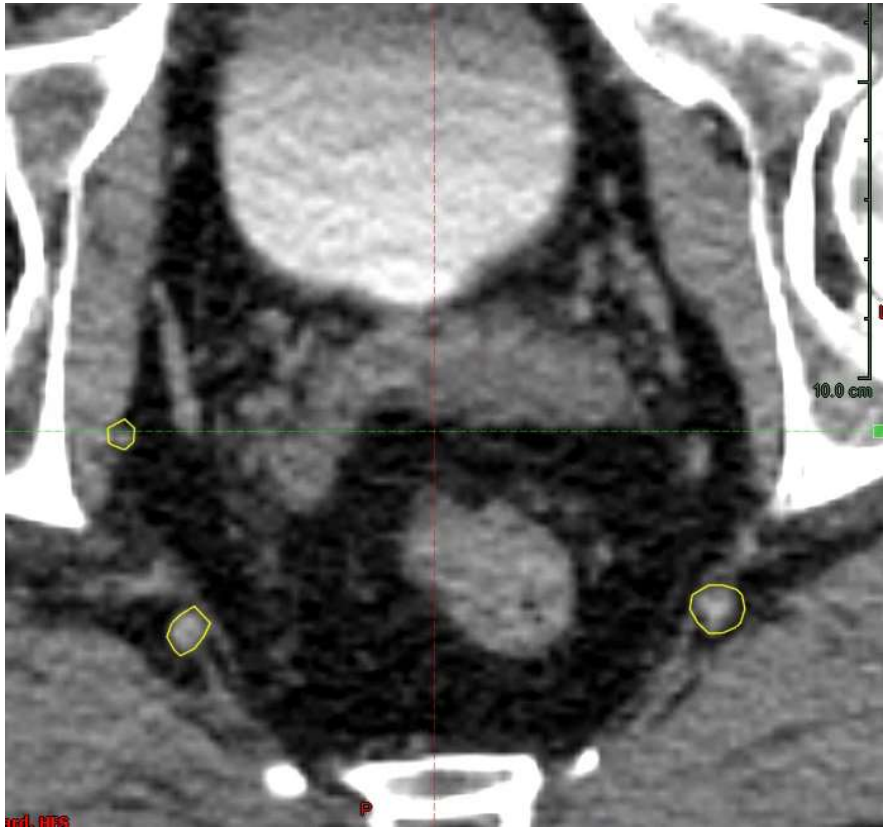
- The smaller cavernosal nerves of the NVB may be difficult to visualize, but it is nevertheless important to interpolate as needed from the last clear visible NVB packet to the erectile tissue, in order to capture these key smaller nerves



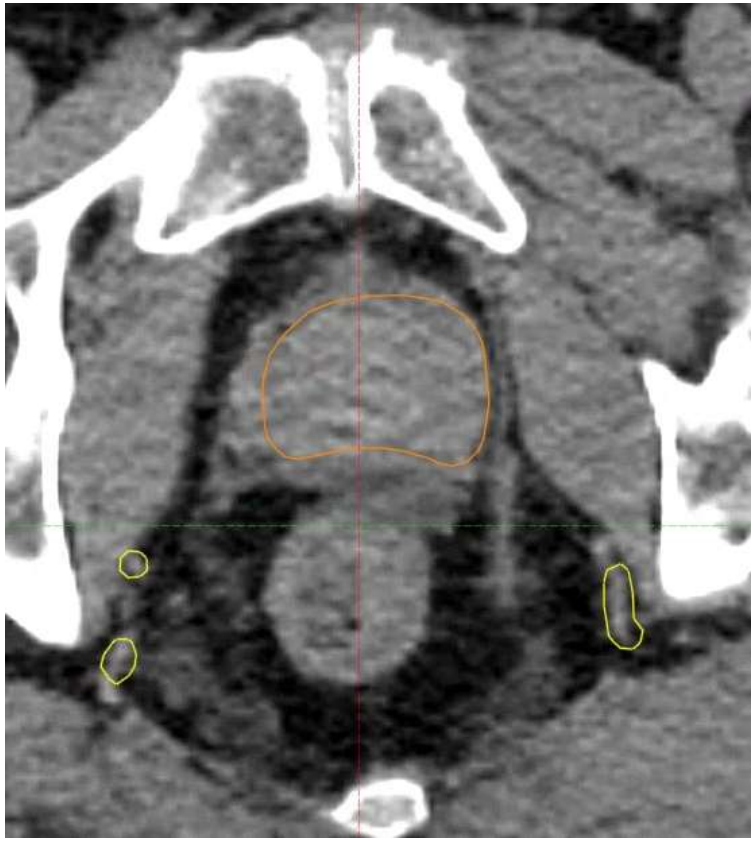
CTV- orange
NVB's - yellow

Case 1 NV sparing – Internal Pudendal Artery (yellow, exiting pelvis to re-entry)

- IPA (yellow) originates as a branch of the internal iliac artery in the posterolateral pelvis, exiting the pelvis below the superior gluteal artery at the lower aspect of the greater sciatic foramen.
- In this case, the cranial starting point was chosen as 1cm along the artery cranial to the PTV.
- **CT was used to delineate** without need for MRI due to decent contrast enhancement.

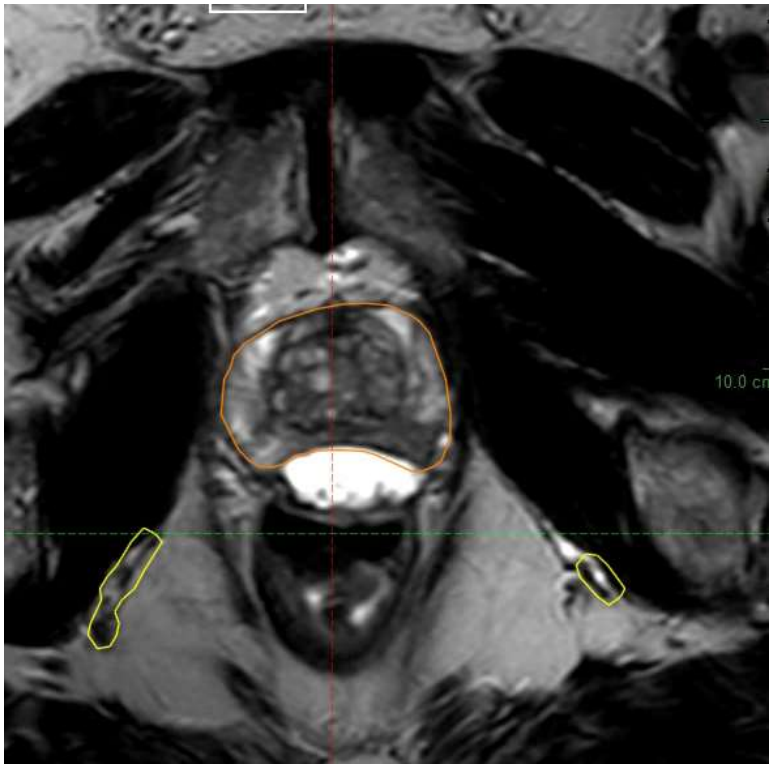


Case 1 NV sparing – Internal Pudendal Artery (yellow, base-mid)



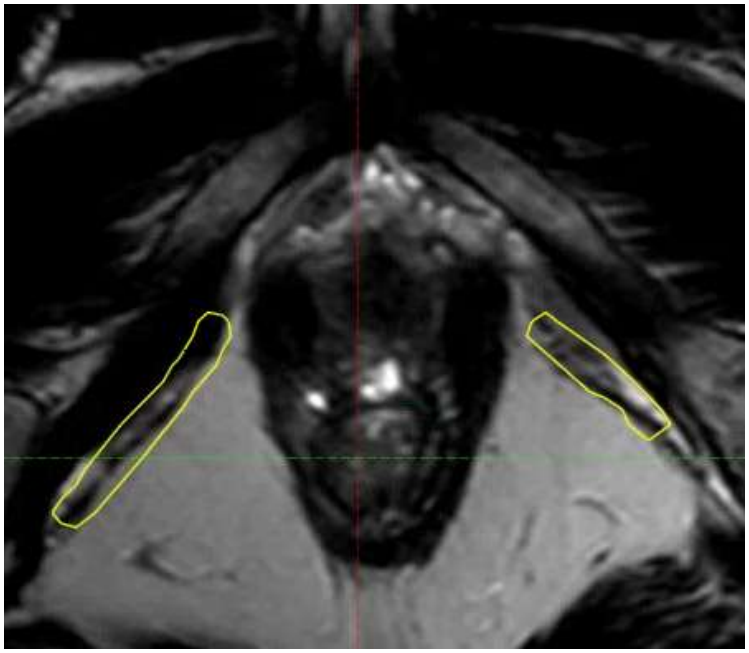
Note on right there are two discontiguous structures, because we felt there may be a variant accessory pudendal artery contribution more anteriorly based on its convergence on the right IPA in the pudendal canal on the obturator muscle more cranially in the following slide

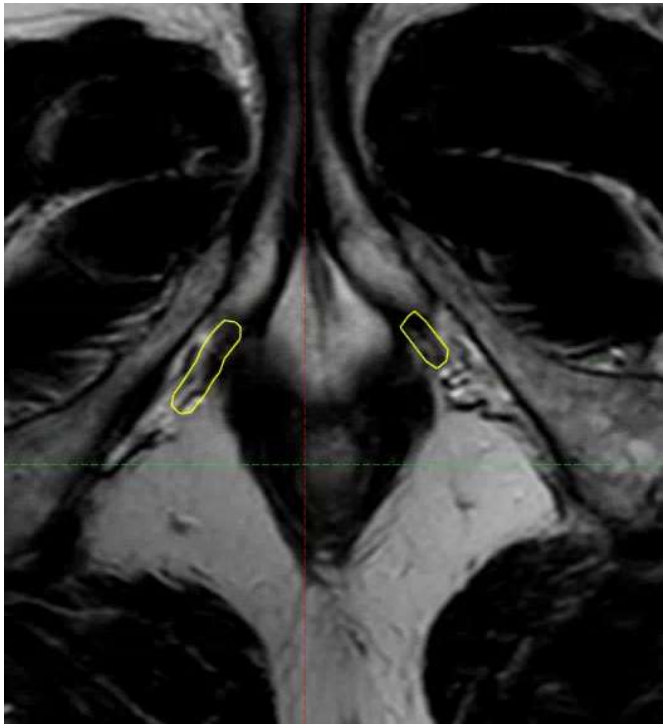
Case 1 NV sparing – Internal Pudendal Artery (yellow, entering pudendal canal)



After re-entry into the pelvis, the IPA will course anteriomedially along the medial edge of the obturator internus in the pudendal canal. Here, two separate contributory vessels converged on the right, giving us reason to believe in the preceding cranial slides that there was an accessory vessel which should be contoured.

Case 1 NV sparing – Internal Pudendal Artery (yellow, terminating on the crus of the corpora cavernosa in the penile artery)

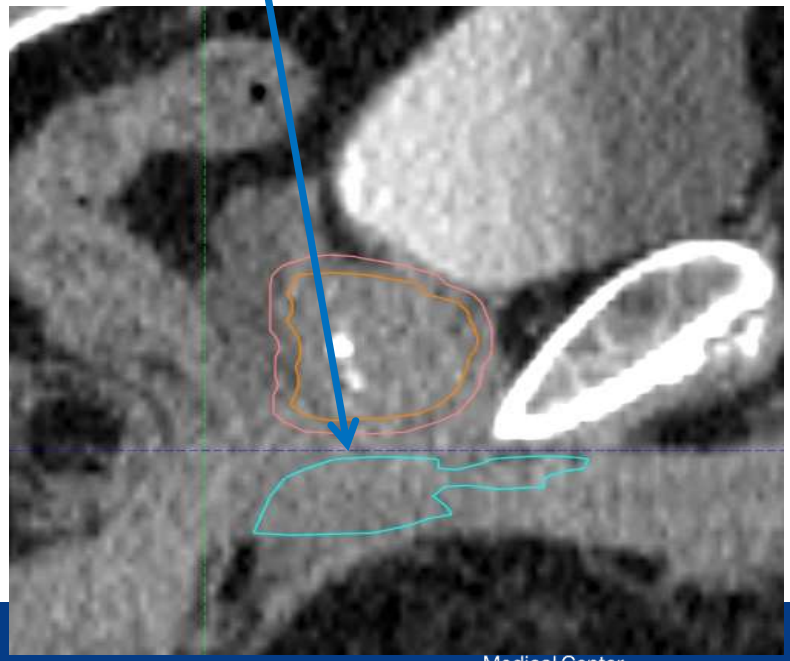




- Caudally, the IPA will course along the medial edge of the obturator internus in the pudendal canal. Here, two separate contributory vessels converged on the right, giving us reason to believe there was an accessory vessel which should be contoured (prior slides).
- At this level, MRI registration may be more helpful than CT and the IPAs course most closely to the apical PTV, emphasizing the need for careful delineation of CTV/anatomy at apex.

Case 1 NV sparing – Penile Bulb/Corpora Cavernosa (cyan)

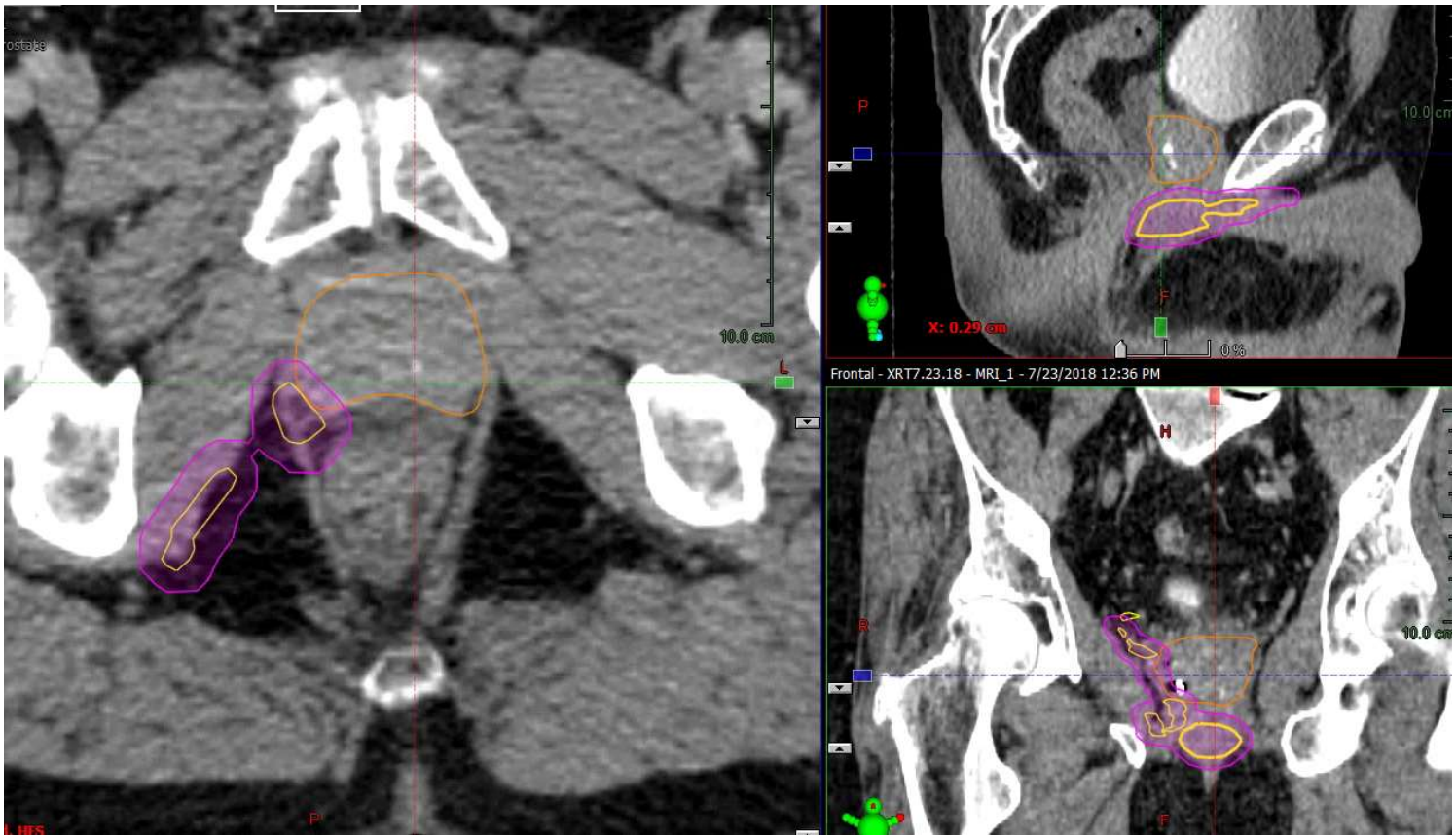
- Include any corpora cavernosa at same axial slice anteriorly.
- Again, apical delineation of CTV/PTV is impt and distance from NVB/IPA/PB likely affects ED



Shaping Structure for Neurovascular Elements

- Standard abbreviated name: *Shaping5mm*
- Create union of spared side (right in this case) IPA, NVB, and penile bulb + corpora cavernosum structure, using boolean or other similar tool
- No overlap with CTV -- favoring accurate delineation of the CTV prostate target
- Expand by 5mm to make shaping structure PRV for creation of PTV2_SAbR

Shaping Structure Case 1



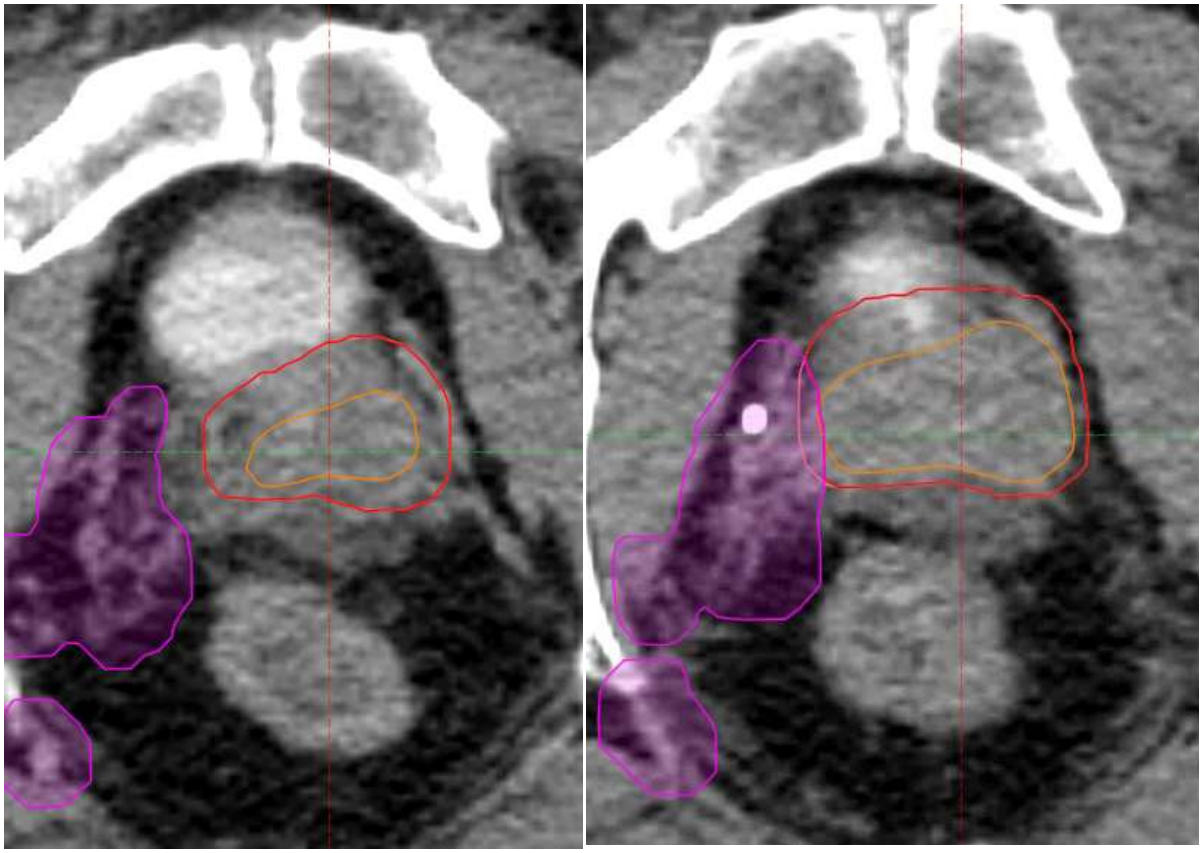
- Yellow = right IPA, right NVB, Penile bulb and CC
- Magenta = 5mm shaping structure on this right side to be spared
- Orange = CTV

PTV Structures

- PTV1_30Gy = CTV + 3mm, excluding the neurovascular structures to be spared (i.e. left NVB, left IPA, penile bulb + corpus cavernosum)

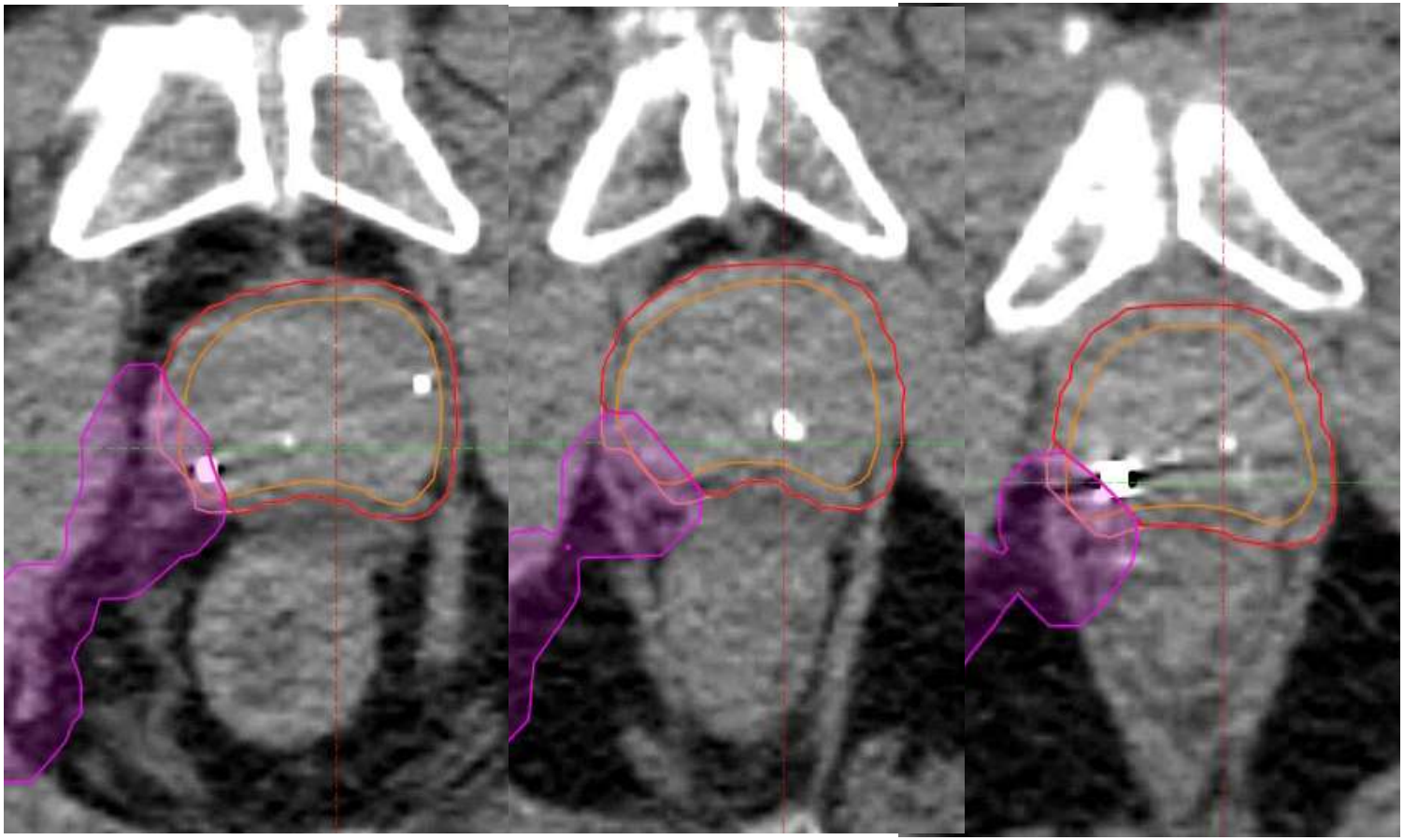
- PTV2_SAbR = PTV1_30Gy, excluding the 5mm PRV around these neurovascular structures (*Shaping5mm* structure).
  - Each institution may elect to treat to 40 Gy or 45 Gy at site activation

PTV's (Red=45Gy, Pink =PTV1 30Gy)



- Pink= PTV1_30Gy
- Red= PTV2_SAbR45Gy
- Orange = CTV
- Magenta = 5mm shaping structure on this right side to be spared

PTV's (Red=45Gy, Pink =PTV1 30Gy)



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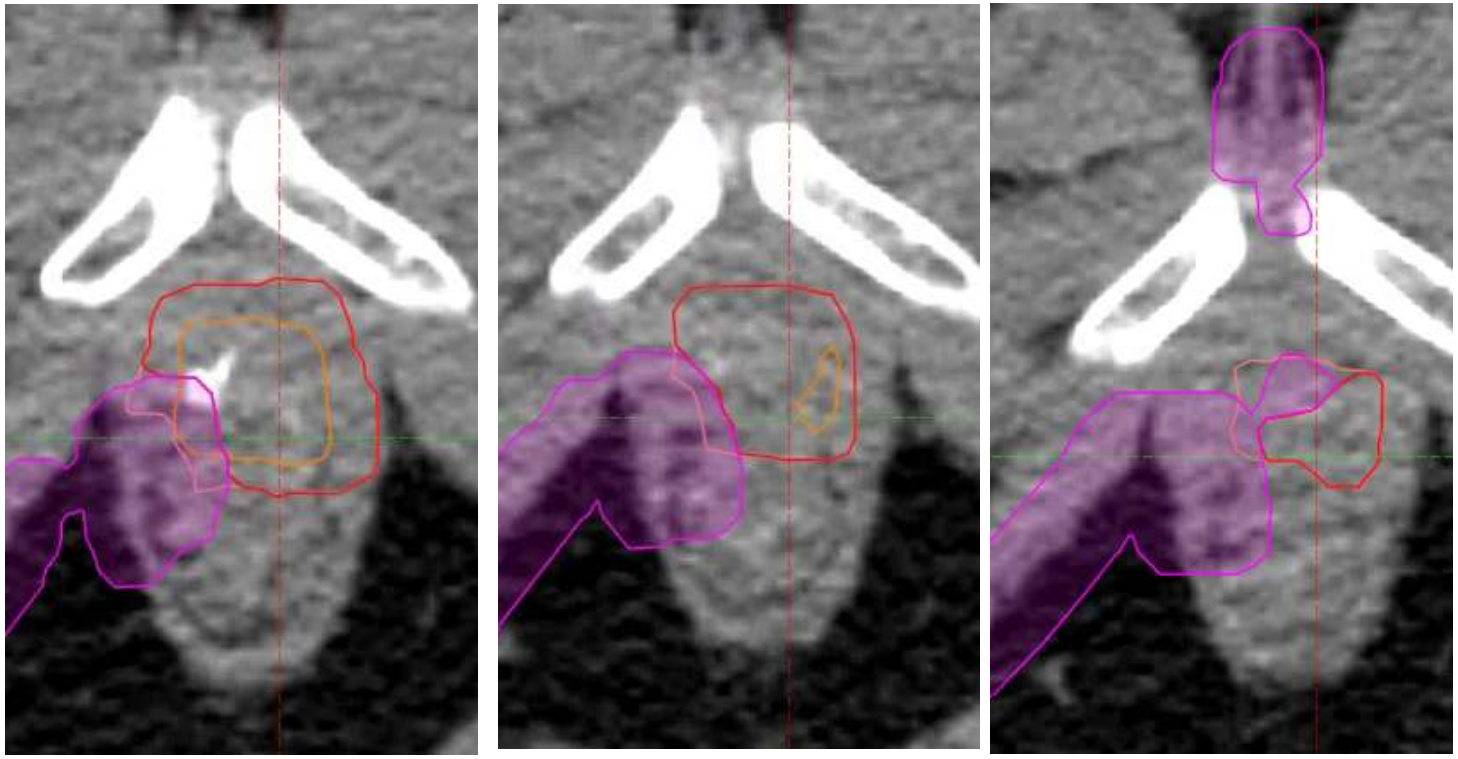
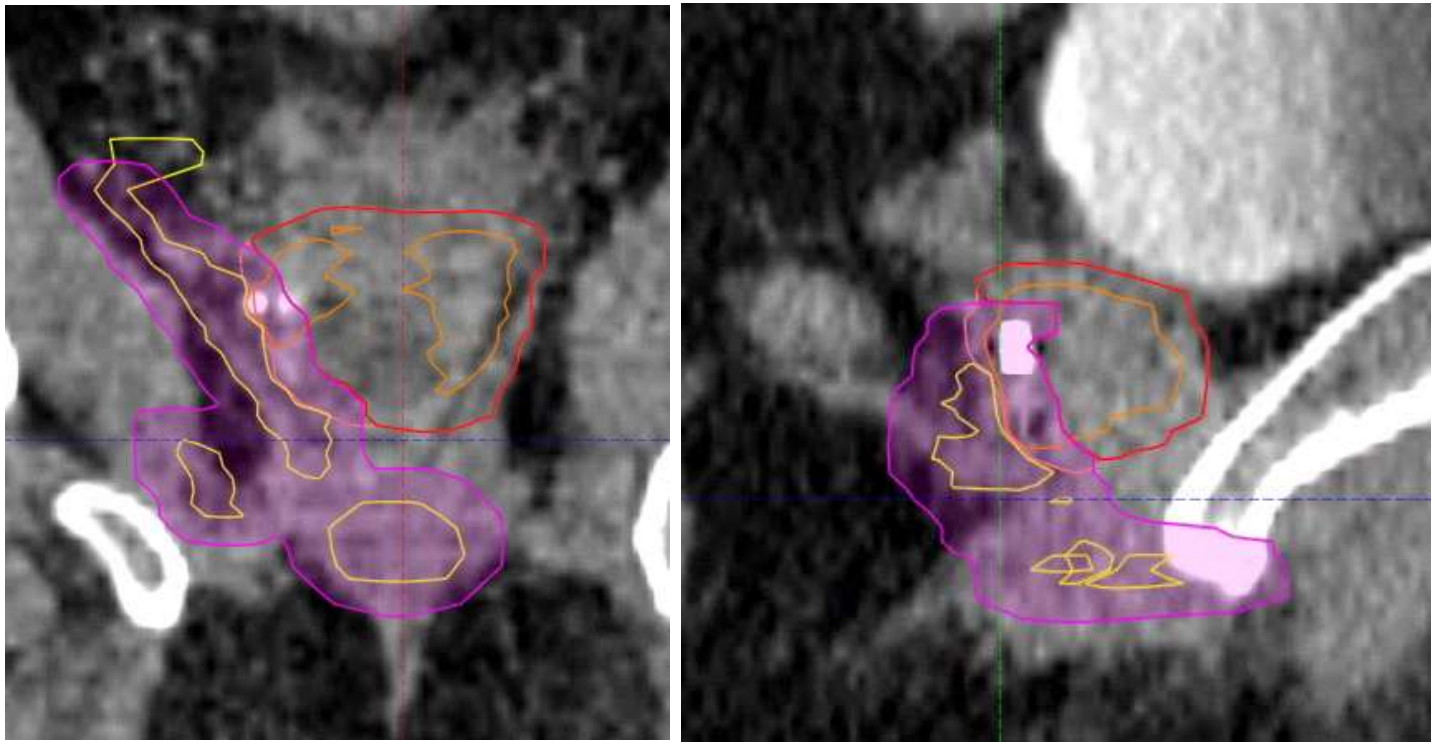


- Pink= PTV1_30Gy
- Red= PTV2_SAbR45Gy
- Orange = CTV
- Magenta = 5mm shaping structure on this right side to be spared

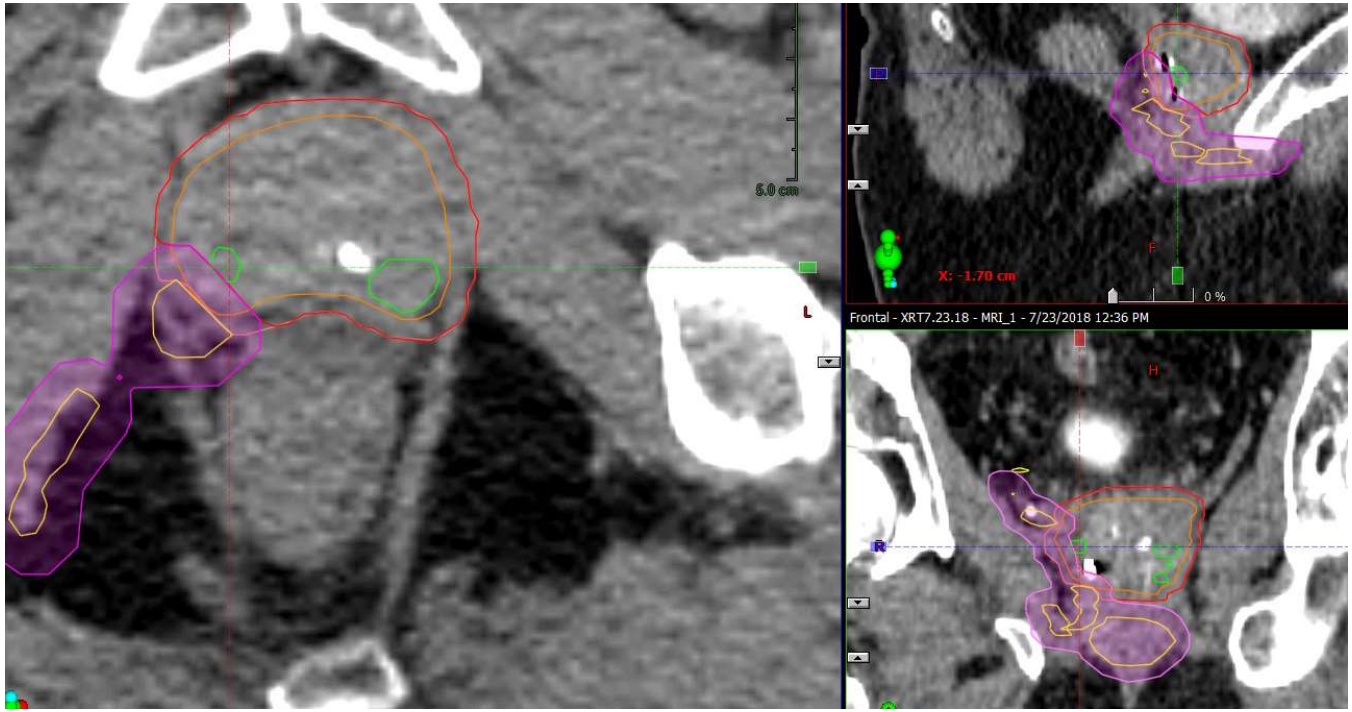
At apex, where NVB/IPA converge, be careful to inspect the effect of the shaping structure on PTV expansion – there will be most trimming of PTV2_SAbR here, meaning apex often will be de-escalated to 30Gy (PTV1)

PTV's (Red=45Gy, Pink =PTV1 30Gy)



- Pink= PTV1_30Gy
- Red= PTV2_SAbR45Gy
- Orange = CTV
- Magenta = 5mm shaping structure on this right side to be spared
- Yellow = right IPA, right NVB, Penile bulb and CC

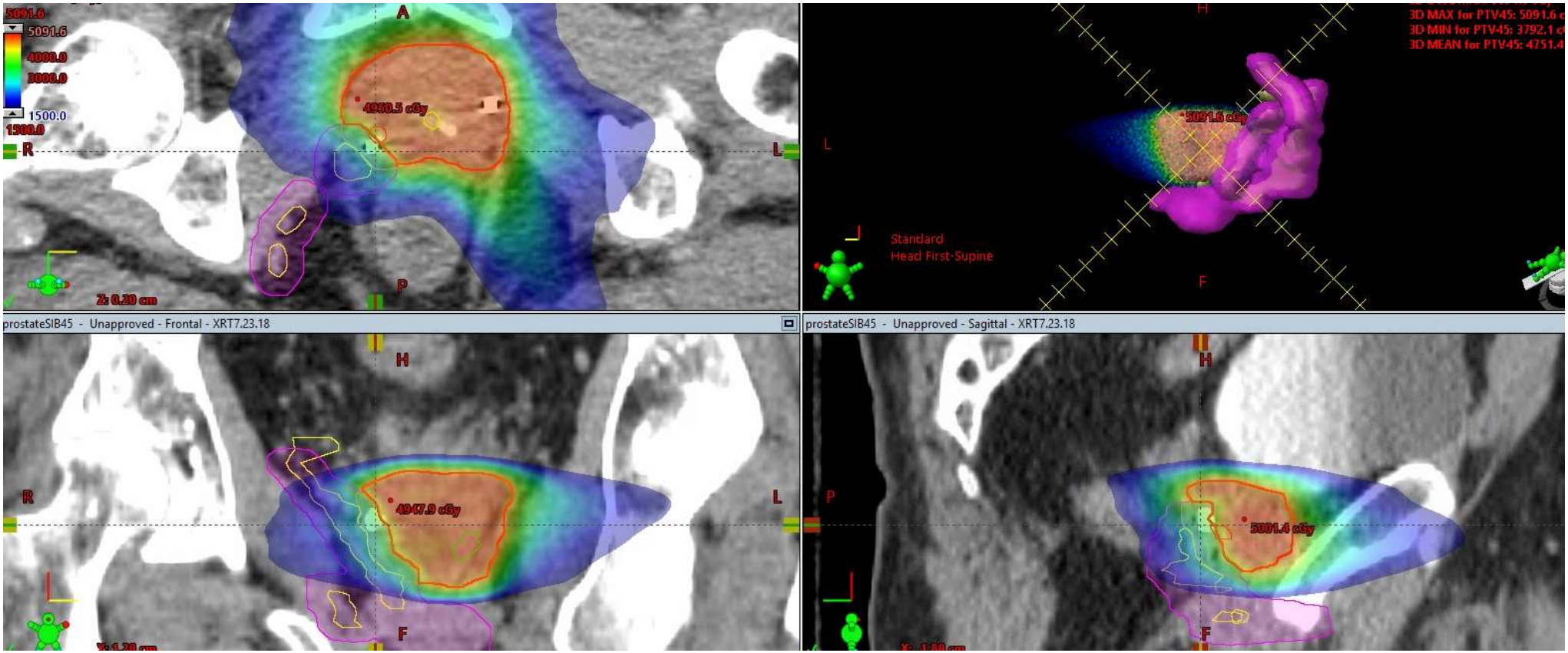
GTV Check



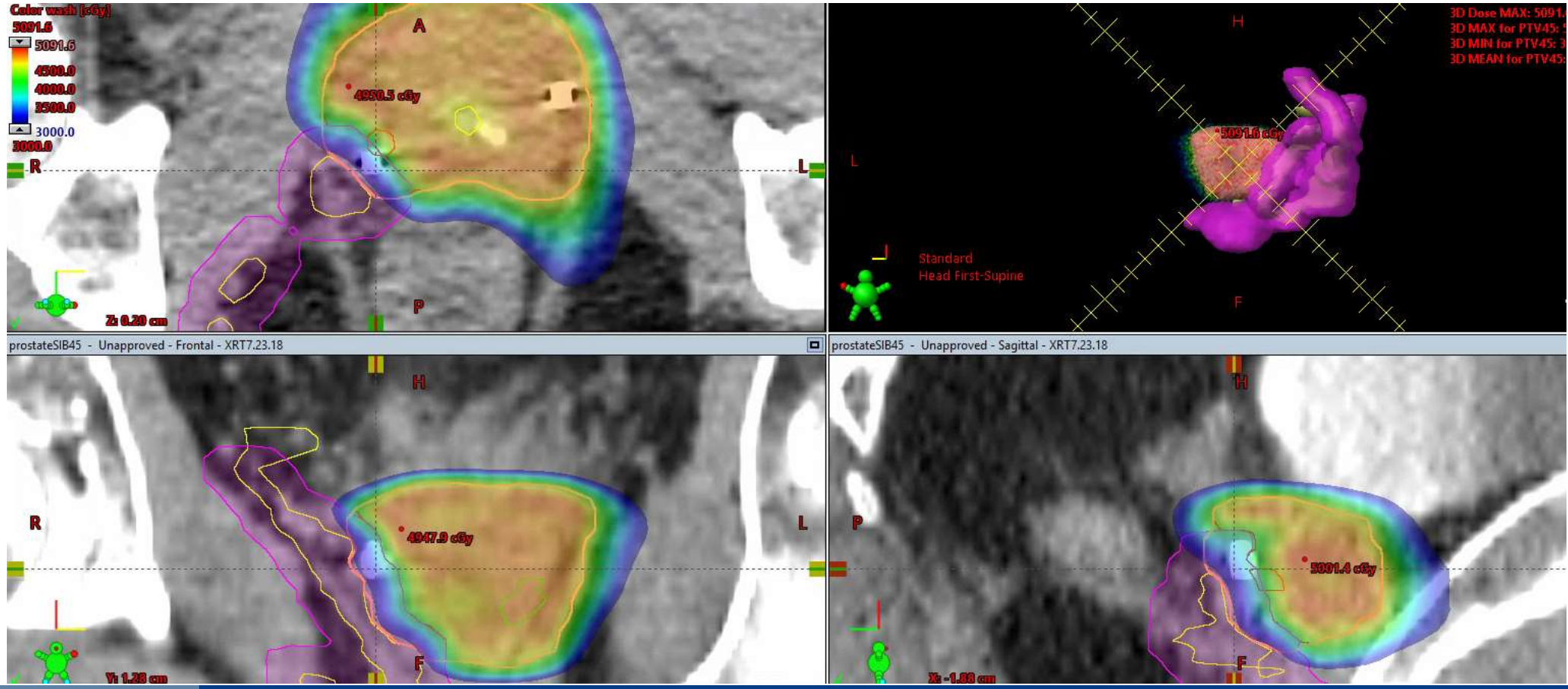
- Pink= PTV1_30Gy
- Red= PTV2_SAbR45Gy
- Orange = CTV
- Magenta = 5mm shaping structure on this right side to be spared
- Yellow = right IPA, right NVB, Penile bulb and CC

At end, double check that your GTV's marking PIRADS v2 score 3-5 lesions with potentially clinically significant PCa are within your PTV2_SAbR, as this should have been 5 mm away from spared structures. If not, then delineation of the NVB may have been overly generous and modify the shaping structure more conservatively.

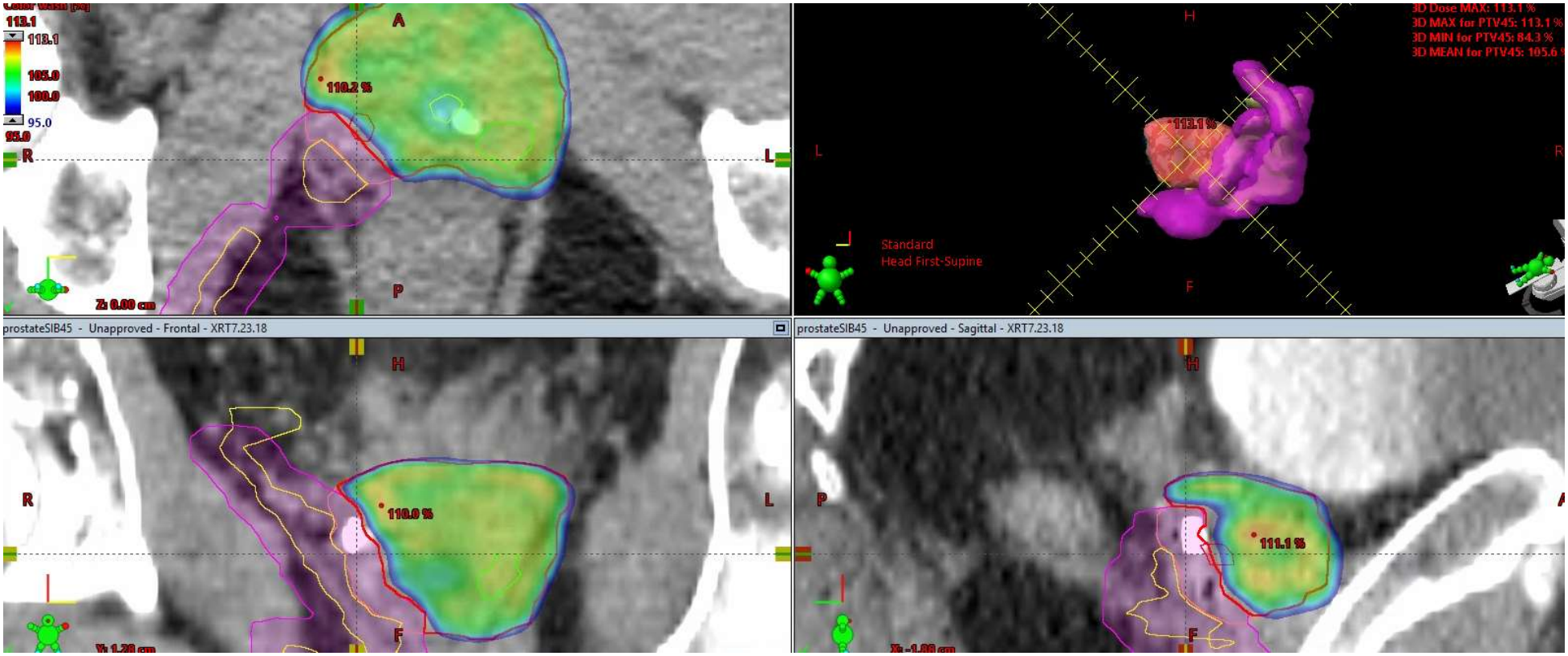
Dosimetry (min dose shown 15Gy, showing effort to come off right IPA)



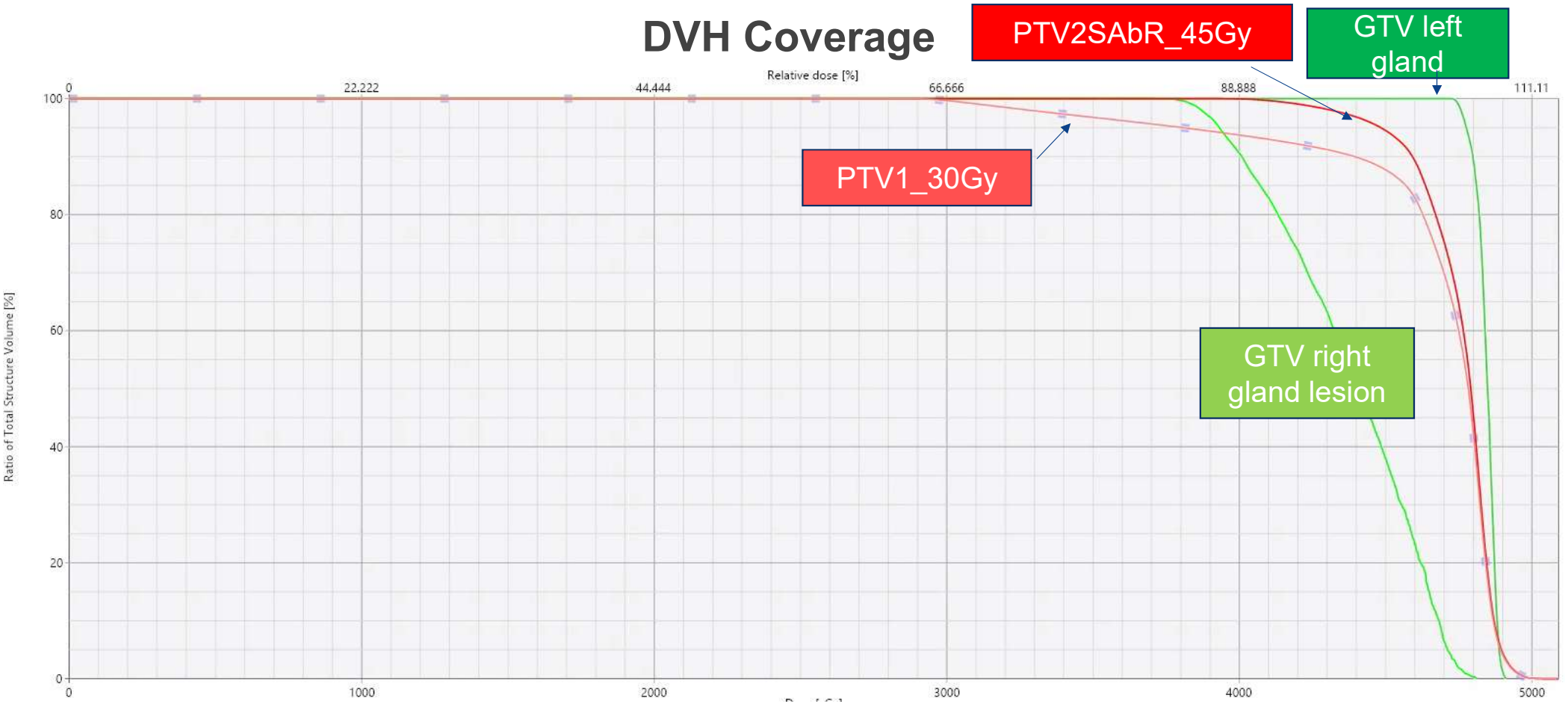
Dosimetry (<u>min dose shown 30Gy</u>, showing effort to to cover PTV1_30Gy but spare right NVB)



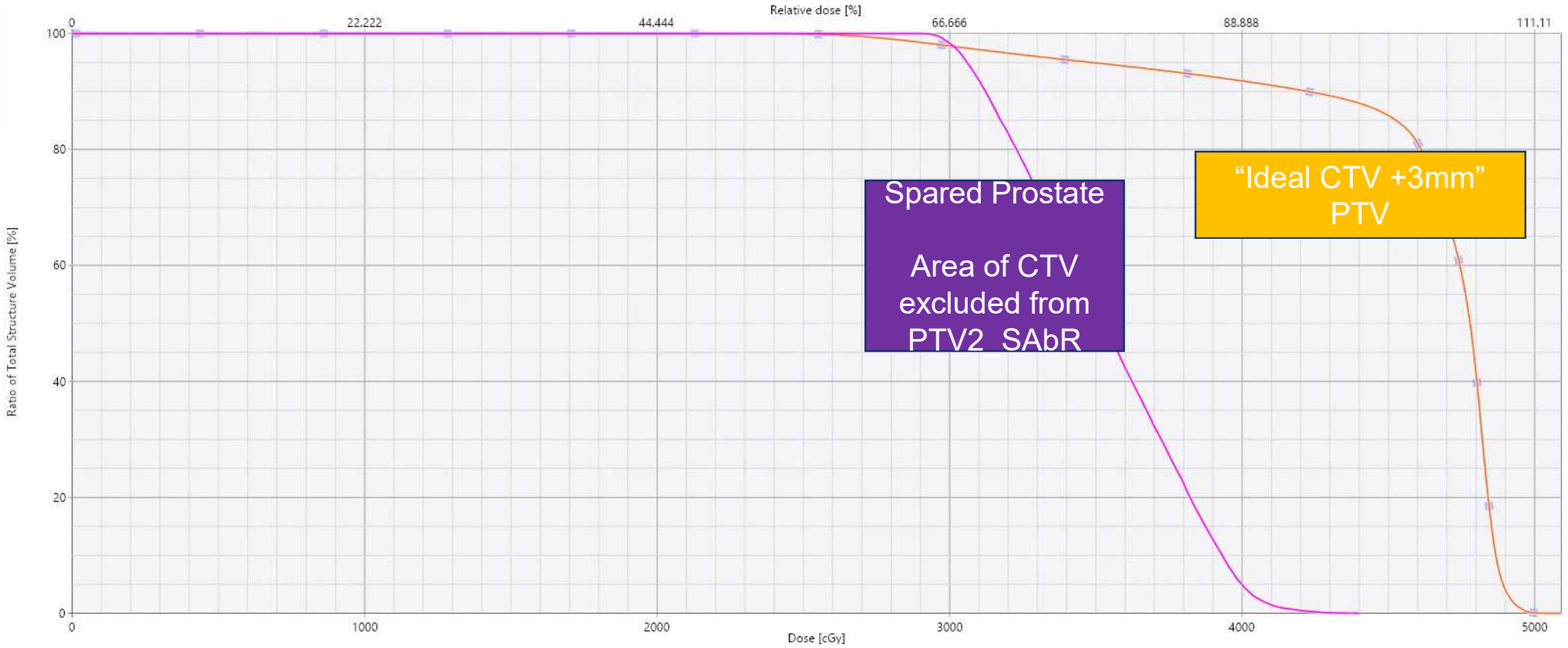
Dosimetry (min dose shown 95% PTV2_SAbR, showing coverage of key areas ie: left GTV retained)



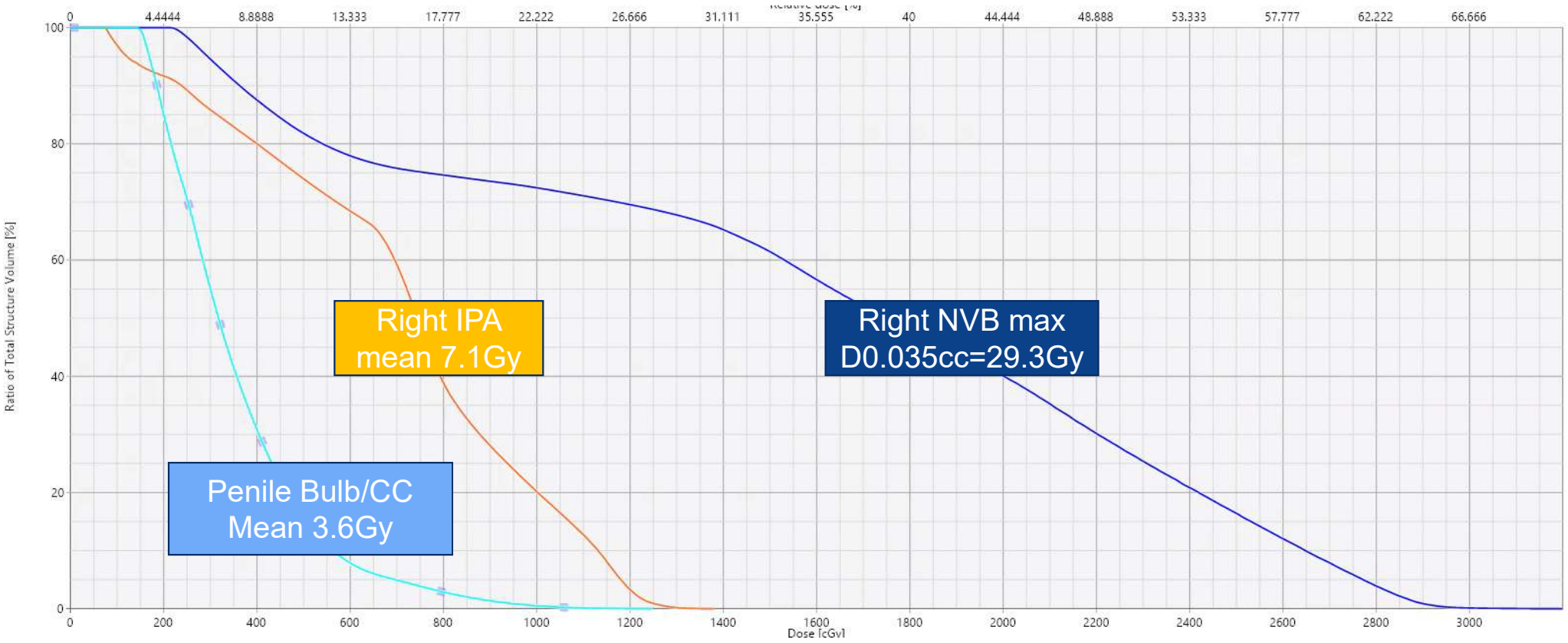
DVH Coverage



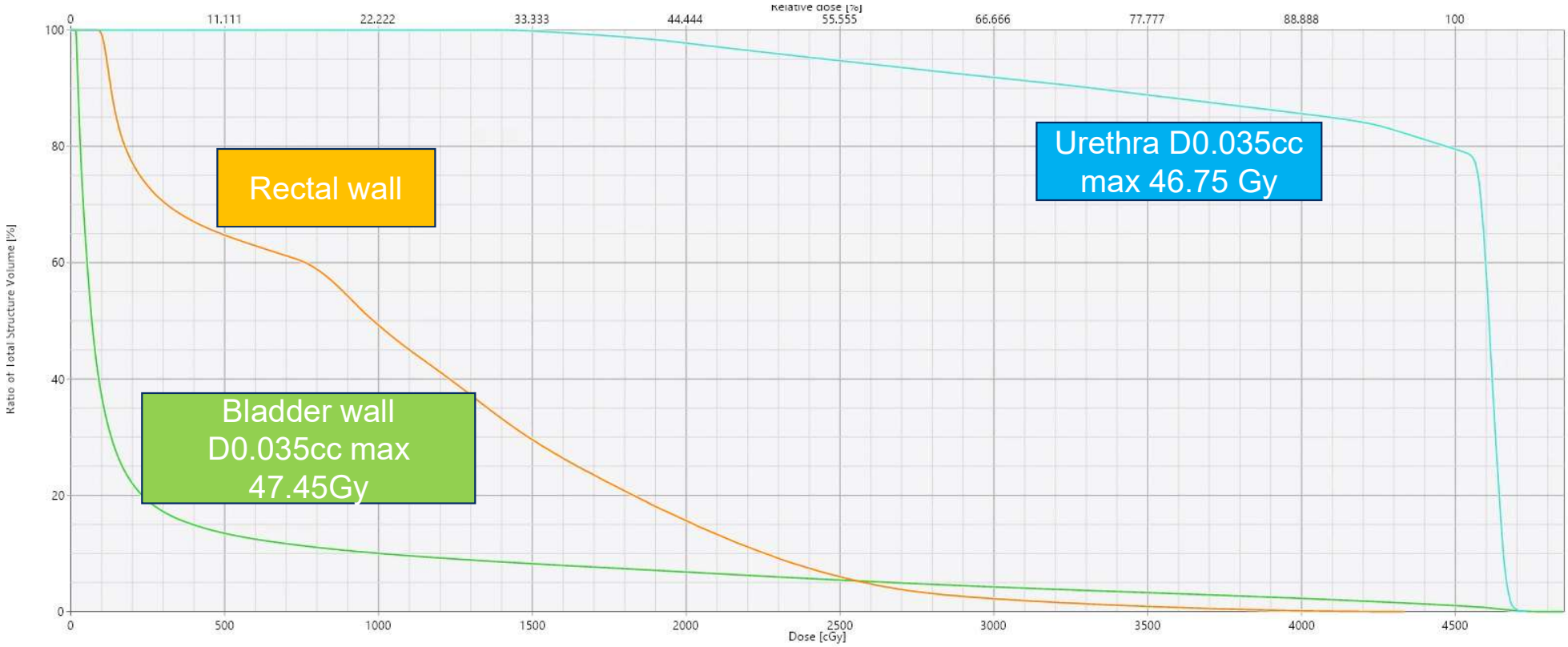
DVH Assessment of De-escalation effect



DVH – right sided ‘spared’ structures



DVH – Other Normal Structures



Thank you for your trial participation

- Please feel free to contact the POTEN-C team with any questions via:
  - https://www.poten-c.org
  - Directly reaching out to Sarah Neufeld (Trial Coordinator) at 214-648-1836
  - PI. Neil.Desai@UTSouthwestern.edu

- Other resources:
  - Example cases on PowerPoint and videos (coming soon) of contour/plan reviews will be posted to website