

Rectal Cancer Contouring Guide

eContour Team

You want to contour: **Rectal Cancer**

What now?

- Find your references
 - RTOG contouring atlas for anorectal:
 - <https://www.rtog.org/CoreLab/ContouringAtlases/Anorectal.aspx>
 - NOTE: this was created for *BOTH anal and rectal cancer*, which are treated quite differently, so pay attention!
 - Publication validating the above atlas: Myerson et al. IJROBP 2009:
<http://www.ncbi.nlm.nih.gov/pubmed/19117696>
 - RTOG protocols?
 - RTOG 0822 actually showed no difference between IMRT and 3D-CRT. While this could still be a reference to guide contouring for 3D block placement per the 3D-CRT arm, let's stick with the published atlas.
 - ARROContour: CAUTION! not peer-reviewed, but a resident presentation created by ARRO (ASTRO's Resident Committee)
 - https://www.astro.org/uploadedFiles/_MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROContourRectal.pdf

**eContour.org aims to be your one-stop shop for contouring guidelines, with hyperlinks to above high-yield references!*

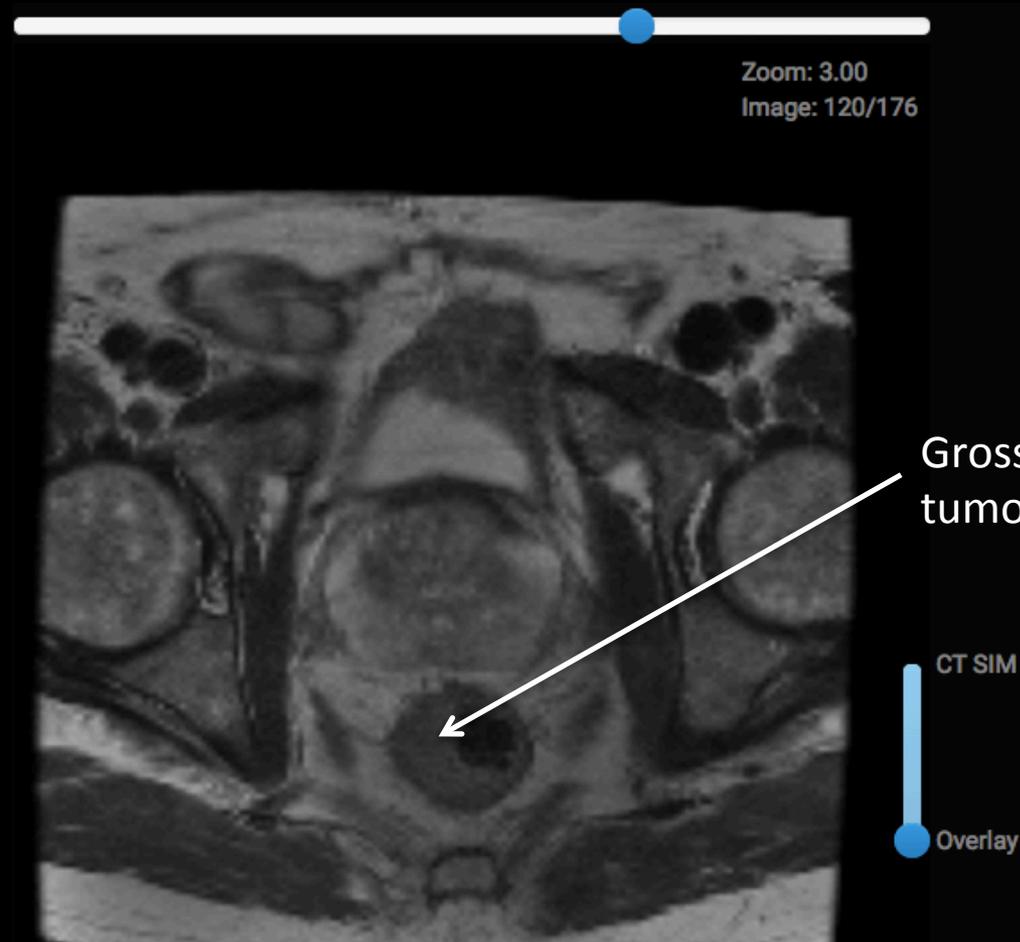
Let *eContour.org* help you!

1. Select CASES
2. From dropdown case list:
GI → Rectal → pre-op
3. Draw the GTV
4. Review pelvic anatomy
5. Draw CTV
6. Add margin/expansion to create final PTV for treatment planning
7. BONUS: Draw “blocks”

The screenshot shows the eContour.org website interface. The navigation bar includes 'Home', 'Cases' (highlighted with a pink box), 'About', 'Contact', and 'Glossary'. The main content area is divided into two columns. The left column contains six category buttons: 'All Sites', 'Head & Neck', 'Gynecology', 'Lymphoma', 'Gastrointestinal', and 'Genitourinary'. The right column displays a list of cases, each with a colored icon (GI or GU), a case name, a clinical stage, and a risk level indicator (A).

Category	Case Name	Stage	Risk Level
GI	Rectal [pre-op]	IIIA (uT2N1M0)	A
GI	Pancreas [post-op]	IIB (pT3N1M0)	A
GI	Esophageal [GEJ (pre-op)]	IIIA (uT3N1M0)	A
GI	Anal [definitive]	IIIA (cT2N1M0)	A
GU	Testicular [dog-leg]	IIA (T1N1M0S1)	A
GU	Prostate [intact]	intermediate risk	A

Step 1: Contour the GTV



In eContour:

1. Turn contours OFF
2. Toggle **overlay** to **MRI**
3. Scroll through slices to view extent of tumor
4. **Start your contour** where the tumor is obvious

Contour GTV inferiorly

Assessment →

ALWAYS check your volume against exam/colonoscopy findings since imaging is less sensitive

66 y/o M presented with stage IIIA (cT2N1M0) adenocarcinoma of the rectum, located 6cm from anal verge

MRI T2 Rx Contours Pearls

Zoom: 3.00
Image: 126/176



CT SIM
Overlay

He was treated with pre-operative chemoradiation with 3D-CRT and concurrent oral capecitabine. He received 45Gy in 25 fractions to perirectal, pre-sacral, and internal iliac nodes, with a sequential boost to 50.4Gy to the primary and mesorectum.

NOTE: This case does not use contrast for simulation. Arteries can be identified by extensive calcifications.

Toggle between MRI and CT

Measure distance GTV to anal verge (Option 1)



Look in lower left of your screen for the “Z” coordinate on **last GTV slice** (-6.98cm here).

Scroll down until you see the **anal verge** and again note the coordinate (-12.98cm here).

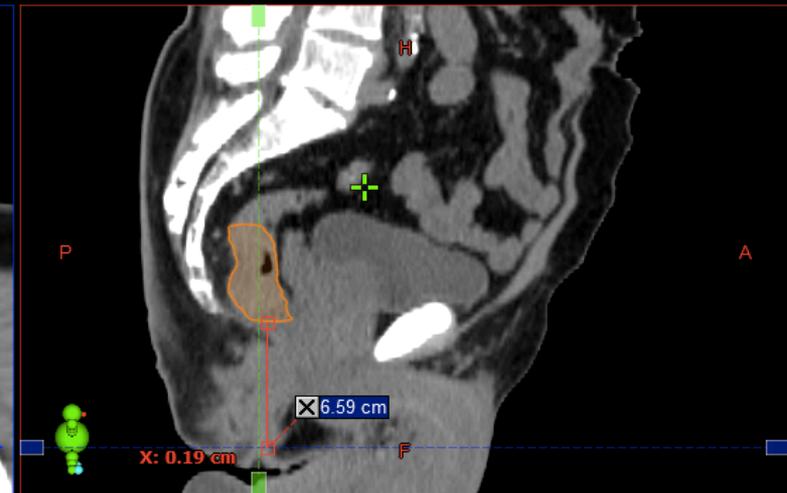
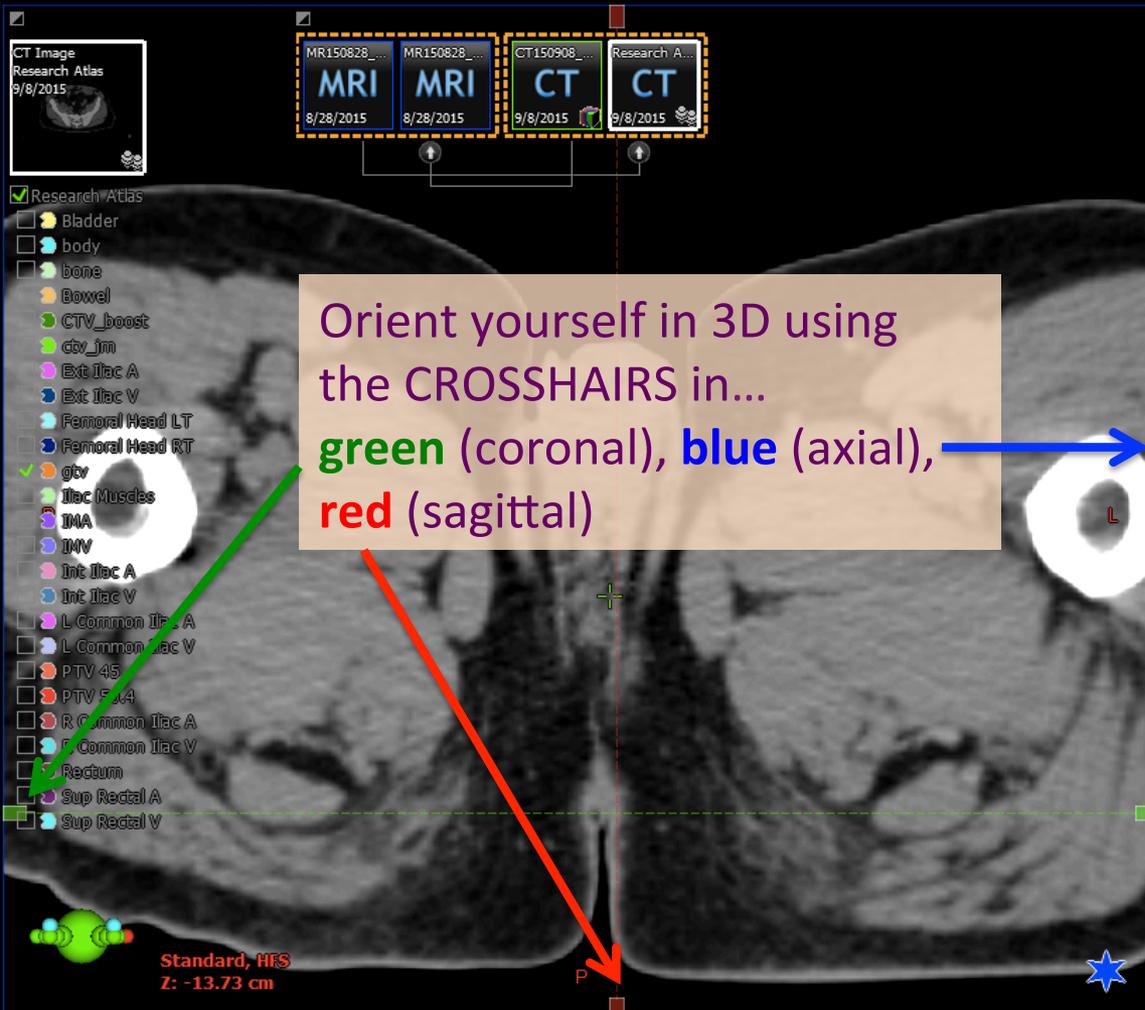
The difference is ~6cm, which was the **distance noted on exam** (which is better than imaging!).



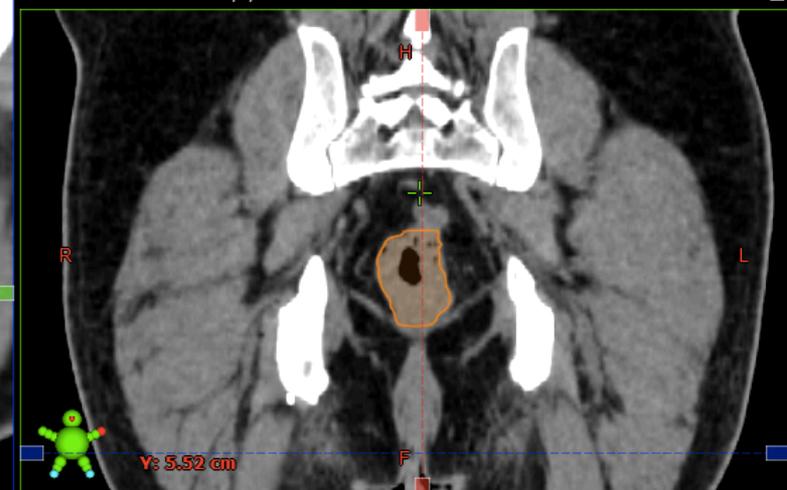
Measure distance GTV to anal verge (Option 2)

Transversal - Research Atlas - 9/8/2015 1:48 PM

Sagittal - Research Atlas - 9/8/2015 1:48 PM



Frontal - Research Atlas - 9/8/2015 1:48 PM



Try using the measuring tool

From this patient's *Assessment*, we know that on exam the tumor is located 6cm from anal verge...let's double check where we are at on SAGITTAL!

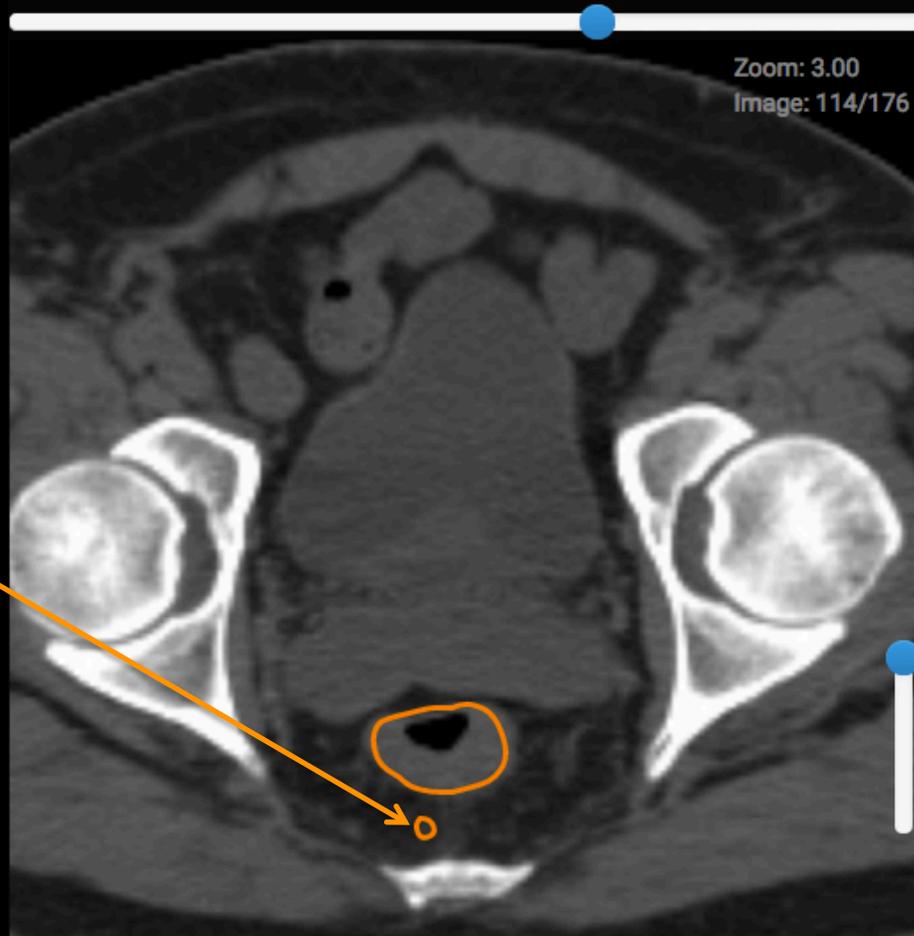
TIP: In the SAGITTAL view, use the measuring tool to check the vertical extent of your contour.



X: 0.19 cm

F

NOTICE: lymph nodes!*



Enlarged
perirectal
lymph node

How do you know if it's a lymph node or a vessel?

1. Use MRI overlay
2. Scroll up and down: nodes will be rounded structures that disappear then reappear
3. Contour the vessels before contouring the GTV

**NOTE: These sub-centimeter perirectal nodes are contoured in the GTV to show you they are in the standard CTV. These DO NOT need to be contoured unless grossly enlarged.*

Step 2: Review anatomy of pelvic vessels (which will define lymph nodes at risk!)

OARs Targets Anatomy

ON Contours

- Common Iliac Artery LT
- Common Iliac Artery RT
- Common Iliac Vein LT
- Common Iliac Vein RT
- External Iliac Arteries
- External Iliac Veins
- Iliac Muscles
- Inferior Mesenteric Artery (IMA)
- Inferior Mesenteric Vein (IMV)
- Internal Iliac Arteries
- Internal Iliac Veins
- Superior Rectal Artery (and branches)
- Superior Rectal Vein (and branches)

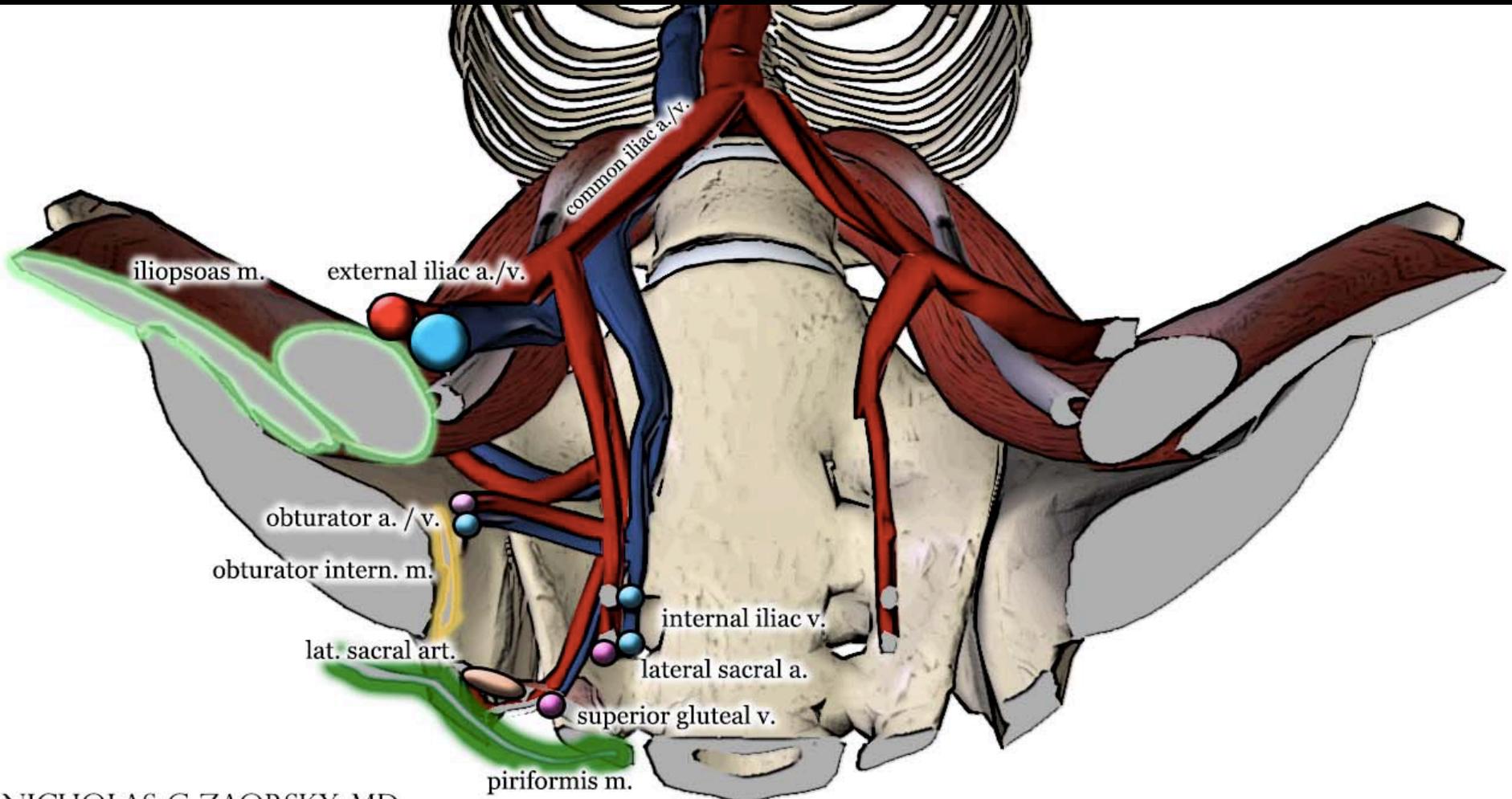
Select Overlay

Zoom: 2.50
Image: 66/176

In eContour:

1. Turn off all contours EXCEPT "Anatomy"
2. Contours start where aorta and IVC branch
3. Scroll inferiorly, following branches

Axial view of vessels



Can you follow these vessels on CT?



1. Now turn off ALL contours
2. Start at abdominal aorta
3. Scroll inferiorly, following branches

Lymph nodes sit on vessels (just can't see them when not enlarged).

This is why we contour vessels in nodal CTV

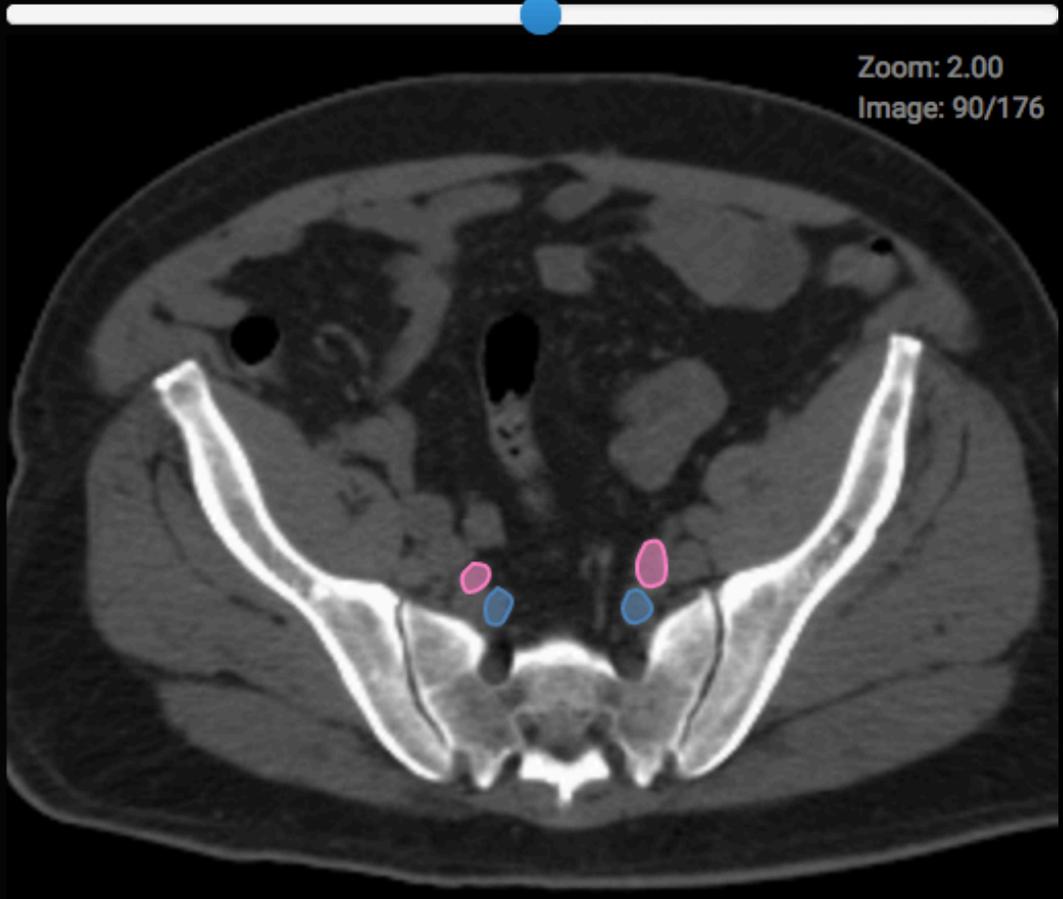
Aorta (artery) or IVC (vein) → Common Iliacs (R and L) → Internal iliac (go posterior/in front of sacrum) and External Iliacs (go anterior...become inguinal/femoral when exit pelvis)

Use anatomy contours

Contours OFF

- Common Iliac Artery LT
- Common Iliac Artery RT
- Common Iliac Vein LT
- Common Iliac Vein RT
- External Iliac Arteries
- External Iliac Veins
- Iliac Muscles
- Inferior Mesenteric Artery (IMA)
- Inferior Mesenteric Vein (IMV)
- Internal Iliac Arteries
- Internal Iliac Veins
- Superior Rectal Artery (and branches)
- Superior Rectal Vein (and branches)

Zoom: 2.00
Image: 90/176



The image shows an axial CT scan of the pelvis. The internal iliac arteries are contoured in pink, and the internal iliac veins are contoured in blue. The contours are visible in the central pelvic region, corresponding to the checked items in the legend. A white progress bar is at the top, and a zoom level of 2.00 and image number 90/176 are shown in the top right corner.

Confirm your findings by individually turning on the contours for each structure

Step 3: Contour your CTV

These are the consensus CTVs for anorectal cancer

CTVA: For this atlas, defined to be the regions that would always be treated for rectal cancer: internal iliac, pre-sacral, peri-rectal.

CTVB: external iliac nodal region

CTVC: inguinal nodal region

For anal cancers, the elective regional target volume would include all three. For rectal cancer, in most cases, CTVA would be the only volume to receive elective radiation. However, for certain presentations (e.g. extension into GU structures, extension to the peri-anal skin) one could consider adding the external iliac (CTVB) and even the inguinal regions (CTVC).

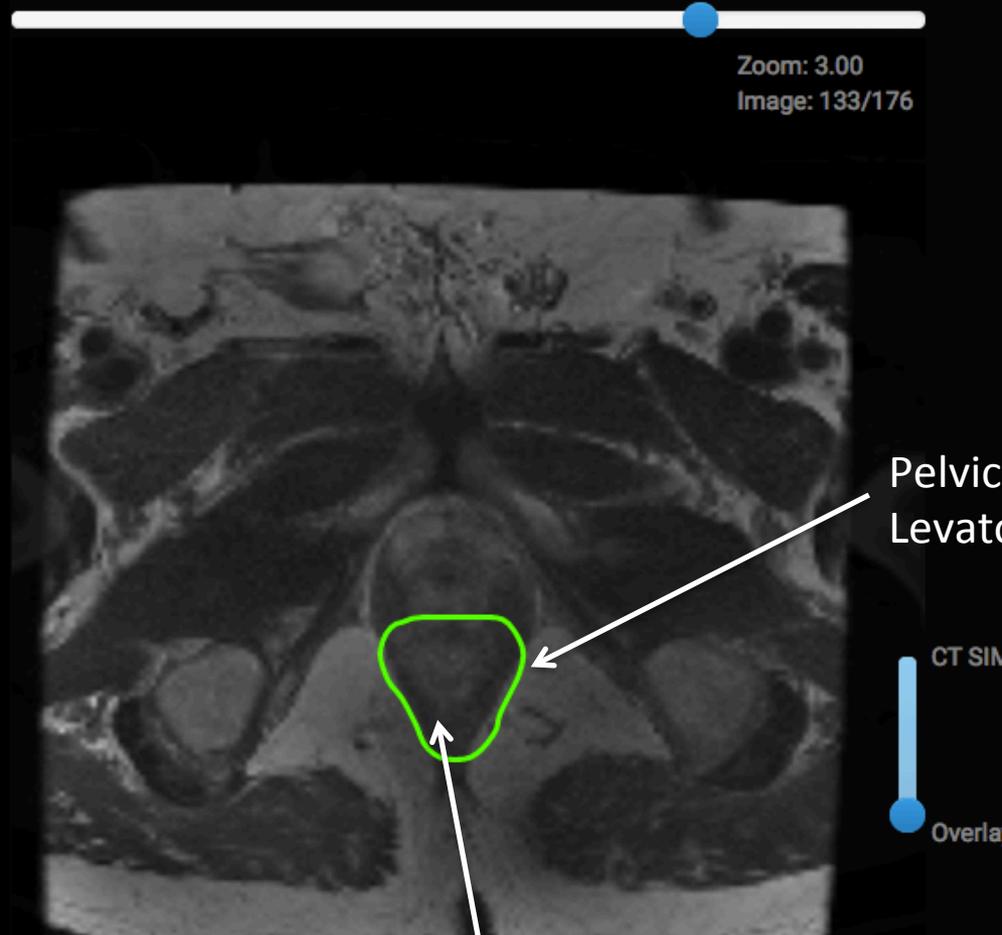
RTOG Anorectal contouring atlas

In rectal cancer, external iliac nodes (CTVB) and inguinal nodes (CTVC) are not at risk of tumor spread*, so we will only contour CTVA

(*FYI The anal canal drains to the inguinal nodes, which is why they are treated in anal cancer)

Caudal (inferior) extent of CTV

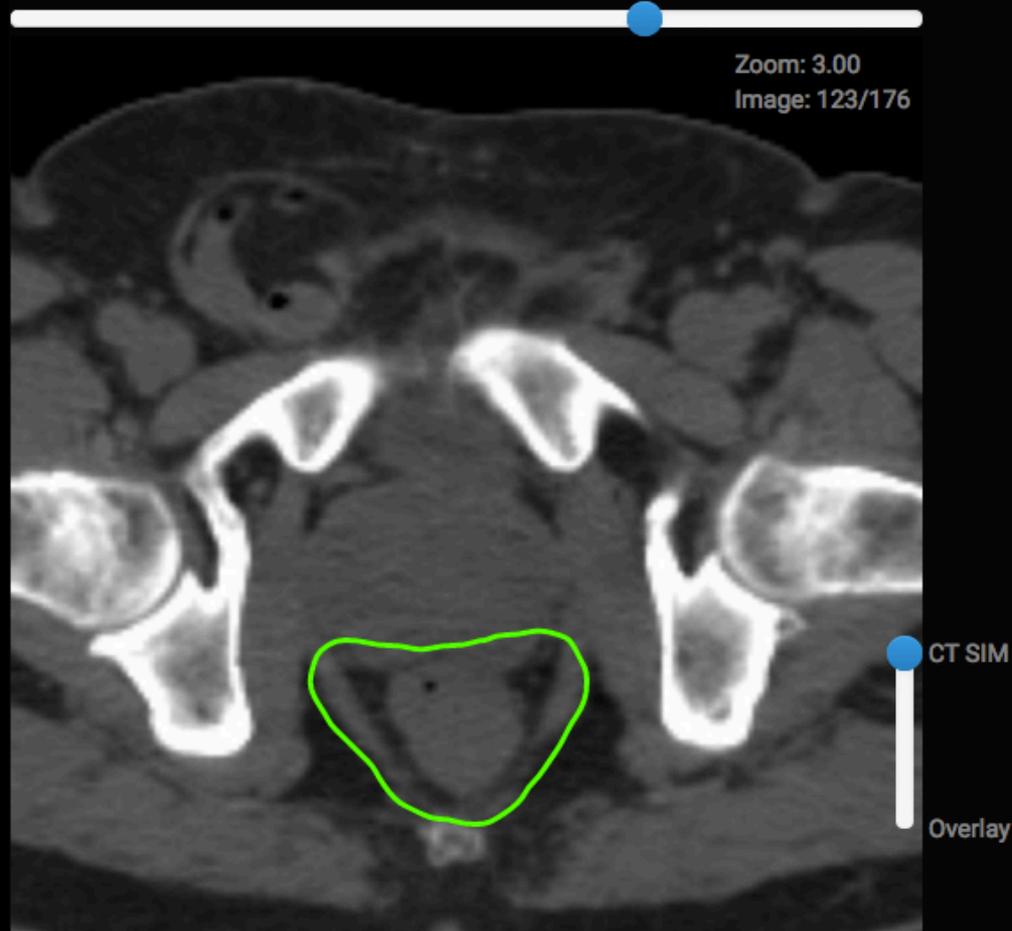
(Muscles and connective tissue of pelvic floor are better visualized with MRI)



1. CTV should extend at least to the pelvic floor, even if upper rectal cancer
2. Extend to a minimum of 2cm caudad to GTV

Mesorectum
(peri-rectal)

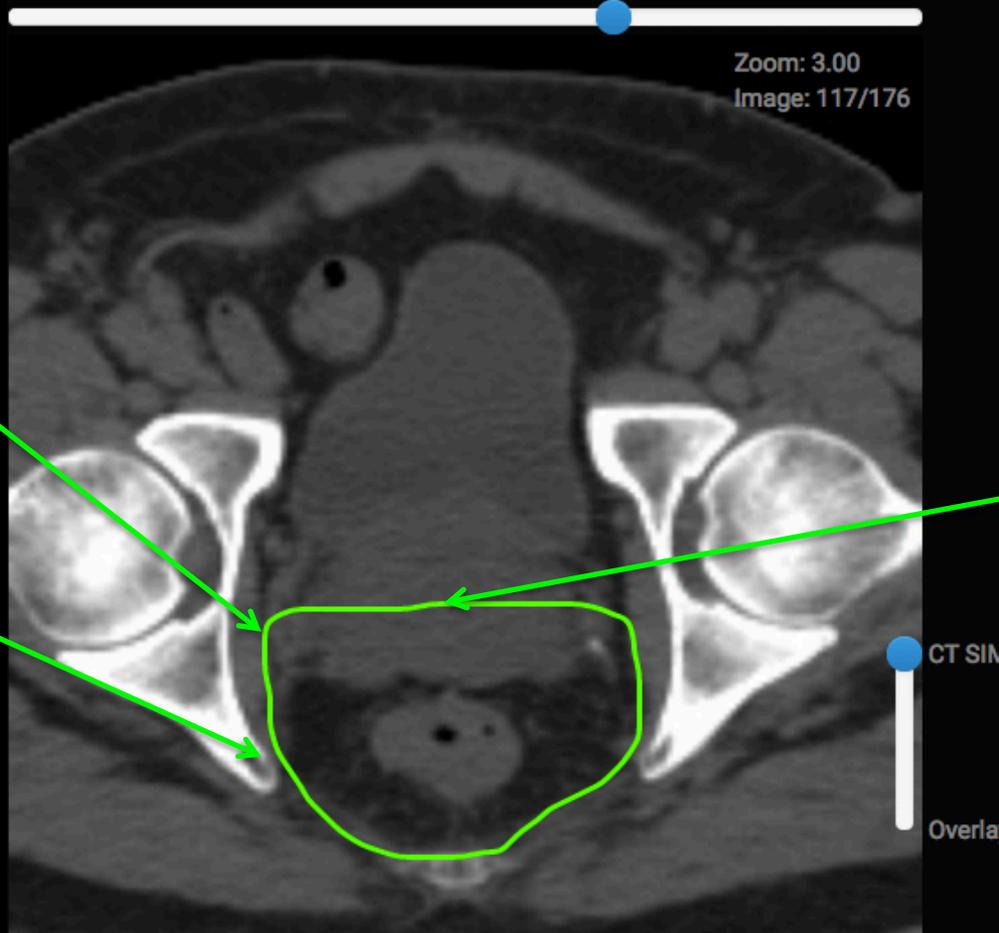
CTV in low pelvis



Scrolling through the CT images, moving superiorly

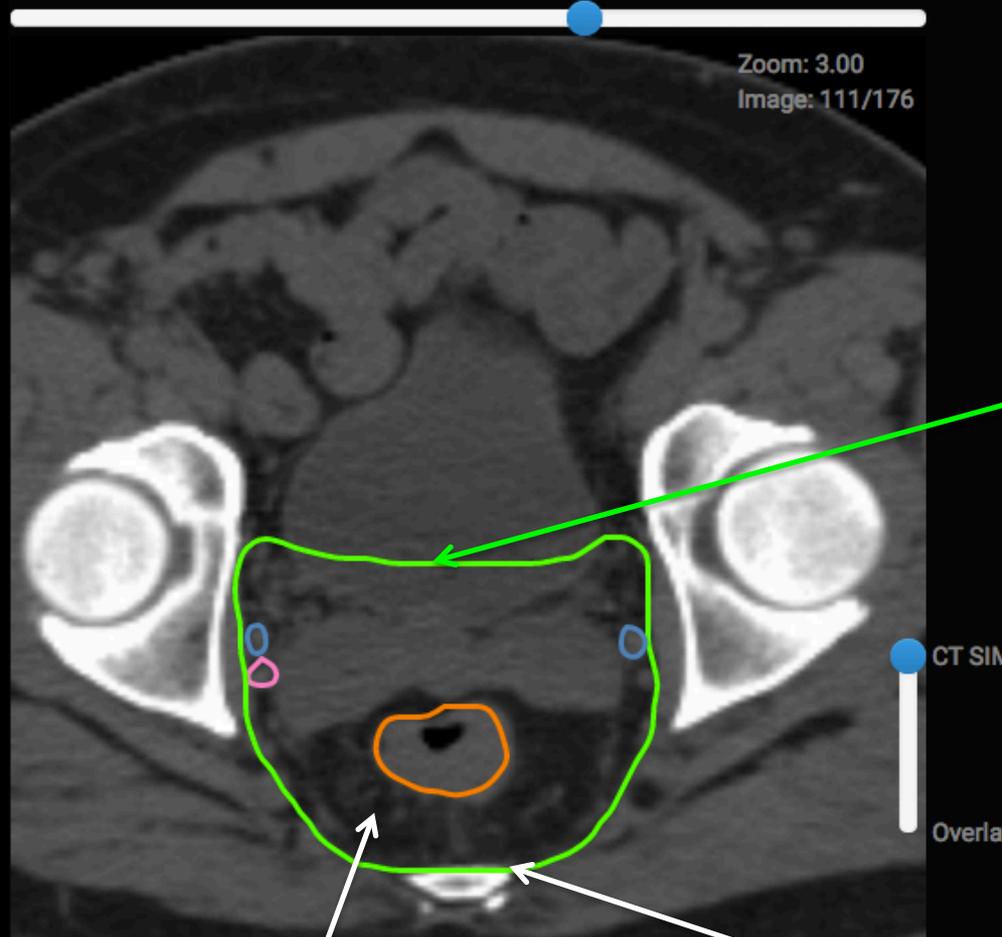
CTV in low pelvis

Posterior and lateral margins:
Extend to lateral pelvic muscles or bone



Anterior margin:
Extend into prostate/seminal vesicles in a male
(vagina for female)

CTV in mid-pelvis



CTVA covers:

Rectum

Mesorectum

Internal iliac vessels

Presacral space

Anterior margin:
Extend 1 cm into
posterior
bladder wall

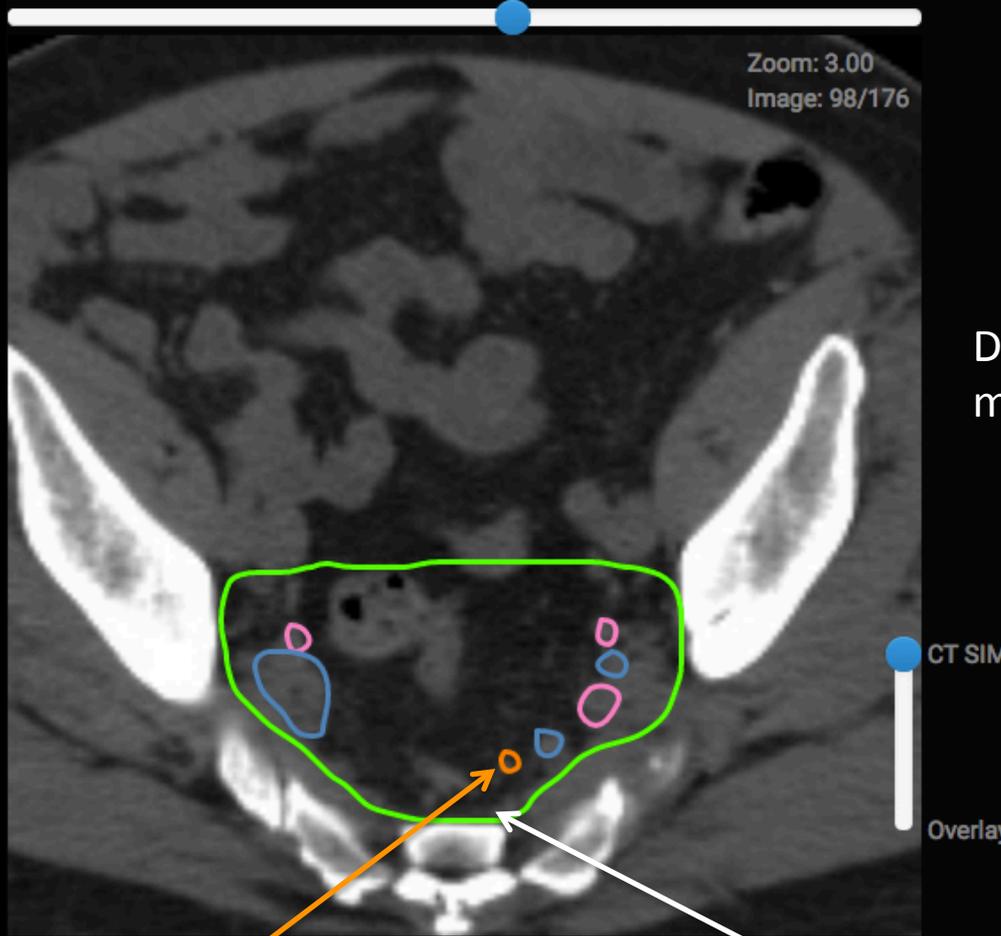
Mesorectum
(peri-rectal)

Prsacral

Moving superiorly in CTV

Include internal iliac arteries and veins

NOTICE: posterior border of CTV abuts external iliac vessels (which we do NOT include unless T4 tumor invading prostate or vaginal anteriorly)



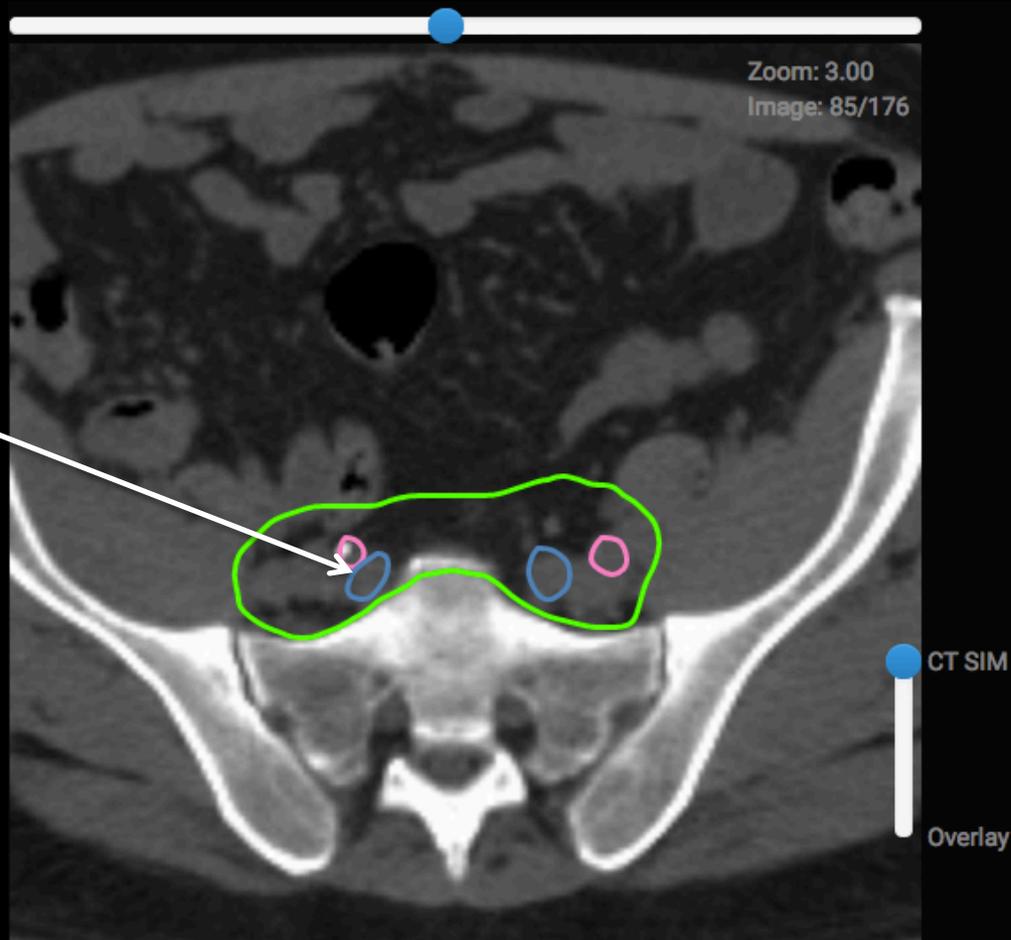
DO NOT include muscle or bone

Lymph node

Presacral

Cephalad (superior) extent of CTV

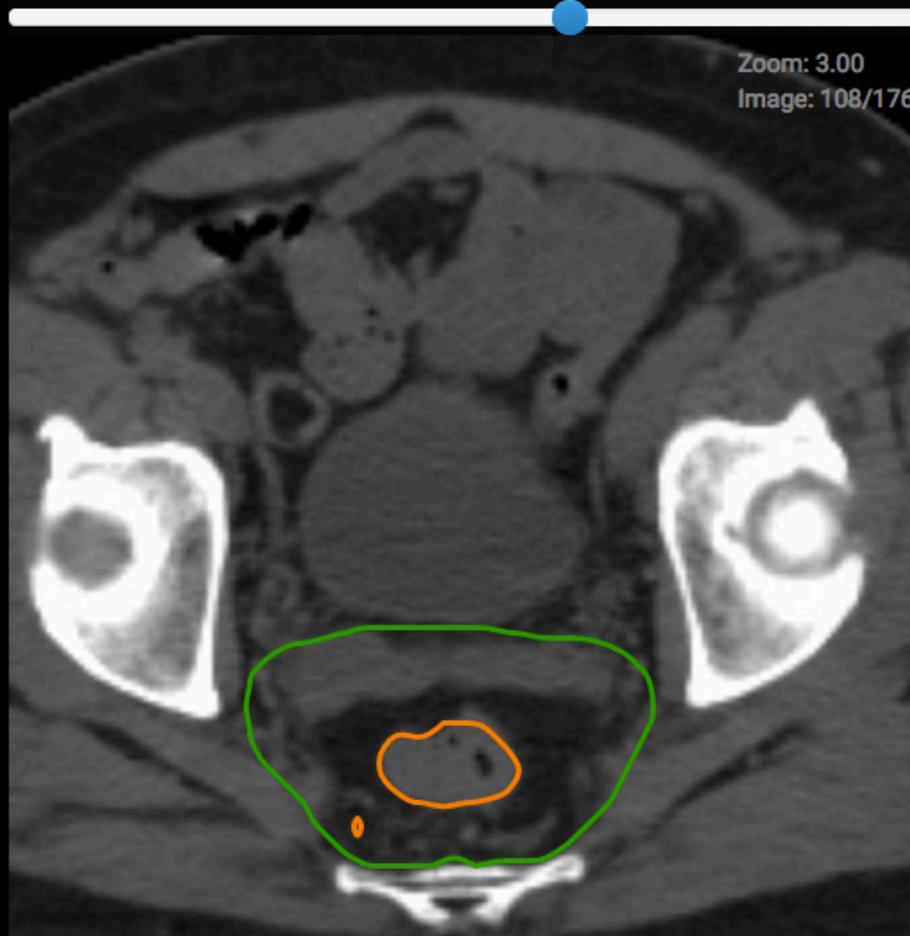
Continue contour
up to where the
common iliacs
bifurcate OR L5/S1
interspace*



*Rad onc is amid a transition away from bony anatomy to guide contours (instead contouring soft tissue), but it still pervades in many ways – including pelvic nodal upper borders (ie L5/S1).

Step 4: Add a CTV Boost volume

Sequential boost means additional treatments to give higher dose to smaller volume

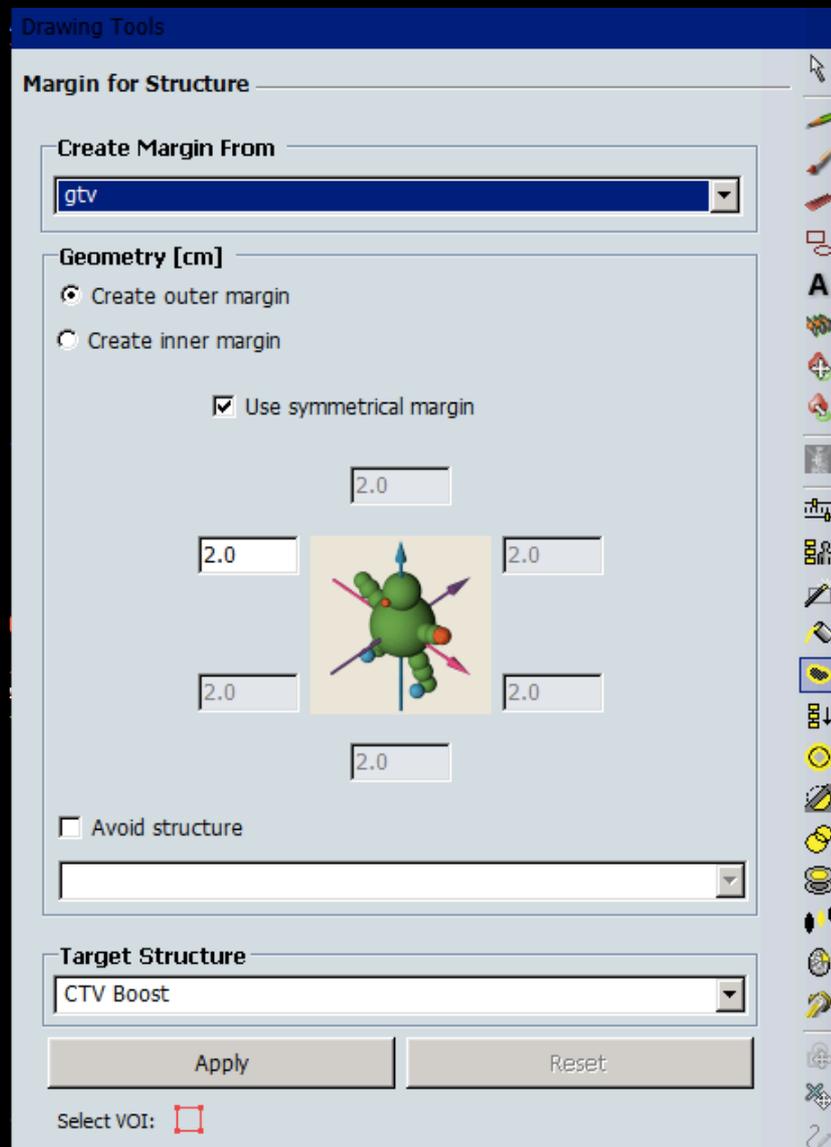


Extend CTV to cover entire mesorectum and presacral region at level of GTV, with a minimum 2cm margin on GTV cephalad and caudad

But how do I do this?? Next slide...

Add margin for CTV Boost

1. Start with 2cm margin from GTV using “Margin for Structure” →
2. If entire mesorectum and presacral area is not included in this 2cm expansion, use brush/pen to expand contour (next slide)
3. “Crop” contour that extends outside CTV (next slide)



Editing CTV Boost

CTV Boost

CTV (incl nodes)



Now we have 2 problems:

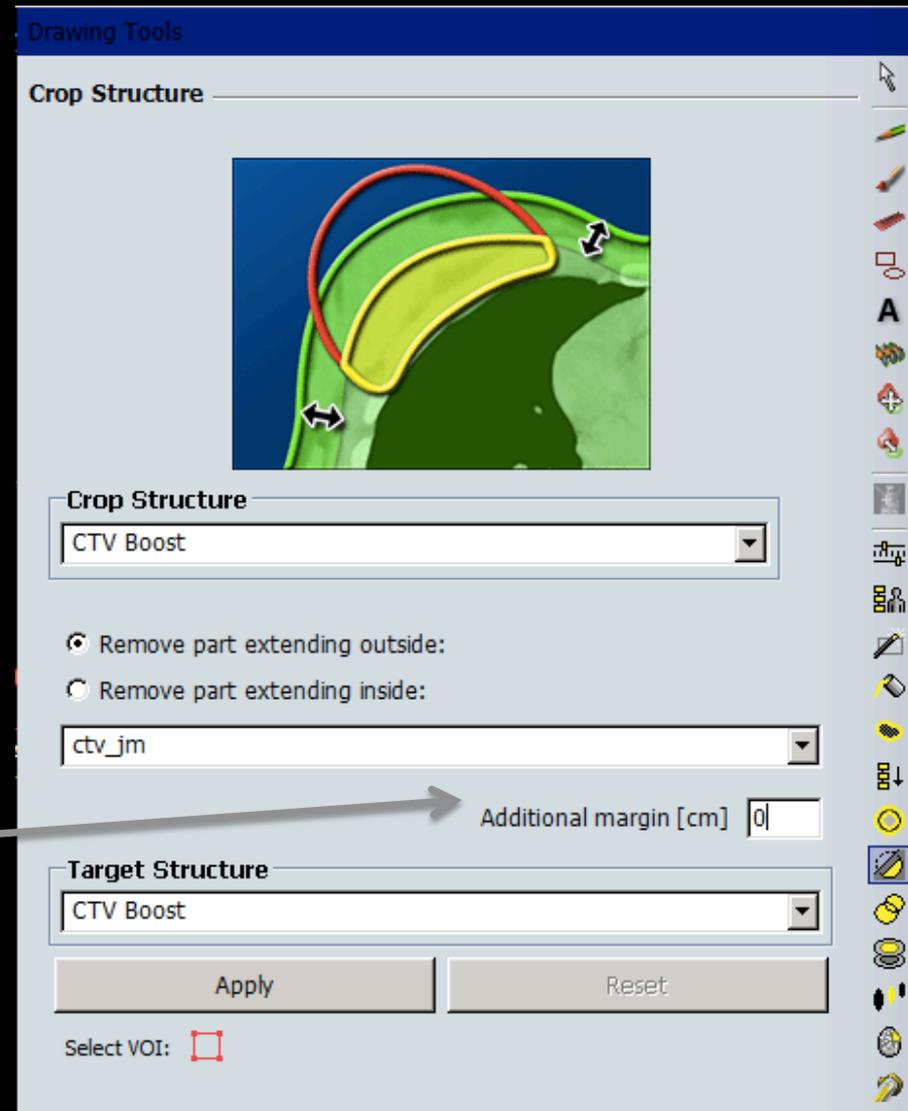
1. The entire mesorectum is not included in our volume
 - SOLUTION: Use pen/brush to expand the volume (final CTV Boost in dark green)
2. The contour extends outside CTV (and into bone!)
 - SOLUTION (next slide)

Current CTV Boost structure shown in RED

Editing CTV Boost

“Crop” contour that extends outside CTV →

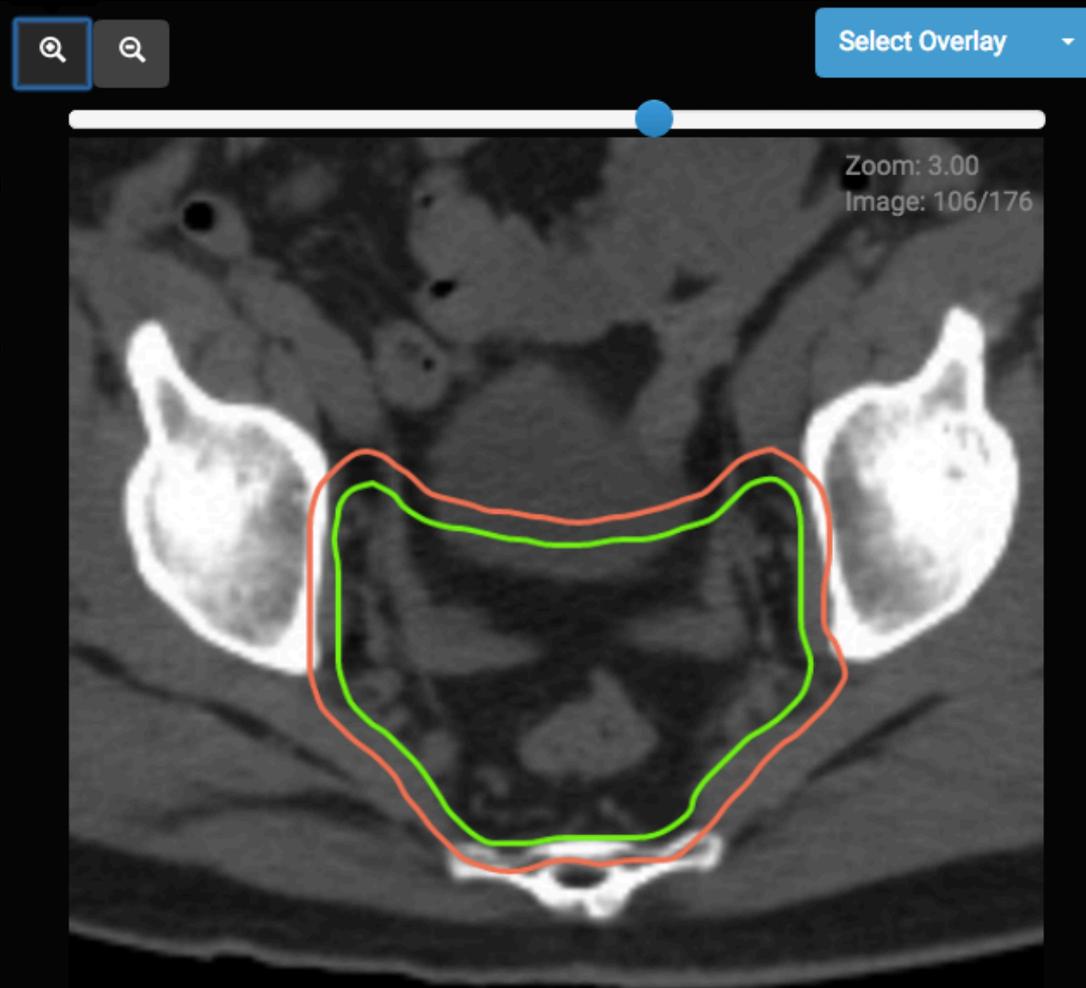
NOTE: Sometimes you will want to crop with an additional margin (ie 0.3cm margin PTV to skin in H&N)



Step 5: Add a margin for PTV

7-10mm margin on
CTV is usually
sufficient to account
for pelvic motion

CTV+7mm = PTV →



*We've done this
before ...*

Margin for Structure

Create Margin From

ctv_jm

Geometry [cm]

Create outer margin

Create inner margin

Use symmetrical margin

0.7

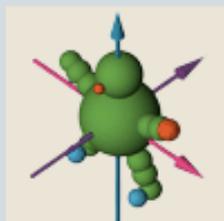
0.7

0.7

0.7

0.7

0.7



Avoid structure

Target Structure

PTV 45

Apply

Reset

Select VOI:



Add a margin for PTV

NOTE: all margins same

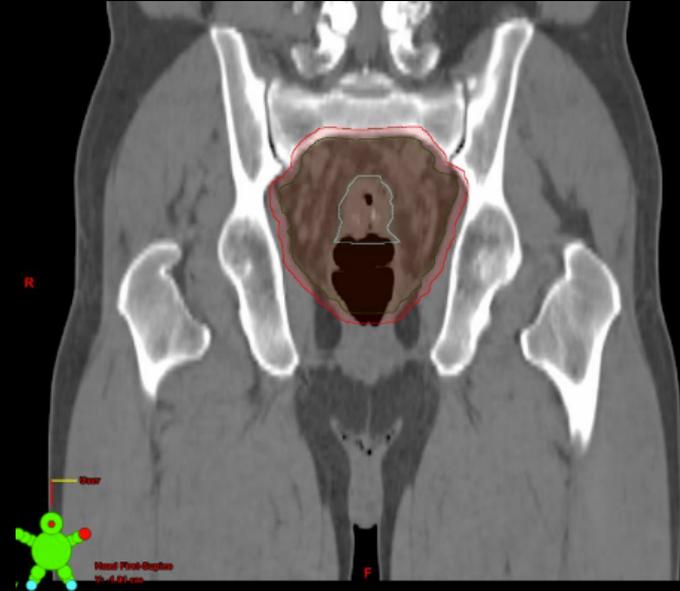
“Margin for structure”

REPEAT this step for CTV boost

Sagittal



Coronal



Always check your final volumes in **sagittal and coronal views** to make sure you have contoured a volume that makes sense in 3 dimensions!

BONUS: You can compare your volumes to “bony anatomy” blocks (next slide)

Images reproduced from:

[https://www.astro.org/uploadedFiles/ MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROContourRectal.pdf](https://www.astro.org/uploadedFiles/MAIN_SITE/Affiliate/ARRO/Resident_Resources/Educational_Resources/ARROcase/Content_Pieces/ARROContourRectal.pdf)

FOR FUN: Draw blocks/MLCs!

You will need to go to “External Beam Planning” in your treatment planning system

eContour → “Pearls” tab describes borders for 3D conformal blocks

NOTE: classic borders for a 3-field beam arrangement were based on BONY ANATOMY. With CT simulation, we can contour areas at risk, and decrease our margins. However, fancy treatment planning (with IMRT) did not improve outcomes on RTOG 0822 (which is DIFFERENT from anal cancer).

The margin from PTV to “block edge” (meaning, the shape of you MLCs) is suggested to be about 7mm because the dose at the end of the field is ~50% (requires some build-up in tissue to get to 100% prescription dose).

Rx

Contours

Pearls

- CT simulation:
 - some institutions use prone position
 - consider placing flexible endorectal tube and radiopaque skin markers
- Anatomy:
 - Aorta → IMA → superior rectal artery (per [Radiopaedia](#))
 - Superior rectal vein → IMV → splenic vein which joins with SMV (at pancreas) to form portal vein (per [e-Anatomy](#) and [wikipedia](#))
- OARs:
 - femoral head and neck
 - bowel (tight margins on bowel with ~1cm above PTV)
 - rectosigmoid largely included in CTV so not an avoidance structure

Fields and Blocks:

- 3-field (opposed laterals + PA)
- PTV + 0.5-1cm to block edge
- *Posterior border*: traditionally entire sacrum included
- *Anterior border*: traditionally T3 to back of symphysis and T4 to front of symphysis (includes external iliacs)

References

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 - <https://www.rtog.org/CoreLab/ContouringAtlases/Anorectal.aspx>
 - NOTE: this was created for *BOTH anal and rectal cancer*, which are treated quite differently, so pay attention!
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