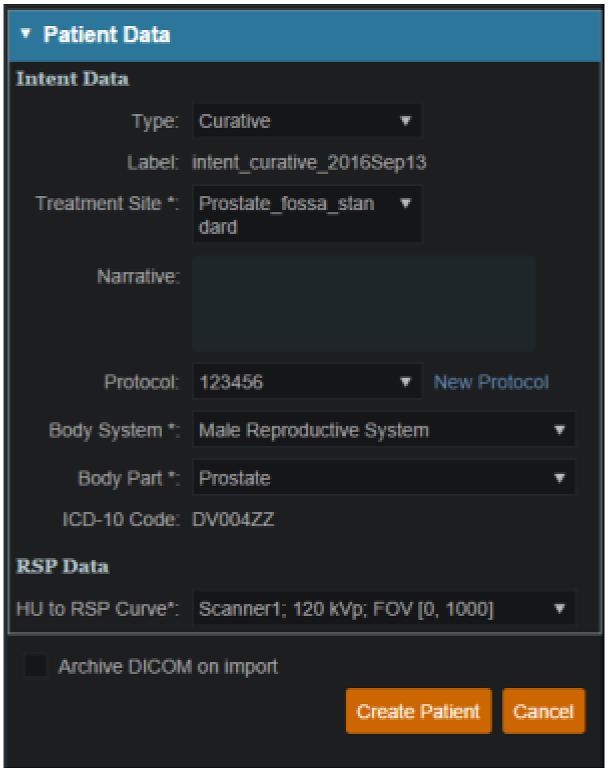
Prostate Plan Walkthrough

Patient Creation

1. Select the CT image set from the list of available files for import
2. Ensure that the MR is correct
    1. If MR needs to be changed you may edit it by choosing the *Edit* button to the left
3. Click the *Create New Patient* button to start the import process
4. Fill in the Patient Intent information and select the appropriate HU to RSP curve (as shown below)



Patient Data

Intent Data

Type: Curative

Label: intent_curative_2016Sep13

Treatment Site *: Prostate_fossa_standard

Narrative:

Protocol: 123456

Body System *: Male Reproductive System

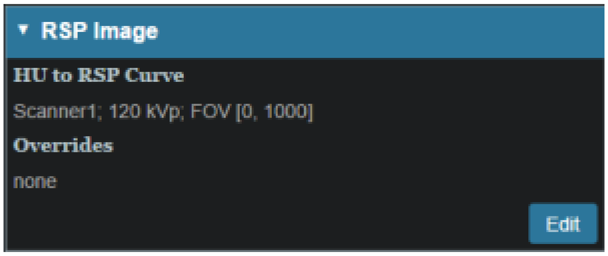
Body Part *: Prostate

ICD-10 Code: DV004ZZ

RSP Data

HU to RSP Curve*: Scanner1; 120 kVp; FOV [0, 1000]

☐ Archive DICOM on import



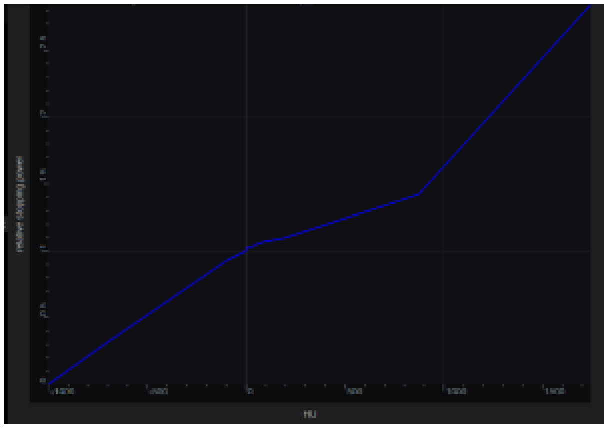
RSP Image

HU to RSP Curve

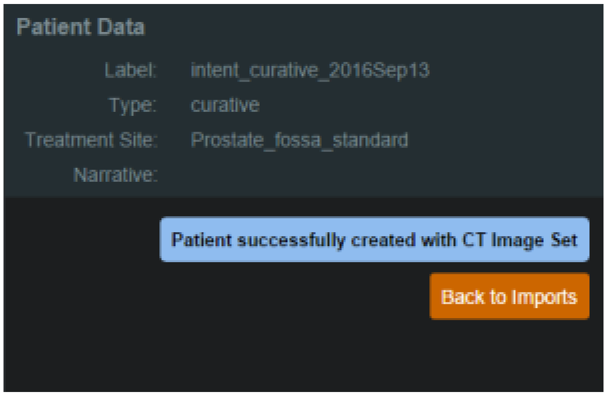
Scanner1; 120 kVp; FOV [0, 1000]

Overrides

none



5. Click the *Create Patient* button and wait for the import to complete
6. Click the *Back to Imports* button



Patient Data

Label: intent_curative_2016Sep13

Type: curative

Treatment Site: Prostate_fossa_standard

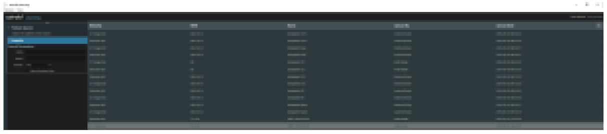
Narrative:

Patient successfully created with CT Image Set

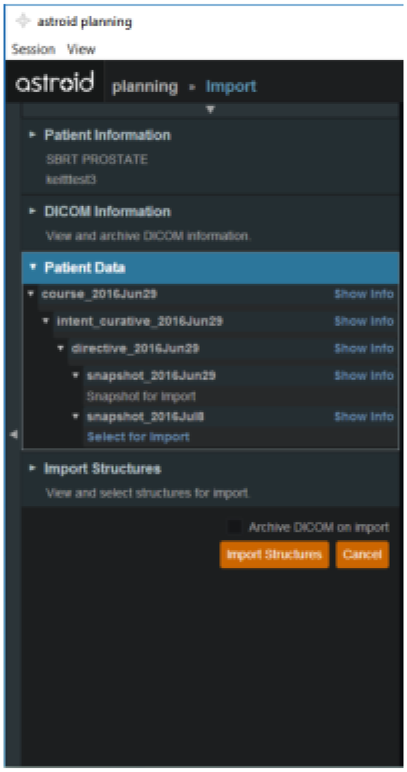
7. Select the Structure Set file that is associated with this patient

   1. Make sure Structure Set MR matches CT image set MR (make any edits to the MRN that are needed)

8. Click the *Import into Patient* button in the patient information window 🔧 Fix Me! : This image doesn't show the button being mentioned

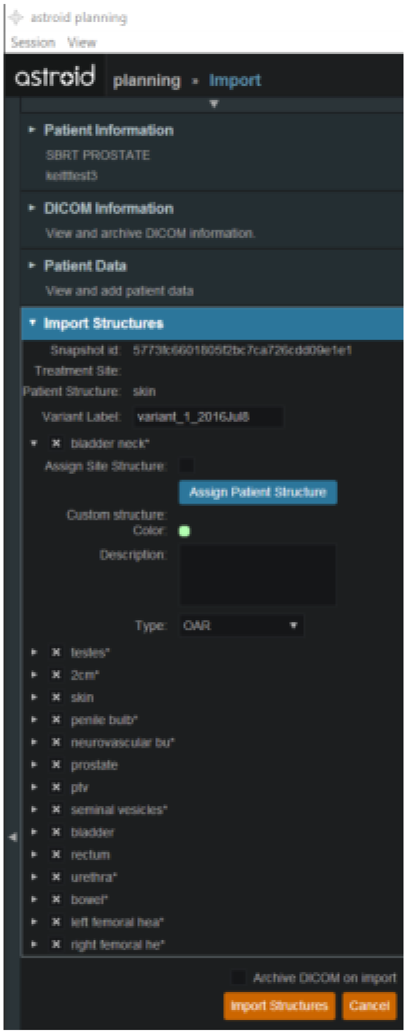


9. In the control pane on the left hand side, the image snapshot will be automatically selected based on the structure set DICOM UID information, and then the *Import Structure* block will automatically expand. 🔧 Fix Me! : Also show image with the expansion complete (as being mentioned)



10. You will see a list of the imported structures. Here you may choose whether or not to import each structure by checking or unchecking the box beside each structure name.
    1. For this case, we will import all available structures and there is nothing to change on this page
11. You also have the ability to assign or edit any structures that are shown as *custom*, which indicates the name did not exactly match a directive structure from the treatment site template list you specified during patient creation.
    1. Matched, Assigned, and Custom structures are designated with corresponding tags at the end of the structure name in the structure list. 🔧 Fix Me! : Show image with these visible

    2. Assigning a custom structure to a defined directive structure will result in the imported structure inheriting all the predefined structure properties (e.g. name, type, color)
    3. For all custom structures the type is by default set to “Other” unless it contains the letters “TV” (as in PTV or CTV), in which case it is assigned the type of “Target”; this may be changed here if needed
12. Once you have completed explored this feature, make sure all structures are back to their default states and click the orange “Import Structures” button **Fix Me!** : This image is old



SBRT PROSTATE
keittest3

Snapshot id: 5773fc6601805f2bc7ca726cdd09e1e1
Treatment Site:
Patient Structure: skin
Variant Label: variant_1_2016Jul8

☒ bladder neck*
Assign Site Structure: ☐
Custom structure:
Color: ●
Description:
Type: OAR

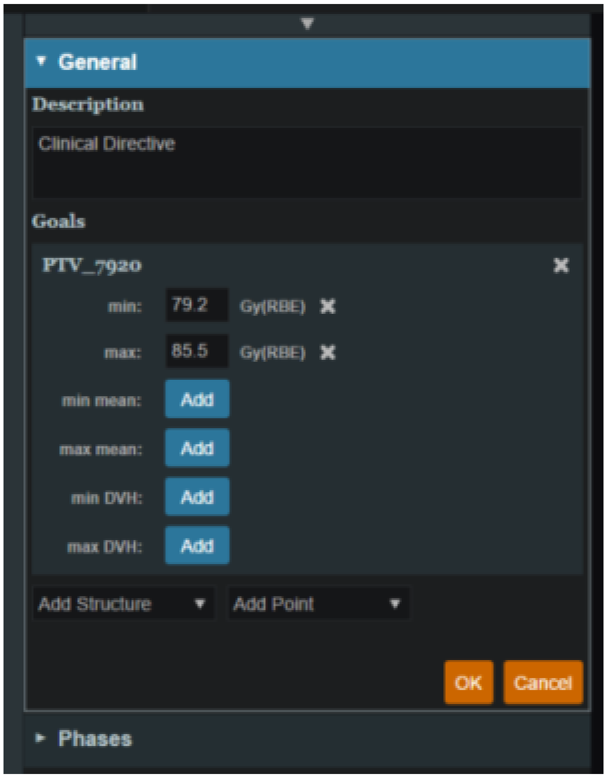
☒ testes*
☒ 2cm*
☒ skin
☒ penile bulb*
☒ neurovascular bu*
☒ prostate
☒ ptv
☒ seminal vesicles*
☒ bladder
☒ rectum
☒ urethra*
☒ bowel*
☒ left femoral hea*
☒ right femoral he*

☐ Archive DICOM on import

Prescription

1. The patient is now created and all available data has been imported, so it is time to proceed with entering the prescription information
2. Click on the *Back to Import* button
3. Click the *Planning* task
4. Click the entry from the table of patients that corresponds to your newly imported patient
5. Prescription information is stored in the *Directive*
6. Click *Open* under the *Directive* entry in the patient overview tree

7. Under *General* fill in *Goals*
    1. In this example we will set a minimum dose to the PTV7920 at 79.2Gy and the maximum dose at 85.5Gy as shown below



General

Description

Clinical Directive

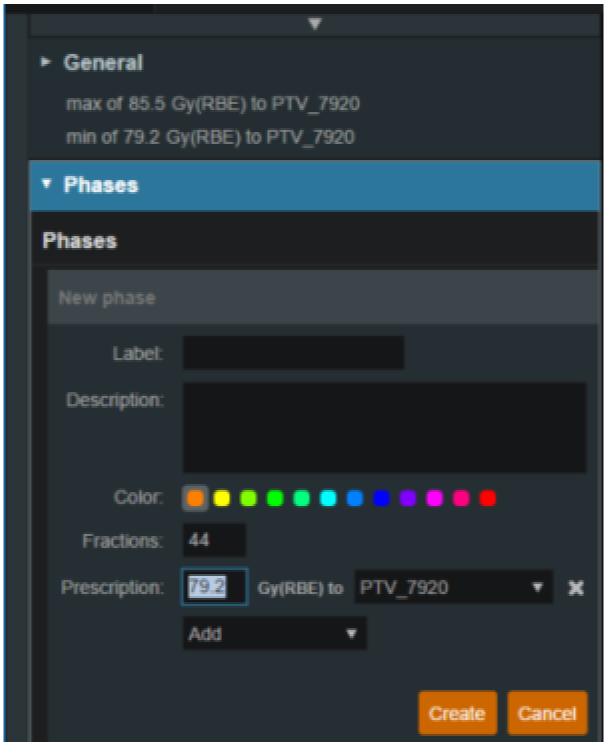
Goals

PTV_7920

min: 79.2 Gy(RBE)

max: 85.5 Gy(RBE)

8. Next proceed to *Phases* and fill in *Fractions* and *Prescription*
    1. For this example the dose will be 79.2Gy in 44 fractions to the PTV7920



General

max of 85.5 Gy(RBE) to PTV_7920

min of 79.2 Gy(RBE) to PTV_7920

Phases

Phases

New phase

Label:

Description:

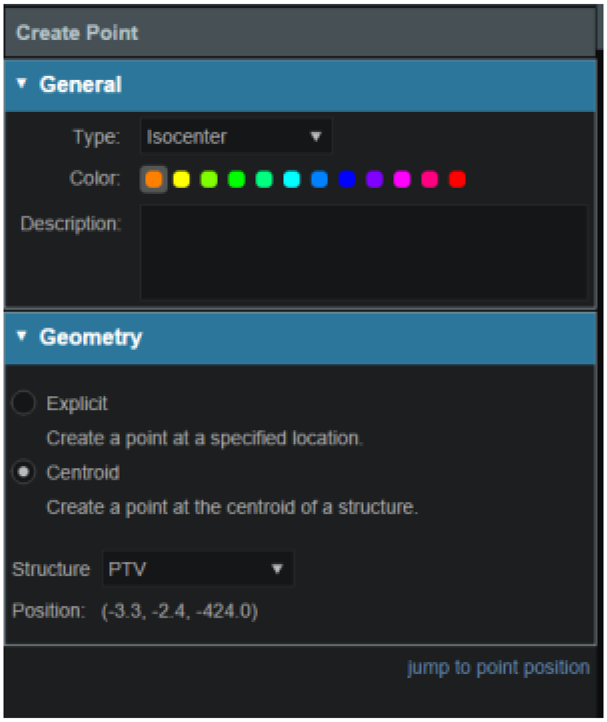
Fractions: 44

Prescription: 79.2 Gy(RBE) to PTV_7920

    2. *Label* and *Description* are free text fields that allow you to “name” each Phase and provide any description or notes necessary to distinguish between each phase in the case of multiple phases. You are free to enter your own values in these fields for this walthrough
9. Click *Create* to complete the phase
10. Click *Done* to complete the *Directive* editing and return to the Patient Overview tree

Plan Creation

1. The required *Intent*, *Course*, and *Snapshot* information was selected during import, so now we can move to creation of a *Request* and *Plan*
2. From the Patient Overview tree, click the *Add Request* button
    1. If a plan will only fulfill a portion of the prescription, then the *Request* should be edited to reflect this, otherwise just proceed to adding a plan
    2. In this case, we will be fulfilling the entire prescription with a single plan, so no editing of the Request is needed
3. Now click the *Add Plan* button under the newly created Request entry
    1. Name the plan and click *Save*
4. Now open the new plan by clicking the *Open* button under the new plan entry in the Patient Overview tree
5. Creating our plan will begin in the *Patient Geometry* block, where we will create any points or planning structures that are needed (if not created in contouring software), such as a combination of the left and right femoral heads (see Structure Geometry for details on how to Create structures)
    1. We will create a point to use for the isocenter (note this step is done for illustration purposes and is not necessary for most plans)
        1. Select a type of isocenter and create the point at the centroid of the prostate



Create Point

General

Type: Isocenter

Color:

Description:

Geometry

○ Explicit

Create a point at a specified location.

● Centroid

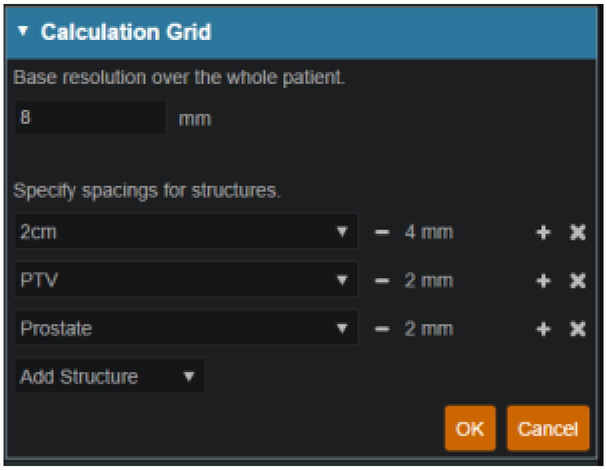
Create a point at the centroid of a structure.

Structure PTV

Position: (-3.3, -2.4, -424.0)

jump to point position

6. Next will will move on to defining the HU to Proton Relative Stopping Power (RSP) conversion
7. Click to open the *RSP Image* block
    1. If any density overrides are needed they are entered here in the *RSP Image* block
    2. If the HU to RSP curve was not chosen upon patient import the user may do so at this point
    3. We do have any density overrides to apply for this case and the proper HU curve has already been selected, so we can move past this block for this example, so click *Cancel* to close this block
8. We are now ready to define the dose calculation grid (see Defining the Dose Grid for a detailed explanation)
9. Click to open the *Calculation Grid* block
    1. Create a grid by performing the following steps:
        1. Set the base grid resolution to 8 mm
        2. Click *Add Structure* and select the “2cm” structure
            1. Set the size to 4 mm
        3. Add the PTV and the Prostate each in the same manner and set their sizes to 2 mm



Calculation Grid

Base resolution over the whole patient.

8 mm

Specify spacings for structures.

2cm − 4 mm + ✖

PTV − 2 mm + ✖

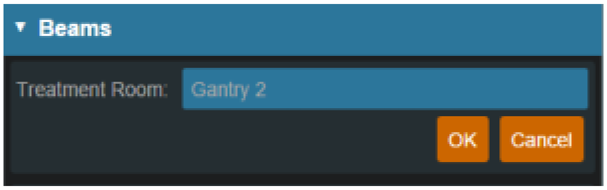
Prostate − 2 mm + ✖

Add Structure

OK Cancel

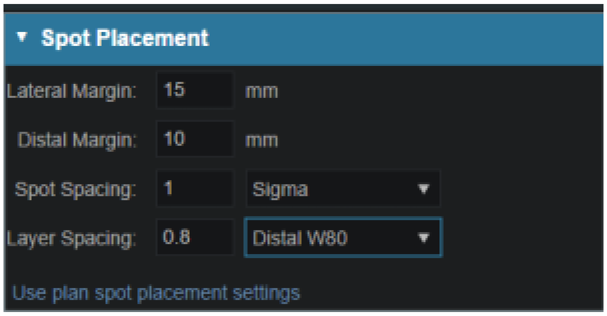
Beams

1. Open the *Beams* block (see Creating a New Beam for detailed explanation)
    1. Choose “Gantry 2” from the *Treatment Room* dropdown



Treatment Room: Gantry 2

    2. Expand the *spot placements* sub-block and set the following values (note this is the plan level spot placement, so it will apply to all our beams)
        1. Lateral margin- 15 mm
        2. Distal margin- 10 mm
        3. Spot spacing- 1 sigma
        4. Layer spacing- .8 Distal 80



Lateral Margin: 15 mm
Distal Margin: 10 mm
Spot Spacing: 1 Sigma
Layer Spacing: 0.8 Distal W80

    3. Now we will make our beams
    4. Start by clicking *Create New Beam*
        1. Enter the following for each beam
            1. General (target)
                1. The user may choose to automatically generate the beam label or manually enter a label
                    1. if the user chooses to automatically generate the label the label will contain the gantry angle, the couch angle, the snout and the shifter
                    2. the user may choose the color that the beam will be denoted in
                    3. the user will need to choose a target from the dropdown or create a new target
                    4. In the example below the PTV was chosen as the target (see Structure Geometry)

General

Color:

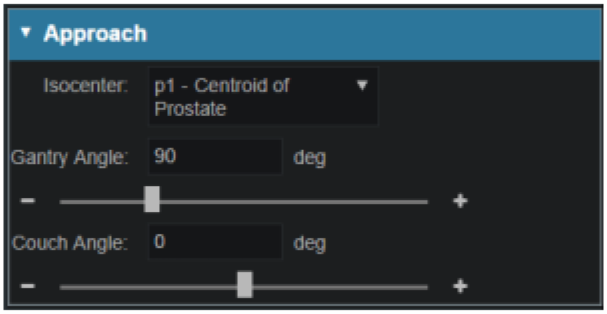
Label: G90 C0; 25 cm; no shifter;

☒ automatically generate label

Target: PTV

Description:

2. Approach
    1. At this point the use will choose the isocenter as well as enter the gantry angle and the couch angle
    2. Beam orientation should be chosen so as to have the shortest and most homogeneous distance to the target
    3. Gantry angles in the range of 90 and 270 (+/- 5 degrees) are typical for prostate plans
    4. If the patient has hip prothesis the angles may need to be increased in order to get adequate coverage
    5. A couch angle of 0 and collimator angle of 0 is typical for prostate plans
        1. As above with the gantry angle the user may need to kick the table +/- 5 degrees in order to avoid hip prosthesis



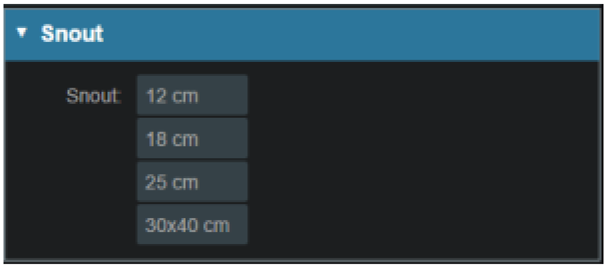
Approach

Isocenter: p1 - Centroid of Prostate

Gantry Angle: 90 deg

Couch Angle: 0 deg

3. Snout
    1. The user will choose a snout next
    2. Depending on the size of the prostate a 12cm snout should be adequate.
    3. If the pelvic nodes need to be included the user may need to increase the snout size to the 18 or 25cm snout



Snout

Snout: 12 cm

18 cm

25 cm

30x40 cm

4. Aperture (if desired)
    1. If there is the need to use an Aperture for sharper penumbra the user can do so at this juncture (see Creating an Aperture)
    2. ASTROID has the ability to utilize an Aperture with pencil beam scanning

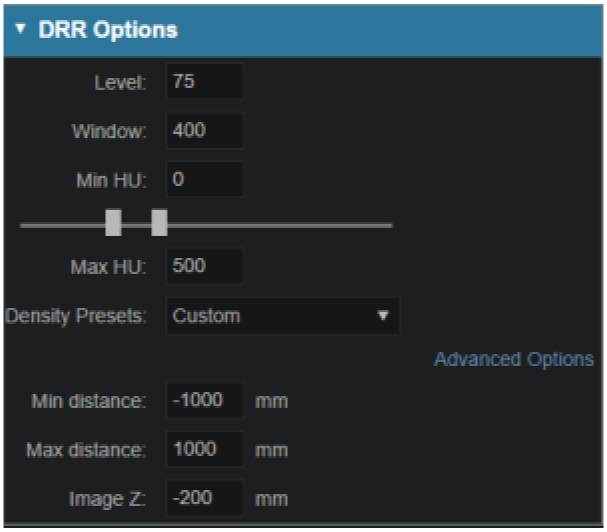
(IMPT)

    5. Shifter
        1. For prostate plans there tpically is no need to add a shifter
        2. If there is a need to add one the user may choose one from the list

Shifter

Shifter: none

    6. Air gap
        1. Depending on patient size, gantry angle etc the user may choose to enter an air gap
        2. The default air gap in 30mm
        3. By clicking on the + or - at the sides the user can increase/decrease the airgap
    7. Spot placement
        1. may choose individual spot placements for each beam or leave with original chosen placements
    8. DRR options
        1. The user may choose one of the preset *Density Presets* from the drop down or manually set the *level, window, min HU* and *max HU*
        2. The user may also choose to go into *Advanced Options* for more control of the DRR's



DRR Options

Level: 75

Window: 400

Min HU: 0

Max HU: 500

Density Presets: Custom

Min distance: -1000 mm

Max distance: 1000 mm

Image Z: -200 mm

  2. After one beam is created the user may clone it and change beam angles etc as necessary or they may choose to create a whole new beam

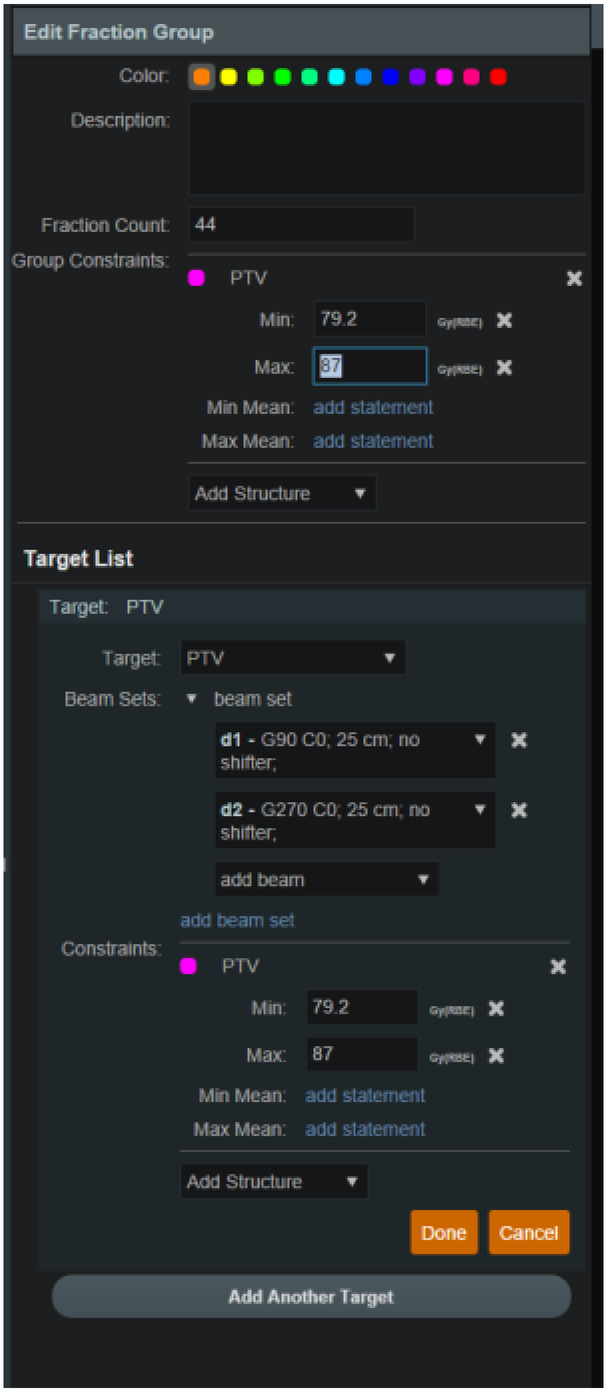
2. With the beams complete, we can now move on organizing our treatment fraction groups and specifying the constraints and objectives

Optimization

1. Open the *Optimization* block (see Astroid Optimization for a detailed explanation of *Optimization*, *Feasibility* and *Constraints*, as well as *Running the Optimizer*)

Fraction Group

1. *Create a New Fraction Group* under the *Fraction Group* block (See Fraction Groups for a more detailed explanation)
    1. Enter a Fraction Count of 44
    2. Create Group Constraints
        1. From the drop down choose the structure you want. In this example the user chose the PTV
        2. Enter the doses that should be achieved to this structure. Here the user chose a min dose of 79.2Gy (1.8Gy per fx) and a max dose of 87Gy.
    3. Add a new Target to the *Target List*
        1. Set the Target to the PTV
        2. Create the following *Beam Set*
            1. Select the beams that will be associated with this fraction group
            2. In this case it will be the G90 and G270 beams in the same beam set
                1. This means the optimizer will try to give 50% of the dose from each beam
        3. Constraints for the associate target
            1. Typically the user will put in the prescription dose for the target as a min or mean contstraint and the max dose they are willing to allow as a max constraint
            2. Here the user chose the PTV as the target from the dropdown and doses of 79.2Gy min dose and 87Gy
        4. Here we is an example of how the above parameters will look in the *Fraction Group* block



Description:

Fraction Count: 44

Group Constraints: PTV
Min: 79.2 Gy(RBE)
Max: 87 Gy(RBE)
Min Mean: add statement
Max Mean: add statement

Target: PTV
Target: PTV
Beam Sets: beam set
d1 - G90 C0; 25 cm; no shifter;
d2 - G270 C0; 25 cm; no shifter;

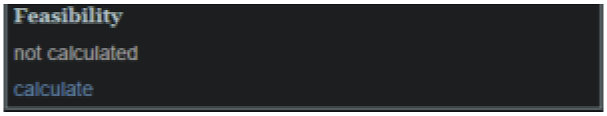
Constraints: PTV
Min: 79.2 Gy(RBE)
Max: 87 Gy(RBE)
Min Mean: add statement
Max Mean: add statement

4. Click *Create* to complete the Target entry and then *Create* again to complete the *Fraction Group*

Constraints and Objectives

1. Open the *Plan Constraints/Objectives* block
    1. Enter the *Constraints* for the planning volumes first
        1. These are the “hard stops/non negotiables” for the plan
        2. These doses will be decided per the users' department protocols
        3. For this case we will enter the following for the targets first:
            1. prostate min 79.2Gy

      2. prostate max 87Gy
      3. PTV min 75.24Gy
      4. PTV max 87Gy
2. After the target constraints have been entered, the user may start the Feasibility calculation by clicking calculate in the Feasibility block. The Feasibility calculation is based solely on the constraints and it should be used to ensure there is a feasible plan possible. The Feasibility calculation may be an iterative processes in order to get appropriate constraints established for a particular plan. In other words, the user may need to enter a constraint, check the feasibility, then progressively drop the constraint and check the feasibility until the plan is no longer feasible. It is recommended practice to start by obtaining a feasible plan utilizing only target constraints then add OAR constraints as desired. Remember, using a narrow range of constraints can improve the optimizer performance and improve the resolution of the Pareto surface navigation.
3. Run the *Feasibility* by choosing the calculate option

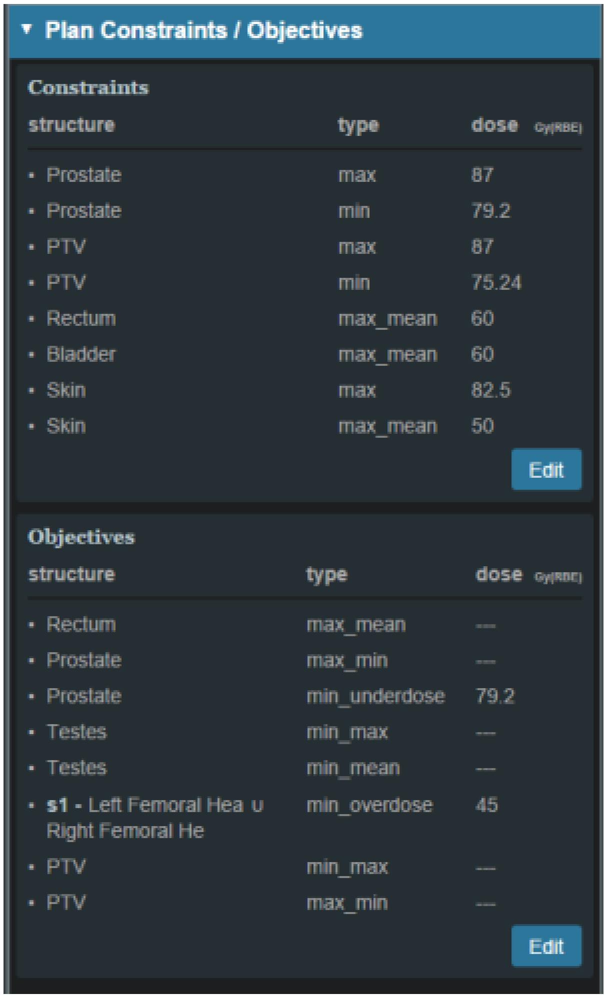


Feasibility

not calculated

calculate

4. Enter the *Constraints* for the OAR's
   1. Constraints for OAR's are like the constraints for the planning volumes- non negotiable
   2. Again these will be set per department protocol
   3. For this example we will use the following constraints for the OAR's:
      1. Rectum max mean 60Gy
      2. Bladder max mean 60Gy
      3. Skin max 82.5Gy
      4. Skin max mean 50Gy
5. Run *Feasibility*
6. Enter the *Objectives*
   1. *Objectives* are the goals the user would like to achieve and these will be the driving forces for the optimizer
   2. For this example use the following objectives
      1. Rectum max_mean
      2. Prostate max_min
      3. Prostate max_underdose 79.2Gy
      4. Testes min_max
      5. Testes min_mean
      6. Left & Right Femur min_overdose 45Gy
      7. PTV min_max
      8. PTV max_min



Constraints

structure	type	dose Gy(RBE)
• Prostate	max	87
• Prostate	min	79.2
• PTV	max	87
• PTV	min	75.24
• Rectum	max_mean	60
• Bladder	max_mean	60
• Skin	max	82.5
• Skin	max_mean	50

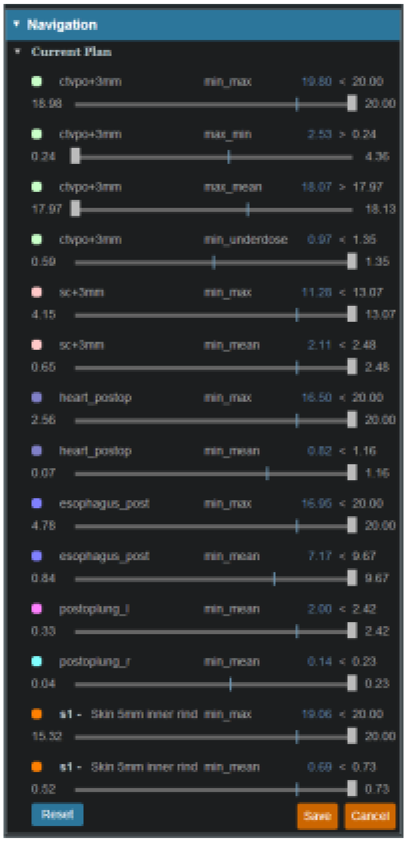
Objectives

structure	type	dose Gy(RBE)
• Rectum	max_mean	---
• Prostate	max_min	---
• Prostate	min_underdose	79.2
• Testes	min_max	---
• Testes	min_mean	---
• **s1** - Left Femoral Hea ∪ Right Femoral He	min_overdose	45
• PTV	min_max	---
• PTV	max_min	---

7. Run the MCO

Navigation

1. Once the MCO has been completed, you can adjust the objectives using the slider bars in the *Navigation* block (see Astroid Optimization *Navigating the Solutions* for a detailed explanation of using the slider bars)
    1. Adjust the slider bars in the *Navigation* block to find what you feel is the optimal plan for this case
        1. Note: All of these adjustments are made without the user having to run a new plan
    2. If you find a plan that you like, but wish to continue exploring further, you can click the *Save* button to save the current slider state
    3. You may then return to the last saved state at any time by clicking the *Reset* button
    4. The *Cancel* button will close the navigation block without saving the current state



●	ctvpo+3mm	min_max	19.80 < 20.00	18.98	20.00
●	ctvpo+3mm	max_min	2.53 > 0.24	0.24	4.36
●	ctvpo+3mm	max_mean	18.07 > 17.97	17.97	18.13
●	ctvpo+3mm	min_underdose	0.97 < 1.35	0.59	1.35
●	sc+3mm	min_max	11.28 < 13.07	4.15	13.07
●	sc+3mm	min_mean	2.11 < 2.48	0.65	2.48
●	heart_postop	min_max	16.50 < 20.00	2.56	20.00
●	heart_postop	min_mean	0.82 < 1.16	0.07	1.16
●	esophagus_post	min_max	16.95 < 20.00	4.78	20.00
●	esophagus_post	min_mean	7.17 < 9.67	0.84	9.67
●	postoplung_l	min_mean	2.00 < 2.42	0.33	2.42
●	postoplung_r	min_mean	0.14 < 0.23	0.04	0.23
●	s1 - Skin 5mm inner rind	min_max	19.06 < 20.00	15.32	20.00
●	s1 - Skin 5mm inner rind	min_mean	0.69 < 0.73	0.52	0.73

2. The plan is ready for physician review at this point
3. After the physician has decided on a treatment plan the user may then proceed to export the chosen plan to the EMR

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