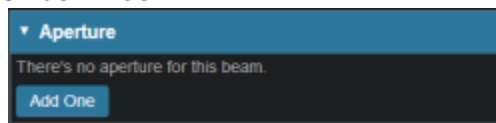# Creating an Aperture

An aperture can be added for any snout that has slabs defined for use in the site specific machine model. The site model also includes a definition for the aperture milling tool and Astroid enforces the "millability" of all apertures so that dose is only computed using a device that exactly matches what will be manufactured. The user has the ability to utilize apertures for all types of proton delivery including: PBS, DS, and US. The major steps involved in creating an aperture are common to all delivery modes, so the PBS beam example below can be referenced for all cases.
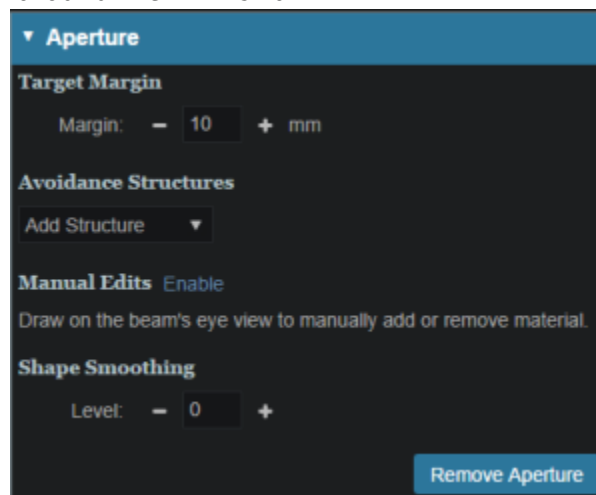
## Adding an Aperture

- From within the PBS Beam Task you may add an aperture to a beam by clicking the "Add One" button from within the *Aperture Task Block* .
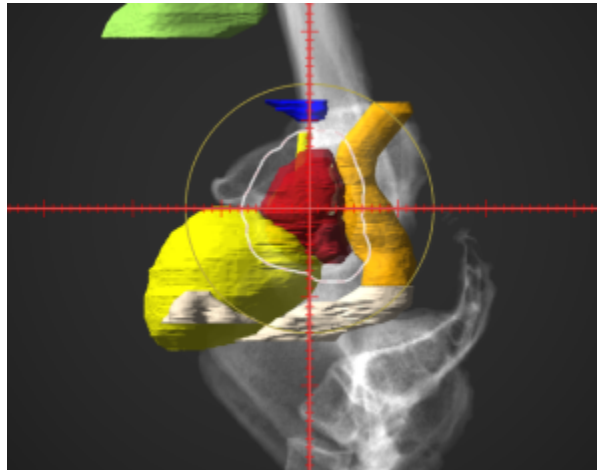


## Target

- Your target structure is automatically selected from your beam setup information. So you need to only specify the number of millimeters you want to expand your aperture around the target structure using the "Margin" option to generate your initial aperture shape. For this example we will give a margin of 10mm around the PTV7920.
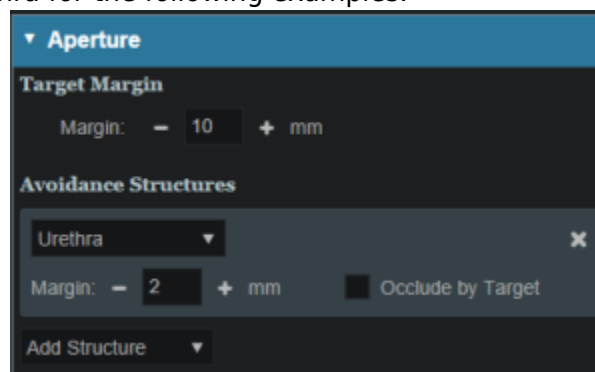


  - Your aperture should now appear in the BEV display window.
  - As seen in the example, the aperture is created so that it there is a 10mm margin from the PTV7920 to the edge of the aperture.
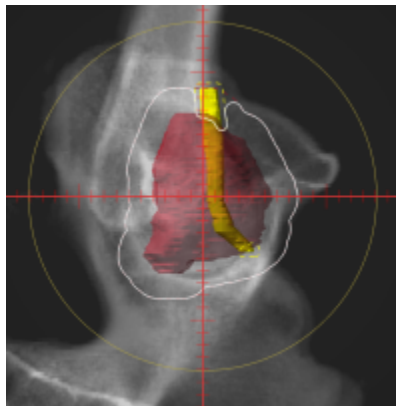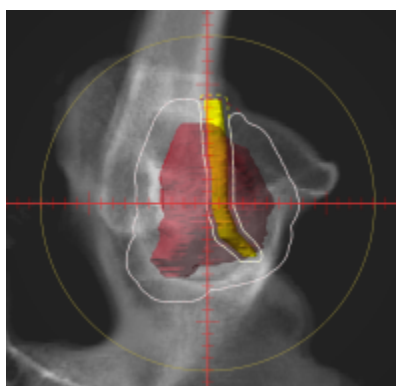
# Avoidance Structures

- In many cases you may have nearby critical structures that must be avoided. You can add an "Avoidance Structure" to your aperture design by clicking on the "Add Structure" dropdown and selecting a structure.
- Once added you can now specify a margin (mm) around this structure if desired (note negative margins will reduce the size of the blocked area, exposing part of the structure to the open field).
    - You may also choose to occlude the structure by the target or not using the "Occlude by Target" option. For the following examples we will use the Urethra as it shows a dramatic example of differences of using or not using the "Occulde by Target" option. A 2mm margin was applied to the Urethra for the following examples.



        - By checking the "Occlude by Target" box you are choosing to give the target priority over the structure in the view you are looking at in the DRR. In other words the visible target (target in front of this structure) will not be blocked by the aperture. Note that just the inferior edge of the Urethra is blocked by the aperture. The part of the Urethra that is behind the PTV7920 is not blocked.

- If you leave the "Occlude by Target" unchecked, you are choosing to give the structure priority over the target. This means you will block the entire structure regardless of its position relative to the target. In this example the aperture blocks out all of the Urethra.
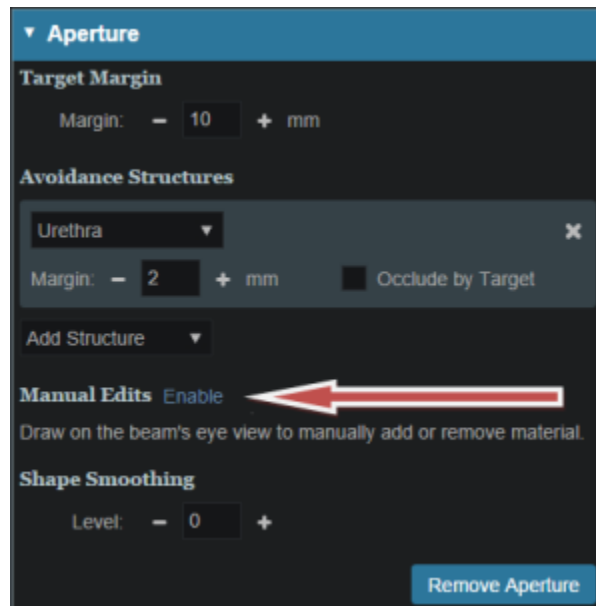


- You may add as many Avoidance Structures as needed to design your aperture shape.
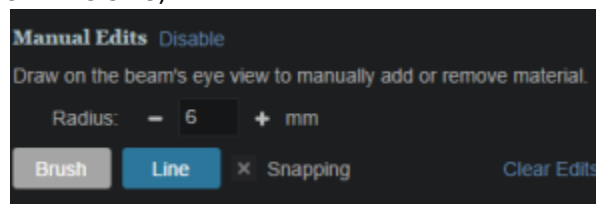
# Shape Smoothing

- The "Shape Smoothing" section allows you to smooth the aperture if needed.
- The smoothing level value can be set from 0-20, with zero applying no smoothing and higher numbers increasing the smoothness of the aperture. See dosimetry explanation on aperture smoothing for more details regarding the smoothing algorithm and process.
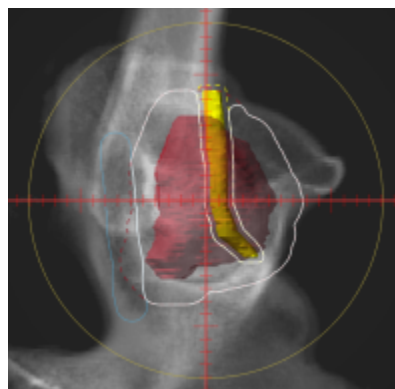
# Manual Edits

- Manual edits allow you to draw on the BEV in order to manually edit the aperture shape. To begin editing simply click the *Enable* link.
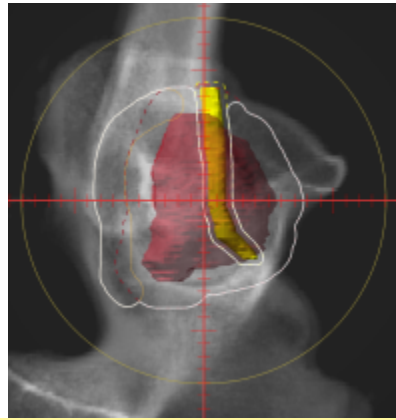
- First, set the radius of the editing tool to the desired size (you can directly type a size or use the -/+ on either side to increment the size)



- You are now free to draw manual override regions directly on the BEV. You draw by simply clicking and dragging the mouse at the desired positions.
  - You have the option to use a freehand brush tool or a straight line drawing tool for performing manual edits.
    - While using the straight line tool, the Snapping option allows snapping for horizontal, vertical, and 45 degree angles.
  - The editing tool automatically switches between adding or subtracting material based on the position of the tool when the mouse is first clicked (i.e. when starting each new draw operation).
    - When outside the aperture, you edit the aperture by pushing in/subtracting and your edit regions are drawn in a blue color. The hashed red line denotes the original placement of the aperture.
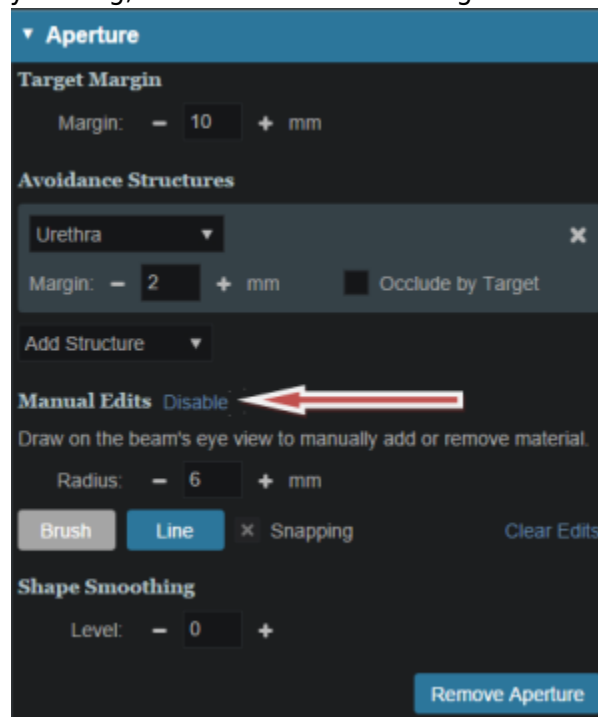


    - When inside the aperture, you edit the aperture by pushing out/adding and your edit regions are drawn as the color of your target.

> ○ The manual edits contain an "undo" feature, so that the user can successively remove the last manual edit step by pressing Ctrl+Z. Please note that the undo functionality only tracks edits performed in the active session, so as soon as you leave this block or disable manual edits, you will be unable to use the undo functionality on those changes when returning to this task.

○ Once done with manually editing, click the "Disable Editing" button to end the process.



○ Note that your edits and the resulting aperture shape will still show on the BEV and your edits will remain as-drawn even when changing other options.

## Removing Edits

- If you need to remove the manual edits for any reason, you may do so by pressing the "Clear Edits" button. Pressing this button will remove ALL manual edits for this aperture.

# Removing an Aperture

- If you wish to remove the aperture from this beam, simply press the "Remove Aperture" button at the bottom of the Aperture Task Block to completely remove it.

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