# Structure Geometry

The Astroid Planning App allows for new structure creation using modifications of existing structures. These modifications include boolean combinations, expansions/contractions, rinds, and clipping (i.e. splitting by a plane).

About Structure Geometry Functions

The following is a detailed explanation of each of the structure geometry functions that may be used to create or edit structures within Astroid.

Combination

Allows for the combination of two or more structures using set (boolean) operations. The planner must choose which type of set operation they desire to create the new structure.
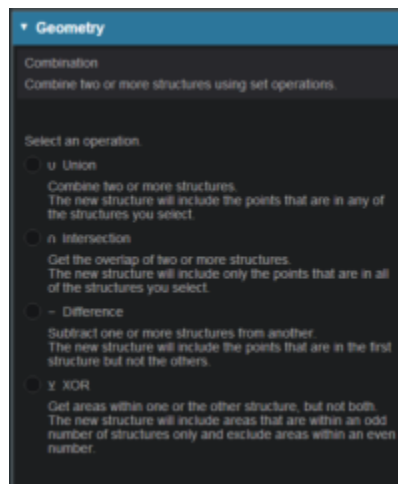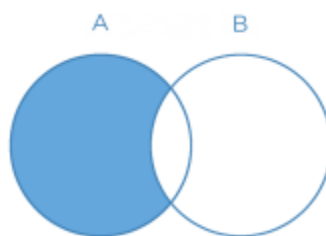

- **Union** - Combine two or more structures. The resulting new structure will contain the points that are in **ANY** of the selected structures. Structures are selected from a series of simple drop down menus. Refer to this example for a sample of a union structure being created.
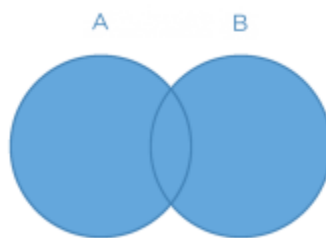
- **_Intersection_** - Use only the overlap of two or more structures. The resulting new structure will include only the points that are in **ALL** of the selected structures. Structures are selected from a series of simple drop down menus. Refer to this example for a sample of a intersection structure being created.
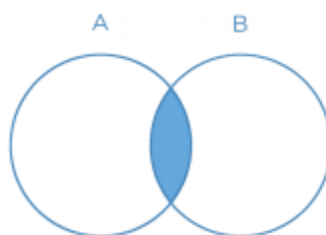
- **_Difference_** - Subtract one or more structures from a base structure. The resulting new structure will include the points that are in the first structure but not the others. The base structure is selected from the first drop down. The structures to subtract are then selected from the next series of simple drop down menus. Refer to this example for a sample of a difference structure being created.

- **_XOR_** (Exclusive OR) - Combine two or more structures with exclusivity. The resulting new structure will include areas that are within an odd number of structures only and will exclude areas that are within an even number of structures. Two or more structures need to be chosen from the drop down to create the new structure. The shaded areas in the examples below show the new structure and demonstrate the XOR functionality. The non-shaded areas would be excluded from the new structure.
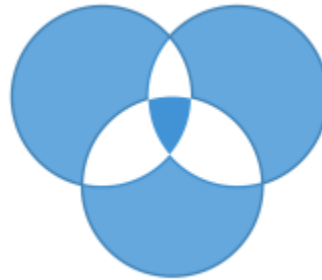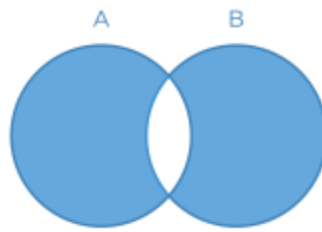
Expansion

Allows for creation of a new structure as an expansion or contraction of an existing structure. The base structure is selected from a simple drop down menu. An expansion is performed by entering a positive number for the expansion amount. Conversely, a contraction is performed by entering a negative number for the expansion amount. Structures may be extranded in two dimensions (structure will only expand/contract within its original slice planes) or three dimensions (structure will expand onto other slices as a true 3D expansion). Refer to this example for a sample of an expansion structure being created.
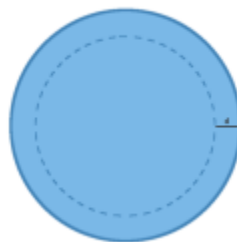
Rind

Allows for creation of a new structure as a thin ring around the outside surface of an existing structure. The base structure is selected from a simple drop down menu and then both an inner margin and outer margin are specified. Inner margin is the thickness of the ring within the existing base structure. Outer

margin is the thickness of the ring outside the existing base structure. Negative margins are not permitted. Refer to this example for a sample of a rind structure being created.
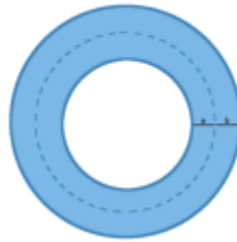
✎ Fix Me! (should show inner and outer margins in this picture)

Clipped

Creates a new structure by splitting an existing structure by a user defined plane (and discarding the portion on the positive side of the plane). Any existing structure may be selected for splitting from a simple drop down menu. The split plane is defined by a single point and a normal vector pointing away from the portion of the structure that will be kept. The normal vector is defined by its three direction components XYZ and the point may be selected (or created) from the available point list menu. The XYZ normal vector directions refer to patient coordinates so that X is left-right, Y is ant-post, and Z is inf-sup (note: if the "wrong" side of the structure is removed, simply reverse the direction of the normal vector by changing the sign of each XYZ value). Refer to this example of a clipped structure being created.
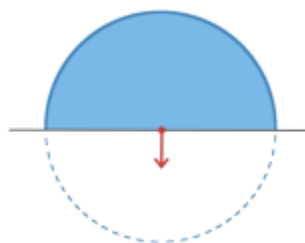

Working with Structures

Within Astroid the planner has the ability to create additional structures that may be needed to perform the plan.

1. Open the Patient Geometry block This will open the patient structure list.
2. Choose the Create New Structure list at the bottom of the list

3. The planner must then choose what type of structure they would like to create from the drop down menu at the top as well as the geometry to create the structure- Combination, Expansion, Rind or Clipped.
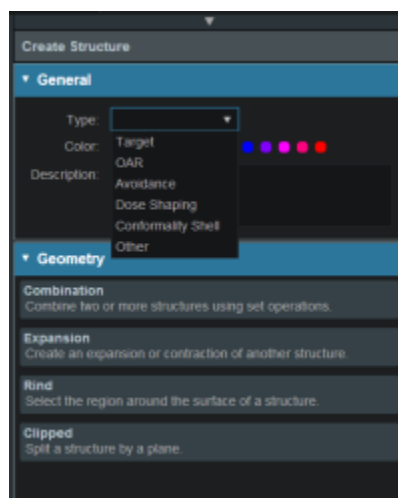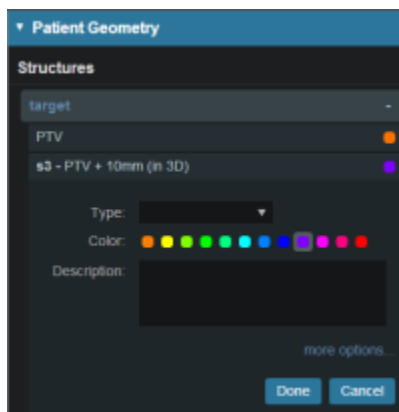

4. Once an additional structure has been created the planner may edit, clone or delete the structure by clicking on the structure.
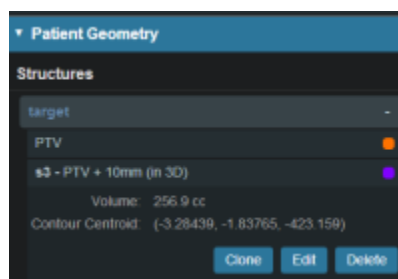
5. If the planner desires to clone (duplicate) or delete the structure they may choose to do so. If they need to further edit the structure they may click on the edit button then choose more options. This

will take the planner to the structure Geometry block and they may proceed with the necessary edits.