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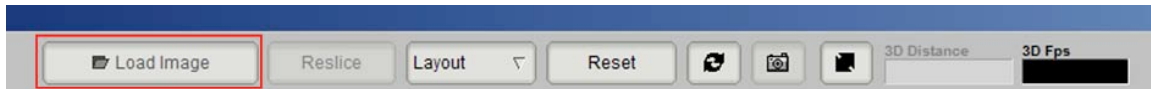
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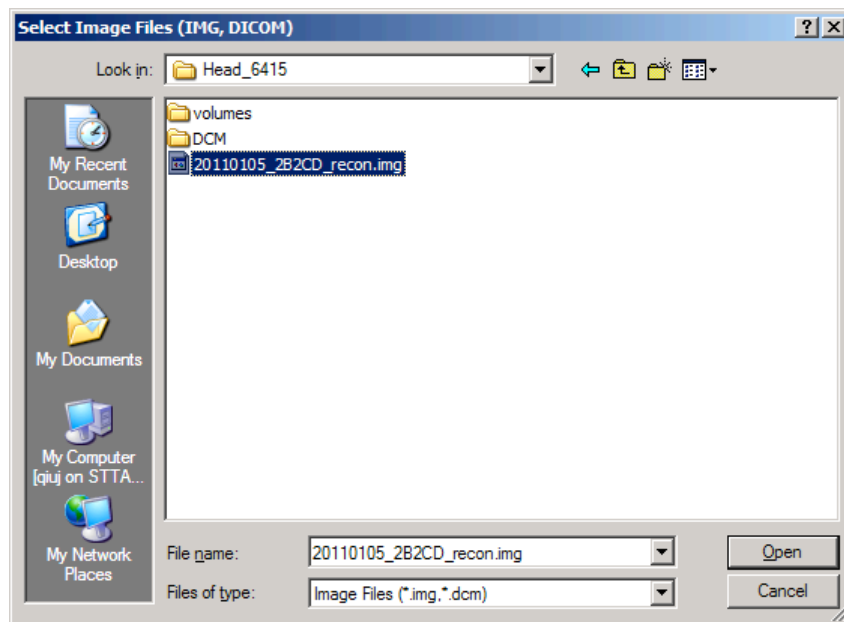
## Navigation set-up

### *Load Image*

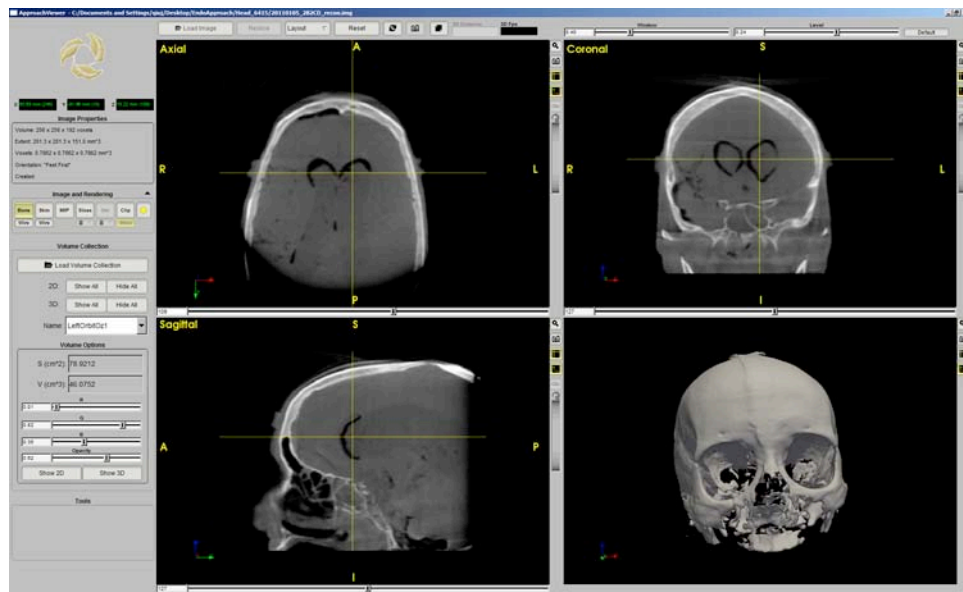
To load an image click on 'Load Image' (boxed in red):



Select the .dcm (diagnostic CT) or .img file (conebeam CT) and click open:

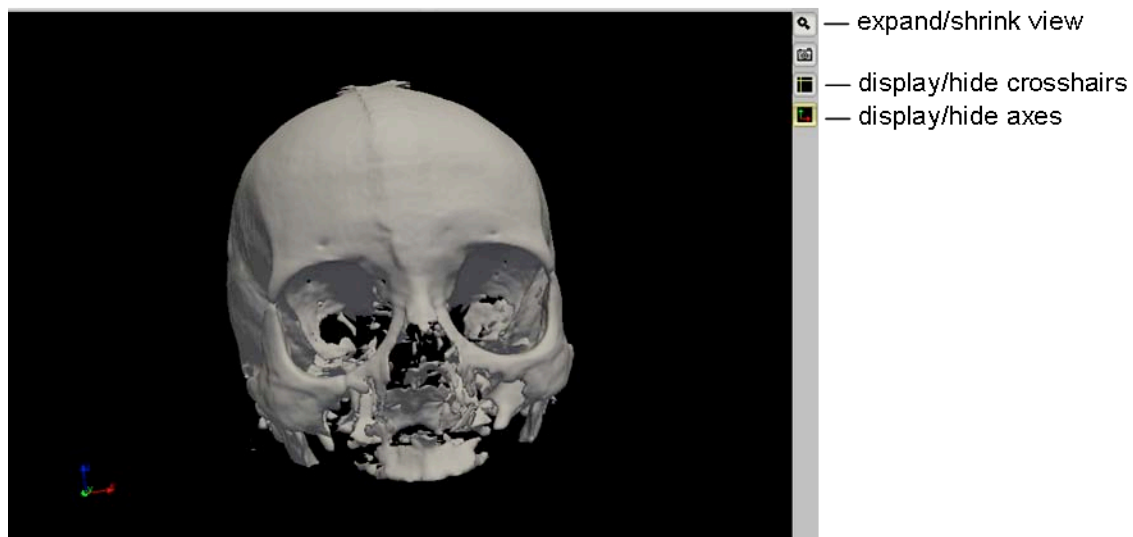


The image set will be loaded into the viewer with an axial view, coronal view, sagittal view, and 3D view:



## Viewing Image

Each of the view has side buttons that can expand/shrink the view, display/hide crosshairs, and display/hide axes:



## ***Mouse controls***

Left mouse button – point picker, slices 2D to location clicked

Left mouse button (hold and drag) – rotates in 3D view, adjusts window/level in 2D views

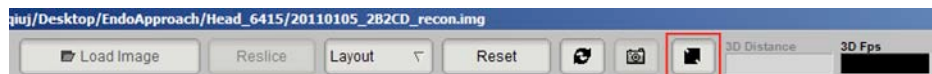
Middle mouse button (hold and drag) – pan

Right mouse button (hold and drag) – zoom

Mouse Wheel – scrolls through slices in the 2D views

## ***Distance Measurement***

To measure the distance between any two points, click on the measurement button on the top panel (boxed in red) and then click any two points in the views.

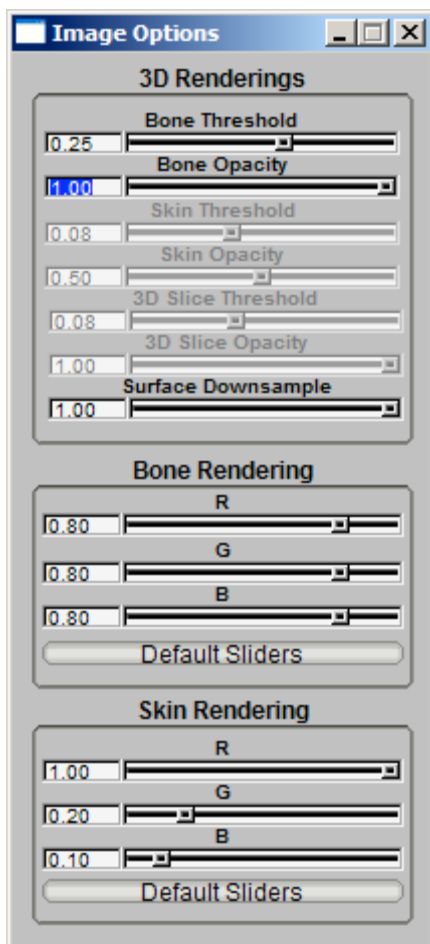


## Rendering Options

By default, bone surface rendering is turned on when an image set is loaded. The viewer also supports skin surface rendering, MIP volume rendering, display of orthogonal slices in 3D, and clipping plane. These options are located on the left side control panel:



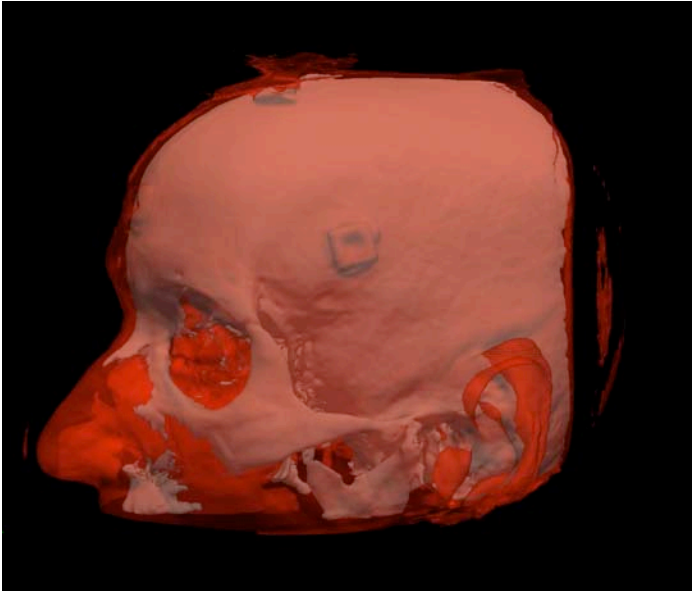
Additional rendering options can be accessed through the 'up arrow' on the left side control panel:



The properties of the surface renderings can be adjusted by setting the threshold, color, and opacity. Surface downsample defaults to 1, but can be lowered to improve speed at the cost of rendering quality.

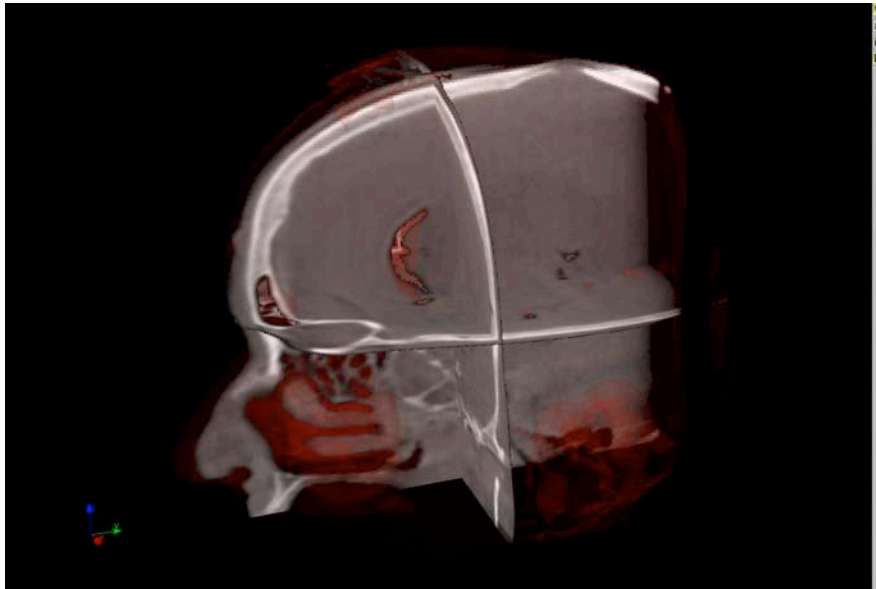
### ***Bone and Skin Surface Rendering***

Bone and skin surfaces are rendered the same way. The difference between them is the CT threshold used to generate the surfaces. The default values might not look right, so feel free to adjust them.



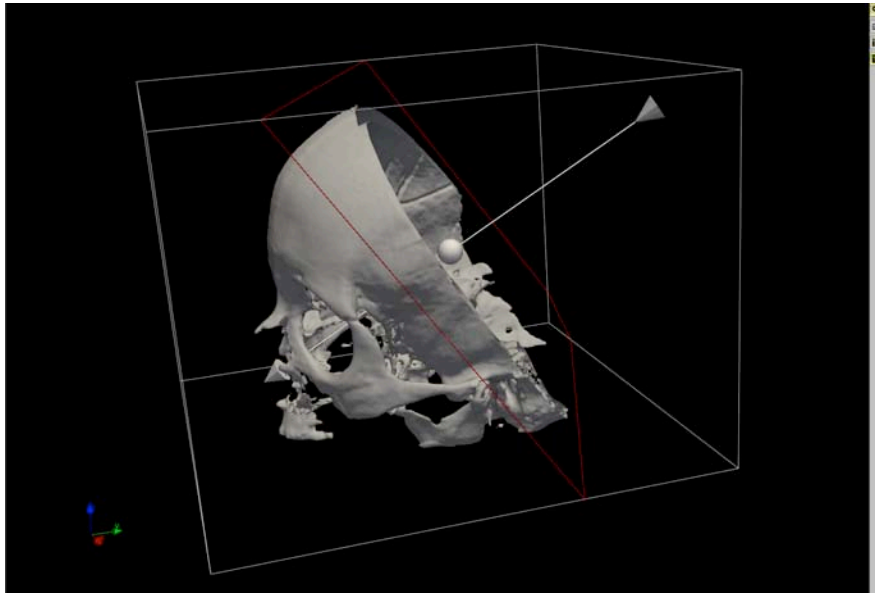
### **Slices in 3D**

Clicking the 'Slices' button will display/hide the orthogonal CT slices in the 3D view.



## Clipping Plane

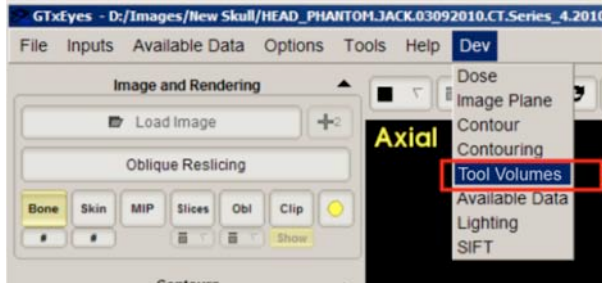
Clicking the 'Clip' button will display/hide the clipping plane tool in the 3D view. To orient the clipping plane, click with the left mouse button and drag the tail of the arrow. To move the clipping plane, click in the plane drag with the left mouse button. Normal viewing mouse controls are accessible outside of the bounding box.





## Data Collection

To record a surgical volume in the anatomy laboratory once the approach has been simulated, open the 'Dev Tool Volumes' window ('Dev->Tool Volumes' in the menu bar).



Go to 'Dev' in the menu bar and click 'Tool Volumes' to open up the tool volumes window

Position the pointer on the deep area of the approach to quantify, and then click 'Start' in the 'Dev Tool Volumes' window.

System:

**Tracked Tool Volume**

Tool:  **Start** **Clear**

Name:  **Add**

**Volume Collection**

2D: **Show All** **Hide All**

3D: **Show All** **Hide All**

Name:

**Volume Options**

S (cm<sup>2</sup>):

V (cm<sup>3</sup>):

R

G

B

Opacity

**Show 2D** **Show 3D**

**Analysis**

Superficial Plane: **Set**

Deep Plane: **Set**

SA

S (cm<sup>2</sup>):

D (cm<sup>2</sup>):

V (cm<sup>3</sup>):

Click 'Start' in the  
'Tracked Tool Volume'  
panel

During the quantification procedure make sure that the status of the tracker and the reference tools remains green; otherwise, check if the navigation system is working properly.

X	Y	Z	Vox	Distance	Polaris			
-85.07	-192.47	429.00	848			Active	Active	Active
					Aurora	Inactive	Inactive	Inactive

Trace all the points of the reachable deep surface, taking care of acquiring also the portions of the area located deeper than the perimeter.

Subsequently, retract the pointer in order to reach the superficial area. While performing this step, avoid the mistake of acquiring points outside the surgical pyramid.

Once the superficial area is reached, trace its perimeter and click 'Stop' in the 'Tracked Tool Volumes' panel (it will be at the level of the previous 'Start' button).

Write the name of the quantified approach in the dedicated field, then click the 'Add' button next to it.

System:

Tracked Tool Volume

Tool:

Start Clear

Name:  **Add**

**Volume Collection**

2D:

3D:

Name:

**Volume Options**

S (cm<sup>2</sup>):

V (cm<sup>3</sup>):

R

G

B

Opacity

**Analysis**

Superficial Plane:

Deep Plane:

SA

S (cm<sup>2</sup>):

D (cm<sup>2</sup>):

V (cm<sup>3</sup>):

Click 'Add' in the  
'Tracked Tool Volume'  
panel

Repeat the previous steps for each surgical pyramid of interest. At the end of the quantifications click the 'Save' icon in the 'Volume Collection' panel and give a unique name to the volumes folder.

System:

Tracked Tool Volume

Tool:

Name:

**Volume Collection**

2D:

3D:

Name:

**Volume Options**

S (cm<sup>2</sup>):

V (cm<sup>3</sup>):

R

G

B

Opacity

**Analysis**

Superficial Plane:

Deep Plane:

SA

S (cm<sup>2</sup>):

D (cm<sup>2</sup>):

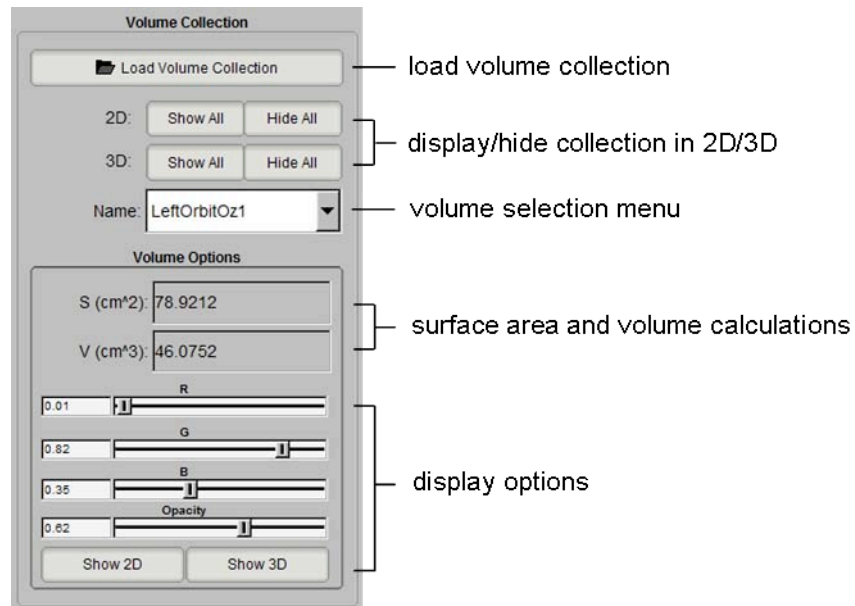
V (cm<sup>3</sup>):

Click the 'Save' icon in the 'Volume Collection' panel

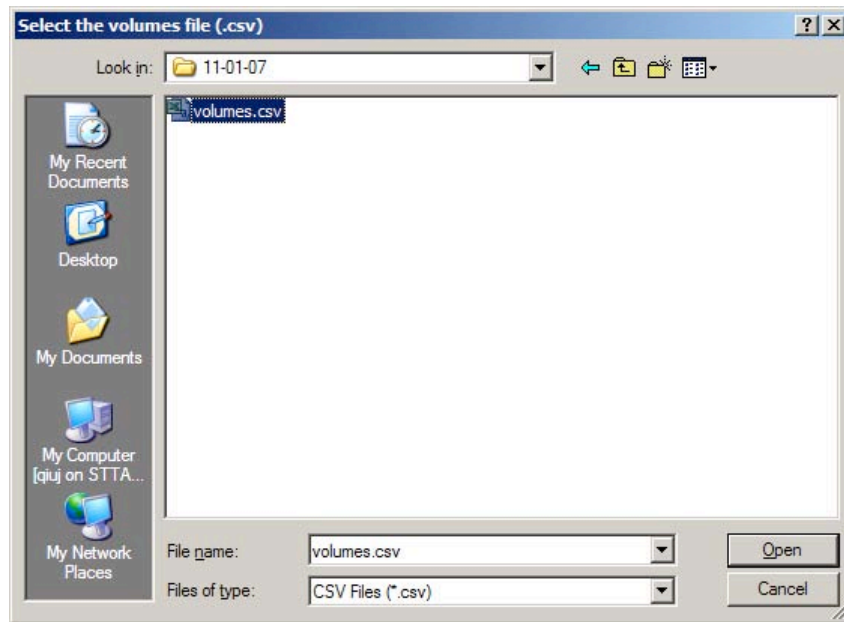
### ***Tips***

- The acquisition of the deep surface can be sped up by tracing the perimeter of the surface and, then, assuring to reach with the pointer all the portions of the surface deeper to its perimeter;
- During the movement of the pointer from the deep surface to the superficial one, mistakes can be avoided by covering the pointer in order to temporarily interrupt the acquisition of data;
- It is useful to repeat the quantification twice for each approach in order to define “**non-crossing**” and “**crossing**” volumes. The difference between those procedures can be described imagining two clocks, one over the deep surface and the other at the level of superficial area. A non-crossing volumetric analysis is obtained when the pointer is positioned at the same hour of the two imaginary clocks (i.e. 3 o'clock at the pyriform aperture and 3 o'clock at the posterior wall of the sphenoid sinus). On the contrary, a crossing position is obtained when the pointer is positioned at the opposite hour of the two imaginary clocks (i.e. 3 o'clock at the pyriform aperture and 9 o'clock at the posterior wall of the sphenoid sinus). Non-crossing volumes correspond to the obstacle-free working space granted by each approach, while crossing measurements allow to acquire the maximum reachable deep surface.

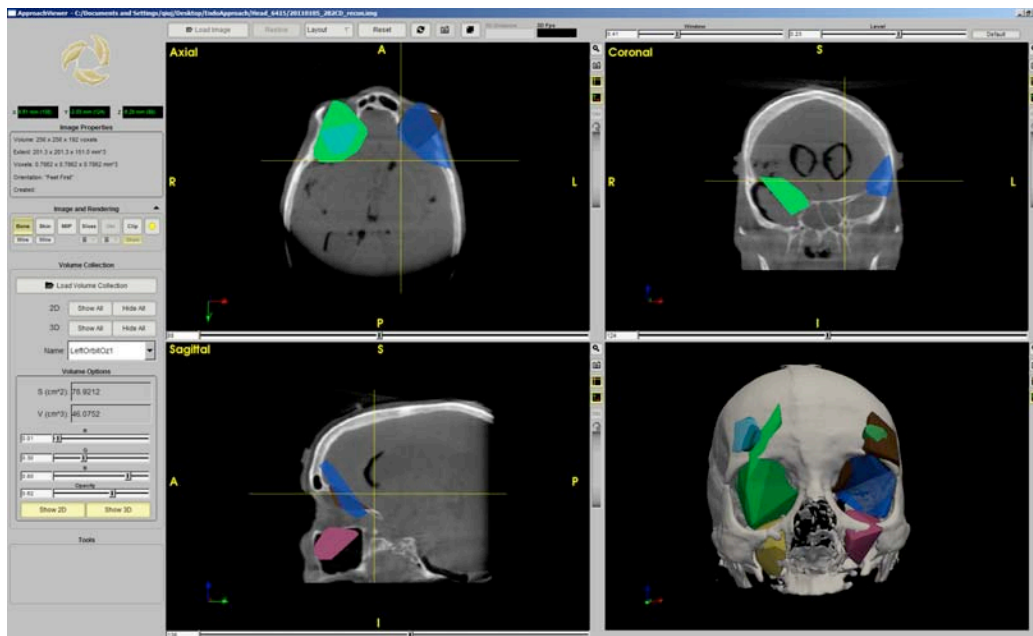
## Loading Tool Volumes



To load saved volumes, click 'Load Volume Collection' on the left side control panel, browse to the volumes directory, and open the 'volumes.csv' file. The collection can be displayed/hidden from the 2D/3D views by clicking the 'Show All'/'Hide All' buttons.



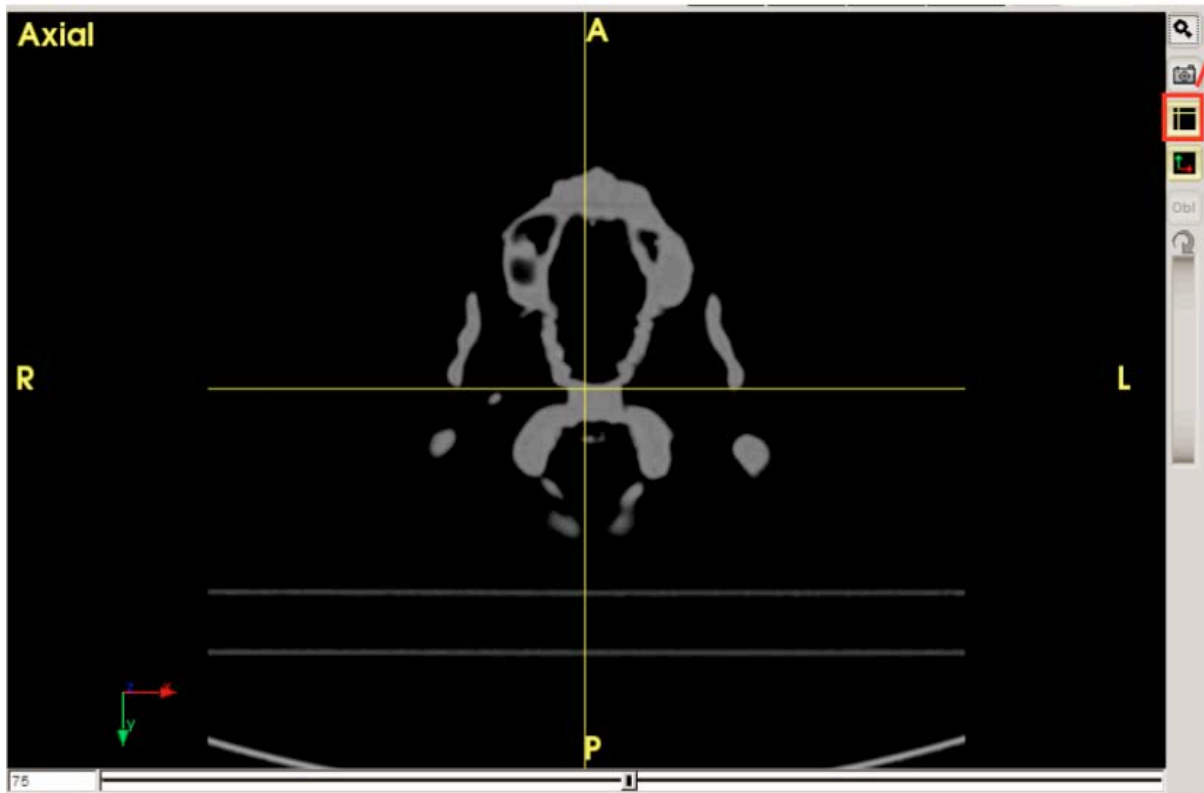
A volume can be selected through the selection menu. The selected volume's properties will be displayed in the 'Volume Options' group and can be adjusted.



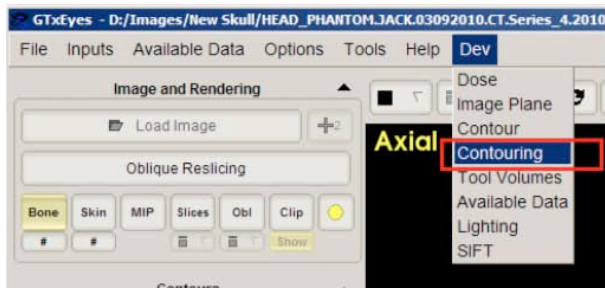


## Contouring

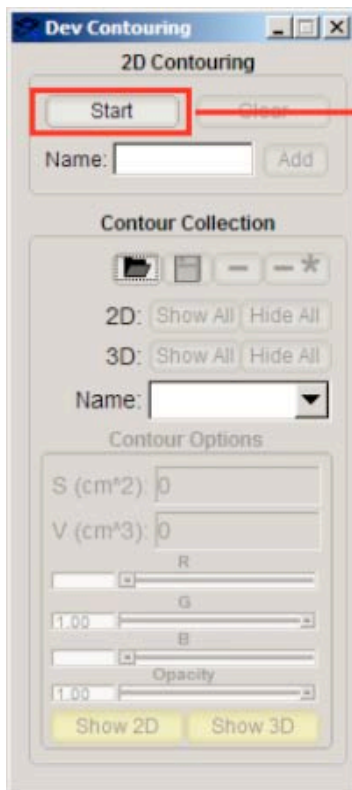
In the axial view, click the crosshair button to turn crosshair off



Go to 'Dev' in the menu bar and click 'Contouring' to open up the contouring window

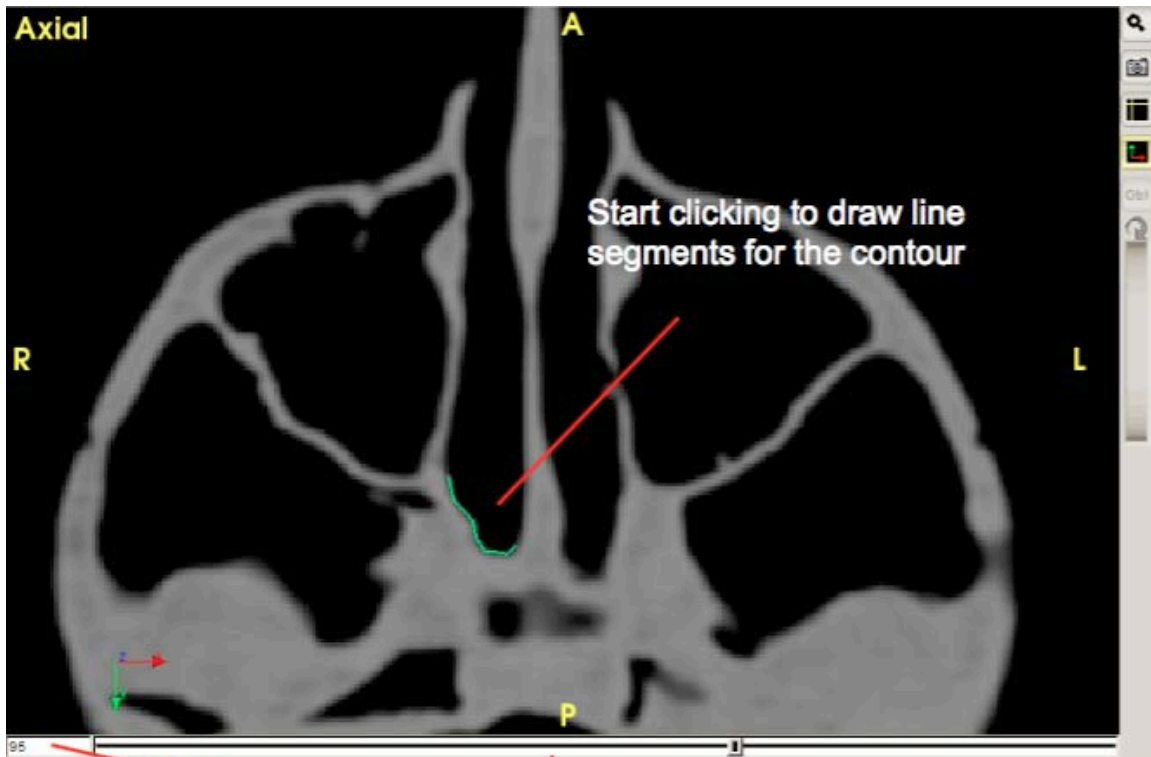


Go to 'Dev' in the menu bar and click 'Contouring' to open up the contouring window



Click 'Start' in the '2D Contouring' panel of the window

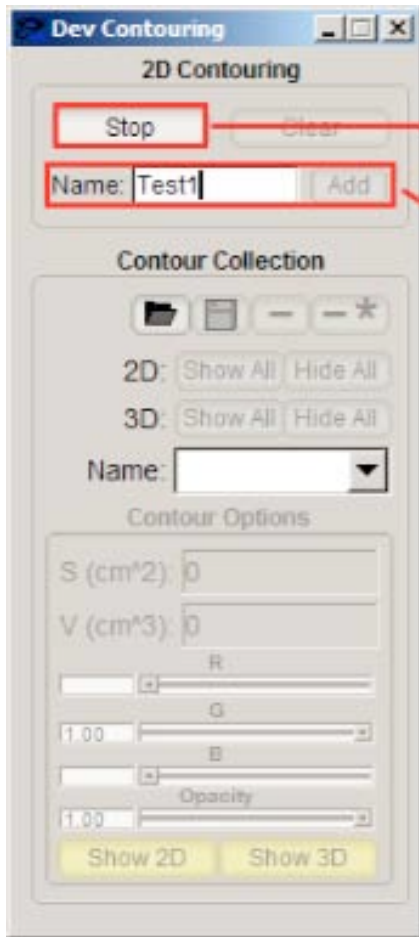
Click 'Start' in the '2D Contouring' panel of the window



Use mouse wheel or slider / input to move to different slice

Start clicking to draw line segments for the contour

Use mouse wheel or slider / input to move to different slice

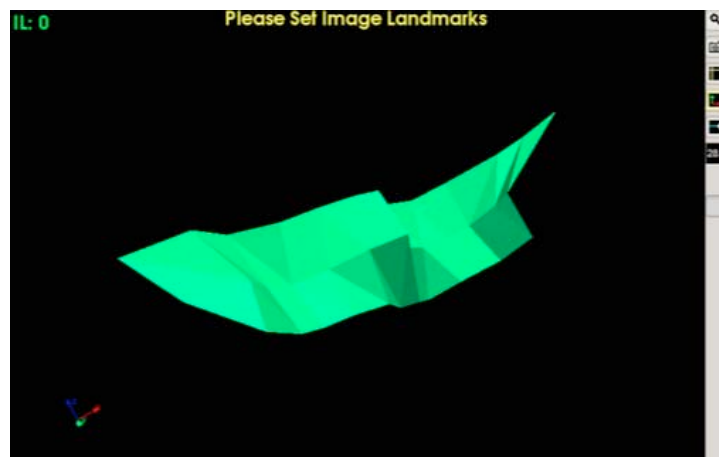


Click 'Stop' when done contouring

Give a unique name and click 'Add' to add to the contour collection. This will turn the 2D contour slices into a 3D mesh

Click 'Stop' when done contouring

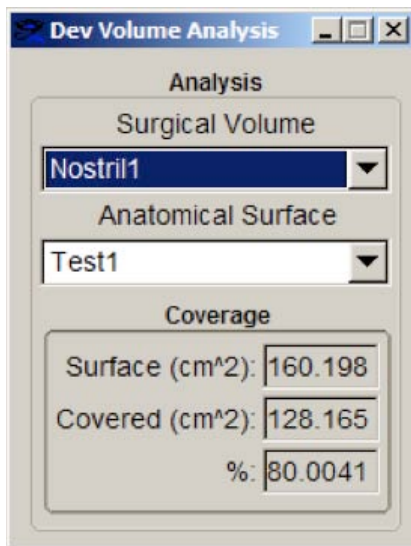
Give a unique name and click 'Add' to add to the contour collection. This will turn the 2D contour slices into a 3D mesh



## Volume-Contour Match

Make sure there are volumes in the 'Volume Collection' panel of the 'Dev Tool Volumes' window ('Dev->Tool Volumes' in the menu bar)

Make sure there are surfaces in the 'Contour Collection' panel of the 'Dev Contouring' window ('Dev->Contouring' in the menu bar)



Open the 'Dev Volume Analysis' window ('Dev->Tool Volume Analysis' in the menu bar). Select a desired volume and contour surface. 'Coverage' reports the absolute and percentage value of the contoured surface included in the volume.

