



 Vitrea Advanced<sup>®</sup>

 Vitrea Workstation<sup>™</sup>

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Education and Reference Guide  
Vascular

VITALU<sup>®</sup>

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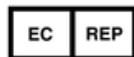
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# Safety and Regulatory Considerations

PLEASE REFER TO THE **ABOUT VITAL IMAGES MEDICAL IMAGING SOFTWARE** DOCUMENT BEFORE USING THIS PRODUCT. This document includes important information regarding general Vitrea Safety and Regulatory considerations.



**CAUTION: Federal law restricts this device to sale by or on the order of a physician, as directed by 21 CFR 801.109(b)(1).**

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- For customer technical support, contact us:
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  - Outside the U.S., contact your Vital distributor.
  - Send an email to [support@vitalimages.com](mailto:support@vitalimages.com).
- For a printed version of the Release Notes, Education and Reference Guide, or Installation Guides, contact Customer Support at 1.800.208.3005.

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## Release Notes

Vitrea Release Notes contain late-breaking information not available at the time the Education and Reference Guide was released. This document is available from your System Administrator or from Vital Images.

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# CT Aorta Analysis

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# CT Aorta Analysis Overview

The CT Aorta Analysis workflow enables you to visualize and evaluate the aorta vasculature.

Use the Segment Anatomy tools to segment the bone from the aorta. Hide the bone or make it semi-transparent.

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## CT Aorta Analysis Lesson

### I. Select Study

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Load an Aorta study.

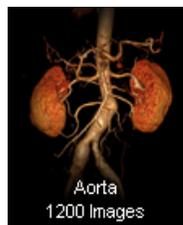
 See the instructions for your Vitrea type (VitreaAdvanced Through the Data Manager or VitreaWorkstation) in the **Select Study** chapter of the **VitreaAdvanced-VitreaWorkstation General Education and Reference Guide**.

### II. Choose Protocol and Preset

---

Use one of these procedures:

#### Data Manager



- Double-click the **Aorta** application thumbnail.

## Gallery Window

1. On the Gallery window, select the **Vascular: Aorta CT** protocol.

The Gallery choices update automatically.

2. Click **Pick** next to the **3D Analysis** preset.

## III. Perform Analysis

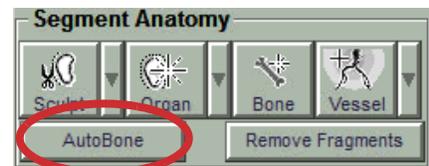
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**NOTE:** Because of the high HU value of contrast media in 100kV scans, the reliability of calcium detection within the vessel lumen is expected to be lower than that of regular kV scans.

### Automatically Segment Bone

1. In the Segment Anatomy Area, click **AutoBone**.

2. Review the segmentation and use the Manually Segment Bone technique to segment any additional bone regions.



### Manually Segment the Bone

You can manually segment the bone if desired.

**Optional** Press T to activate the **Trim** tool, then drag the posterior yellow line in the sagittal view to remove the table from the image.

3. From the Analysis tab, click **Bone**.

4. In the 3D view, click the iliac crest or another bone.

**OR**

In the 2D view, click a portion of cortical bone.



**TIP:** Vitrea displays a blue overlay on areas that will be segmented. Use this as a guide to determine if you need to include more or less to the selected area.

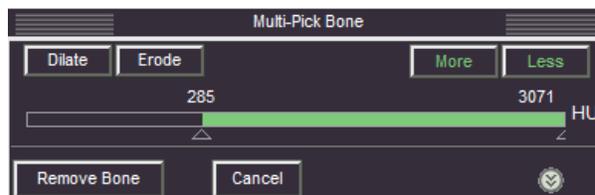
**TIP:** Be sure the blue overlay is on bone areas only. If it displays on vessels, click **Less**, or adjust the HU slider, to select a smaller HU range.

**TIP:** To remove a portion of the selected (blue) area

- a. Place the cursor over the area until a purple overlay displays.
  - b. Roll the mouse wheel to increase or decrease the size of the purple overlay.
  - c. Click the purple overlay.
- That area will not be segmented with the rest of the Bone area.

5. Click **Less** or **More** as needed.

**TIP:** The **Less** and **More** buttons decrease or increase the HU range by 20.



6. Adjust the HU slider bar to adjust the HU range as needed.

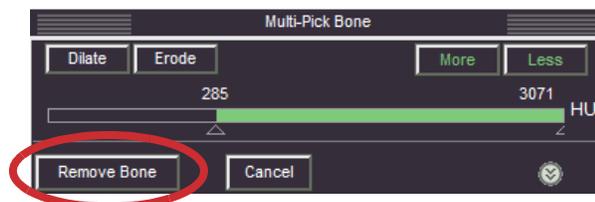


7. Click **Dilate** or **Erode** as needed.

**TIP:** The **Dilate** and **Erode** buttons decrease or increase the selected area by 1 pixel in the 2D views and 1 voxel in the 3D views per click.

**TIP:** When you use the **Dilate** button, be sure the blue overlay does not “bleed” into an area you do not want selected.

8. Click **Remove Bone**.



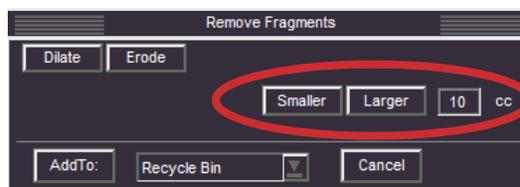
A listing is added to the Anatomy area.

9. Repeat from step 4 to segment all the bones in the view.

10. To remove fragments, click **Remove Fragments** from the Analysis tab.

11. Review the blue overlay to be sure all the fragments are selected.

**TIP:** To adjust the size of the fragments selected, click **Smaller** or **Larger** in the Remove Fragments dialog box.



12. Verify the Add To dropdown indicates **Recycle Bin**, then click

**AddTo:** .

13. In the Anatomy area, select/highlight an anatomy option.



14. Right-click in the 3D view, then select .

15. Click and drag in the view to adjust the window/level settings for that region.

**TIP:** Window level is also available when you left + right-click and drag.

16. From the Preset Selector options on the Analysis tab, click **Semi-Transp Bone**.



17. Right-click, then select .

18. In the MPR views, draw rulers to measure areas of interest.

## Take Snapshots

19. Right-click and select  (or press S) to activate the camera.

20. Move the cursor to the image and click.

Snapshots, measurements, rulers, W/L, or segmentation option can be restored from the Report page or the Study Directory.

## IV. Distribute Findings

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The snapshots you save in the Viewer window are saved to the Report window.

1. Click  at the bottom of the window.
2. Export your findings or create a report.

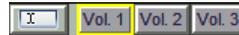
 See the **Distribute Findings** chapter of the **VitreiaAdvanced-VitreiaWorkstation General Education and Reference Guide** for instructions on exporting findings, restoring workflow, and creating reports.

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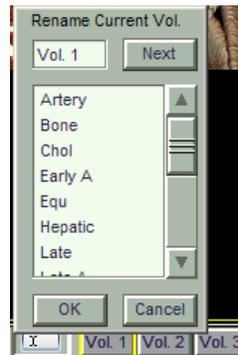
# Additional Procedures

## Switching Active Volumes

With multiple volumes loaded, switch the selected volume by using the Volume Navigation buttons at the bottom of the Viewer window.



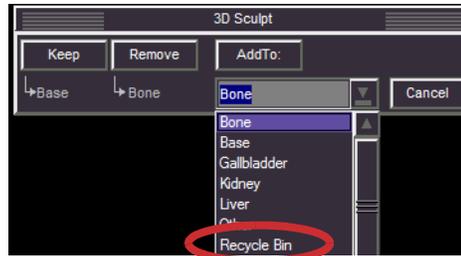
- To change the label on the button for the currently selected button, click  and select a name or type a new one.



## Manual Sculpt

Remove larger fragments or other regions by manually sculpting them from the view.

1. In the Segment Anatomy area, click  .
2. If necessary, rotate the 3D view to isolate the area to discard from the rest of the view.
3. In the 3D view, draw around areas to discard.
4. Click the dropdown and select **Recycle Bin**.



Your selection is automatically added to the Anatomy area.

## Segment a Device

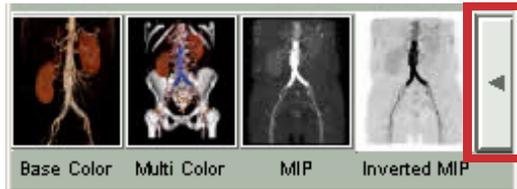
Segment a stent or other implant.

1. In the Segment Anatomy area, click **Bone**.
2. Click on the device.
3. Adjust the selection area as necessary.
4. Click in the dropdown and highlight the text and rename the text to **Implant**.
5. Click **Add To:**.

## Fly Through the Aorta

Use the fly through feature in Vitrea to navigate through passageways in the anatomy such as aorta or carotid.

1. From the Analysis tab, select the Preset Selector dropdown.



2. Select **Flythrough Contrast** from the Preset Selector dialog box.

3. Right-click and select .

4. In the coronal or sagittal view, click on the top of the aorta.

5. In the 3D image, roll the mouse wheel toward you to fly forward (or right-click and drag down).

Roll the mouse wheel away from you to fly backward (or right-click and drag up).

## Reposition the Volume

Reposition the volume so you are flying directly toward the passage you want to fly through.

To center the volume in the Fly Through mode without flying forward:

1. Position the cursor over the center of the volume view.
2. Click and drag toward the area that you want to center.

## Probe the Renal Arteries

Use the Vessel Probe feature to view the highlighted vessel in 3D, a curved reformat view of the vessel, and cross-sectional reformat views.

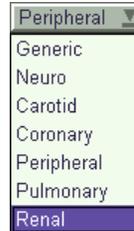
1. Click  in the lower-left of the 3D view.

**TIP:** If necessary, click and drag in the 3D view to rotate it for a better view of the vessel.

2. In the Vessel Probe area click .



3. Click the Vessel Type dropdown and select Renal.



4. Click the left renal artery in the 3D view.

**TIP:** When you click in a 3D view, press the mouse button down, pause a moment, then release.

5. Click .



6. Click the right renal artery in the 3D view to extend the vessel probe to include both left and right renal arteries.

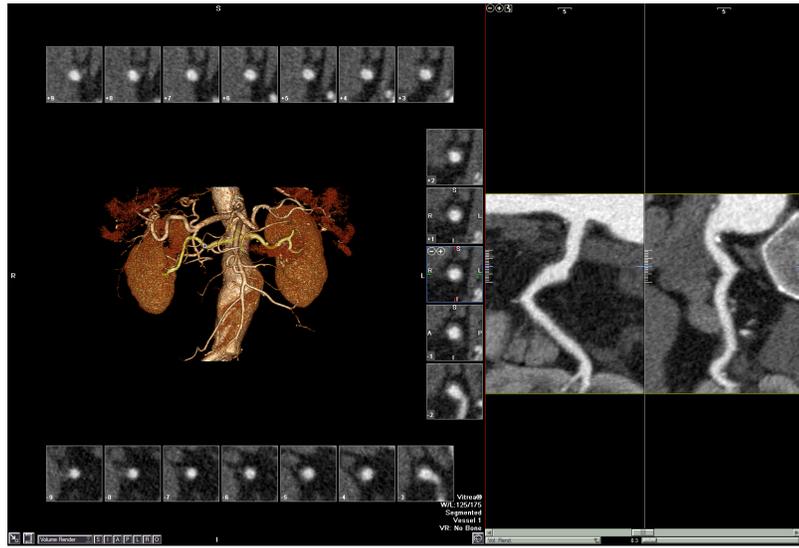
**TIP:** Vitrea shades the artery green and adds a listing in the Vessel Management area.



See the Additional Procedures section of this module for information on managing the vessel listings.

**TIP:** The Extend tool  remains active until another tool is selected.

**TIP:** Vitrea displays two Curved Planar Reformat (CPR) views and several cross-sectional views.



7. Click and drag the slider bar to the right of the CPR views to move along the vessels.
8. Click and drag the slider bar under the CPR views to rotate them.

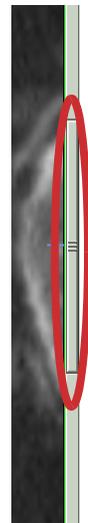


**TIP:** The blue line in the CPR view corresponds to the location of the blue dot in the green shaded vessel and the cross-sectional view with the blue border.

 See the Additional Procedures section of this module for information on working with the cross-sectional and CPR views.

9. Review the CPR views to verify Vitrea probed the entire vessel.
10. To extend the vessel, activate  , then click further along the already selected vessel.

**TIP:** Vessel Probe can only follow one branch of a bifurcated vessel. You must probe the branches separately.



- To hide the green vessel overlay, clear the Show check box for the vessel in the Vessel Management area.



## Define Curved Reformats

In Curved MPR mode, use one of the MPR views to define a curve to measure curved vessels in another MPR view. This is useful for pre-surgical renal artery measurements for stent planning and placement.

- Click  to switch to a 4-up view.
- Select the vessel listing in the Vessels Management area.

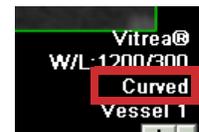


**TIP:** Do not select a lesion listing.

- In the lower-right corner of the axial view, click the dropdown arrow.
- Click .



**TIP:** The axial view is now labeled as the Reference view, the coronal view is now labeled as the Curved view, and the sagittal view is now labeled as the Transverse view.



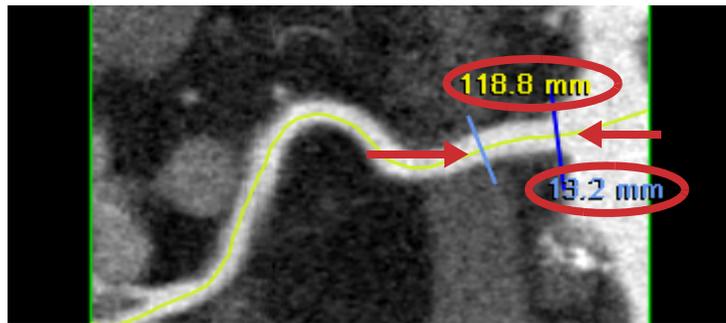
The curved centerline displays in the Curved view, and the measurement of the entire centerline displays in yellow.

- To zoom in on the view, left + middle click and drag down in the view.



6. In the Curved view (formerly the coronal view), drag the smaller, lighter blue line (Measuring line) to a point along the centerline you want to measure.
7. Drag the longer, darker blue line (Transverse line) to the other point along the centerline you want to measure.

**TIP:** The measurement between the two blue lines displays in blue and the measurement of the entire centerline displays in yellow.

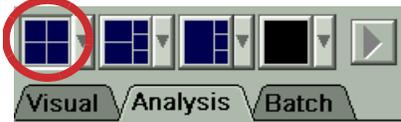


8. Right-click in the image, then click .

**TIP:** If the centerline and measuring lines disappear when you click the camera button, right-click in the view again and select Hide Crosshair Export, then click the view to take the snapshot.

## Define a Manual Curved Reformat

Define a curved centerline and perform curved measurements manually. This is useful if you do not wish to perform a Vessel Probe or you are not satisfied with the curved centerline Vitrea displays after Vessel Probe.

1. Click  to switch to a 4-up view. 
2. In the lower-left corner of the axial view, click .
3. In the lower-right corner of the axial view, click  twice until the icon shows .

4. Right-click and drag in the view until you see the left-most point of the left renal.
5. Click the endpoint of the green line on the right side of the viewer and drag it to inside the left kidney.
6. Follow the left renal artery by dragging the green line to various points along the center of the lumen.

**TIP:** A green X displays where you place the green line

**TIP:** Use the mouse wheel to scroll up and down in the view to follow the center of the artery.

7. Continue along the entire left renal artery, crossing the aorta, then along the right renal artery.
8. Click the endpoint of the green line on the left side of the viewer and drag it to inside the right kidney.
9. Click  in the lower left corner of the view.
10. In lower-left corner of the Curved view (formerly the coronal view), click .
11. Review the yellow centerline to verify it follows the centers of the arteries.
12. If necessary, click and drag to yellow centerline to reposition it.
13. Drag the smaller, lighter blue line (Measuring line) to a point along the centerline you want to measure.
14. Drag the longer, darker blue line (Transverse line) to the other point along the centerline you want to measure.

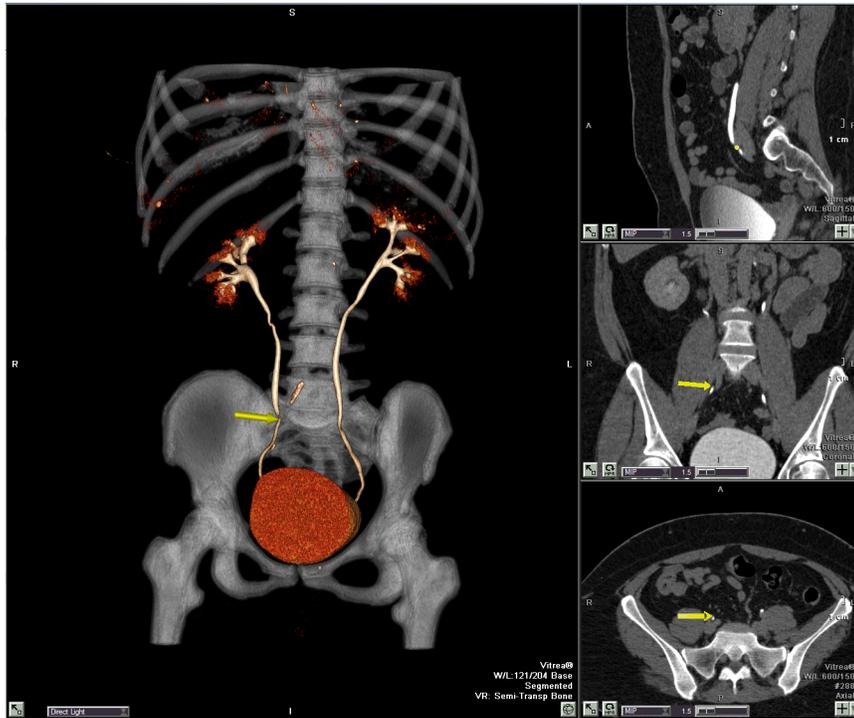
**TIP:** The measurement between the two blue lines displays in blue and the measurement of the entire centerline displays in yellow.

## CT Urography

1. From the Study Directory, select and load a study.
2. On the Gallery window, select the **Vascular: Aorta CT** protocol.
3. Double-click in the **3D Analysis** preset.
4. From the Segment Anatomy area, click Bone.
5. In the 3D view, click on the iliac crest or another bone.  
**OR**  
In the 2D view, click a portion of cortical (brightest white) bone.
6. Click **Less** or **More** as needed.
7. Adjust the HU slider bar to adjust the HU range as needed.
8. Right-click and select  then click and drag in the view to adjust the window/level.
9. Press T to activate **Trim** tool.
10. Drag the yellow lines in the MPR views to isolate the kidneys, ureters, and bladder.
11. To draw arrows to areas of interest, right-click and select  then click and drag in the image.
12. To display the semi-transparent bone, click **Semi-Transp Bone**.



13. Take snapshots or create a batch.



# Automated Vessel Measurements (AVM)

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- Automated Vessel Measurements Error Analysis

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# AVM Overview

Vitreia® Automated Vessel Measurements (AVM) is intended for the study/analysis of selected vessels for stenosis analysis, pre- and post-surgery stent planning and directional vessel tortuosity evaluation.

The Automated Vessel Measurements (AVM) option is designed to support activities such as pre-surgical diagnosis, evaluation and stent planning in the abdominal aorta, carotid arteries, coronary arteries, and renal arteries.

The AVM option quickly generates and measures a centerline curve through a contrast-enhanced vessel lumen of a CT series. This procedure is faster and easier than using the manual Curved MPR mode. Instead of plotting points along the full length of the lumen to center the curve, you plot just two points. The AVM option creates the curve and displays a list of related measurements.

## Minimum Lumen Size

The AVM option is intended for the study of CT images of contrast filled vessels between 3mm and 60 mm in diameter. It generates a set of measurements of the displayed vessel lumen:

- Length of the curve through the center
- Minimum and Maximum cross-sectional areas and diameters
- Maximum Tortuosity
- Tortuosity and
- Areas of all cross-sections



### CAUTIONS:

- **Contrast-enhanced CT images are required for Automated Vessel Measurements. Measurements are based on the contrast-enhanced lumen only.**

- **In the Vitrea Automated Vessel Measurements feature measurement accuracy can vary from the actual anatomical measurements in the patient's body.**

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# AVM Lesson

## I. Select Study

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Load an AVM study.

 See the instructions for your Vitrea type (VitreaAdvanced Through the Data Manager or VitreaWorkstation) in the **Select Study** chapter of the **VitreaAdvanced-VitreaWorkstation General Education and Reference Guide**.

## II. Choose Protocol and Preset

---

Use one of these procedures:

### Data Manager

- Double-click the **Aorta** application thumbnail.



### Gallery Window

1. On the Gallery window, select the **Vascular: Aorta CT** protocol.

The Gallery choices update automatically.

2. Click  next to the **3D Analysis** preset.

### III. Perform Analysis

---

#### Plot Proximal and Distal Point in the Aorta

1. Press T to activate the **Trim** tool, then trim in the MPR views.

**TIP:** Trim data to areas of interest to speed processing.

2. Click  in the bottom-left corner of the coronal image.
3. From the coronal view, scroll until you locate the area of the aorta you want to analyze.

4. Click .



5. To make the first plot point, click and drag across the vessel and plot a point above the area of interest.
6. Click and drag across the vessel and plot a point below the area of interest.

7. Click .

**NOTE:** Vitrea takes a few moments to calculate the measurements between the first and last points you plotted.



**CAUTION:** Click-and-drag to scroll through the MPR images to confirm the minimum (MinD) and maximum diameter (MaxD) measurements are displayed correctly in the Volume view.

8. If necessary, edit the centerline.

 See the Additional Procedures section for additional information on editing the centerline.

## Stent Planning

9. In the Curved view, click  to maximize the image.
10. Click in the image and drag the mouse to rotate the curved view around the center line. Rotate the image to locate a position just below the lowest renal artery location. Drag the pink line to this location.
11. Click and drag the pink and red lines to separate.

The pink number is the distance between the lines.

## Take Snapshots

12. Right-click and select  (or press S) to activate the camera.
13. Move the cursor to the image and click.

Snapshots, measurements, rulers, W/L, or segmentation option can be restored from the Report page or the Study Directory.

## IV. Distribute Findings

---

The snapshots you save in the Viewer window are saved to the Report window.

1. Click  at the bottom of the window.
2. Export your findings or create a report.



See the **Distribute Findings** chapter of the **VitreAdvanced-VitreWorkstation General Education and Reference Guide** for instructions on exporting findings, restoring workflow, and creating reports.

---

# Additional Procedures

## Edit Lumen Cross Sections

1. In the MPR view that shows each AVM measurement, right-click and drag to scroll to the image where you see a contour you want to change.
2. Press F to activate the **ROI** tool.
3. Position the cursor over the contour.

A pencil cursor displays. You may need to wait until the Volume view is rendered before editing.

4. Click and drag the contour to the desired position.

The diameters recalculate and the new measurements display.

## Edit the Centerline

1. Select the Edit Center Line check box.
2. In the MPR view that transverses the curve, adjust the curve manually.
3. Right-click and drag to scroll to the MPR view showing a blue square (or press the Page Up or Page Down keys).
4. In the reference view, notice where the intersecting crosshair displays.
5. If the crosshair intersects the centerline at a crooked or invalid point, click and drag the blue square to a different position.
6. If necessary, scroll through the MPR view to change the position of the blue square in multiple slices.

**NOTE:** When in curved MPR mode, press the Page Up or Page Down keys, the transverse view scrolls to the next or previous control point. This helps you to change existing point positions rather than adding points to the centerline. Shift + Page Down helps you view every contour.

---

## 3D Imaging Measurements

Measurement	Description
Len (yellow)	Length between the two points along the centerline. Represented by the yellow line on the 3D image.
MinA (red)	The minimum area along the path that was evaluated. Represented by small red disc on the 3D image.
MaxA (green)	The maximum area along the path. Represented by the large, green disk in the 3D image.
MinD (red)	The minimum diameter found along the path. Represented by the small, red disk in the 3D image. It is found on the image demonstrating the minimum cross-sectional area.
MaxD (green)	The greatest diameter length along the path. Represented by the large, green disk in the 3D image. It is on the image demonstrating the maximum cross-sectional area.
Sten (yellow)	Percentage that the diameter of a vessel lumen narrows from the MaxA to the MinA.
MaxT (red)	The maximum degree of tortuosity along the path being evaluated. Represented by the red "sleeve" on the yellow centerline on the 3D image.
Area (blue)	Area of cross-section (displayed on an MPR view) that intersects the centered curve.
Tort (blue)	Tortuosity - a measurement of how sharply the lumen curves at a point where the centered intersects a cross-section.

---

# Appendix

## Automated Vessel Measurements Error Analysis

The information listed in the following table is based on error analysis. The analysis compared known vessel measurements in a scanned phantom with those created in Vitrea using AVM. For tortuosity measurements, actual displayed values in degrees may be higher than 180. This is not a discrepancy in the measuring capability but rather a result of reducing the rate to degrees/1 centimeter.



**CAUTION: The accuracy of measurements may be less than those listed in tables, if you have plotted the points of the centerline curve incorrectly.**

Measurement Calculation	Measurement Range	Measurement Error in Vitrea
Minimum and maximum diameters	3 mm to 60 mm or > 5 pixels (see Example following this table)	< 10%
Area of a lumen cross-section	Approximately 9 mm <sup>2</sup> to 360 mm <sup>2</sup>	< 10%
Stenosis — Percentage of stenosis  This is calculated as: Stenosis = $\frac{(\mathbf{vMaxA} - \mathbf{vMinA})}{(\mathbf{vMaxA})} \times 100$	0 to 100%	< 10%
Length along the centerline curve	Not limited	< 5%
Tortuosity — measured as degrees/cm	0 to 180 degrees for the numerator  • Length for the denominator is not limited; normalized to 1 centimeter	For measurements in degrees:  • Less than 2 degrees: < 10% • More than 10 degrees: < 5%  For length measurements:  • Less than 2 mm: < 10% • 2 mm to 10 mm: < 5% • More than 10 mm: < 2%

**NOTE:** In this table, length measurements refer to distances in the patient's body, not on the computer screen. Do not measure distances by holding a standard ruler to the monitor because discrepancies occur.

# CT Endovascular Stent Planning (EVSP)

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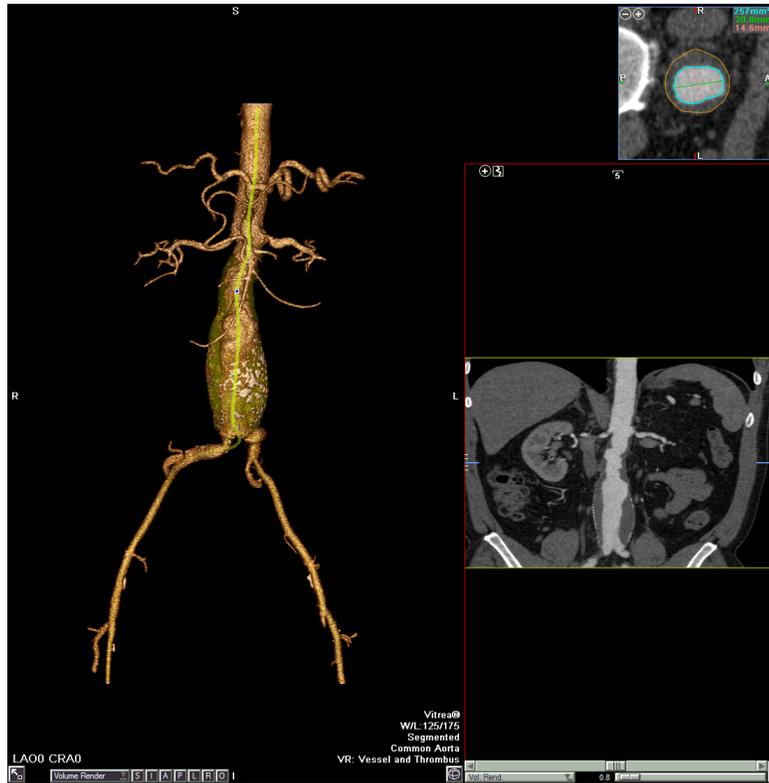
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# CT EVSP Overview

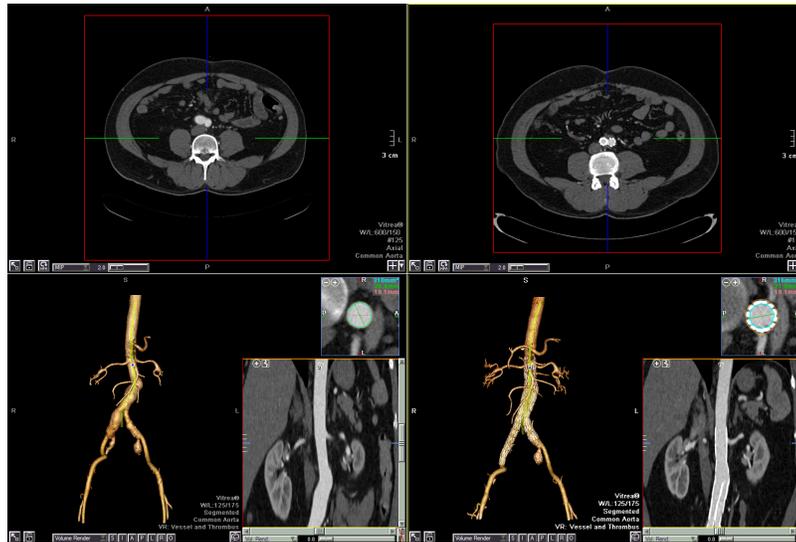
The CT Endovascular Stent Planning (EVSP) application enables visualization and measurements of the aortic vessel for evaluation, treatment, and follow-up for aortic vascular disorders that may require a stent procedure. The software performs automated 3D segmentation of the aorta and initializes stent measurements based on a template provided by the stent manufacturers. Physicians can review the 2D and 3D images, verify and correct the results of the segmentation and initialization, and generate a report with the stent measurements.

**NOTE:** Because of the high HU value of contrast media in 100kV scans, the reliability of calcium detection within the vessel lumen is expected to be lower than that of regular kV scans.

### AAA with Thrombus



## Original to Follow-up AAA Stent



## TAA with Thrombus



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# CT EVSP Lesson

## I. Select Study

---

Load an Aorta Stent study.

 See the instructions for your Vitrea type (VitreaAdvanced Through the Data Manager or VitreaWorkstation) in the **Select Study** chapter of the **VitreaAdvanced-VitreaWorkstation General Education and Reference Guide**.

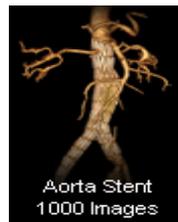
## II. Choose Protocol and Preset

---

Use one of these procedures:

### Data Manager

- Double-click the **Aorta Stent** application thumbnail.



### Gallery Window

1. On the Gallery window, select the **Vascular: Aorta Stent CT** protocol. The Gallery choices update automatically.

**NOTE:** Automatic segmentation of the aorta and iliacs takes place after you select the Vascular: Aorta Stent CT protocol.

2. Click  next to the **3D Planning** preset.

**TIP:** Pick the 3D Analysis preset if you only want to view/monitor the vessels or aneurysm and are not going to do stent planning.

3. Continue with the appropriate Perform Analysis section: Stent Planning or Fenestrated Stent Planning

## III. Perform Analysis - Stent Planning

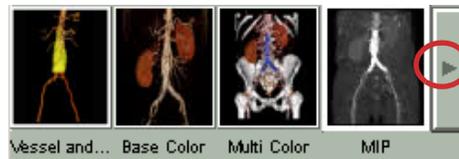
---

### Assess the Aneurysm in 3D/MPR Viewing

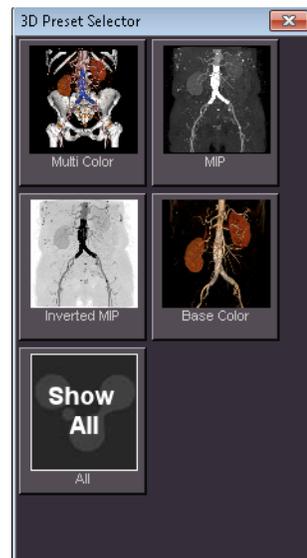
1. Review the anatomy in the following views:
  - MPR view
  - Orthogonal view
  - 3D view
2. Select the Expand icon to display the entire Analysis tab.



3. Select the dropdown to display the additional visualization options.



 See the Additional Procedures section for additional information on the Preset Selector settings.



### Review and Edit the Vessel Centerline



**CAUTION:** Review the automated vessel segmentation, centerline, and contour results and edit as necessary.

4. Press the SPACEBAR to verify the three (aorta and two iliacs) centerlines for possible editing.
5. To edit the centerline in the CPR view, right-click on any inset view and select **Edit Centerline**.



The cursor changes to a pen.

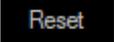
**OR**

Click  from the Vessel Probe area to edit the centerline in the Curved MPR view.

6. To zoom the CPR view, click  at the top of the CPR view.
7. Assess the centerline to verify accuracy.
8. Move the cursor (pen) to a specific point along the centerline and click to plot a point to modify the path of the vessel centerline.

**TIP:** As you plot points, a new red line displays to show you how the centerline displays if you click . This line also displays in the 3D view.

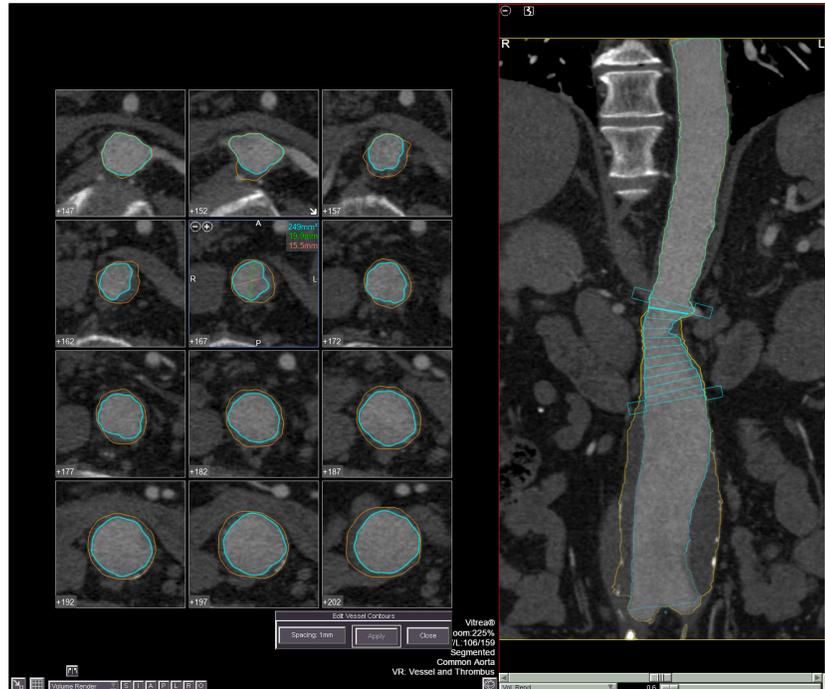


9. If necessary, move the cursor (pen) to a different point along the centerline and click to plot a point. Continue to plot all additional points. As you plot additional points, the line updates to go through all the user control points.
10. Click and drag the line and it dynamically shows the resulting line as you drag. The point displays after you release the mouse.
11. Rotate, zoom, and scroll the curved view while the line is being created.
12. To move a plotted point, hover until the cursor changes to a hand and drag.
13. If necessary, click  to clear the red centerline and start over.
14. Click  to apply the modified (red) centerline to be the final centerline.

## Review and Edit Contours

15. Press the SPACEBAR to toggle to the desired vessel.
16. Right-click on any inset view and select **Edit Contours** to open the contour editing view with several cross-sectional views.





The curved image displays in a straightened view next to the graph of the lumen and wall. A grid on the straightened view represents locations of the corresponding cross-sections along the curved view.

- Click and drag the grid to move it vertically.
- Page Up and Page Down keys to set the last displayed cross-section to the first.

- Use the arrow keys to cine the cross-sectional images by 1 mm each.



17. Click and drag to set the proximal end of the grid at the first inaccurate contour you want to edit.
18. Click and drag to set the distal end of the grid at the last inaccurate contour you want to edit.
19. Edit the first level of contours.

20. Click  to perform an interpolation between all edited slices to form a smooth region.

**TIP:** The Apply button will have an orange border after two or more contours have been edited. The orange border identifies that interpolation can be applied.

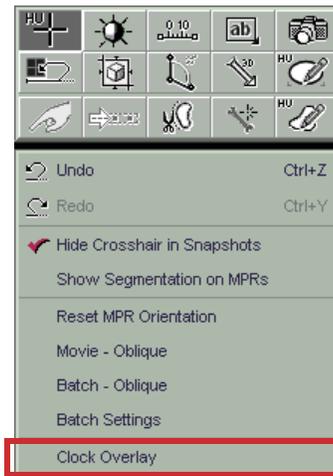
21. Start at the top of the anatomy and use **Page Up** and **Page Down** to review the anatomy.

**TIP:** You may also edit from the 1mm Review mode.

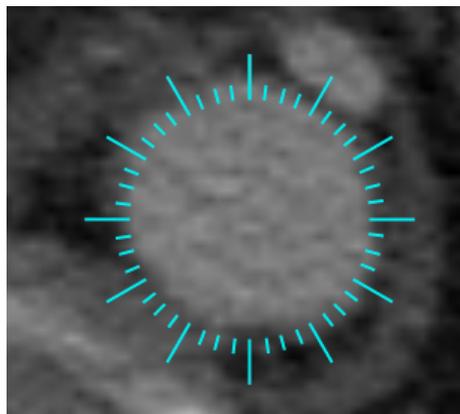
22. Return to the Original view.

## Display Clock Overlay

23. Right-click in an MPR view and select **Clock Overlay**.



24. Zoom and pan the image to fit the overlay.



25. To hide the clock overlay, right-click and select **Clock Overlay** again.

## View the C-arm Angles



When you are in oblique crosshair mode, the C-arm angles display. The view displays the 3D and oblique MPR views relative to the valve plane. The clinical values display in the lower right corner of the view.

**TIP:** You also have the option to rotate the 3D view. The C-arm angles display in the lower left corner of the 3D view.

**NOTE:** The first value indicates Right Anterior Oblique or Left Anterior Oblique. The second value indicates Cranial or Caudal.

## Review and Verify Measurements

Review and verify the measurements along the vessels to plan stent placement.

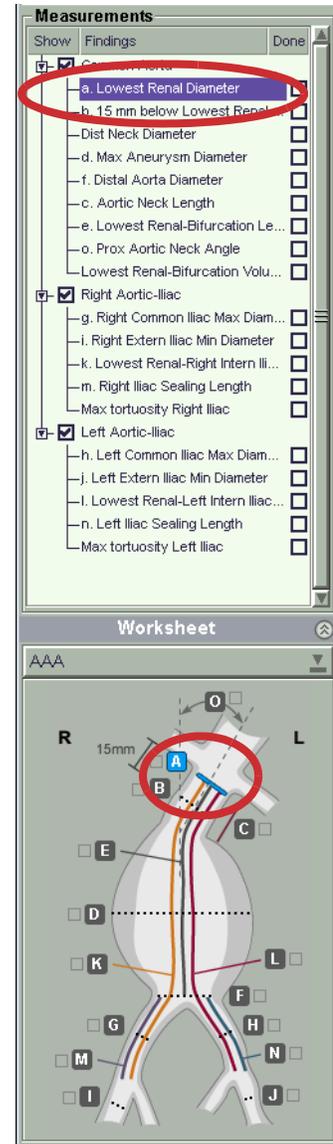


**CAUTION:** Review every measurement for accuracy to prevent incorrect diagnosis or planning. The CT Endovascular Stent Planning application requires contrast enhanced CT images for measurements.

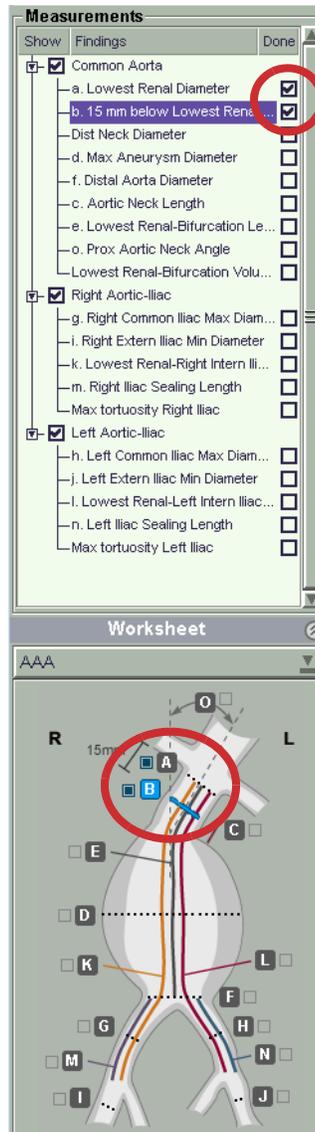
**26.** Select the first measurement listed in the Measurements list and review the diameter. Make any necessary adjustments to the measurements.

**TIP:** The schematic worksheet below the measurements provides a visual of the measurements location along the vessel. The measurement is highlighted in blue on the worksheet. Work from the Measurements list or the worksheet.

 See the Additional Procedures section for information on how to rename vessels and measurements.



**27.** When you finish reviewing the measurement, select the **Done** check box next to the name of the measurement or click the box in the schematic worksheet.



**28.** Press the SPACEBAR to move to the next measurement. Continue this process to review all measurements.

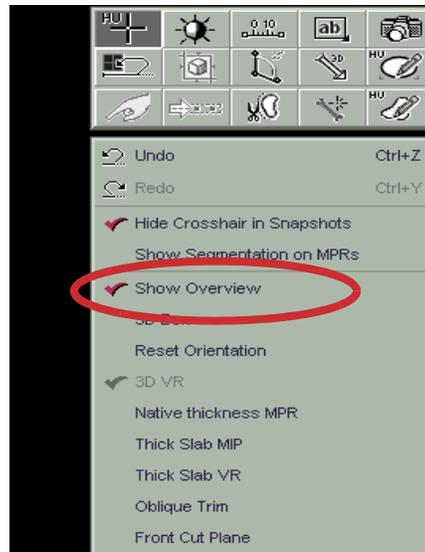
**TIP:** If there are measurements you do not want to display in the report, do not select **Done**.

**29.** To mark or clear all measurements, right-click in the Measurements box and select **Mark All Reviewed** or **Unmark All Reviewed**.

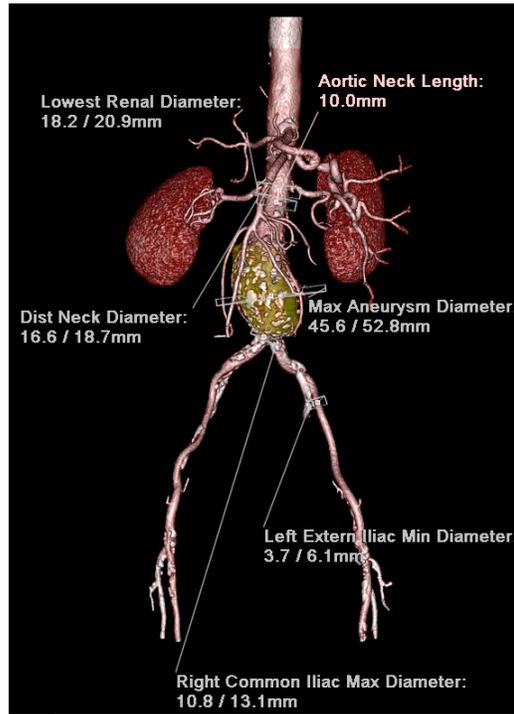
**NOTE:** Once the **Done** box is selected, the measurements are locked and cannot be moved.

**30.** In the lower left corner of the 3D image, click  to maximize the 3D image.

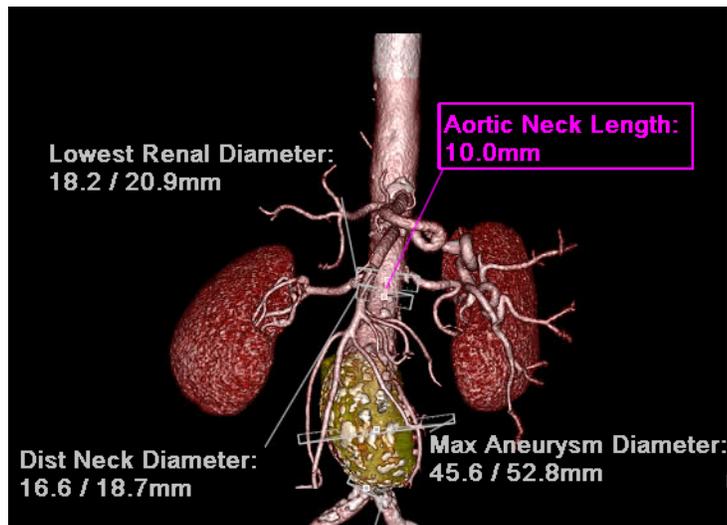
**31.** Right-click in a 3D view and select **Show Overview** to view all of the diameter measurements from the worklist.



**NOTE:** Only the measurements selected as **Done** will display when you select **Show Overview**.



**32.** Click the name of the measurement to highlight and drag the name to a different location. The name changes color when you click on it.



**33.** To delete measurements, right-click on a highlighted measurement and select **Delete** or **Delete All**.

## Take Snapshots

34. Right-click and select  (or press S) to activate the camera.

35. Move the cursor to the image and click.

Snapshots, measurements, rulers, W/L, or segmentation option can be restored from the Report page or the Study Directory.

## III. Perform Analysis - Fenestrated Stent Planning

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1. From the worksheet template dropdown, select **AAA Fenestrated**,



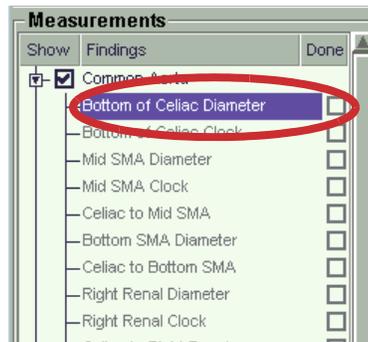
**TIP:** To display the Fenestrated Stent Planning layout, click  in the Axial view, then click the mode button  until the Cath view displays.

**OR**

Select the **Gallery** tab and pick **Fenestrated Stent Planning**.

**NOTE:** The Fenestrated Stent Planning workflow does not include a schematic worksheet.

2. Select a listing in the Measurements box.



## Apply a Diameter Measurement

3. Select a diameter measurement in the Measurements list.

**OR**

Click  .

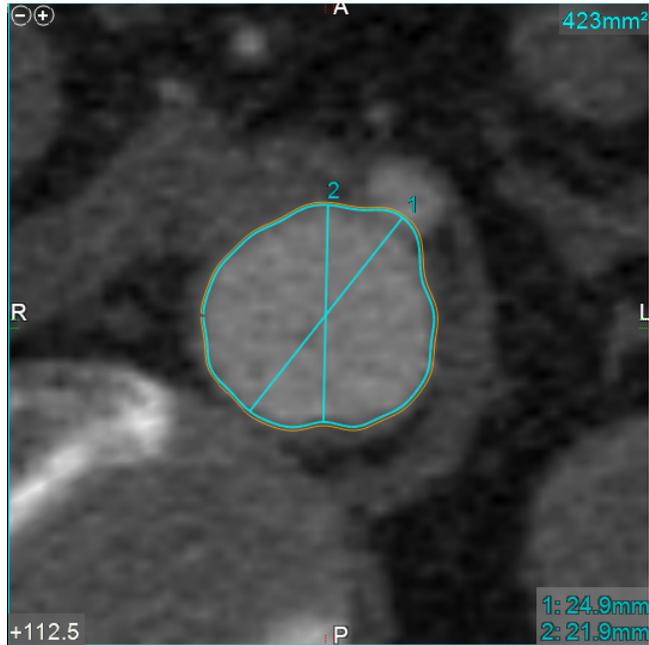
4. Scroll to the appropriate location in one of the following ways:
  - Roll the mouse wheel, or right-click and drag, in the inset view

**OR**

  - Drag the blue line in the CPR view

The inset view displays the maximum and minimum diameters.

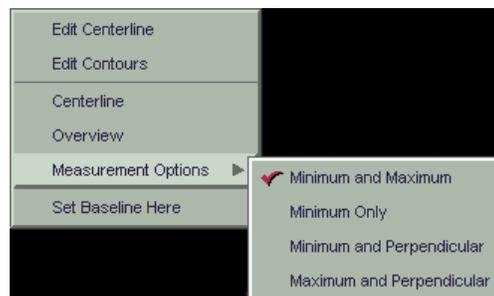
5. To accept the displayed maximum and minimum diameters, click in the inset view.



**OR**

Drag in the inset view to draw a ruler.

**TIP:** To set the measurement options, right-click in the inset view, select **Measurement Options**, then select an option.



6. Select **Done** next to the listing.
7. Press the SPACEBAR to move to the next listing.

### **Apply a Clock Angle Measurement**

8. Scroll to the appropriate location in the Axial, axial inset, or transverse view.

9. Select a clock measurement in the Measurement list.

**OR**

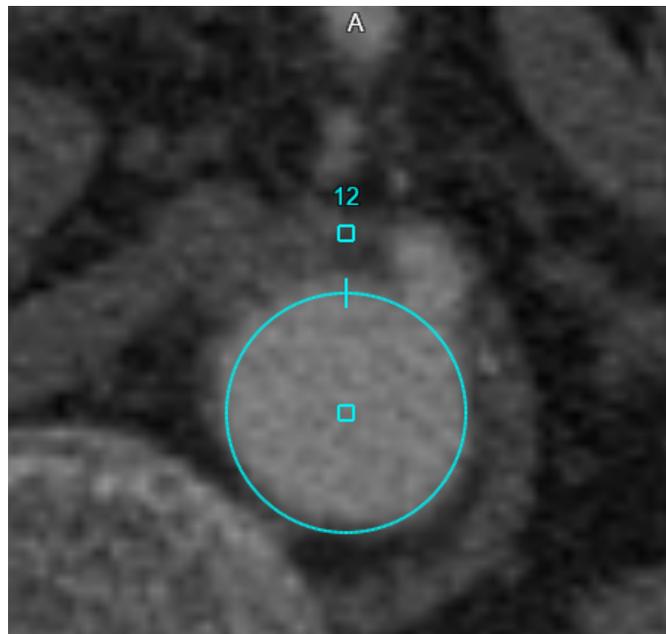
Click .

**NOTE:** If the image is more than 45 degrees from true axial, the clock will not display and a message will display in the status area.

**TIP:** As an alternate to the clock tool, you can display the clock overlay as described on page 43.

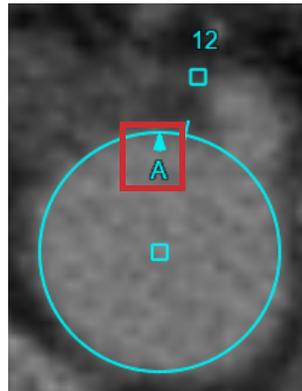
10. If you are using the Axial view, zoom in on the view so the aorta is about the same size as the clock.

11. Click in the center of the aorta in the Axial view to place the clock.  
The 12:00 position is aligned with the anterior position of the image.



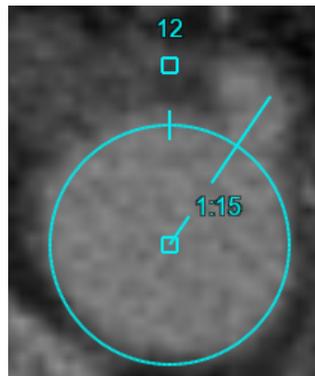
12. If necessary, drag the square in the center to move the clock.
13. Optionally, to align the 12:00 position to somewhere other than the anterior position of the image (for example, the opposite of spine), drag the square at the 12:00 position to a new location.

**TIP:** When the 12:00 position is moved off the anterior location, a small A and arrow will display to indicate the anterior direction.



**14.** Drag the edge of the clock to adjust the size of the circle.

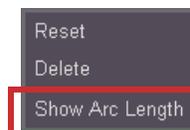
**15.** Move the  cursor to the point of the takeoff artery and click to place the clock hand.



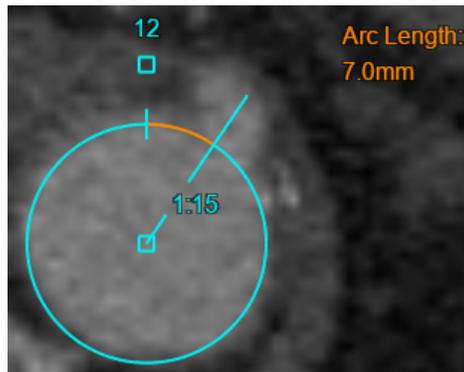
The hour and minutes display, in increments of 15 minutes.

**16.** Click and drag the hand to adjust the placement if necessary.

**17.** To apply an arc length, right-click and select **Add Arc Length**.



The measurement from the noon position to the clock hand, in mm, displays.



**NOTE:** For optimal arc length measurement, be sure the clock tool is sized to fit the size of the aorta.

18. Select **Done** next to the listing.
19. Press the SPACEBAR to move to the next listing.

### Apply a Length Measurement

20. Select a length measurement in the Measurement area.

**OR**

Click .

21. In the CPR view, roll the mouse wheel to move the blue line to the appropriate location to verify the correct location in the inset and Axial views.

**OR**

Drag the blue line to the appropriate location.

**TIP:** Drag the scroll bar at the bottom of the CPR view to rotate to better visualize the vessels.

22. Click in the CPR at the beginning of the measurement, and drag to the end of the measurement.

**TIP:** Drag either end-line of the measurement to adjust the placement if necessary.

**23.** Select **Done** next to the listing.

**24.** Press the SPACEBAR to move to the next listing. Continue this process to complete all necessary measurements.

## Take Snapshots

**25.** Right-click and select  (or press S) to activate the camera.

**26.** Move the cursor to the image and click.

Snapshots, measurements, rulers, W/L, or segmentation option can be restored from the Report page or the Study Directory.

## IV. Distribute Findings

---

The snapshots you save in the Viewer window are saved to the Report window.

**1.** Select  at the bottom of the window.

The Aorta Endovascular Stent Planning worksheet template displays by default.

**NOTE:** All measurements selected as **Done** populate on the report.

**2.** Export your findings or create a report.

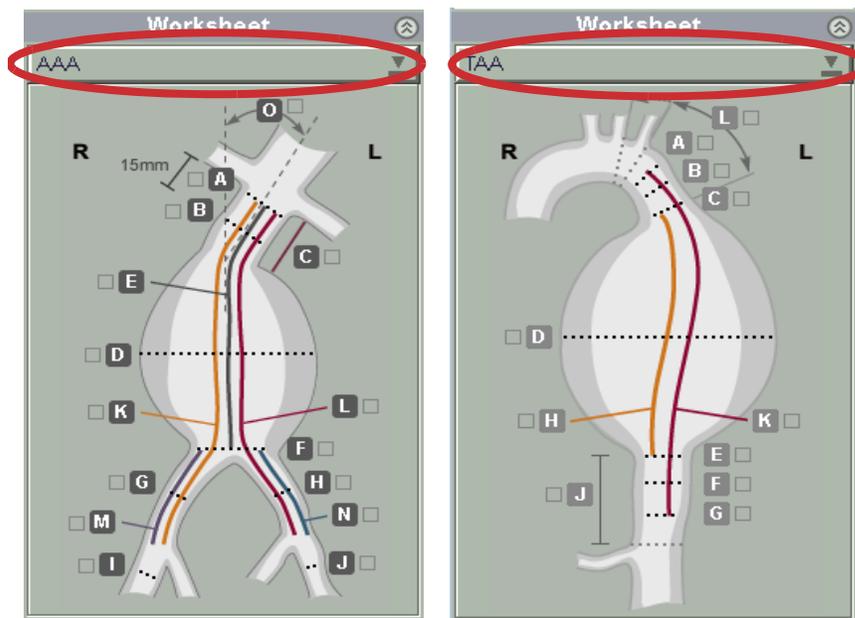
 See the **Distribute Findings** chapter of the **VitreiaAdvanced-VitreiaWorkstation General Education and Reference Guide** for instructions on exporting findings, restoring workflow, and creating reports.

# Additional Procedures

## Change Templates

The Worksheet contains a dropdown list with generic templates and several manufacturer templates.

1. From the Worksheet section, select the dropdown box.



2. Select a template:

Template	Description
AAA	This is the default Abdominal Aortic Aneurysm template. Select this option for generic abdominal cases if the stent is unknown.
AAA Fenestrated	Select this option for fenestrated stents.
TAA	This is the default Thoracic Aortic Aneurysm template. Select this option for generic thoracic cases if the stent is unknown.

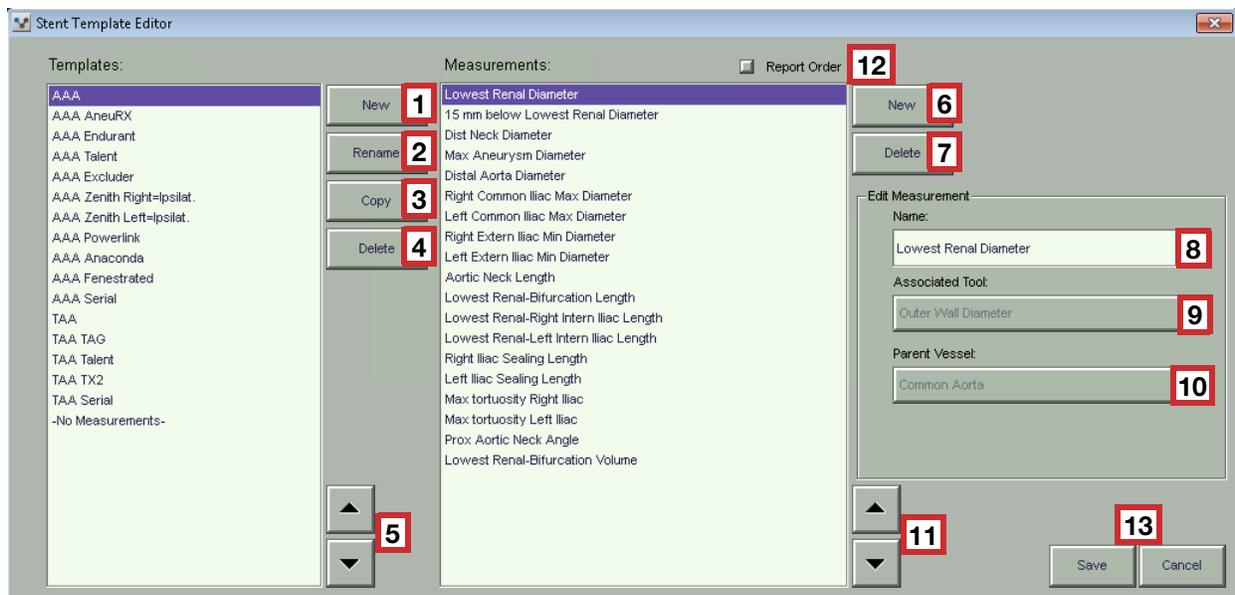
Template	Description
Manufacturer Templates (For example, AAA AneuRx, TAA TAG)	If you have a known stent, select the name from the list.
No Measurements	This option gives you vessels only. Draw your own measurements.

## Edit Stent Templates

Use the Stent Template Editor to create, delete, or modify stent templates.

1. Right-click in the Measurements area and select **Edit Measurement Lists**.

The Stent Template Editor Displays



Task	Workflow
Add a new template	<ol style="list-style-type: none"> <li>1. Click <b>New</b> [1].</li> <li>2. Click <b>Rename</b> [2], then enter a name for the template.</li> <li>3. Add new measurements [6] as described below.</li> </ol>
Rename a template	<ol style="list-style-type: none"> <li>1. Select a template.</li> <li>2. Click <b>Rename</b> [2], then enter a name for the template.</li> </ol>

<b>Task</b>	<b>Workflow</b>
Copy a template (create a new template while preserving the original)	<ol style="list-style-type: none"> <li>1. Select a template.</li> <li>2. Click <b>Copy</b> [3].</li> <li>3. Click <b>Rename</b> [2], then enter a name for the template.</li> <li>4. Add, remove, or edit measurements as described below, if desired.</li> </ol>
Delete a template	<ol style="list-style-type: none"> <li>1. Select a template</li> <li>2. Click <b>Delete</b> [4].</li> </ol>
Rearrange the order of the templates in the list	<ol style="list-style-type: none"> <li>1. Select a template</li> <li>2. Click the Up or Down arrow [5] to move the name in the list.</li> </ol>
Add a new measurement	<ol style="list-style-type: none"> <li>1. Click <b>New</b> [6].</li> <li>2. Edit measurement [8], [9], and [10] as described below.</li> </ol>
Delete a measurement	<ol style="list-style-type: none"> <li>1. Select a measurement.</li> <li>2. Click <b>Delete</b> [7].</li> </ol>
Rename a measurement	<ol style="list-style-type: none"> <li>1. Select a measurement.</li> <li>2. Type the name [8].</li> </ol>
Associate a tool with a new measurement	<ol style="list-style-type: none"> <li>1. Select the new measurement.</li> <li>2. Click the Associated Tool dropdown [9], and select the tool that will be the default when the measurement is used.</li> </ol> <p><b>NOTE:</b> The associated tool for a default measurement cannot be changed.</p>
Assign the parent vessel to a new measurement	<ol style="list-style-type: none"> <li>1. Select the new measurement.</li> <li>2. Click the Parent Vessel dropdown [10] and select the vessel where the measurement is applied.</li> </ol> <p><b>NOTE:</b> The parent vessel for a default measurement cannot be changed.</p>
Rearrange the order of the measurements in the list	<ol style="list-style-type: none"> <li>1. Select a measurement.</li> <li>2. Click the Up or Down arrow [11] to move the name in the list.</li> </ol>

Task	Workflow
Rearrange the order of the measurements in the report	<ol style="list-style-type: none"> <li>1. Select the <b>Report Order</b> check box [12].</li> <li>2. Click the Up or Down arrow [11] to move the name in the list.</li> </ol>
Save or cancel your changes	<ol style="list-style-type: none"> <li>1. Press <b>Save</b> or <b>Cancel</b> [13].</li> </ol>

**NOTE:** For existing templates with automated measurements associated, the Associated Tool and Parent Vessel will not be available for editing for already defined measurement names that represent automated measurements.

## Manual Workflow for Stent Planning

This section includes a manual workflow for stent planning using the orthogonal MPR planes without centerlines.

Use the manual workflow if automation fails due to unusual anatomy or lack of contrast, or if you prefer to make measurements on orthogonal planes.

**NOTE:** Delete any automated measurements and centerlines and then select the appropriate template.

**TIP:** Delete All is located in the right-click menu.

1. Select the 4-up view. 
2. Click  to draw measurements.

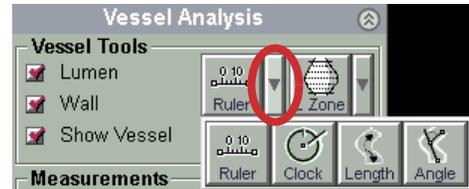
- Identify the measurement using the right-click menu or measurements menu:

Right-Click Menu	Measurements Menu
<ol style="list-style-type: none"> <li>Create the measurement in an orthogonal MPR view.</li> <li>Right-click on the measurement and name the measurement.           <div data-bbox="363 537 662 1276" data-label="Image"> </div> </li> <li>To add a custom ruler or angle to the measurement list, select <b>Add Ruler to Measurement List</b> or <b>Add Angle to Measurement List</b> and enter a name.</li> <li>Scroll to the location of the next measurement and continue this process for all measurements.</li> </ol>	<ol style="list-style-type: none"> <li>Select a listing in the Measurements box.</li> <li>Use the ruler to define the diameter in the axial or other MPR view. Make any necessary adjustments to the measurements.           <p><b>NOTE:</b> The Ruler tool is automatically selected when you select a measurement in the Measurements box.</p> <p><b>TIP:</b> The schematic worksheet below the measurements provides a visual of the measurements location along the vessel. The measurement is highlighted in blue on the worksheet. Work from the Measurements list or the worksheet.</p> </li> <li>Press the SPACEBAR to move to the next measurement. Continue this process to define all measurements.</li> </ol>

## Add Manual Measurements

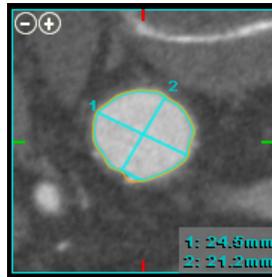
Use the following methods to create additional measurements.

1. From the Ruler dropdown, select a measurement method.

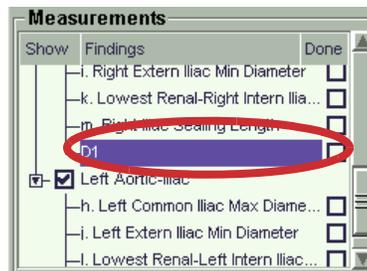


## Measure Diameters

- a. Select .
- b. Draw the ruler measurements.



The new diameter measurement displays in the Measurements box on the Analysis tab.



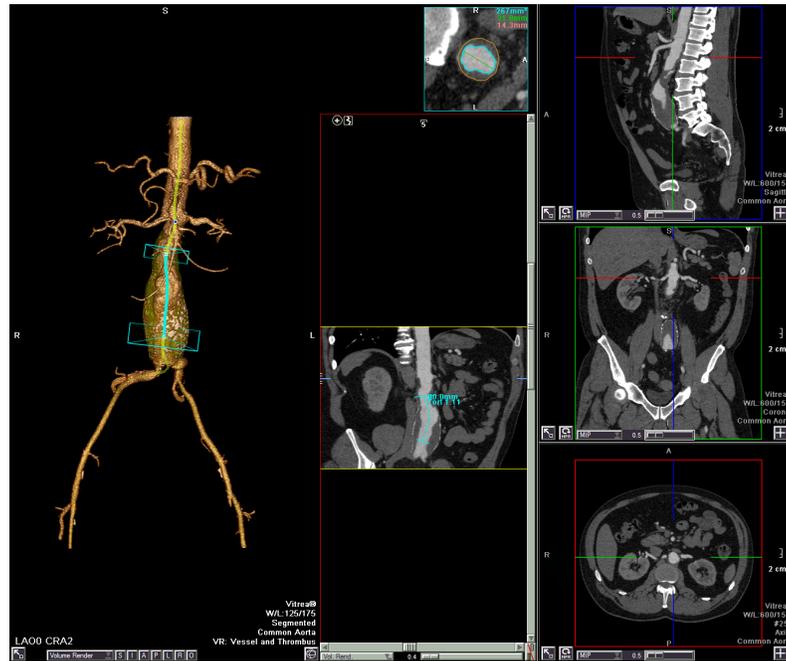
## Place a Clock Angle

- a. Select .
- b. Follow the instructions starting on page 51 to apply a clock angle measurement.

## Measure Centerline Length

- a. Select .
- b. Click  to change the volume view to a 1-up image and display a vessel probe view.
- c. Click and drag either end to edit the length.

The value of the length displays at the proximal end of the length measurement. It represents the length along the centerline between the two specified points.



## Create Centerline Angles

The Angle tool creates an angle.

- a. Select .
- b. Click  to change the volume view to a 1-up image and display a vessel probe view.
- c. In Curved CPR view, click and release at the start of the angle.
- d. Move the cursor to the vertex location on the centerline and click and release.

- e. Move the cursor to the end point of the angle and click and release to complete the angle.



## TAA Workflow

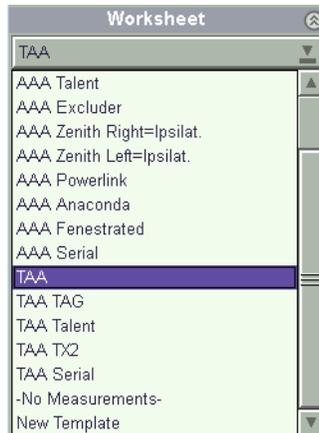
Define measurements on the aneurysm to plan stent placement.



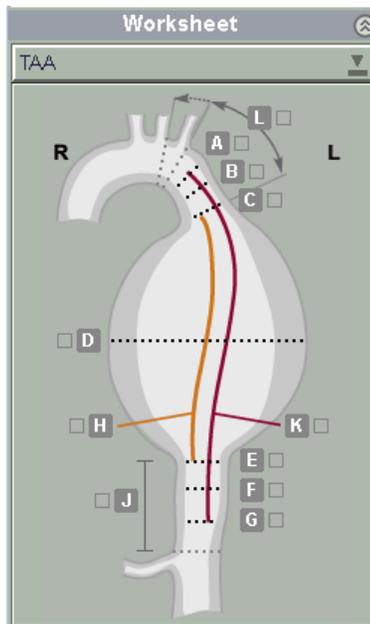
**CAUTION: Review every measurement for accuracy to prevent incorrect diagnosis or planning. The Endovascular application requires contrast enhanced CT images for measurements.**

1. In the lower left corner of the 3D image, click  to maximize the 3D image.

2. Select the appropriate template from the Worksheet dropdown list.



The TAA Measurements table and schematic display.



3. Define measurements by using the right-click menu, or the Measurements menu. Use one of the procedures in the table below to define measurements.

## Right-Click Menu

- a. Rotate the CPR view to view vessels of interest.
- b. Select  in the CPR view to display the Straightened Vessel view.

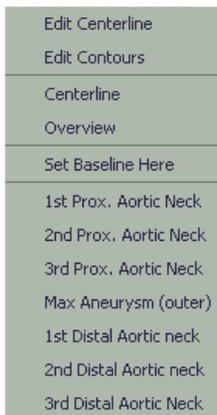
- c. Select the Ruler.



- d. Click in the transverse view to define the measurement.

**TIP:** D1 displays in the Measurements box. A blue box displays around the transverse view.

- e. Right-click in the view and name the measurement.



**TIP:** The D1 in the Measurements box automatically changes when you name the measurement.

- f. Scroll to the location of the next measurement and continue this process for all measurements.

**TIP:** The length measurement is automatically defined when two connecting diameter measurements are defined.

## Measurements Menu

- a. Rotate the CPR view to view vessels of interest.
- b. Select  in the CPR view to display the Straightened Vessel view.

- c. Select a grayed-out measurement in the Measurements box.

**NOTE:** The Ruler tool is automatically selected when you select a measurement in the Measurements box.

- d. Scroll through the transverse view to locate the measurement.
- e. Click in the transverse view to place the measurement.

**TIP:** You also have the option to click and drag to define the measurement.

**NOTE:** After you define the measurement, the measurement displays in bold in the Measurements box.

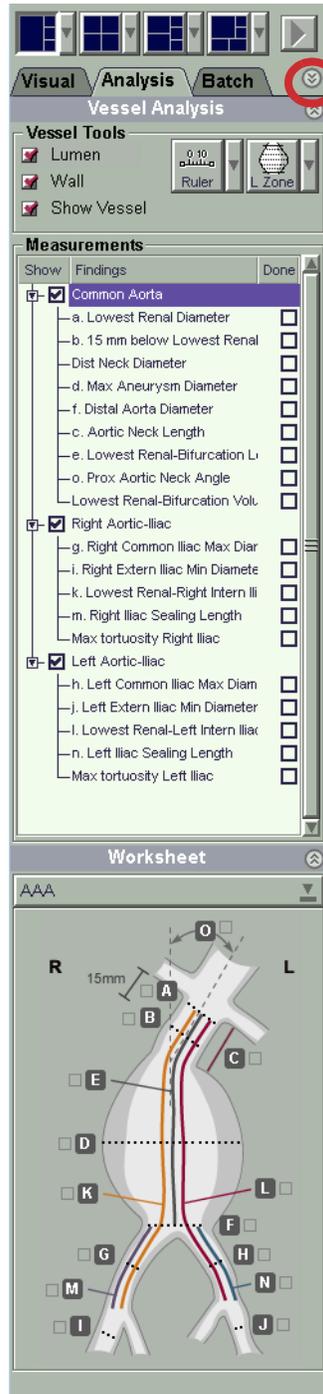
**TIP:** The schematic worksheet below the measurements provides a visual of the measurements location along the vessel. The measurement is highlighted in blue on the worksheet. Work from the Measurements list or the worksheet.

- f. Press the SPACEBAR to move to the next grayed-out measurement. Continue this process to define all measurements.

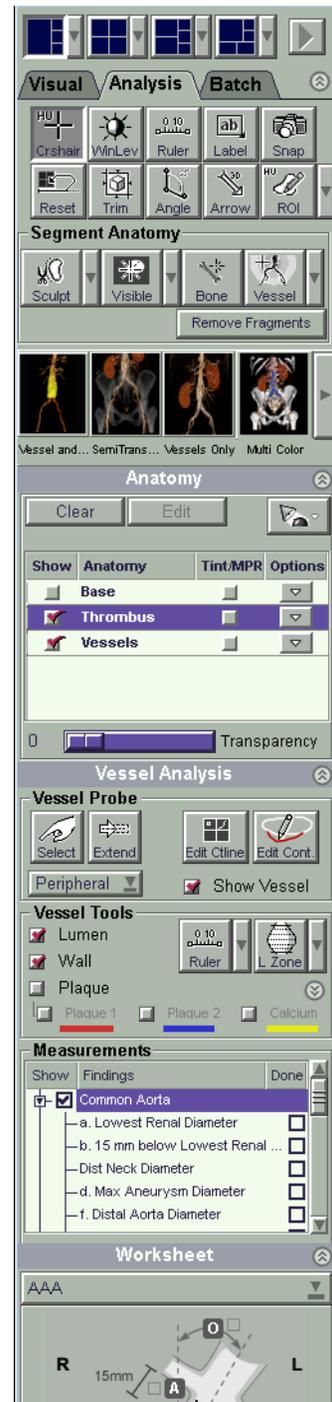
## Analysis Tab Tools

The Analysis Tab defaults to a minimized view to show tools necessary for Endovascular Stent Planning (Vessel Tools, Measurements, and the Worksheet).

Select the Expand icon to display all tools.

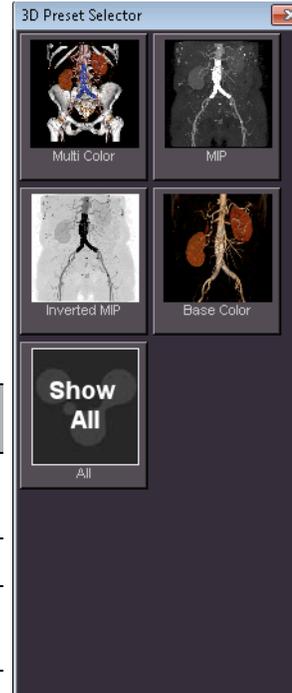
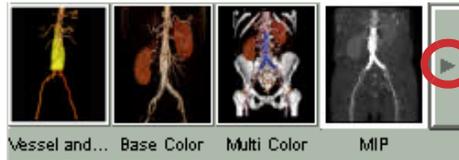


**Expand icon**



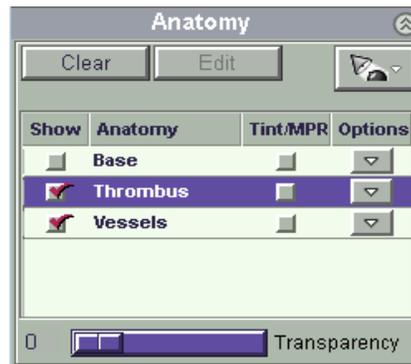
## Visualization Preset Settings

Select the Visualization Preset buttons dropdown. The options display in the Preset Selector dialog box. On the Vessels tab, choose from Visualization Preset buttons.



Visibility Option	Description
Vessel and Thrombus	Displays the vessel and the Thrombus.
Base Color	Displays the vessels.
Multi Color	Displays the base, vessels, and Thrombus.
MIP	Probed vessels are light. All other data is partially opaque on a dark background.
Inverted MIP	Probed vessels are dark. All other data is partially opaque on a white background.
SemiTransp Bone	Displays the semi-transparent bone.
Vessels Only	Displays the lumen segmentation of the vessels.
All	Displays all anatomy without segmentation.

Select a region in the Anatomy Management list to apply a preset visibility setting to a single region.



**TIP:** To change the Transparency of the region, drag the Transparency slider.

## Create a MIP

MIP is a shading setting that displays data using the highest data values for each voxel of the image. MIP is a good setting to use when competing features composed of voxels with similar or higher values might be obscuring the feature of interest.

1. From the Volume Render dropdown list, select **MIP**.



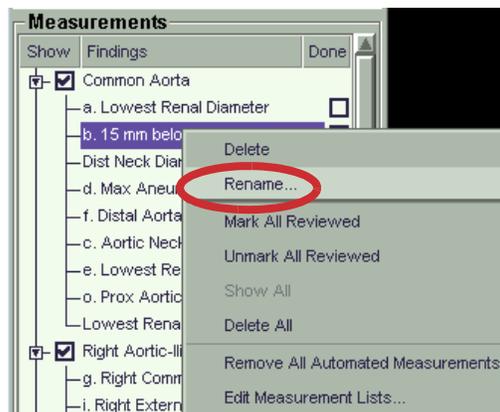
2. View the 3D image as a MIP.



## Rename Vessels and Measurements

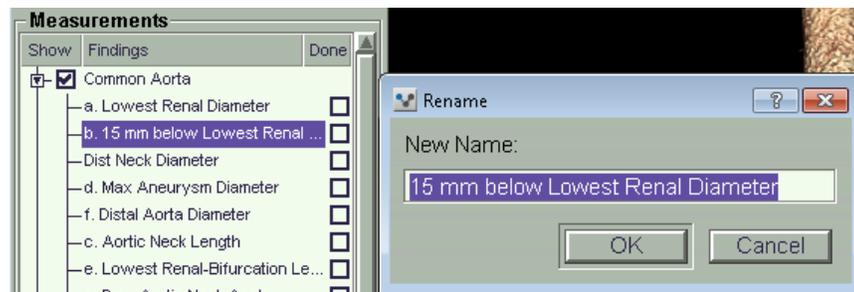
To rename vessels and measurements:

1. Right-click and select Rename from the right-click menu.



**TIP:** Double-click on the measurement to open the Rename dialog box.

2. Rename the vessel or measurement and click **OK**.



## Vessel Tools

The Vessel dropdown contains the following tools:



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**Single** – When you draw a lesion using the Single method, Vitrea automatically identifies a point as the reference point. Vitrea displays the minimum diameter at the narrowest point and at the reference point.

**NOTE:** Review the reference line and move it manually if necessary.



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**Average** – When you draw a lesion using the Averaged method, Vitrea uses the top and bottom line to get the average reference. Vitrea displays the minimum diameter at the narrowest point and both end points to determine the average reference.



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**Dual** – Dual Reference allows average reference measurements and separate length measurements. The top and bottom green cross sections as reference. The red cross section is the minimum diameter. The blue line represents the length measurement.

---



**Volume** – When you draw a region using the Volume method, Vitrea displays the volume of the lumen and outer wall. It also identifies the maximum outer wall diameter. Use this option for thrombosed regions.

**NOTE:** The Volume tool is available for vessels found automatically in the **Vascular: Aorta Stent CT** protocol or vessel types with SUREPlaque enabled (renal, peripheral, coronary, carotid).



**Landing Zone** – Use the Landing Zones option to define specific regions for in-depth analysis.

---

## Identify the Volume of Lumen and Outer Wall

1. Click  to change the volume view to a 1-up image and display a vessel probe view.
2. Click the dropdown arrow in the Vessel Tools section and select Volume.



3. Move the mouse into the CPR view over the region of interest such as a lesion.
4. Click and drag the cursor above and through the area of interest.

The volume of the lumen and outer wall for the defined region displays.  
The maximum outer wall diameter also displays.



## Define Landing Zones

Use the Landing Zones option to define specific regions for in-depth analysis.

1. Click .
2. Select  from the Vessel Tools.
3. Click and drag in the curved view to define the proximal and distal ends of the zone.

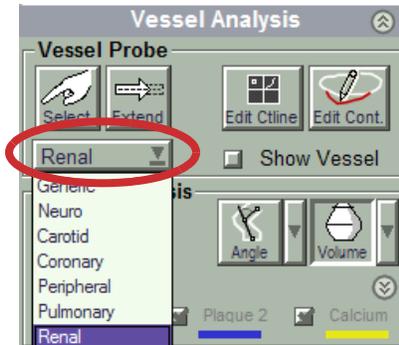
**TIP:** After you define the landing zone, it displays in the Measurements box. Right-click to rename the landing zone.

4. View the diameters for the landing zone.

## Probe Accessory Vessels

Probe any accessory vessels. The segmentation must display in 3D and MPR for visualization of anatomic landmarks.

1. From the Analysis tab, select a vessel type from the dropdown in the Vessel Probe section.
2. Click select and probe any accessory vessels.
3. View the vessels in 3D.



## Extend Probed Vessels

You have the option to extend or refine a probed vessel. The vessel you want to extend or refine must be selected in the Vessel Management list.

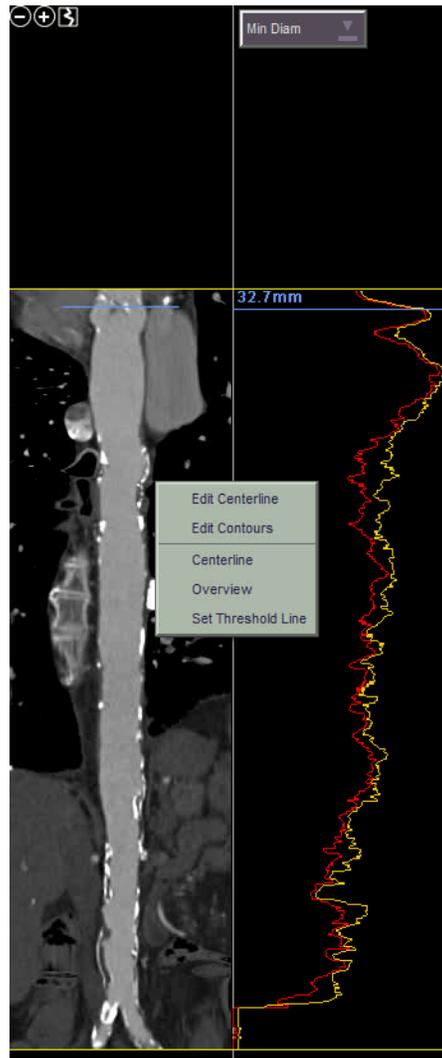
To extend a vessel, right-click and select Extend  and click a point farther along the already selected vessel.

To refine the vessel indicator line, drag the cursor along the vessel indicator line to a desired end point and click.

**NOTE:** As you drag the cursor, the vessel indicator line disappears. It will not be removed until you click.

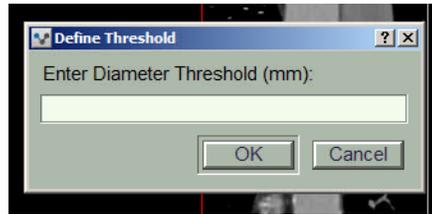
## Set Threshold Line

1. Click  in the bottom right corner of the CPR view to display the straightened vessel view.
2. Right-click in the view and select **Set Threshold Line**.



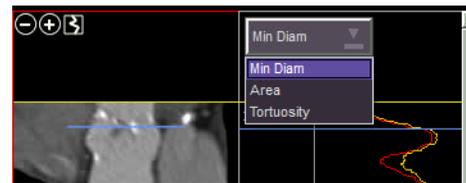
**CAUTION:** Zoom in to review specific sections of the graph. Graph detail may be lost if the zoom factor is too small.

3. Enter the measurement (area or diameter).



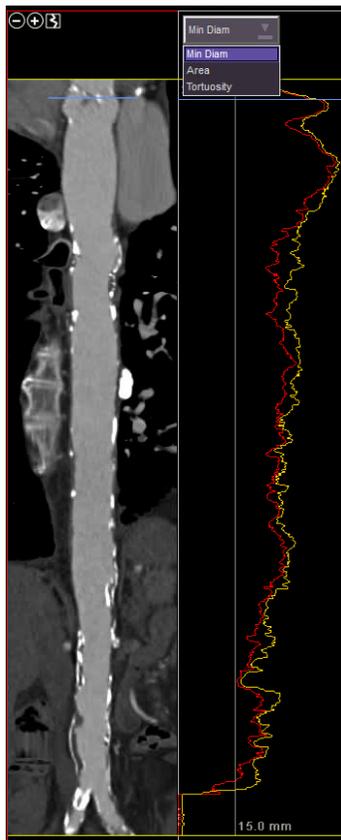
4. Click **OK**.

### View Minimum Diameter, Area, and Tortuosity

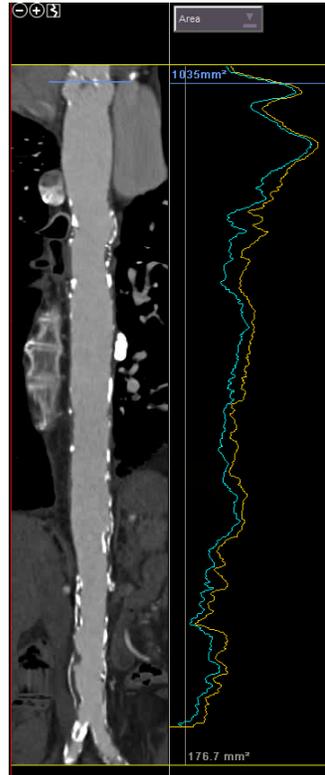


1. Click  in the bottom right corner of the CPR view to display the straightened vessel view.
2. From the CPR straightened vessel view dropdown, select one of the following layouts:

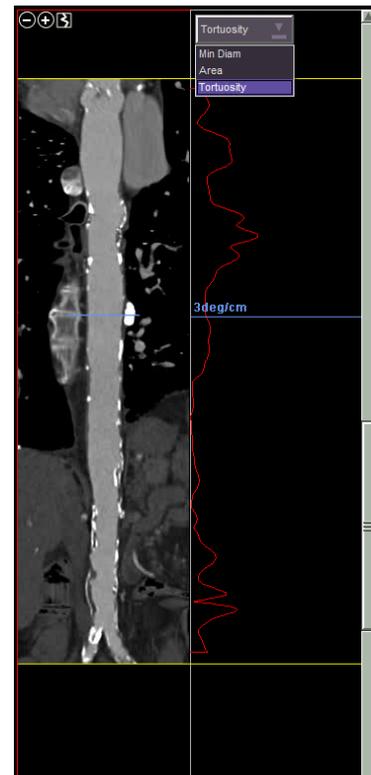
## Minimum Diameter



## Area



## Tortuosity

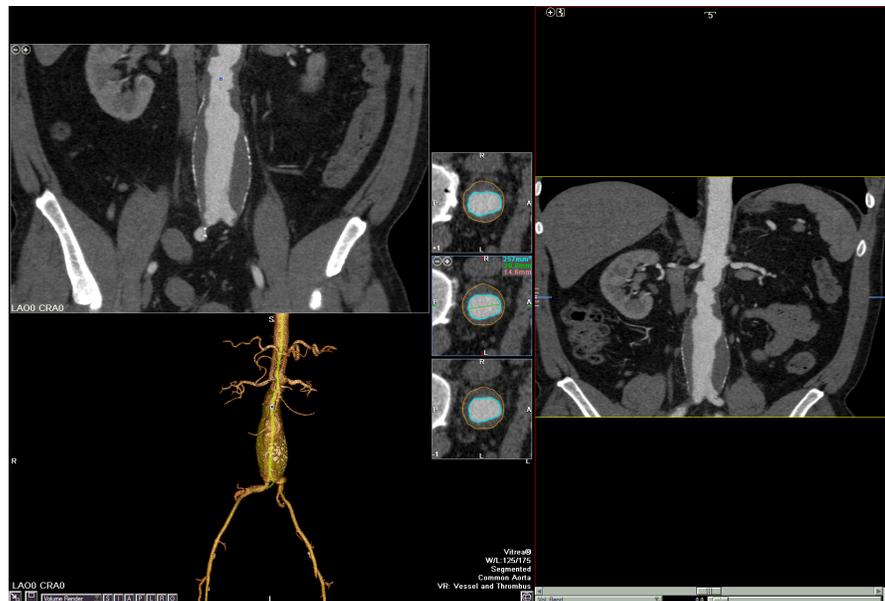


**NOTE:** Tortuosity is calculated by taking the length of the curve divided by the shortest distance between the two points.

## Review in the CathView Layout

1. Select the mode button in the lower left corner of the image.
2. Select the mode button  until you select the CathView layout.

**NOTE:** The mode button allows you to toggle between different layouts of the reformatted views.



When the crosshair tool is active, a blue crosshair displays at the location of the current centerline point to allow cross-referencing across images.

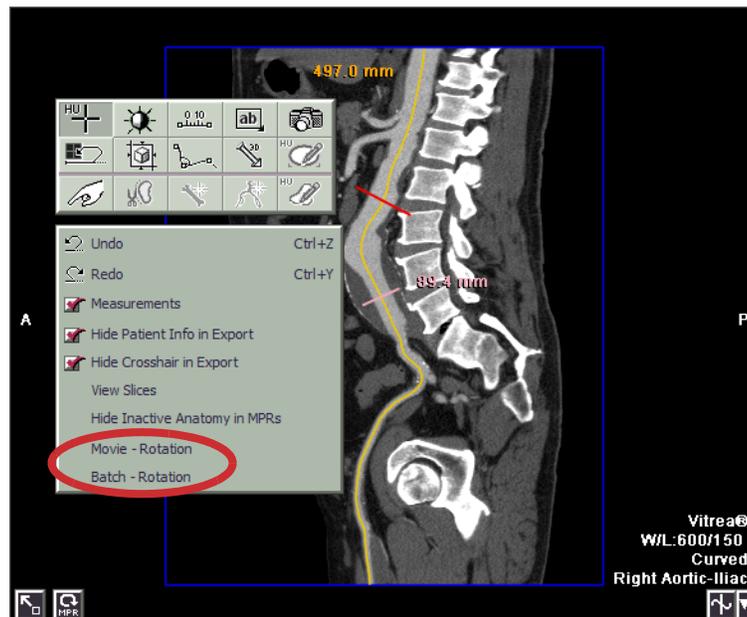
## Create a Batch Rotation in Curved View

1. Select the Curved MPR mode in the sagittal plane and generate the curved batch from the coronal plane.



2. Set the reference line where the fulcrum point of the rotation occurs.
3. From the Curved view, right-click and select **Batch-rotation**.

**TIP:** Right-click and select **Movie-rotation**.



4. A batch preview window opens for you to review the batch.





# CT Endovascular Stent Surveillance

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## Contents

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CT Endovascular Stent Surveillance Overview

CT Endovascular Stent Surveillance Lesson

- I** Select Study
- II** Choose Protocol and Preset
  - Data Manager
  - Gallery Window
- III** Perform Analysis
  - Lock the Exams Together
  - Assess the Comparative Exams
  - Review the Comparative Measurements
  - Take Snapshots
- IV** Distribute Findings

Additional Procedures

- Rename Vessels and Measurements
- Measure Diameter
- Measure Centerline Length
- Create Centerline Angles
- Identify the Volume of Lumen and Outer Wall
- Define Landing Zones
- Review and Edit Vessel Centerline

- Create a Batch Rotation in Curved View

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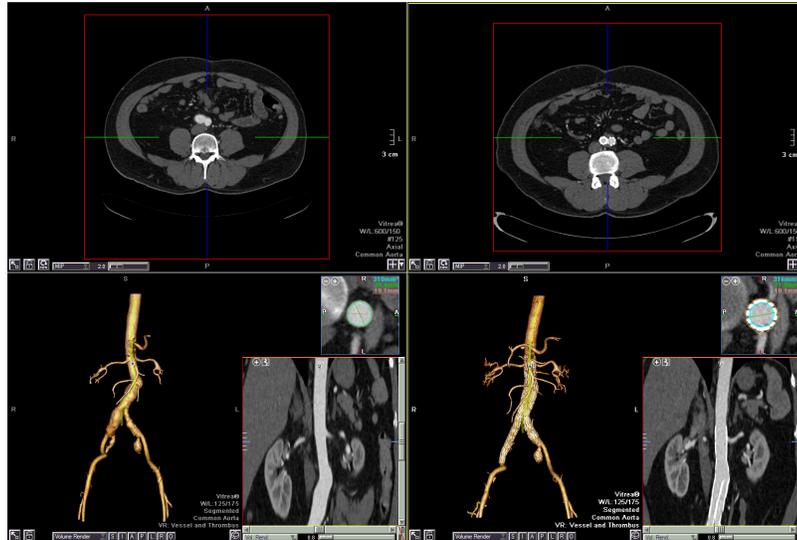
## CT Endovascular Stent Surveillance Overview

The CT Endovascular Stent Planning (EVSP) application enables visualization and measurements of the aortic vessel for evaluation, treatment, and follow-up for aortic vascular disorders that may require a stent procedure. The software performs automated 3D segmentation of the aorta and initializes stent measurements based on a template provided by the stent manufacturers. Physicians can review the 2D and 3D images, verify and correct the results of the segmentation and initialization, and generate a report with the stent measurements.

The software facilitates evaluation of patient anatomy, pre-stent or surgical treatment planning, stenosis evaluation, and surveillance post-treatment.

**NOTE:** Because of the high HU value of contrast media in 100kV scans, the reliability of calcium detection within the vessel lumen is expected to be lower than that of regular kV scans.

 This module contains detailed information about surveillance post-treatment. For detailed information about pre-stent or surgical treatment planning, see the CT Endovascular Stent Planning (EVSP) Module.



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# CT Endovascular Stent Surveillance Lesson

## I. Select Study

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Load an Aorta Stent study.

 See the instructions for your Vitrea type (VitreaAdvanced Through the Data Manager or VitreaWorkstation) in the **Select Study** chapter of the **VitrearAdvanced-VitrearWorkstation General Education and Reference Guide**.

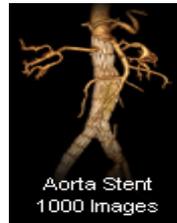
## II. Choose Protocol and Preset

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Use one of these procedures:

### Data Manager

- Double-click the **Aorta Stent** application thumbnail.



### Gallery Window

1. On the Gallery window, select the **Vascular: Aorta Stent CT** protocol. The Gallery choices update automatically.

**NOTE:** Automatic segmentation of the aorta and iliacs takes place after you select the Vascular: Aorta Stent CT protocol.

2. Click  next to the **Stent Planning** preset.

**NOTE:** The Dual Vol icon  displays when two volumes are selected on the Study Directory. The prior (oldest) exam displays on the left side of the screen. The current exam displays on the right side of the screen.

**TIP:** Pick the 3D Analysis preset if you only want to view/monitor the vessels or aneurysm and are not going to do stent planning.

## III. Perform Analysis

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### Lock the Exams Together

Synchronize the views and link them so visualization and spatial operations can be replicated across views in a locked set. When you lock

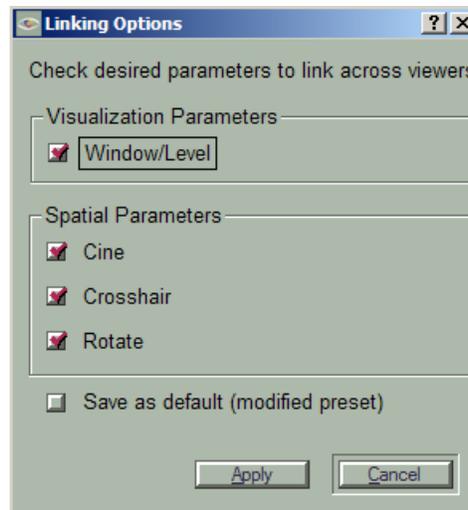
views, manipulations made in one view are reflected in the other synchronized views.

1. Right-click and adjust the axial views until they show the corresponding anatomy in both views.

2. Select  . 

**TIP:** The views are “locked” with respect to window/level, scroll/cine, zoom and pan, crosshair location, and rotating. If you manipulate one view, the other view(s) update automatically.

To change the lock settings, select the dropdown arrow next to the Lock button and click **Configure**. The Linking Options dialog box displays.



3. Review the two exams.

**NOTE:** Compare the two exams:

- One pre-operative exam and one post-operative exam
  - Two post-operative exams
- OR
- Two pre-operative exams

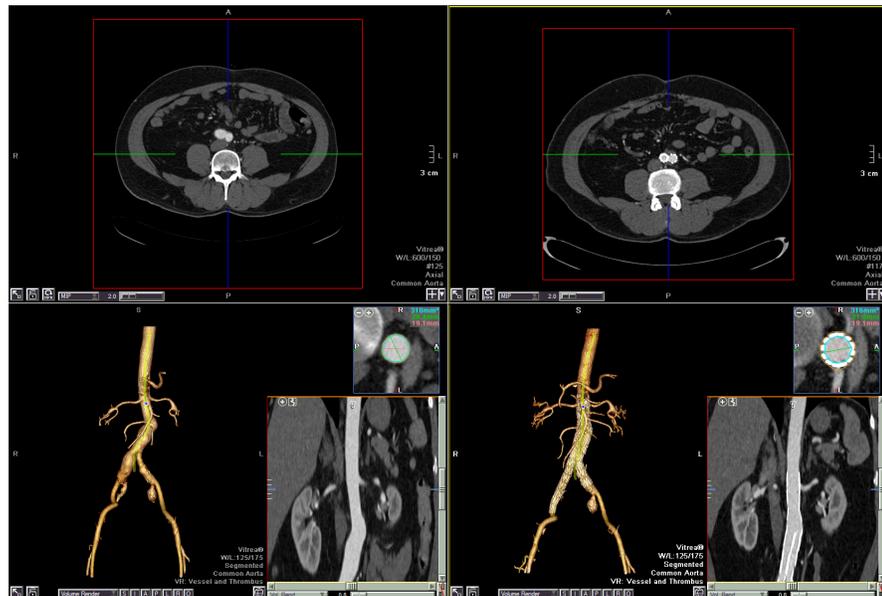
## Assess the Comparative Exams

4. Compare the two images to view the exams.

**TIP:** The current exam displays on the right side of the screen and the prior exam displays on the left side of the screen.

**Prior Exam**

**Current Exam**



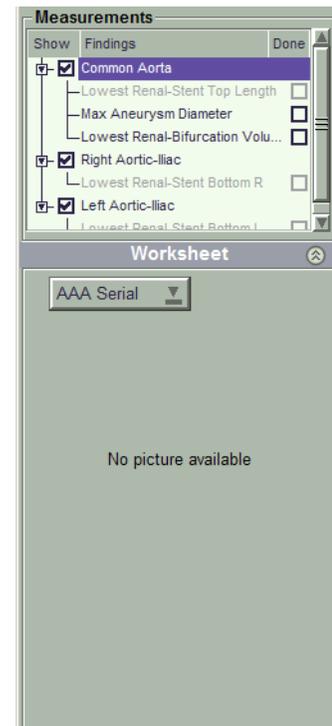
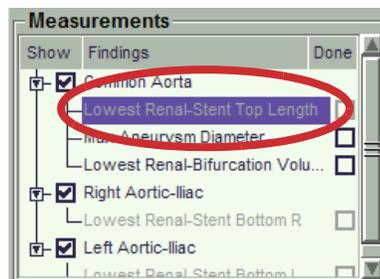
## Review the Comparative Measurements

A default worksheet template is provided for post-operative AAA and TAA stent follow-up (serial studies). Use the default serial template for the follow-up of the current stent.



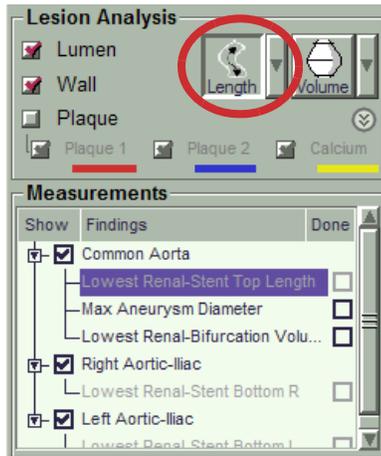
**CAUTION: The Endovascular application requires contrast enhanced CT images for measurements. To prevent incorrect diagnosis or planning, you must review every measurement for accuracy.**

5. Select the first measurement. The first measurement is grayed out. Manually create the grayed out measurements.



The tool (Length, Ruler, Angle) you should use for the grayed out measurements is automatically selected when the measurement is selected.

 See the Additional Procedures section for information about the measurement tools.



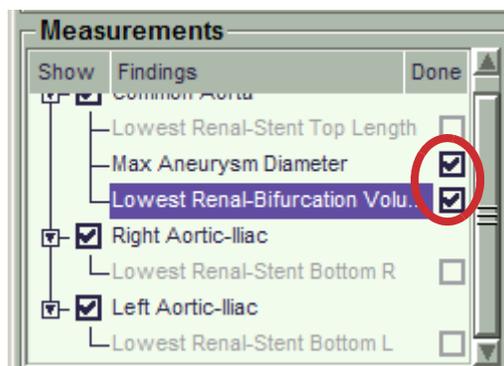
**NOTE:** Repeat this step for all grayed out measurements.

6. Draw the measurement in the CPR view.
7. The measurements that display in **bold** have been automatically selected and measured for you. Select the bold measurements to review and make any necessary edits.

 See the Additional Procedures section for information on how to rename vessels and measurements.

8. When you finish reviewing the measurement, select the Done box next to the name of the measurement.

**When the Done box is selected, the measurement displays in the report.**



**TIP:** If there are measurements you do not want to display in the report, do not select Done.

9. To select or clear all measurements, right-click in the Measurements box and select **Mark All Reviewed** or **Unmark All Reviewed**.
10. Repeat these steps for the other exam.

## Take Snapshots

11. Right-click and select  (or press S) to activate the camera.
12. Move the cursor to the image and click.

Snapshots, measurements, rulers, W/L, or segmentation option can be restored from the Report page or the Study Directory.

## IV. Distribute Findings

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The snapshots you save in the Viewer window are saved to the Report window.

1. Click  at the bottom of the window.
2. Export your findings or create a report.



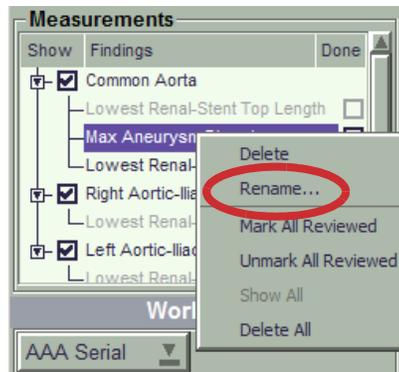
See the **Distribute Findings** chapter of the **VitreAdvanced-VitreWorkstation General Education and Reference Guide** for instructions on exporting findings, restoring workflow, and creating reports.

# Additional Procedures

## Rename Vessels and Measurements

To rename vessels and measurements, perform the following:

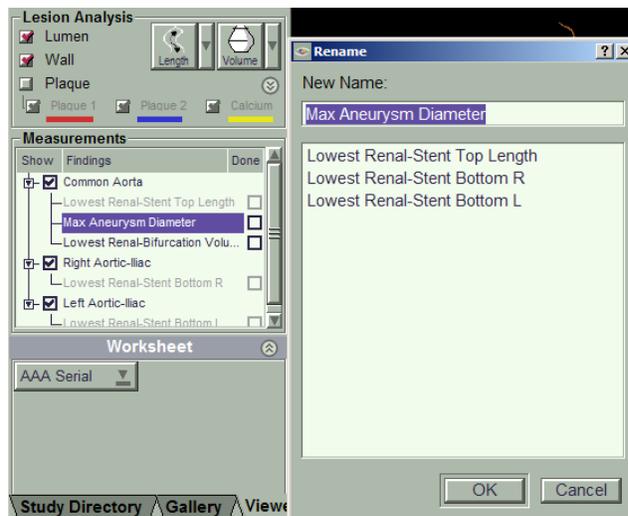
1. Right-click and select **Rename** from the right-click menu.



OR

Double-click the measurement to open the Rename dialog box.

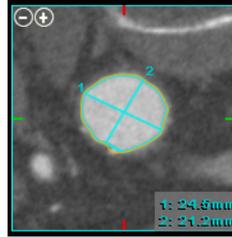
2. Rename the vessel or measurement and click **OK**.



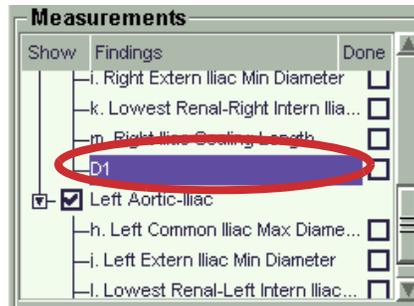
## Measure Diameter

1. Right-click in the 3D image and select the ruler  icon.

2. Draw the ruler measurements.



The diameter displays in the Measurements box on the Analysis tab.



## Measure Centerline Length

The Length tool measures length along the centerline or between two points on the CPR view.

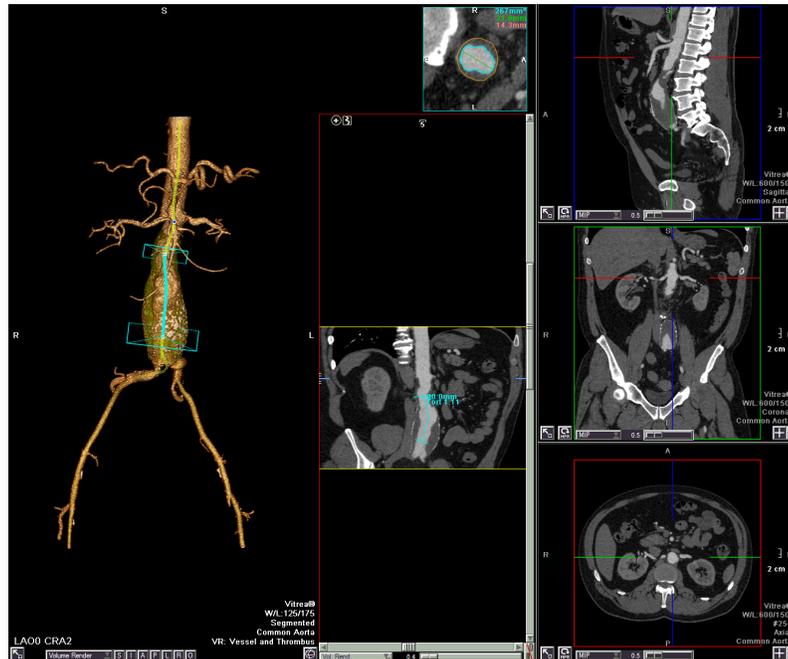
1. Click  to change the volume view to a 1-up image and display a vessel probe view.

2. Select   located under Vessel Tools.



3. Click and drag either end to edit the length.

The value of the length displays at the proximal end of the length measurement. It represents the length along the centerline between the two specified points.



## Create Centerline Angles

The Angle tool creates an angle along the centerline.

1. Click  to change the volume view to a 1-up image and display a vessel probe view.
2. Select  located under Lesion Analysis.

3. Select . The 'Angle' tool is circled in red.

**TIP:** Once you select Angle, the dropdown changes to Angle. You can toggle the Length, Angle, and Ruler buttons.

4. In the CPR view, click and release at the start of the angle.

5. Move the cursor to the vertex location on the centerline and click and release.
6. Move the cursor to the end point of the angle and click and release to complete the angle.



## Identify the Volume of Lumen and Outer Wall

1. Select  located under Lesion Analysis.

**TIP:** The Volume tool is available for vessels found automatically in the **Vascular: Aorta Stent CT** protocol or vessel types with SUREPlaque enabled (renal, peripheral, coronary, carotid).

2. Click the dropdown arrow in the Vessel Tools section and select **Volume**. The cursor changes to the selected Measurement shape.



When you draw a region using the Volume method, Vitrea displays the volume of the lumen and outer wall. It also identifies the maximum outer wall diameter. Use this option for thrombosed regions.

For accurate measurements, the lumen wall contours must be edited properly.

3. Move the cursor into the CPR view over the region of interest such as a lesion.
4. Click and drag above and through the lesion area.

The volume of the lumen and outer wall for the defined region displays. The maximum outer wall diameter also displays.

## Define Landing Zones

Use the Landing Zones option to define specific regions for in-depth analysis

1. Click .
2. Select  from the Vessel Tools.
3. Click and drag in the curved view to define the proximal and distal ends of the zone.

**TIP:** After you define the landing zone, it displays in the Measurements box. Right-click to rename the landing zone.

4. View the diameters for the landing zone.

## Review and Edit Vessel Centerline

 See the Endovascular Stent Planning Module - Additional Procedures section for detailed information about reviewing and editing the vessel centerline.

## Create a Batch Rotation in Curved View

1. In the Coronal view, switch to a 4-up single volume viewer window format.
2. Select the Curved MPR mode.



3. From the Curved view, right-click and select **Batch-rotation**.

**TIP:** Right-click and select **Movie-rotation**.



4. A batch preview window opens for you to review the batch.



# CT Transcatheter Aortic Valve Replacement (TAVR) Planning

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## Contents

CT TAVR Planning Overview

CT TAVR Planning Lesson

- I Select Study
- II Choose Protocol and Preset
  - Data Manager
  - Gallery Window
- III Perform Analysis
  - TAVR Tools
  - Review Automatic Segmentation
    - Assess the Vascular Anatomy
    - Review the Vessel Centerline
    - Review the Contours
  - Aortic Root Analysis
    - View the C-arm Angles
    - Define the Valve Plane
    - Display a Semi-automated Approximate Valve Plane
    - Define Device Measurements
    - Display Semi-automated Contour Measurements
    - Display Semi-automated Ruler Measurements
  - Approach Planning

- Display Iliac Access
- Display Subclavian Access
- Trans-apical Planning
- Review and Verify Measurements
- Take Snapshots

#### **IV** Distribute Findings

##### Additional Procedures

- Edit the Vessel Centerline
- Edit Vessel Contours
- Display Analysis Tab Tools
- Display Visualization Preset Settings
- Create a MIP
- Rename Vessels and Measurements
- Extend Probed Vessels
- Select Measurement Options
- Draw Contours
- Measure the Diameter
- Display Clock Overlay
- Display Landing Zone
- Measure Centerline Length
- Create Centerline Angles
- Set Threshold Line
- View Minimum Diameter, Area, and Tortuosity
- Review in the CathView Layout
- Create a Batch Rotation in Curved View
- Define the Valve Plane using the Crosshair Tool
- Edit Stent Templates
- Use the Volume Navigation Panel

---

# CT TAVR Planning Overview

CT Transcatheter Aortic Valve Replacement (TAVR) Planning assists with the assessment of the aortic valve and in pre-operational planning and post-operative evaluation of transcatheter aortic valve replacement procedures.

Key Features:

- Comprehensive template of measurements, including diameter, circumference and length
- Automated segmentation and centerlines of aorta and aortic root for assessment and delivery approach
- Display of C-Arm angle for device placement
- Flexibility to enable planning for the transfemoral, subclavian and transapical delivery approaches
- 3D display of TAVR measurements
- Report template auto fills with user-selected measurements
- Optimized viewing for cardiac valves and calcium
- Tortuosity calculations along a centerline
- Volume rendering, MIP, MPR and curved MPR

**NOTE:** Because of the high HU value of contrast media in 100kV scans, the reliability of calcium detection within the vessel lumen is expected to be lower than that of regular kV scans.

**NOTE:** For best segmentation results, it is recommended that these scanning parameters are followed:

- 200HU+ and relatively uniform contrast in the vasculature,
- Scan starts below shoulders, and
- Scan FOV is appropriate to include the vascular anatomy and not be overly constrained.

---

# CT TAVR Planning Lesson

## I. Select Study

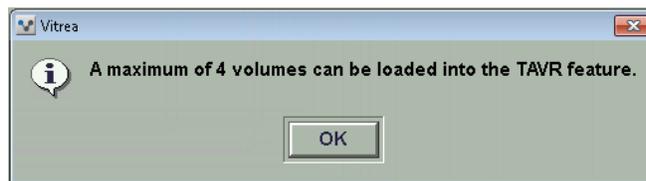
---

Load a Transcatheter Aortic Valve Replacement (TAVR) Planning study.

 See the instructions for your Vitrea type (VitreaAdvanced Through the Data Manager or VitreaWorkstation) in the **Select Study** chapter of the **VitreaAdvanced-VitreaWorkstation General Education and Reference Guide**.

You may load up to four series in TAVR, (this could be three gated series along with a single run-off series).

**NOTE:** If more than four volumes are loaded, the following message displays:



**TIP:** To help you determine the end-systolic and end-diastolic phases from which to define a valve plane, load several volumes into the Generic CT protocol.

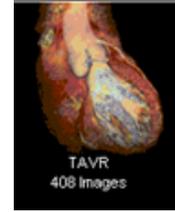
## II. Choose Protocol and Preset

---

Use one of these procedures:

## Data Manager

- From the Applications tab, double-click the TAVR application thumbnail.



## Gallery Window

1. On the Gallery window, select the **Vascular: TAVR CT** protocol. The Gallery choices update automatically.

**NOTE:** Automatic segmentation of the aorta and iliacs takes place after you select the Vascular: TAVR CT protocol.

2. Click  next to the **TAVR** preset.

## III. Perform Analysis

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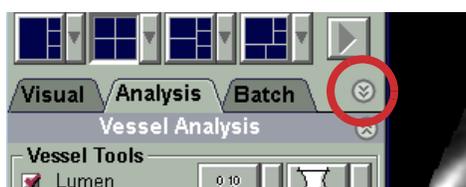
The Perform Analysis section contains four main sections:

- TAVR Tools
- Review Automatic Segmentation
- Aortic Root Analysis
- Approach Planning

## TAVR Tools

---

**TIP:** If the full set of TAVR Tools is not visible, click the Expand icon to display the tools.



**NOTE:** Each loaded series will have its own set of measurements. TAVR will display the measurements of the currently selected series.

Tool	Description
<b>Ruler</b> 	Draw a simple ruler in any view.
<b>Angle</b> 	Draw a multi-line ruler and angle measurement in any view.
<b>ROI</b> 	Draw contours to define a region of interest.
<b>Vessel Probe tools</b> 	Define vessels: <ul style="list-style-type: none"> <li>• <b>Select:</b> probe the vessel.</li> <li>• <b>Extend:</b> extend the probed vessel.</li> <li>• <b>Edit Ctline:</b> examine and edit the vessel centerline.</li> <li>• <b>Edit Cont:</b> open the contour editing view.</li> </ul>
<b>Vessel Grow</b> 	Segment vessels by dynamically “growing” the selection area.
<b>Centerline Length</b> 	Measure length of vessel along centerline.
<b>Centerline Angle</b> 	Measure angle of vessel along centerline.

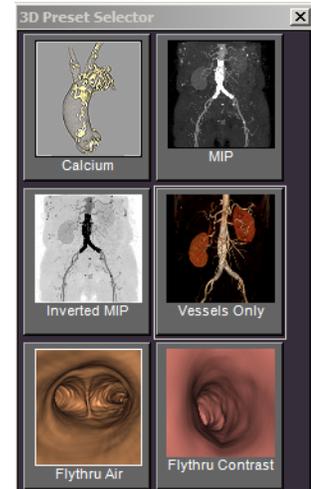
## Review Automatic Segmentation

---

### Assess the Vascular Anatomy

1. Review the anatomy.
  - MPR view
  - Orthogonal view
  - 3D view

- On the Analysis tab, select the dropdown to display the additional visualization options.



See the Additional Procedures section for additional information on the 3D Preset Selector settings.

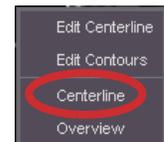
## Review the Vessel Centerline

**NOTE:** Follow the instructions below if you are going to perform the Iliac Access and Subclavian Access procedures.

- From the Analysis tab, select **Show Vessel..**



- Right-click in the CPR view and select **Centerline**.



**NOTE:** To turn off the centerline, right-click and select **Centerline** again.

- Press the spacebar to toggle between the aortic, left iliac, and right iliac centerlines.

See the Additional Procedures section for additional information on how to edit the vessel centerline.

## Review the Contours

**NOTE:** Follow the instructions below if you are going to perform the Iliac Access and Subclavian Access procedures.

6. Right-click on the inset view and select **Edit Contours** to open the contour editing view with several cross-sectional views



7. Press **Page Up** or **Page Down** to toggle to the area of interest.



The curved image displays in a straightened view next to the graph of the lumen and wall. A grid on the straightened view represents locations of the corresponding cross-sections along the curved view.

 See the Additional Procedures section for additional information on how to edit contours.

# Aortic Root Analysis

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## View the C-arm Angles



When you are in oblique crosshair mode, the C-arm angles display. The view displays the 3D and oblique MPR views relative to the valve plane. The clinical values display in the lower right corner of the view.

**TIP:** You also have the option to rotate the 3D view. The C-arm angles display in the lower left corner of the 3D view.

**NOTE:** The first value indicates Right Anterior Oblique or Left Anterior Oblique. The second value indicates Cranial or Caudal.

## Define the Valve Plane

 See the Additional Procedures section for information regarding using the crosshair tool to define a valve plane.

This workflow will help you define three points in a plane in any oblique MPR plane.

1. Select a 4-up view



2. Select **Valve Plane** in the Measurements list in the Vessel Analysis section.

**NOTE:** When **Valve Plane** is selected, the cursor will change to



3. Scroll in the MPR views to best display the bottom of an aortic cusp.
4. Place a point at the bottom of the cusp.
5. Repeat from step 3 for the other two cusps.

When the third point is placed, the axial view snaps to the new valve plane.

6. To refine the valve plane, click and drag the point to the desired location.
7. To toggle between defined points, press SPACEBAR.

**NOTE:** Points are editable in the MPRs but not the 3D view.

**NOTE:** The points will be visible in all MPRs and 3D views when the valve plane is highlighted.

## Display a Semi-automated Approximate Valve Plane

8. Select **Valve Plane** in the Measurements list in the Vessel Analysis section.
9. Double-click inside an MPR.

**NOTE:** This plane will overwrite an existing valve plane or create one if one does not exist.



**CAUTION:** Review the valve plane for accuracy as this procedure only defines an approximation. Failure to do so may result in incorrect diagnosis or planning.

## Define Device Measurements

This section includes a device measurements workflow for Transcatheter Aortic Valve Replacement Planning using the orthogonal (MPR) planes without centerlines.

10. Select a 4-up view.



## Right-Click Menu

- a. Select

### Ruler.



### OR

Click **Angle** to draw a polyline measurement.

- b. Scroll through the MPR view to locate the measurement.
- c. Click and drag to draw ruler(s) or angle(s) to define the measurement.
- d. Right-click in the view and name the measurement



**TIP:** The listing in the Measurements box automatically changes when you name the measurement.

- e. To add a custom ruler or angle to the measurement list, select **Add Ruler to Measurement List** or **Add Angle to Measurement List** and enter a name.
- f. Scroll to the location of the next measurement and continue this process for all measurements.

## Measurements Menu

- a. Select a grayed-out measurement in the Measurements box.

**NOTE:** The appropriate tool is automatically selected when you select a measurement in the Measurements box.

- b. Scroll through the MPR view to locate the measurement.

**TIP:** Click and drag to draw ruler(s) to define the measurement.

**NOTE:** After you define the measurement, the measurement displays in bold in the Measurements box.

**TIP:** The schematic worksheet below the measurements provides a visual of the measurements location along the vessel. The measurement is highlighted in blue on the worksheet. Work from the Measurements list or the worksheet.

- c. Select the spacebar to move to the next grayed-out measurement. Continue this process to define all measurements.

## Display Semi-automated Contour Measurements



**CAUTION:** Review every measurement for accuracy as this procedure only establishes an approximate measurement. Failure to do so may result in incorrect diagnosis or planning.

**NOTE:** These measurements are generated on an oblique MPR plane based on the vessel region.

11. Click .

**OR**

Select a contour-based measurement in the Measurements list in the Vessel Analysis section.

**NOTE:** The Semi-Automated Region of Interest (ROI) tool is active when an item in the Measurements List that uses the ROI tool is selected.

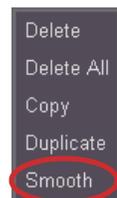
12. Double-click on an oblique MPR plane near where you want to take your measurement.

13. To smooth the contour, right-click and select **Smooth**.

14. To edit the contour, put the cursor on the contour, then drag the edge to the new location.

**OR**

Click to add more anchor points.



## Display Semi-automated Ruler Measurements



**CAUTION:** Review every measurement for accuracy as this procedure only establishes an approximate measurement. Failure to do so may result in incorrect diagnosis or planning.

**NOTE:** These measurements are generated on an oblique MPR plane based on the vessel region.

15. Click  .

**OR**

Select a diameter measurement in the Measurements list in the Vessel Analysis section.

**NOTE:** The Semi-Automated Ruler Tool is active when an diameter measurement in the Measurements List is selected.

16. Double-click on an oblique MPR plane near where you want to take your measurement.

## Approach Planning

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Select the appropriate procedure to complete approach planning:

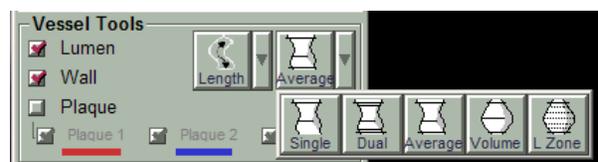
- Display Iliac Access
- Display Subclavian Access
- Trans-apical Planning

### Display Iliac Access

You can use the existing lesion tool to perform the procedure below.

1. From the Average dropdown in the Vessel

Tools area, select 



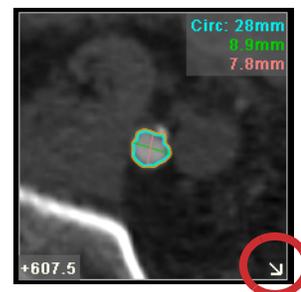
to analyze long segments of the vessel.

 See the Additional Procedures section for information regarding displaying landing zones.

2. Click and drag in the CPR view for the area to survey.
3. Review the diameter measurements in the grid.

- Click  to magnify the axial image of interest.

**TIP:** Create diameter measurements if you want to define measurements other than the automated measurements.



 See the Additional Procedures section for information on how to rename vessels and measurements.

**TIP:** If necessary, perform this procedure on the other side.

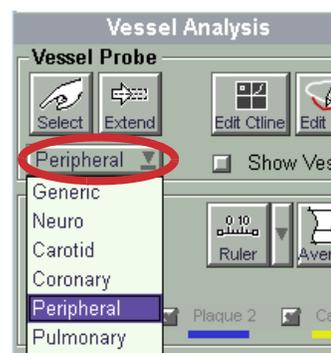
- Take Snapshots.

 See the Review and Verify Measurements section for more detailed information on taking snapshots.

## Display Subclavian Access

Use vessel probe to probe any accessory vessels. The segmentation displays in 3D and MPR for visualization of anatomic landmarks.

- From the Analysis tab, select a vessel type from the dropdown in the Vessel Probe section.



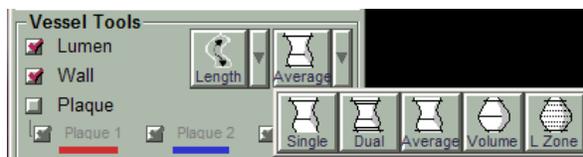
- Click select and probe the subclavian vessel.

- View the vessels in 3D.

 See the Additional Procedures section for information on how to rename vessels and measurements.

- From the Average dropdown in the Vessel

Tools area, select 



to document diameters along the vessel.

 See the Additional Procedures section for information regarding displaying landing zones.

10. Verify  is selected.

11. Click and drag across the vessel.

## Trans-apical Planning

12. Select an Aorta protocol.

13. Use vessel grow to segment the heart.

a. From the Vessel dropdown, click



b. Click and hold on the vessel to grow the vessel branches.

c. Type `heart` in the box.

d. Select **Add to:**.



14. Use vessel grow to segment the aorta.

a. From the Vessel dropdown, click .

b. Click and hold on the vessel to grow the vessel branches.

a. Type `aorta` in the box.

b. Select **Add to:**.

15. Use the Transparency Slider to adjust the transparency of the Bone region to get a better view of the heart.

**NOTE:** Verify you can see the ribs.

16. Create a valve plane with an oblique MPR.

17. Click .

18. Create an angle measurement in 2D for proposed angle of access to the ventricle.
19. Right-click in the 2D view and select **Show in 3D**.

## Review and Verify Measurements

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Review and verify the measurements along the vessels to plan placement.



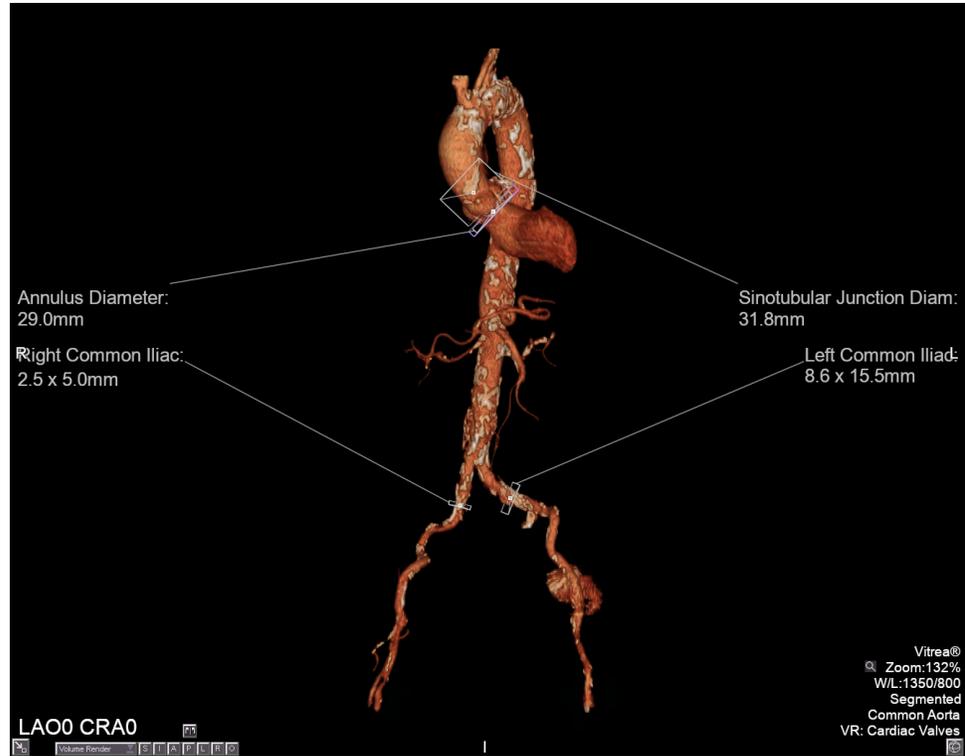
**CAUTION:** Review every measurement for accuracy as this tool only establishes an approximate measurement. Failure to do so may result in incorrect diagnosis or planning.

**NOTE:** Some of the steps in this section may have been completed in the Approach Planning section.

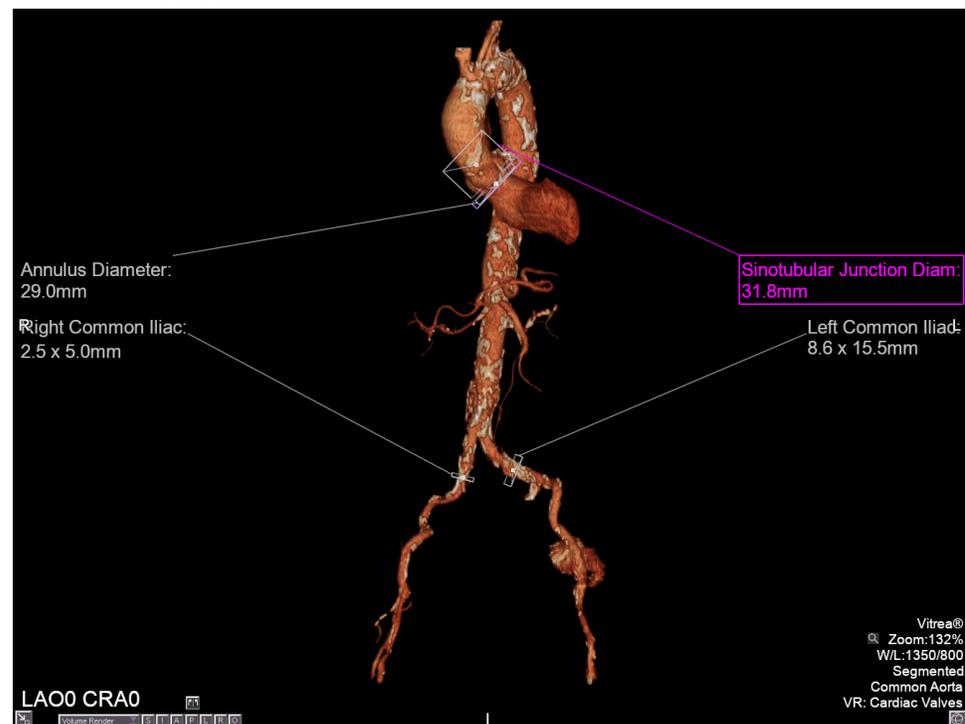
1. In the lower left corner of the 3D image, click  to maximize the 3D image.
2. Right-click in a 3D view and select **Show Overview** to view all of the diameter measurements from the worklist.

**TIP:** Only the measurements selected as **Done** will display when you select **Show Overview**.





**TIP:** Click the name of the measurement to highlight and drag the name to a different location. The name changes color when you click on it.



**TIP:** To remove tortuosity measurements, right-click on a highlighted measurement and select **Delete** or **Delete All** to delete all measurements.

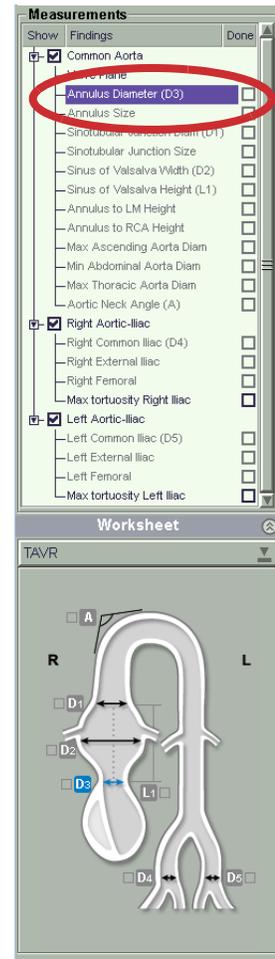
3. Choose a 3D preset from the Preset Selector.
4. Select a measurement listed in the Measurements box and review the diameter. Make any necessary adjustments to the measurements.

**TIP:** The schematic worksheet below the measurements provides a visual of the measurements location along the vessel. The measurement is highlighted in blue on the worksheet. Work from the Measurements list or the worksheet.



See the Additional Procedures section for information on how to rename vessels and measurements.

5. When you finish reviewing the measurement, select the Done box next to the name of the measurement or click the box in the schematic worksheet.



**TIP:** When the Done box is selected, the measurement automatically displays in the report.

6. Select the spacebar to move to the next measurement. Continue this process to review all measurements.

**TIP:** Right-click in the Measurements box and select Mark All Reviewed or Unmark All Reviewed.

**TIP:** If there are measurements you do not want to display in the report, do not select Done.

## Take Snapshots

---

7. Right-click and select  (or press S) to activate the camera.
8. Move the cursor to the image and click.

Snapshots, measurements, rulers, W/L, or segmentation option can be restored from the Report page or the Study Directory.

## IV. Distribute Findings

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The snapshots you save in the Viewer window are saved to the Report window.

1. Click  at the bottom of the window.
2. Export your findings or create a report.



See the **Distribute Findings** chapter of the **VitreAdvanced-VitreWorkstation General Education and Reference Guide** for instructions on exporting findings, restoring workflow, and creating reports.

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# Additional Procedures

## Edit the Vessel Centerline



**CAUTION:** Review and edit the automated vessel segmentation, centerline, and contour results as necessary.

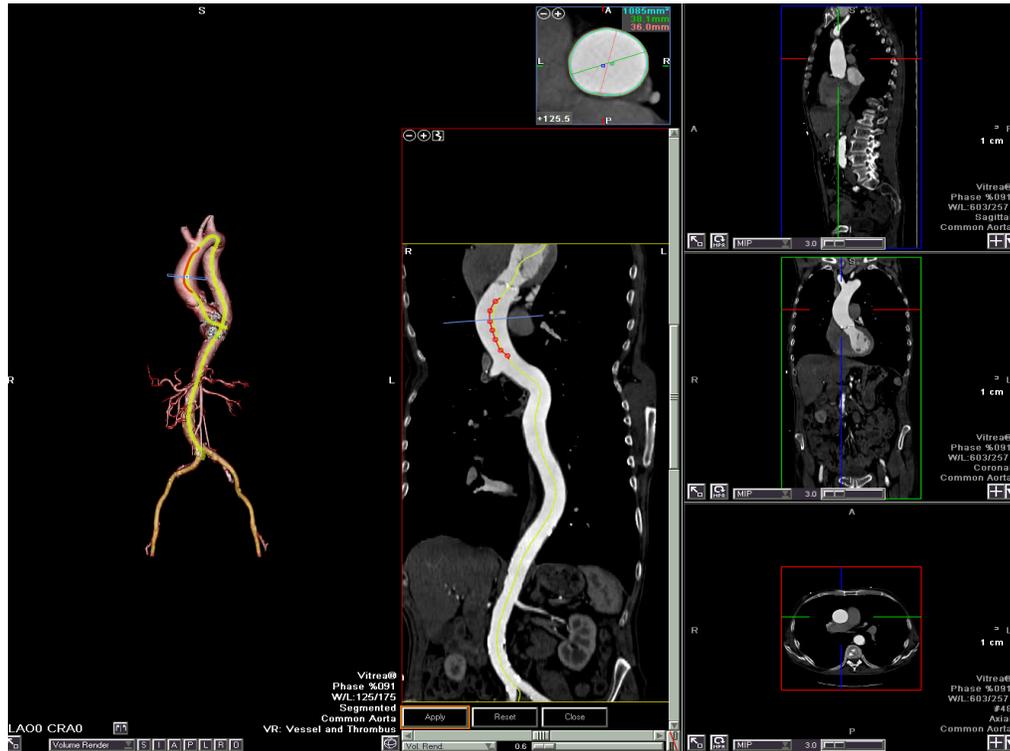
1. Press the spacebar to verify the aortic and iliac centerlines for possible editing.
2. Right-click on any inset view and select **Edit Centerline**.

The cursor changes to a pen.

**TIP:** Select  from the Analysis tab to edit the centerline.

3. Assess the centerline to verify accuracy.
4. Move the cursor (pen) to a specific point along the centerline and click to plot a point to modify the path of the vessel centerline.

**TIP:** As you plot points, a new red line displays to show you how the centerline will display. This line also displays in the 3D view.



5. If necessary, move the cursor (pen) to a different point along the centerline and click to plot a point.
6. Continue to plot all additional points.

**TIP:** As you plot additional points, the line updates to go through all the user control points.

**NOTE:** The line becomes dynamic if you click and drag. The point displays after you release the mouse.

7. Rotate, zoom, and scroll the curved view while the line is being created.

**TIP:** The pencil changes to a hand over a plotted point. Click and drag to move the plotted point.

**NOTE:** Click **Reset** to clear the red centerline and start over.

- Click  to apply the modified (red) centerline to be the final centerline.

## Edit Vessel Contours

- Press the spacebar to toggle to the desired centerline.
- Right-click on any inset view and select **Edit Contours** to open the contour editing view with several cross-sectional views, or access contour editing from the contour editing button in the lower left corner of the

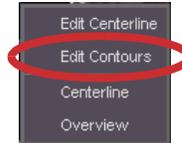


image .

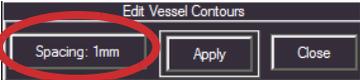


The curved image displays in a straightened view next to the graph of the lumen and wall. A grid on the straightened view represents locations of the corresponding cross-sections along the curved view.

- Click and drag the grid to move it vertically.
- Page Up and Page Down keys to set the last displayed cross-section to the first.

- Use the arrow keys to cine the cross-sectional images by 1 mm each.
3. Click and drag to set the proximal end of the grid at the first inaccurate contour you want to edit.
  4. Click and drag to set the distal end of the grid at the last inaccurate contour you want to edit.
  5. Edit the first level of contours.



6. Click  to perform an interpolation between all edited slices to form a smooth region.

**TIP:** The Apply button will have an orange border after two or more contours have been edited. The orange border identifies that interpolation can be applied.

**TIP:** Start at the top of the anatomy and use **Page Up** and **Page Down** to review the anatomy.

**TIP:** You may also edit from the 1mm Review mode.

7. Return to the Original view.

## Display Analysis Tab Tools

The Analysis Tab defaults to a full view to show tools necessary for Transcatheter Aortic Valve Replacement Planning (Vessel Tools, Measurements, and the Worksheet).

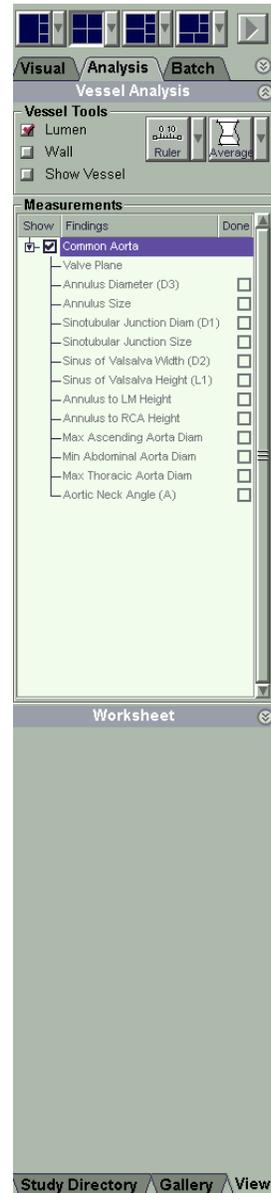
Click the Expand  icons to display/collapse all tools.

**TIP:** The state of the toolbar can be saved as a modified preset.

### Expanded View

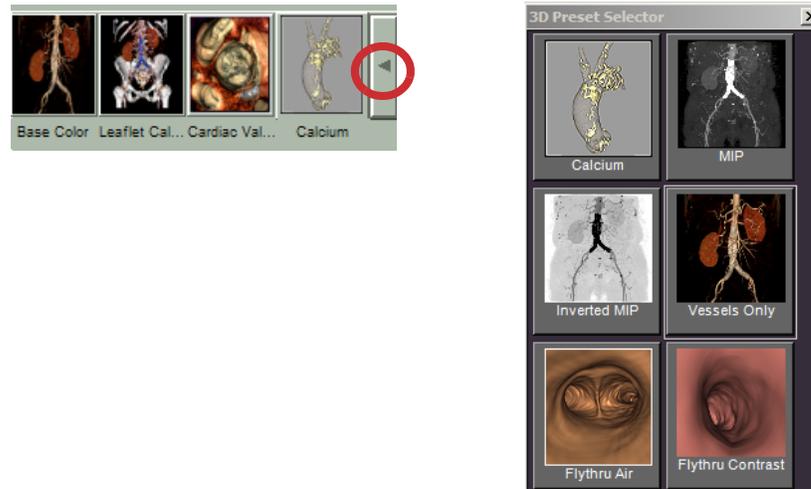


### Collapsed View



## Display Visualization Preset Settings

Select the Visualization Preset buttons dropdown. The options display in the Preset Selector dialog box. On the Vessels tab, choose from Visualization Preset buttons.



Select a region in the Anatomy Management list to apply a preset visibility setting to a single region.



**TIP:** To change the Transparency of the region, drag the Transparency slider.

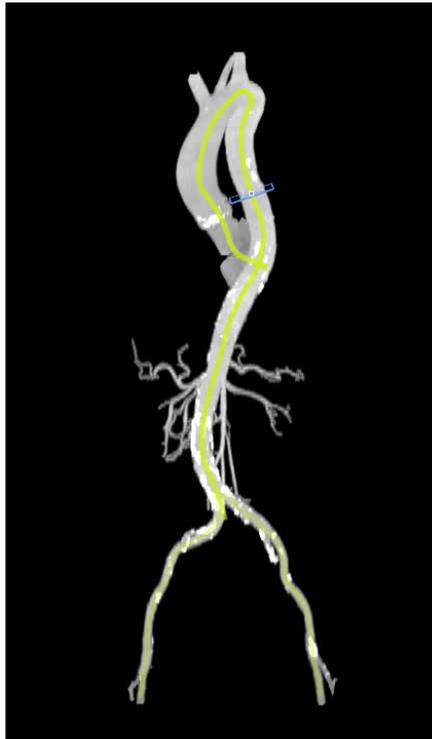
## Create a MIP

MIP is a shading setting that displays data using the highest data values for each voxel of the image. MIP is a good setting to use when competing features composed of voxels with similar or higher values might be obscuring the feature of interest.

1. From the Volume Render dropdown list, select **MIP**.



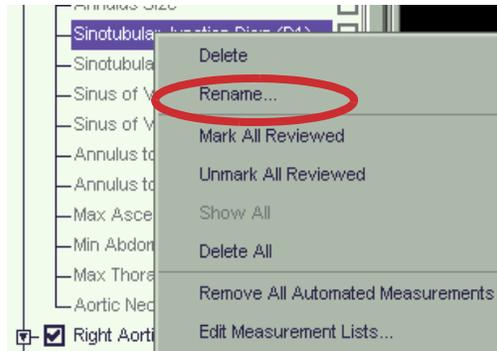
2. View the 3D image as a MIP.



## Rename Vessels and Measurements

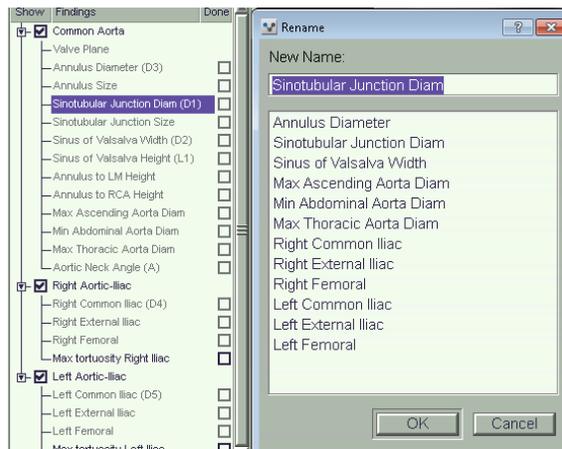
To rename vessels and measurements:

1. Right-click and select **Rename** from the right-click menu.



**TIP:** Double-click on the measurement to open the Rename dialog box.

2. Rename the vessel or measurement and click **OK**.



## Extend Probed Vessels

You have the option to extend or refine a probed vessel. The vessel you want to extend or refine must be selected in the Vessel Management list.

To extend a vessel, right-click and select Extend  and click a point farther along the already selected vessel.

To refine the vessel indicator line, drag the cursor along the vessel indicator line to a desired end point and click.

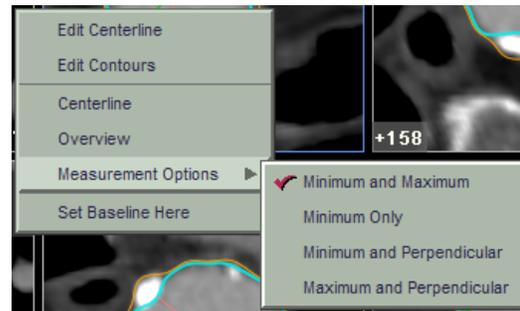
**NOTE:** As you drag the cursor, the vessel indicator line disappears. It will not be removed until you click.

## Select Measurement Options

From the Cross-section view, right-click and select **Measurement Options**.

Select one of the cross-section options:

- Minimum and Maximum
- Minimum Only
- Minimum and Perpendicular
- Maximum and Perpendicular



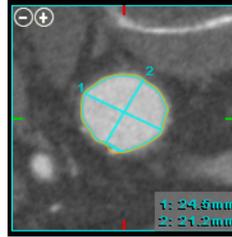
## Draw Contours

1. Click .
2. Click and drag in the view to draw.  
**OR**
  - a. Click around the perimeter of the area of interest placing anchor points.
  - b. Double-click to place the final anchor point.
3. To edit a contour, put the cursor on the contour, then drag the edge to the new location.  
**OR**  
Click to add more anchor points.

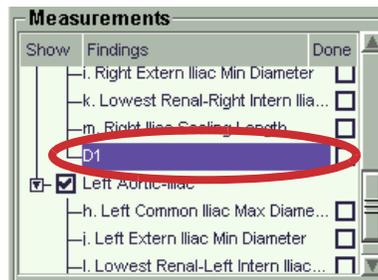
## Measure the Diameter

1. Click .

2. Draw the ruler measurements.

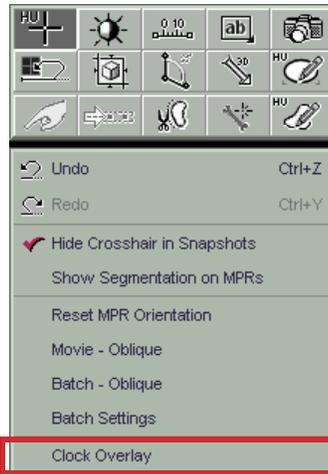


The new diameter measurement displays in the Measurements box on the Analysis tab.

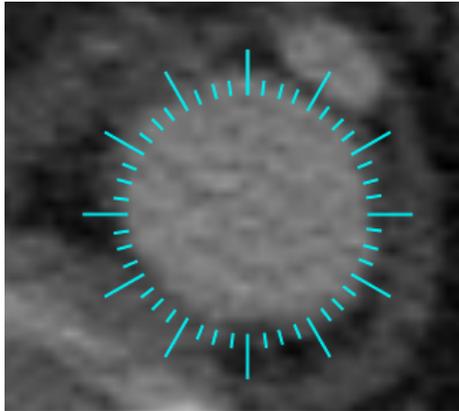


## Display Clock Overlay

3. Right-click in an MPR view and select **Clock Overlay**.



4. Zoom and pan the image to fit the overlay.



5. To hide the clock overlay, right-click and select **Clock Overlay** again.

## Display Landing Zone

Use the Landing Zones option to define specific regions for in-depth analysis.

1. Click .
2. Select  from the Vessel Tools.
3. Click and drag in the curved view to define the proximal and distal ends of the zone.

**TIP:** After you define the landing zone, it displays in the Measurements box. Right-click to rename the landing zone.

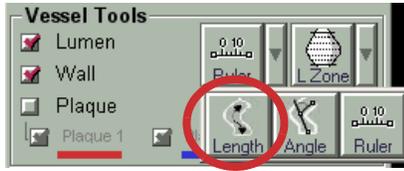
4. View the diameters for the landing zone in the cross-sectional views.

## Measure Centerline Length

The Length tool measures length along the centerline or between two points on the vessel centerline.

1. Click  to change the volume view to a 1-up image and display a vessel probe view.

2. Select  located under Vessel Tools.



3. Click and drag either end to edit the length.

The value of the length displays at the proximal end of the length measurement. It represents the length along the centerline between the two specified points.

## Create Centerline Angles

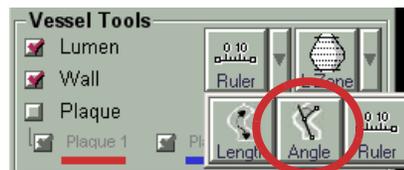
The Angle tool creates an angle along the centerline.

1. Click  to change the volume view to a 1-up image and display a vessel probe view.

2. Select  located under Vessel Tools.



3. Select

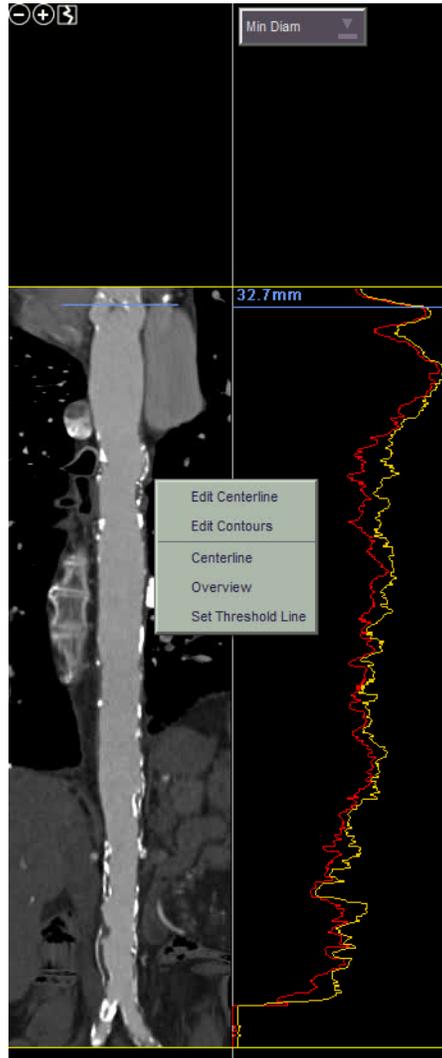


**TIP:** Once you select Angle, the Length dropdown changes to Angle. Toggle the Length and Angle buttons.

4. In Curved CPR view, click and release at the start of the angle.
5. Move the cursor to the vertex location on the centerline and click and release.
6. Move the cursor to the end point of the angle and click and release to complete the angle.

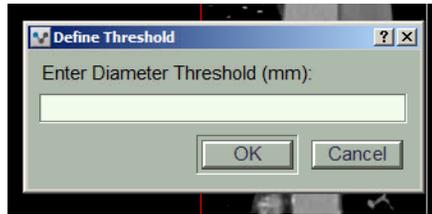
## Set Threshold Line

1. Click  in the bottom right corner of the CPR view to display the straightened vessel view.
2. Right-click in the view and select **Set Threshold Line**.



**CAUTION:** Zoom in to review specific sections of the graph. Graph detail may be lost if the zoom factor is too small.

3. Enter the measurement (area or diameter).



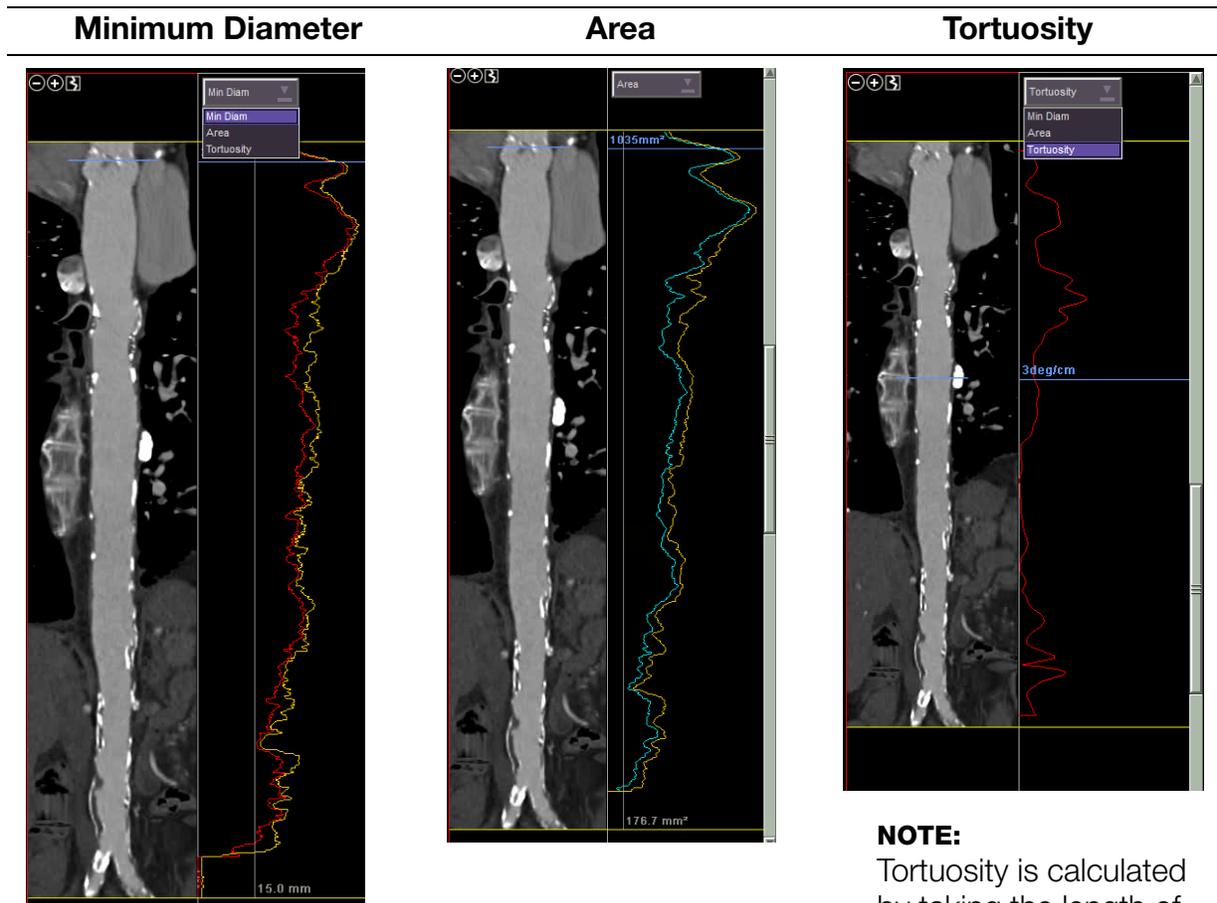
4. Click **OK**.

### **View Minimum Diameter, Area, and Tortuosity**



1. Click  in the bottom right corner of the CPR view to display the straightened vessel view.

- From the CPR straightened vessel view dropdown, select one of the following layouts:



**NOTE:**  
Tortuosity is calculated by taking the length of the curve divided by the shortest distance between the two points.

### Review in the CathView Layout

- Select the mode button in the lower left corner of the image.
- Select the mode button  until you select the CathView layout.

**NOTE:** The mode button allows you to toggle between different layouts of the reformatted views.



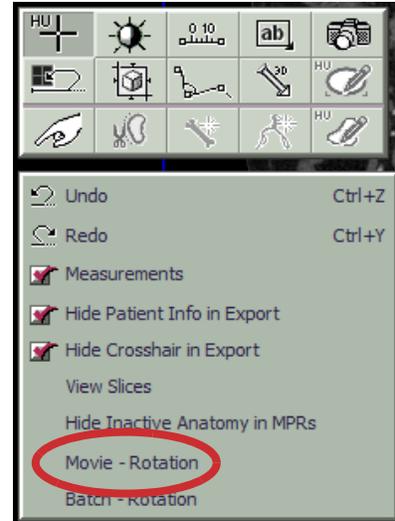
When the crosshair tool is active, a blue crosshair displays at the location of the current centerline point to allow cross-referencing across images.

### Create a Batch Rotation in Curved View

1. Select the Curved MPR mode in the sagittal plane and generate the curved batch from the coronal plane.
2. Set the reference line where the fulcrum point of the rotation occurs.
3. From the Curved view, right-click and select **Batch-rotation**.

**TIP:** Right-click and select **Movie-rotation**.

4. A batch preview window opens for you to review the batch.



### Define the Valve Plane using the Crosshair Tool

1. From the Analysis tab, verify  is selected.
2. Verify you are in oblique crosshair mode. 
3. Select a 4-up view.



- In one of the long axis views, place the crosshair at the bottom of one of the cusps.



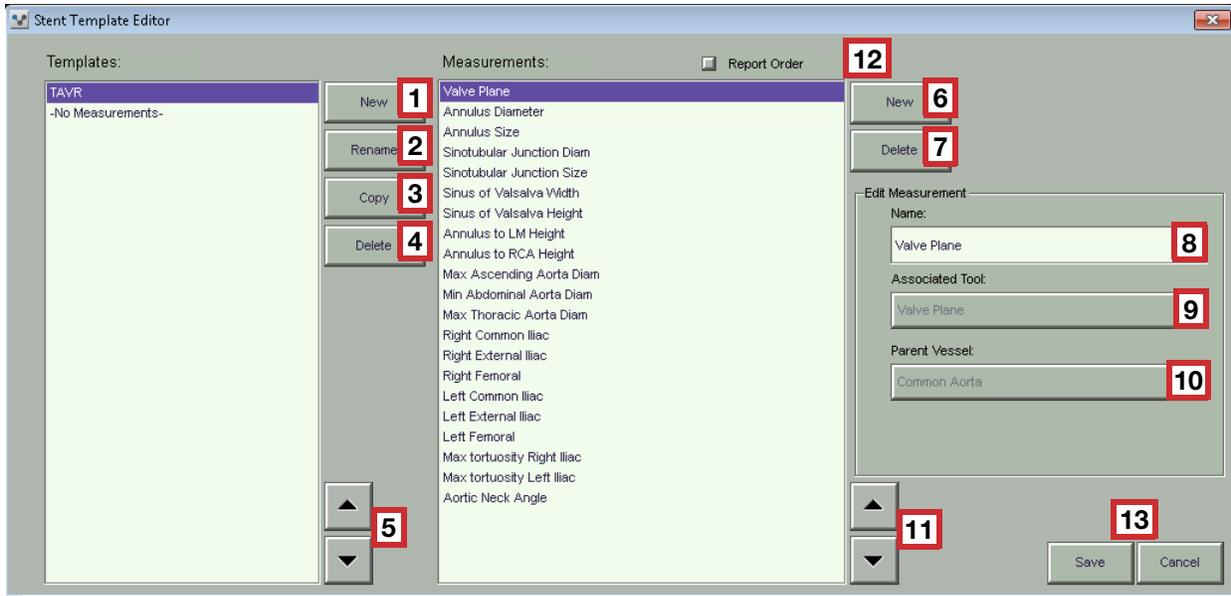
- In the same view, scroll to locate the bottom of the second cusp.
  - Rotate the red line until it meets up with the two cusps.
  - In the other long axis view, rotate the red line to be parallel with the cusps.
- TIP:** The red plane should touch the bottom of the cusps.
- To verify you are in the correct plane, scroll through the valve until all three cusps come into view at the same time in the short axis view.

## Edit Stent Templates

Use the Stent Template Editor to create, delete, or modify stent templates.

- Right-click in the Measurements area and select **Edit Measurement Lists**.

The Stent Template Editor Displays

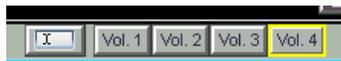


Task	Workflow
Add a new template	<ol style="list-style-type: none"> <li>1. Click <b>New</b> [1].</li> <li>2. Click <b>Rename</b> [2], then enter a name for the template.</li> <li>3. Add new measurements [6] as described below.</li> </ol>
Rename a template	<ol style="list-style-type: none"> <li>1. Select a template.</li> <li>2. Click <b>Rename</b> [2], then enter a name for the template.</li> </ol>
Copy a template (create a new template while preserving the original)	<ol style="list-style-type: none"> <li>1. Select a template.</li> <li>2. Click <b>Copy</b> [3].</li> <li>3. Click <b>Rename</b> [2], then enter a name for the template.</li> <li>4. Add, remove, or edit measurements as described below, if desired.</li> </ol>
Delete a template	<ol style="list-style-type: none"> <li>1. Select a template</li> <li>2. Click <b>Delete</b> [4].</li> </ol>
Rearrange the order of the templates in the list	<ol style="list-style-type: none"> <li>1. Select a template</li> <li>2. Click the Up or Down arrow [5] to move the name in the list.</li> </ol>
Add a new measurement	<ol style="list-style-type: none"> <li>1. Click <b>New</b> [6].</li> <li>2. Edit measurement [8], [9], and [10] as described below.</li> </ol>

Task	Workflow
Delete a measurement	<ol style="list-style-type: none"> <li>1. Select a measurement.</li> <li>2. Click <b>Delete</b> [7].</li> </ol>
Rename a measurement	<ol style="list-style-type: none"> <li>1. Select a measurement.</li> <li>2. Type the name [8].</li> </ol>
Associate a tool with a new measurement	<ol style="list-style-type: none"> <li>1. Select the new measurement.</li> <li>2. Click the Associated Tool dropdown [9], and select the tool that will be the default when the measurement is used.</li> </ol> <p><b>NOTE:</b> The associated tool for a default measurement cannot be changed.</p>
Assign the parent vessel to a new measurement	<ol style="list-style-type: none"> <li>1. Select the new measurement.</li> <li>2. Click the Parent Vessel dropdown [10] and select the vessel where the measurement is applied.</li> </ol> <p><b>NOTE:</b> The parent vessel for a default measurement cannot be changed.</p>
Rearrange the order of the measurements in the list	<ol style="list-style-type: none"> <li>1. Select a measurement.</li> <li>2. Click the Up or Down arrow [11] to move the name in the list.</li> </ol>
Rearrange the order of the measurements in the report	<ol style="list-style-type: none"> <li>1. Select the <b>Report Order</b> check box [12].</li> <li>2. Click the Up or Down arrow [11] to move the name in the list.</li> </ol>
Save or cancel your changes	<ol style="list-style-type: none"> <li>1. Press <b>Save</b> or <b>Cancel</b> [13].</li> </ol>

## Use the Volume Navigation Panel

When multiple volumes are loaded, the Volume Navigation Panel will display at the bottom of the viewer window.



The Volume Navigation Panel is pre-populated with the TAVR identifiers Systole, Diastole, Access and Sizing. The user may use their own identifiers.

To assign an identifier to a volume:

1. Click on Rename Current Volume



2. Select either a pre-determined identifier, or create your own.



**NOTE:** The identifiers are tied to the measurements in the report linking them to the appropriate series.

**TAVR**

<b>Patient ID:</b> TAVR 1 <b>Patient Name:</b> CT_TAVR 1 <b>Date of Birth:</b> 1920.01.01 <b>Gender:</b> M	<b>Referring Physician:</b> <b>Exam Type:</b> CTA CORONARY AND <b>Scan Date:</b> 2012.12.17 <b>Report Date:</b> 2013.03.14-05:08PM
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Description	Value	Type	Series ID
Annulus Diameter	2.6 mm	MPR Ruler	Vol. 1
Annulus Size (Area)	835 mm <sup>2</sup>	Area	Vol. 2
Annulus Size (Circumference)	114 mm	Circumference	Vol. 2
Sinotubular Junction Diam	131.0 x 29.0 mm	MPR Ruler	Vol. 3
Sinus of Valsalva Width	38.4 x 28.1 mm	MPR Ruler	Vol. 4

Comments

# CT Runoff (Peripheral)

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## CT Runoff (Peripheral) Overview

The CT Runoff Analysis workflow provides the ability to visualize and measure bone and vessel structures.

The Vessel Probe option segments contrast-filled peripheral arteries, and permits you to calculate arterial stenosis and plaque burden.

**NOTE:** Because of the high HU value of contrast media in 100kV scans, the reliability of calcium detection within the vessel lumen is expected to be lower than that of regular kV scans.

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## CT Runoff (Peripheral) Lesson

### I. Select Study

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Load a Runoff or Peripheral study.

 See the instructions for your Vitrea type (VitreaAdvanced Through the Data Manager or VitreaWorkstation) in the **Select Study** chapter of the **VitreaAdvanced-VitreaWorkstation General Education and Reference Guide**.

## II. Choose Protocol and Preset

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Use one of these procedures:

### Data Manager

- Double-click the **Peripheral** (Runoff) application thumbnail.



### Gallery Window

1. On the Gallery window, select the **Vascular: Runoff CT** protocol.

The Gallery choices update automatically.

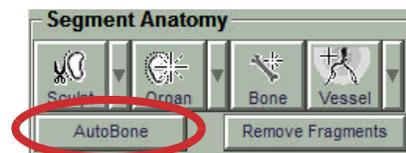
2. Click  next to the **3D Analysis** preset.

## III. Perform Analysis

---

### Automatically Segment Bone

1. In the Segment Anatomy Area, click **AutoBone**.
2. Review the segmentation and use the Manually Segment Bone technique to segment any additional bone regions.



### Manually Segment the Bone

You can manually segment if desired.

- Optional** Press T to activate the **Trim** tool, then drag the yellow lines in the MPR views to trim the image.

3. From the Segment Anatomy area, click Bone.



4. In the 3D view, click on the iliac crest or another bone.

**OR**

In the 2D view, click a portion of cortical (brightest white) bone.

**TIP:** Vitrea displays a blue overlay on areas that will be segmented. Use this as a guide to determine if you need to include more or less to the selected area.

**TIP:** Be sure the blue overlay is on bone areas only. If it displays on vessels, click **Less**, or adjust the HU slider, to select a smaller HU range.

5. To remove a portion of the selected (blue) area
  - a. Place the cursor over the area until a purple overlay displays.
  - b. Roll the mouse wheel to increase or decrease the size of the purple overlay.
  - c. Click the purple overlay.

That area will not be segmented with the rest of the Bone area.

6. Click **Less** or **More** as needed.

**TIP:** The **Less** and **More** buttons decrease or increase the HU range by 20.

7. Adjust the HU slider bar to adjust the HU range as needed.



8. Click **Dilate** or **Erode** as needed.

**TIP:** The **Dilate** and **Erode** buttons decrease or increase the selected area by 1 pixel in the 2D views and 1 voxel in the 3D views per click.

**TIP:** When you use the **Dilate** button, verify the blue overlay does not “bleed” into an area you do not want selected.

**9.** Click **Remove Bone**.

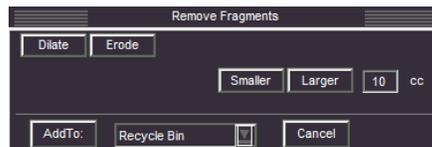
Vitrea adds a listing to the Anatomy Management area.

**10.** Repeat from step 4. to segment all the bones in the view.

**11.** To remove fragments, click .

**12.** Review the blue overlay to verify all the fragments are selected.

**13.** To adjust the size of the fragments selected, click **Smaller** or **Larger**.



**14.** At the top of the view, verify the Add To dropdown indicates **Recycle Bin**, then click .

**15.** In the Anatomy Management area, select an region to change the window/level settings.

**16.** Right-click in the 3D view, then select .

**17.** Click and drag in the view to adjust the window/level settings for that region.

**TIP:** Window level is also available when you left + right-click and drag.

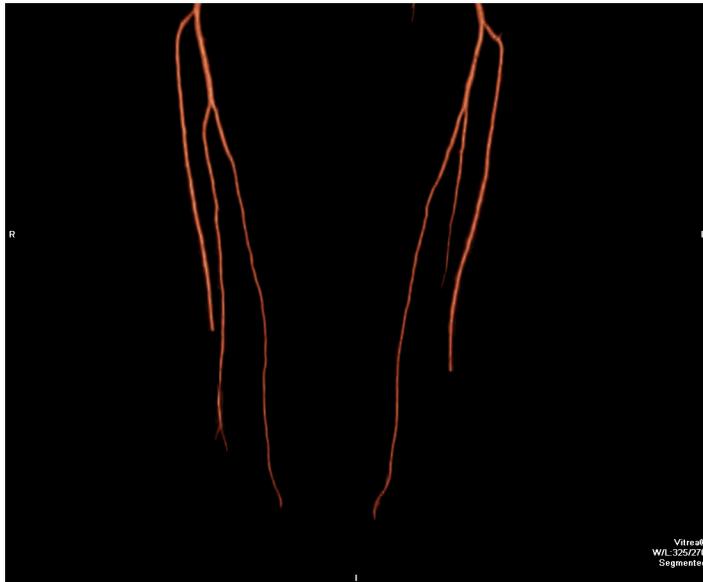
**18.** To draw arrows to areas of interest, right-click and select  then click and drag in the image.

## Probe the Peripheral Arteries

Vessel Probe is an option for runoffs to isolate and analyze the vessels.

19. From the Analysis tab, click  .

20. Click the vessel in either 3D or any MPR image below the trifurcation.



The Vessel Management box displays named vessels and unnamed vessels to show progression of work.

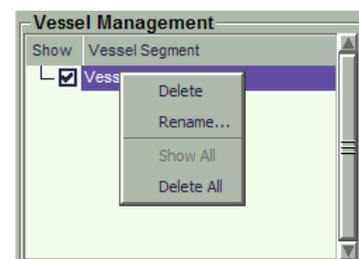
## Rename the Vessel

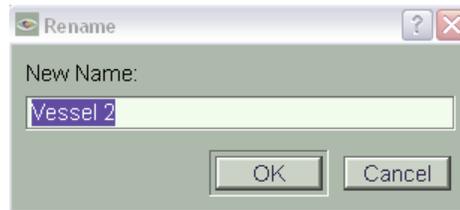
21. Select the vessel in the Vessel management box.

22. Right-click and select **Rename**, or double-click the vessel name.

The Rename dialog box displays.

23. In the New name field, enter the name of the vessel.





24. Click **OK**.

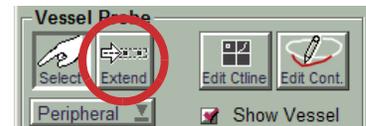
## Extend a Probed Vessel

25. If the vessel you want to extend is not the currently selected vessel in the Vessel Management list, click the vessel name to select it.

26. Rotate the 3D image to display the area of the vessel you want to extend.

27. Click **Extend**.

The cursor changes to a pointed finger



28. Click a point farther along the already selected vessel.

**TIP:** If the vessel probe can extend the vessel, it adds to the current vessel indicator line. If the vessel probe cannot extend the vessel, the status line displays the message Failed to find vessel.

29. To refine the vessel indicator line, drag the cursor along the vessel indicator line to a desired end point and click.

**TIP:** As you drag the cursor, the vessel indicator line disappears. It will not be removed until you click.



## Define a Lesion

The Lesion tool defines a lesion in the vessel in either of the CPR views.

1. In the Vessel Tools area, click the dropdown for the second button.

The dropdown contains the following tools:



**Single** – When you draw a lesion using the Single method, Vitrea identifies a point as the reference point. Vitrea displays the area and minimum diameter at the narrowest point and at the reference point, and uses these measurements to calculate the area and diameter stenosis.

**TIP:** The reference point may need to be moved manually.



**Average** – When you draw a lesion using the Averaged method, Vitrea calculates the average of the area and minimum diameter for the start and end points. It compares these measurements to the area and minimum diameter at the narrowest point to create stenosis measurements.

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**Dual** – When you draw a lesion using the Dual Reference method, Vitrea calculates the average of the area and minimum diameter for the reference points marked with green lines. It compares these measurements to the area and minimum diameter at the narrowest point to create stenosis measurements.



**Volume** – When you draw a region using the Volume method, Vitrea displays the volume of the lumen and outer wall. It also identifies the maximum outer wall diameter. Use this option for thrombosed regions.



**Landing Zone** – Use the Landing Zones option to define specific regions for in-depth analysis.

2. Select a tool.
3. Click in the CPR view just above the start of the lesion and drag to just below the end.

Vitrea adds an entry in the Vessel Management area.

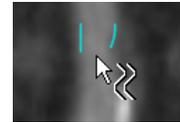


FIGURE 1. **Vitrea identifies:**

Feature	Identified by
Identified lesion	Cyan lines
Point of maximum narrowing (stenosis)	Red arrows
Lumen diameter at the stenosis point	Number in the curved view with red border, corresponding to the red arrows (displays in the two-up curved view)
Reference point(s) for single or dual-reference lesions	Green line <ul style="list-style-type: none"> <li>• Be sure to review the location of the reference line and decide if it is accurate for the identified lesion. If necessary, drag the green line to move it.</li> </ul>

Feature	Identified by
Lumen diameter at the reference point	Number(s) in the curved view with green border, corresponding to the green line(s) (displays in the two-up curved view)
Stenosis measurements	Table at the bottom of the CPR view

Stenosis:  
Area: 11%  
Diam: 12%  
Length: 88.7mm

### Vessel Probe Curved Inset View

The curved inset view is similar to the view you create by changing the MPR to curved reference. The length is preserved when you rotate the CPR.

#### Fit the image in view

Fit the image on the side that currently has the larger longitudinal length. After the image is fit in the view, zoom the image in and out to cover most of the viewer area.



**NOTE:** When you fit the image to the viewer in curved mode and switch to the straightened mode, re-fit the image to view it in the viewer.

#### Measurement in the Left and Right CPR on Y direction

The ruler references that refer to the same ruler have different Y coordinates in the left and right CPR.

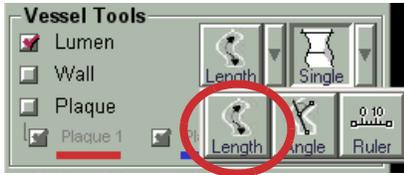
- For **ruler** references, the annotation is drawn in different Y coordinates in the left and right CPR view.
- For **lesion** references, the annotation is drawn in the middle of the left and right viewer and uses the Y coordinate from the ruler drawn on the right CPR.

## Measure the Centerline Length

The Length tool measures the length along the centerline or between two points on the vessel centerline.

4. Click  to change the volume view to a 1-up image and display a vessel probe view.

5. Select  located under Vessel Tools.



6. Click and drag either end to edit the length.

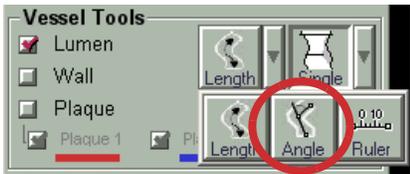
The value of the length displays at the proximal end of the length measurement. It represents the length along the centerline between the two specified points.

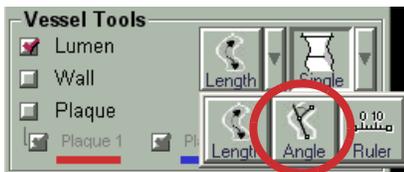
## Create Centerline Angles

The Angle tool creates an angle along the centerline.

7. Click  to change the volume view to a 1-up image and display a vessel probe view.

8. Select  located under Vessel Tools.

9. Select  located under Vessel Tools.



**NOTE:** Once you select Angle, the Length dropdown changes to Angle. Toggle the Length and Angle buttons.

10. In Curved CPR view, click and release at the start of the angle.

11. Move the cursor to the vertex location on the centerline and click and release.
12. Move the cursor to the end point of the angle and click and release to complete the angle.

## Take Snapshots

13. Right-click and select  (or press S) to activate the camera.
14. Move the cursor to the image and click.

Snapshots, measurements, rulers, W/L, or segmentation option can be restored from the Report page or the Study Directory.

## IV. Distribute Findings

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The snapshots you save in the Viewer window are saved to the Report window.

1. Click  at the bottom of the window.
2. Export your findings or create a report.

 See the **Distribute Findings** chapter of the **VitreiaAdvanced-VitreiaWorkstation General Education and Reference Guide** for instructions on exporting findings, restoring workflow, and creating reports.

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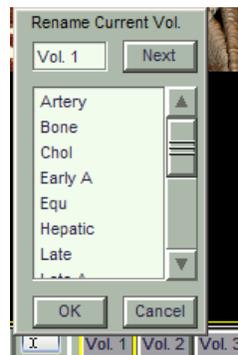
# Additional Procedures

## Switching Active Volumes

With multiple volumes loaded, switch the selected volume by using the Volume Navigation buttons at the bottom of the Viewer window.

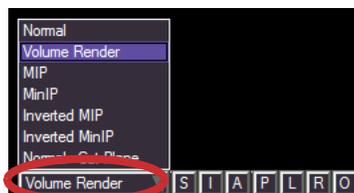


**TIP:** To change the label on the button for the currently selected button, click  and select a name or type a new one.



## Change the 3D into a MIP

1. At the bottom of the 3D image, click the **Volume Rendering** dropdown.

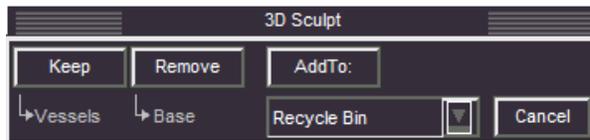


2. Select **MIP**.

## Sculpt in 3D

1. Select  .
2. In 3D, draw a contour around the segment.

3. Verify the dropdown indicates **Recycle Bin**.



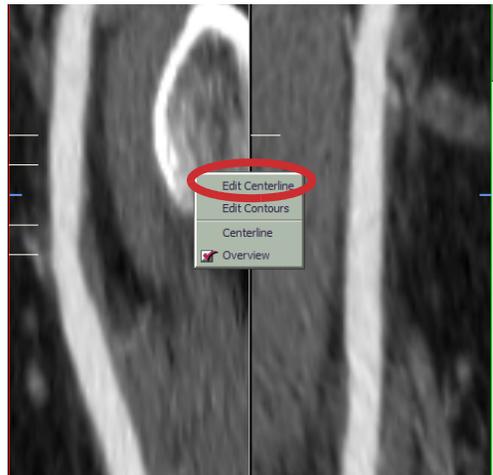
4. Click **Add To**.

## Edit the Centerline



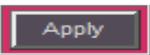
**CAUTION:** Review the automated vessel segmentation, centerline, and contour results and edit as necessary.

1. Right-click on any inset view and select **Edit Centerline**.



**NOTE:** Select the **Edit Ctlne** button from the Analysis tab to edit the centerline.

2. The cursor changes to a pen.
3. Assess the centerline to verify accuracy.
4. Move the cursor (pen) to a specific point along the centerline and click to plot a point to modify the path of the vessel centerline.

**NOTE:** As you plot points, a new red line displays to show you how the centerline displays if you click . This line also displays in the 3D view.

5. If necessary, move the cursor (pen) to a different point along the centerline and click to plot a point. Continue to plot all additional points. As you plot additional points, the line will update to go through all the user control points.

**NOTE:** Click and drag the line and it dynamically shows the resulting line as you drag. The point displays after you release the mouse.

**NOTE:** Rotate, zoom, and scroll the curved view while the line is being created.

**NOTE:** Hover over a plotted point. The pencil changes to a hand. Click to move the plotted point.

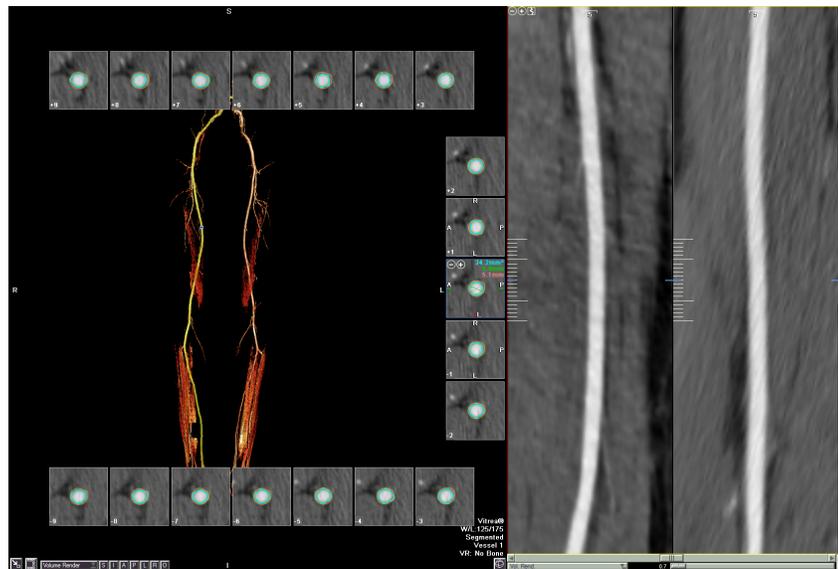
**NOTE:** Click  to clear the red centerline and start over.

6. Click  to apply the modified (red) centerline to be the final centerline.

## Cross-sectional and Curved Planar Reformat Vessel Views

- The curved vessel views are orthogonal CPR (Curved Planar Reformatted) views consisting of two elongated vessel views 90 degrees from each other. Use Vessel Probe to display these vessel views.
  - The right curved vessel view shows the vessel segment in a field of view that shows the least curvature.

- The left orthogonal vessel view (on the left of the two curved vessel views) is perpendicular to the field of view in the right-hand curved vessel view.



- The Cross-sectional and Curved Planar Reformat views display one or more cross-sectional views, 1mm reconstructions.
- Independently magnify/minify, scroll, and rotate the vessel views.

## Create 3D Image Batches

Create a manual batch by selecting the desired starting, intermediate, and ending images.

1. From the Visual tab, select desired settings or display options.
2. Select the **Batch** tab.

The **Start** button is automatically selected.



3. To capture intermediate images manually:
  - a. Click the image.

A check mark displays on the image. The Start button is unavailable and the Via button is available to collect intermediate

images for the batch. The Via button stays available until you click the End button.

**b.** Change the volume image position.

**c.** Click  to capture an intermediate image.

A check mark displays on the image.

**d.** Repeat steps b and c until you capture all desired intermediate images.

**e.** Change the volume position for ending image.

**4.** Click .

**5.** Click .



# CT Carotid

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## CT Carotid Artery Overview

The CT Carotid workflow the ability to visualize vessel structures.

The evaluation of contrast filled carotid arteries can be performed with one-click segmentation using Vitrea. The one-click segmentation permits you to easily calculate arterial stenosis and plaque burden.

**NOTE:** Because of the high HU value of contrast media in 100kV scans, the reliability of calcium detection within the vessel lumen is expected to be lower than that of regular kV scans.

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## CT Carotid Artery Lesson

### I. Select Study

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Load a Carotid study.

 See the instructions for your Vitrea type (VitreaAdvanced Through the Data Manager or VitreaWorkstation) in the **Select Study** chapter of the **VitreaAdvanced-VitreaWorkstation General Education and Reference Guide**.

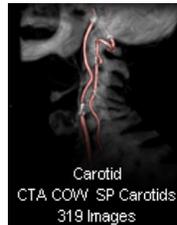
## II. Choose Protocol and Preset

---

Use one of these procedures:

### Data Manager

- Double-click the **Carotid** application thumbnail.



### Gallery Window

1. On the Gallery window, select the **Vascular: Carotid CT** protocol.

The Gallery choices update automatically.

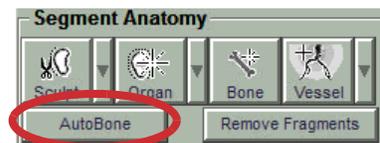
2. Click  next to the **3D Analysis** preset.

## III. Perform Analysis

---

### Automatically Remove Bone

1. In the Segment Anatomy Area, click **AutoBone**.
2. Review the segmentation and use the Manually Segment Bone technique to segment any additional bone regions.



### Segment Vessels

You can segment additional vessels that the automatic vessel segmentation missed.

**NOTE:** The default window/level value is the optimal setting for vessel segmentation using dynamic grow in COW studies.

- In the Segment Anatomy area, select the dropdown arrow next to Vessel and click  .



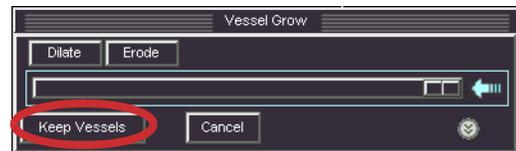
- Click and hold on a vessel.

**TIP:** Watch the blue selection area “grow”. Keep holding until entire vessel is selected.

- Repeat from step 3 for other vessels.

- Click  .

- Apply Visualization settings to the Vessels region.



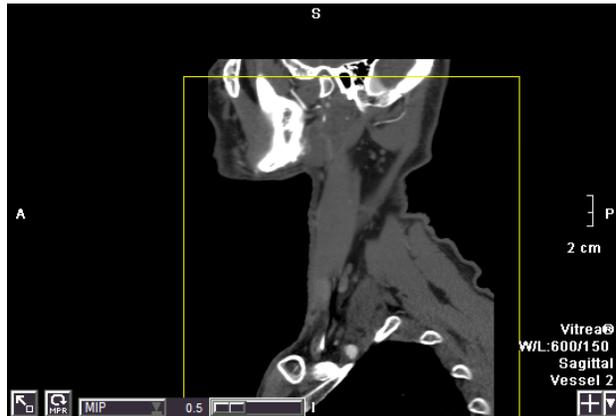
## Probe the Carotids

- Press **F7** to display the Right Lateral view or press **F6** to display the Left Lateral view.



- To remove a portion of the jaw to view the distal portions of the carotid:
  - Press T to activate the **Trim** tool.

- b. On the Sagittal MPR view, click and drag the yellow line to the desired location.



- c. To undo the trim, click the Reset Trim Limits icon.



10. On the Analysis tab, click  .

11. Probe the internal carotid followed by the external carotid artery bilaterally in 3D or any MPR view:

**TIP:** You may need to rotate the image to get the best view of the vessel in the 3D view.

- a. Click the vessel.

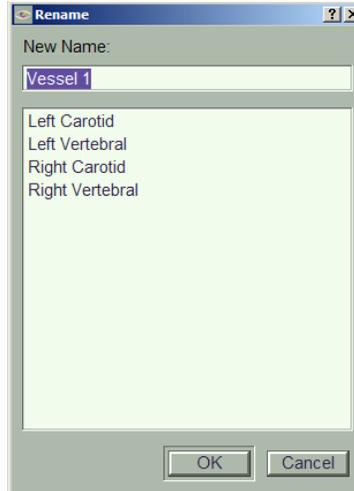
The Vessel Management box displays named vessels and unnamed vessels to show progression of work.

- b. Select the vessel in the Vessel management box. Right-click and select **Rename**, or double-click on the vessel name.

The Rename dialog box displays.



- c. In the New name field, select a name from the list or type the name of the vessel.



- d. Click **OK**.

### Extend a Probed Vessel

- 12. If the vessel you want to extend is not the currently selected vessel in the Vessel Management list, click the vessel name to select it.

- 13. Rotate the image to display the desired area of the vessel.

- 14. Click **Extend**.



The cursor changes to a pointed finger .

- 15. Click a point farther along the already selected vessel.

**TIP:** If the vessel probe can extend the vessel, it adds to the current vessel indicator line. If the vessel probe cannot extend the vessel, the status line displays the message Failed to find vessel.

- 16.** To refine the vessel indicator line, drag the cursor along the vessel indicator line to a desired end point and click.

**TIP:** As you drag the cursor, the vessel indicator line disappears. It will not be removed until you click.

## **Define a Lesion**

The Lesion tool defines a lesion in the vessel in either of the CPR views.

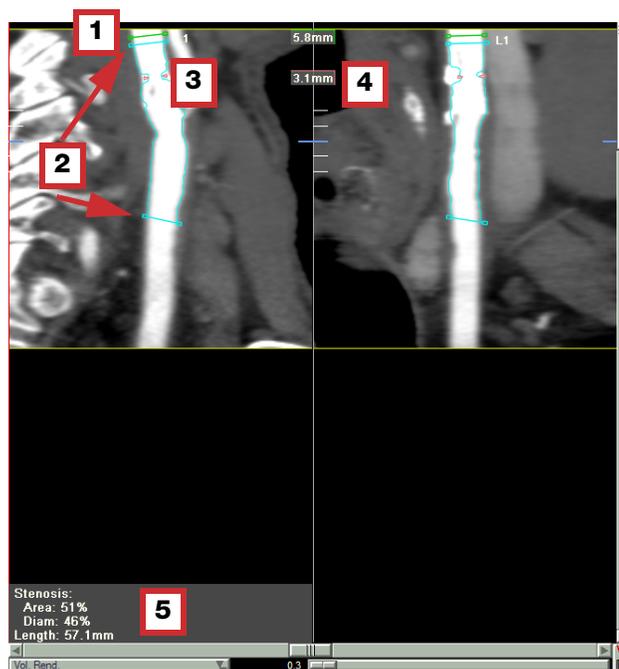
- 17.** From the Analysis tab, verify **Show Vessel** is selected.
- 18.** In the Vessel Tools area, click the dropdown for the second button.

The dropdown contains the following tools:



**Single** - When you draw a lesion using the Single method, Vitrea identifies a point as the reference point. Vitrea displays the area and minimum diameter at the narrowest point and at the reference point, and uses these measurements to calculate the area and diameter stenosis.

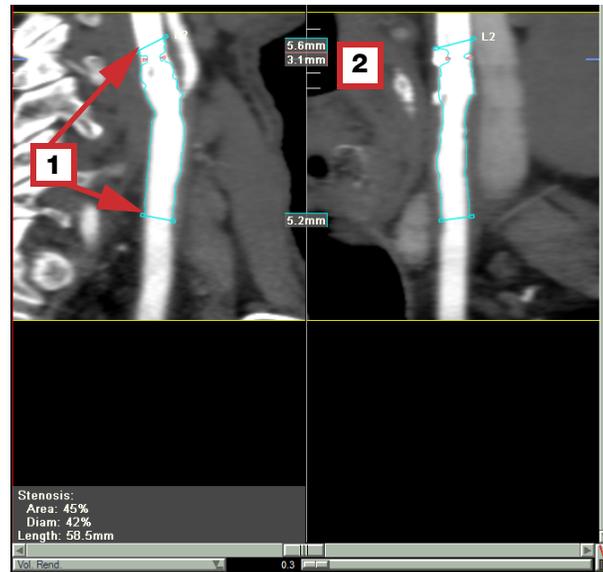
**TIP:** The reference point may need to be moved manually.



Callout	Description
1	Green line indicates reference point
2	Cyan lines indicate start and end points of lesion
3	Red arrows indicate stenosis point
4	Minimum lumen diameter at the stenosis point
5	Stenosis measurements



**Average** - When you draw a lesion using the Averaged method, Vitrea calculates the average of the area and minimum diameter for the start and end points. It compares these measurements to the area and minimum diameter at the narrowest point to create stenosis measurements.



Callout	Description
1	Averages diameter/area (top and bottom line) as the reference measurement
2	Minimum lumen diameter at the stenosis point



**Dual** -When you draw a lesion using the Dual Reference method, Vitrea calculates the average of the area and minimum diameter for the reference points marked with green lines. It compares these measurements to the area and minimum diameter at the narrowest point to create stenosis measurements.

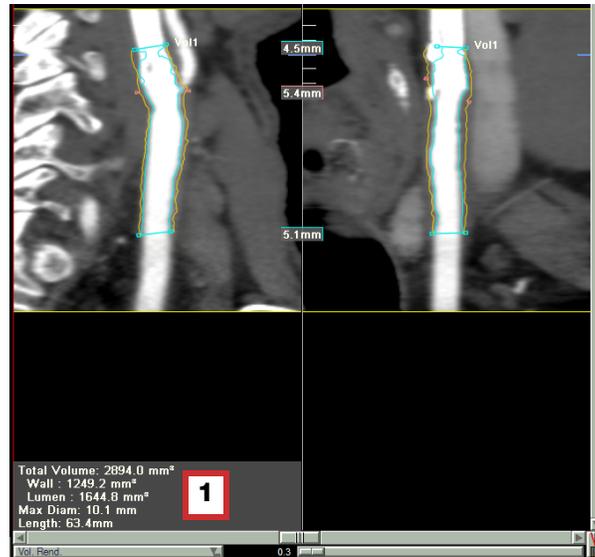


Callout	Description
1	Top and bottom green cross sections as reference
2	Red cross section is the minimum diameter
3	Blue line represents length measurement



**Volume** - When you draw a region using the Volume method, Vitrea displays the volume of the lumen and outer wall. It also identifies the maximum outer wall diameter. Use this option for thrombosed regions.

FIGURE 2. Lesions – Volume Method



Callout	Description
1	Displays the volume of the lumen and outer wall, and identifies the maximum outer wall diameter.

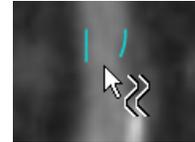


**Landing Zone** - Use the Landing Zone option to define specific regions for in-depth analysis.

19. Click the dropdown arrow next to the Single tool and select Single. The cursor changes to the selected Lesion Measurement shape.



**20.** Click in the CPR view just above the start of the lesion and drag to just below the end.



**TIP:** Vitrea adds an entry in the Vessel Management area.

**TIP:** Vitrea identifies:

Feature	Identified by
Identified lesion	Cyan lines
Point of maximum narrowing (stenosis)	Red arrows
Lumen diameter at the stenosis point	Number in the curved view with red border, corresponding to the red arrows (displays in the two-up curved view)
Reference point(s) for single or dual-reference lesions	Green line(s) <b>TIP:</b> Be sure the location of the reference point is accurate for the identified lesion. If necessary, drag the green line to move it.
Lumen diameter at the reference point	Number(s) in the curved view with green border, corresponding to the green line(s) (displays in the two-up curved view)
Stenosis measurements	Table at the bottom of the CPR view

Stenosis:  
Area: 96 %  
Diam: 90 %  
Length: 22.8mm

**21.** Repeat the step above as many times as necessary.

## Lesion Measurements

Each lesion object displays the following measurements:

- Minimum lumen diameter at each of the above points
- Length of the lesion in mm
- Percentage Area Stenosis

The percentage area stenosis is calculated using the formula:

**% area stenosis = (1 - Stenosed lumen area / Reference lumen area) × 100%**

- Percentage Diameter Stenosis

The percentage diameter stenosis is calculated using the formula:

**% diameter stenosis = (1 - Stenosed min lumen diameter / Reference min lumen diameter) × 100%**

## Vessel Probe Curved Inset View

The curved inset view is similar to the view you create by changing the MPR to curved reference. The length is preserved when you rotate the CPR.

### Fit the image in view

Fit the image on the side that currently has the larger longitudinal length. After the image is fit in the view, zoom the image in and out to cover most of the viewer area.

**NOTE:** When you fit the image to the viewer in curved mode and switch to the straightened mode, re-fit the image to view it in the viewer.



## Measurement in the Left and Right CPR on Y direction

The ruler references that refer to the same ruler have different Y coordinates in the left and right CPR.

- For **ruler** references, the annotation is drawn in different Y coordinates in the left and right CPR view.
- For **lesion** references, the annotation is drawn in the middle of the left and right viewer and uses the Y coordinate from the ruler drawn on the right CPR.

## Measure Centerline Length

The Length tool measures length along the centerline or between two points on the vessel centerline.

22. Click  to change the volume view to a 1-up image and display a vessel probe view.

23. Select  located under Lesion Analysis.

24. Click and drag either end to edit the length.

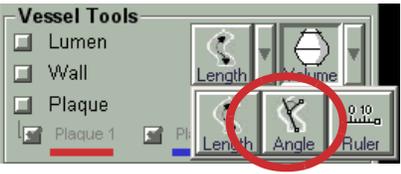
The value of the length displays at the proximal end of the length measurement. It represents the length along the centerline between the two specified points.

## Create Centerline Angles

The Angle tool creates an angle along the centerline.

25. Click  to change the volume view to a 1-up image and display a vessel probe view.

26. Select  located under Lesion Analysis.

27. Select 

**NOTE:** Once you select Angle, the Length dropdown changes to Angle. Toggle the Length and Angle buttons.

28. In Curved CPR view, click and release at the start of the angle.

29. Move the cursor to the vertex location on the centerline and click and release.
30. Move the cursor to the end point of the angle and click and release to complete the angle.

### Apply a Visibility Preset Setting

Change the appearance of the 3D view by applying an anatomy setting.

31. Select a Visibility Preset setting.



**NOTE:** Select the dropdown arrow for more preset selector options.

**TIP:** Drag the Transparency slider  to adjust the transparency of a region.

### Take Snapshots

32. Right-click and select  (or press S) to activate the camera.
33. Move the cursor to the image and click.

Snapshots, measurements, rulers, W/L, or segmentation option can be restored from the Report page or the Study Directory.

## IV. Distribute Findings

---

The snapshots you save in the Viewer window are saved to the Report window.

1. Click  at the bottom of the window.
2. Export your findings or create a report.

 See the **Distribute Findings** chapter of the **VitreAdvanced-VitreWorkstation General Education and Reference Guide** for instructions on exporting findings, restoring workflow, and creating reports.

---

## Additional Procedures

### Point-of-Interest View Mode

The Point-of-Interest View mode shows the volume immediately surrounding the current crosshair position. This mode removes all surrounding tissue, bone, and so on, to reveal the point of interest.



**5:1 format**



**Point of Interest Box**

To activate the Point-of-Interest box:

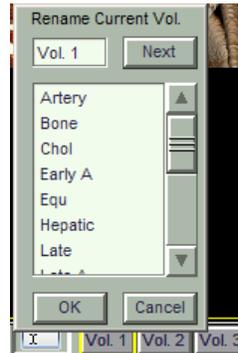
1. Click the crosshair on the anatomy of interest in 2D.
2. In the POI box, right-click and drag the mouse away from you to decrease the size of the POI cube; move the mouse toward you to increase.

### Switching Active Volumes

1. With multiple volumes loaded, switch the selected volume by using the Volume Navigation buttons at the bottom of the Viewer window.



2. To change the label on the button for the currently selected button, click  and select a name or type a new one.



## Manual Stenosis Measurement

To measure vessel diameter and calculate stenosis ratio percentage:

1. Click  .
2. Click and drag across the width of the displayed lumen of the axial cross-sectional view.
3. Scroll to a narrowed area and measure the lumen.
  - The system displays the current maximum and minimum diameter measurements in green (max) and red, (min) respectively, in the CPR views. Any other measurements display in blue.
  - When you have drawn at least 2 rulers, the system calculates the percentage of stenosis by comparing the maximum (normal) and minimum (stenosed) measurements. The percentage and the formula to calculate it display in the lower corner of the CPR views.

**TIP:** Place two rulers per cross-section, but you may redraw the rulers as many times as needed.

## Rotate CPR Views

To rotate the CPR views:

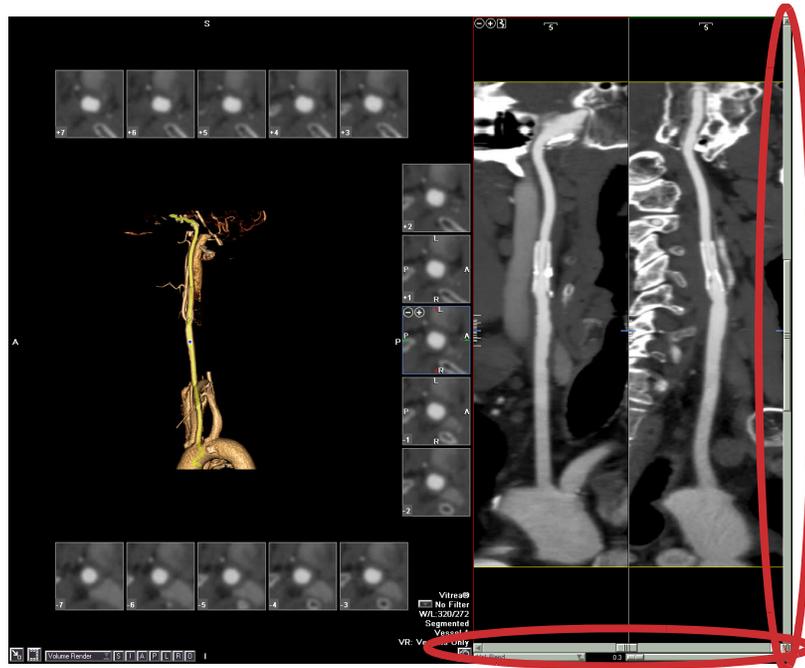
- Click and drag the slider bar to the right of the CPR views to move along the vessels.

**TIP:** Roll the mouse wheel to move the CPR views.

- Click and drag the slider bar under the CPR views to rotate them.

**TIP:** In the CPR view, you also have the option to click and drag to rotate.

**TIP:** The blue line in the CPR view corresponds to the location of the blue dot in the green shaded vessel and the cross-sectional view with the blue border.

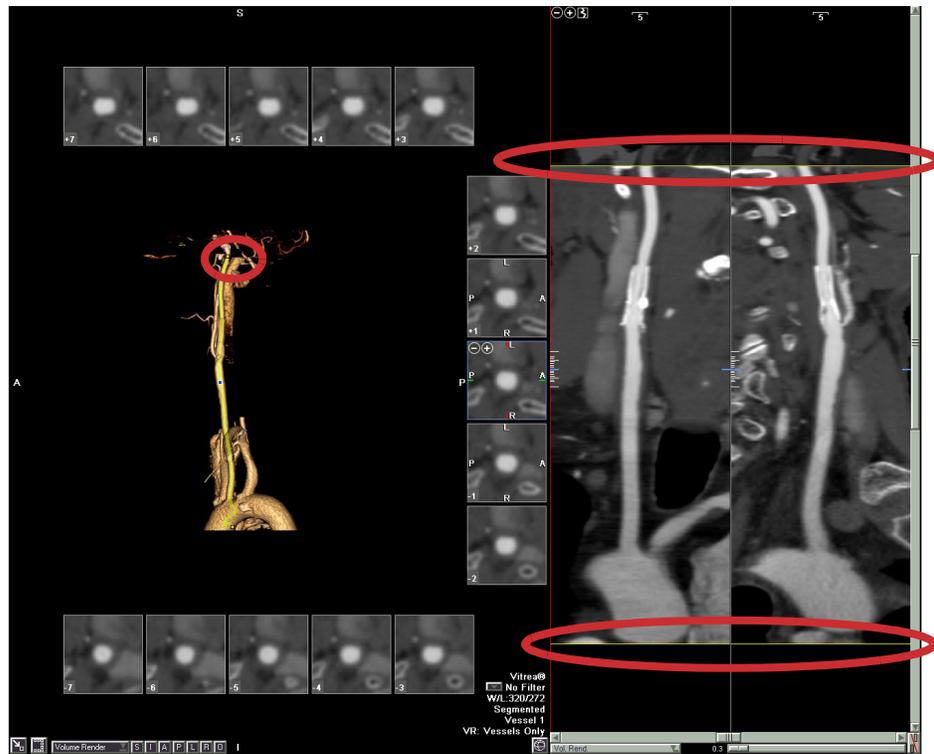


## Trim CPR Views

To trim the CPR views, locate the yellow trim line on the top or bottom of the CPR view. Click and drag the yellow trim line.

**TIP:** A yellow dot displays in the 3D view to identify the trim location.

**NOTE:** Press **F11** to Undo.



## Create an Automatic MIP

MIP is a shading setting that displays data using the highest data values for each voxel of the image. MIP is a good setting to use when competing

features composed of voxels with similar or higher values might be obscuring the feature of interest.



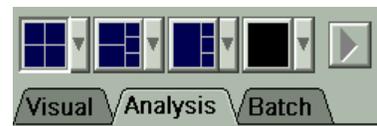
Use MIP to:

1. Differentiate between contrast and calcium in vessels.
2. View thick slab MPRs with many tiny, loose body bone fragments.
3. View the carotids.
4. View a thick slab MPR.

## Automatic Curved Reformats

In Curved MPR mode, use one of the MPR views to define a curve to measure curved vessels in another MPR view. This is useful for pre-surgical carotid artery measurements.

1. Click  to switch to a 4-up view.
2. Select the vessel listing in the Vessel Management area.

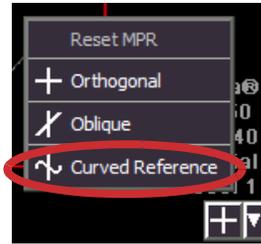


**TIP:** Do not select a lesion listing.

3. In the lower-right corner of the axial view, click the dropdown arrow.



4. Click **Curved Reference**.



**TIP:** The curved centerline displays in the Curved view, and the measurement of the entire centerline displays in yellow.

**TIP:** To zoom in on the view, left + middle click and drag down in the view.



5. In the Curved view, drag the smaller, lighter blue line (Measuring line) to a point along the centerline you want to measure.
6. Drag the longer, darker blue line (Transverse line) to the other point along the centerline you want to measure.

**TIP:** The measurement between the two blue lines displays in blue and the measurement of the entire centerline displays in yellow.

7. Right-click in the image, then click .

**TIP:** If the centerline and measuring lines disappear when you click the camera button, right-click in the view again and select Hide Crosshair in Export, then click the view to take the snapshot.

## Head and Neck Bone Subtraction

Use the head and neck bone subtraction feature to display a volume of the vessels with the bone removed.

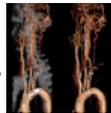


1. Load two coincident CT volumes of the head and neck: a pre-contrast series and a post-contrast series.

**NOTE:** Loading thick-slice datasets may result in sub-optimal performance.

2. Select a preset:
  - From the Data Manager, double-click the Head/Neck Subtraction

Application icon.



**OR**

- From the Gallery, click **Pick** for the 3D Analysis preset.

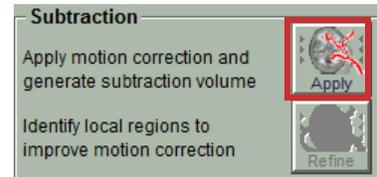
Vitrea attempts to register the two volumes to correct for patient motion, then creates a “subtraction” volume that attempts to retain all contrast-enhanced structures, such as vessels, and to eliminate all high-density structures, such as bone or calcium.

**NOTE:** Vitrea uses the contrast/bolus agent DICOM tags to classify each volume as “Pre” and “Post.” If Vitrea is unable to classify the volumes, or if Vitrea misidentified the volumes, you must rename the volumes before applying the registration.

- Click the Volume Rename button and rename each volume “Pre” and “Post” appropriately.



3. If Vitrea did not apply the motion correction registration automatically, or if you wish to re-apply the motion correction registration, click **Apply**.



**TIP:** To cancel the registration during processing, click



Vitrea creates a new “Sub” volume, which displays on the left side of the viewer. The views are locked with regard to crosshair position, pan, and zoom.

**TIP:** Click  to display all three volumes in one view.

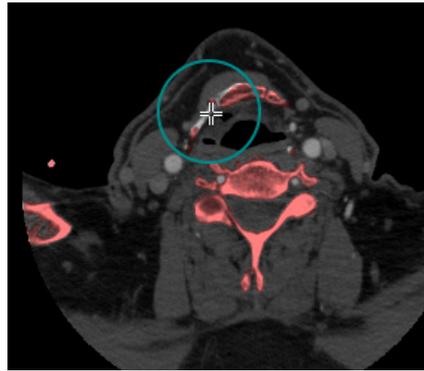
4. To refine the motion correction in local regions with misregistration, do the following steps:

- a. Click .

A red overlay displays on the “Post” volume.

- b. Scroll through the MPR view of the “Post” volume looking for bone, artifact, or calcium that did not get subtracted.

- c. Click in the MPR view to start the local motion correction registration.



- d. Repeat from step b as necessary.

**NOTE:** The Refine tool is not available for volumes with gantry tilt. With the Refine tool, you can undo/redo one step back, but no more than one. When you undo/redo, verify refinement.

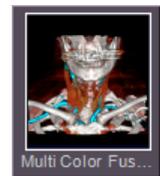
- 5. Perform segmentation, sculpting, measuring, Vessel Probe, Lesion Analysis, and other tasks on the “Sub” volume to complete your workflow.

**NOTE:** The software may adjust the HU values in the “Sub” volume during subtraction, especially for high-density regions.

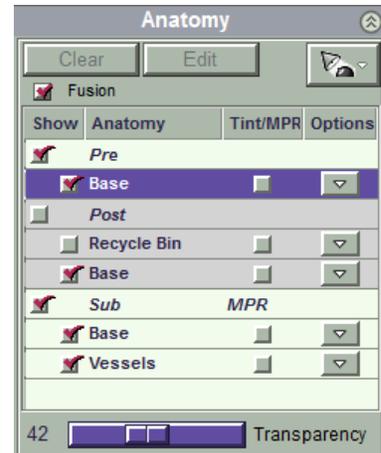
**NOTE:** Wall contours and SUREPlaque measurements are not supported in the “Sub” volume.

**NOTE:** Denoising is not available with the subtraction feature.

- 6. To create a fused volume of the “Pre” and “Sub” volumes to visualize bony landmarks or calcium, select the Multi-color Fusion preset selector.



7. Adjust the transparency as desired.
8. Take snapshots.





# General MRA (MR Angiography)

---

## Contents

General MRA Overview

General MRA Lesson

- I Select Study
- II Choose Protocol and Preset
- III Perform Analysis
  - Segment Anatomy
  - Include Additional Arterial Structures
  - Probe Vessels
  - Take Snapshots
- IV Distribute Findings

Additional Procedures

- Create 3D Image Batches
- Change the 3D Image into a MIP

---

## General MRA Overview

Use Vitrea tools to segment and isolate specific vessels of an MRA data set for analysis.

- Point and Click Segmentation
- Vessel Probe Analysis

---

# General MRA Lesson

## I. Select Study

---

Load an MR study.

 See the instructions for your Vitrea type (VitreaAdvanced Through the Data Manager or VitreaWorkstation) in the **Select Study** chapter of the **VitreaAdvanced-VitreaWorkstation General Education and Reference Guide**.

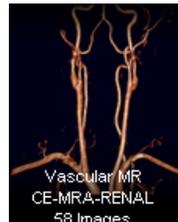
## II. Choose Protocol and Preset

---

Use one of these procedures:

### Data Manager

- Double-click the **Vascular MR** application thumbnail.



### Gallery Window

1. On the Gallery window, select the **Vascular MR** protocol.

The Gallery choices update automatically.

2. Click  next to the **COW Analysis** preset.

**NOTE:** Choose the Vascular MR protocol to perform the workflow for carotid, aorta, runoff, and renal analysis. The Analysis steps will be the same as the steps given for Circle of Willis.

### III. Perform Analysis

---

**NOTE:** Use this section for MR Circle of Willis workflow and MR Carotid workflow.

#### Segment Anatomy

1. In the lower left corner of the 3D image, click  to maximize the 3D image.

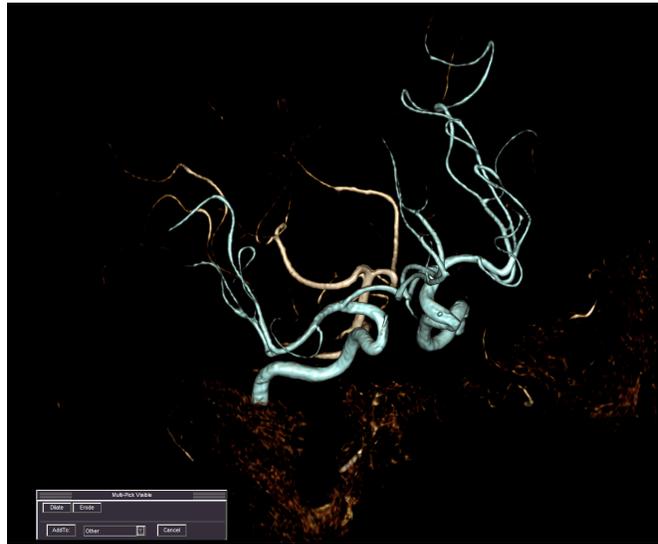


2. Right-click and select  to window level the 3D image.

**TIP:** Window level is also available when you left + right-click and drag.

3. From the Analysis tab, click  .

4. Click on a vessel in the 3D image.

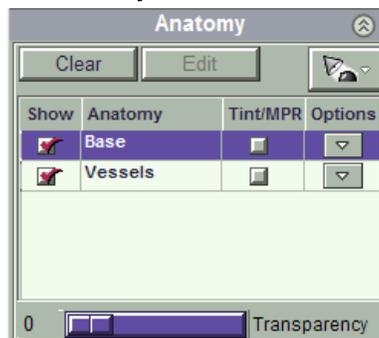


5. From the dropdown, select vessels.



6. Click **Add To:**.

The selection is automatically added to the Anatomy area.



## Include Additional Arterial Structures

7. Click  to return to 4-up view.
8. Select Tint/MPR in the Vessel listing.

**NOTE:** Select the Options dropdown and select **Highlight & Tint/MPR**.

9. In the 2D view, scroll to find a vessel that does not display in red and sculpt in the vessel region.

The vessel displays in red.

- a. Click **Sculpt**.
- b. Draw a contour.
- c. Select Vessels from the dropdown and click **Add To:**.

## Probe Vessels

10. From the Analysis tab, click  to probe the vessel.

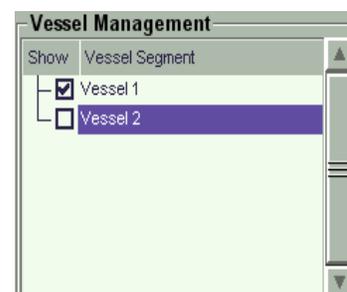
11. Click the vessel.

The Vessel Management box displays named vessels and unnamed vessels to show progression of work.

**TIP:** Press **F11** to Undo.

Select the vessel in the Vessel management box, right-click and select **Rename**. The rename dialog box displays.

**NOTE:** If the vessel name in the Vessel Management box is highlighted but the check box is cleared, the vessel in the volume rendered view may be labeled incorrectly.



## Take Snapshots

12. Right-click and select  (or press S) to activate the camera.
13. Move the cursor to the image and click.

Snapshots, measurements, rulers, W/L, or segmentation option can be restored from the Report page or the Study Directory.

 See the Additional Procedures section for information on Creating 3D Image Batches.

## IV. Distribute Findings

---

The snapshots you save in the Viewer window are saved to the Report window.

1. Click  at the bottom of the window.
2. Export your findings or create a report.

 See the **Distribute Findings** chapter of the **VitreiaAdvanced-VitreiaWorkstation General Education and Reference Guide** for instructions on exporting findings, restoring workflow, and creating reports.

---

## Additional Procedures

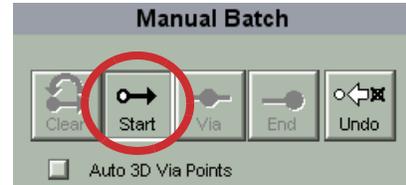
### Create 3D Image Batches

Create a manual batch by selecting the desired starting, intermediate, and ending images.

1. From the Visual tab, select desired settings or display options.

2. Select the **Batch** tab.

The **Start** button is automatically selected.



3. To capture intermediate images manually:

- a. Click the image.

A check mark displays on the image. The Start button is unavailable and the Via button is available to collect intermediate images for the batch. The Via button stays available until you click the End button.

- b. Change the volume image position.

- c. Click  to capture an intermediate image.

A check mark displays on the image.

- d. Repeat steps b and c until you capture all desired intermediate images.

- e. Change the volume position for ending image.

4. Click  .

5. Click  .

## Change the 3D Image into a MIP

1. From the bottom of the 3D image, select the Volume Render dropdown box.



2. Select **MIP**.



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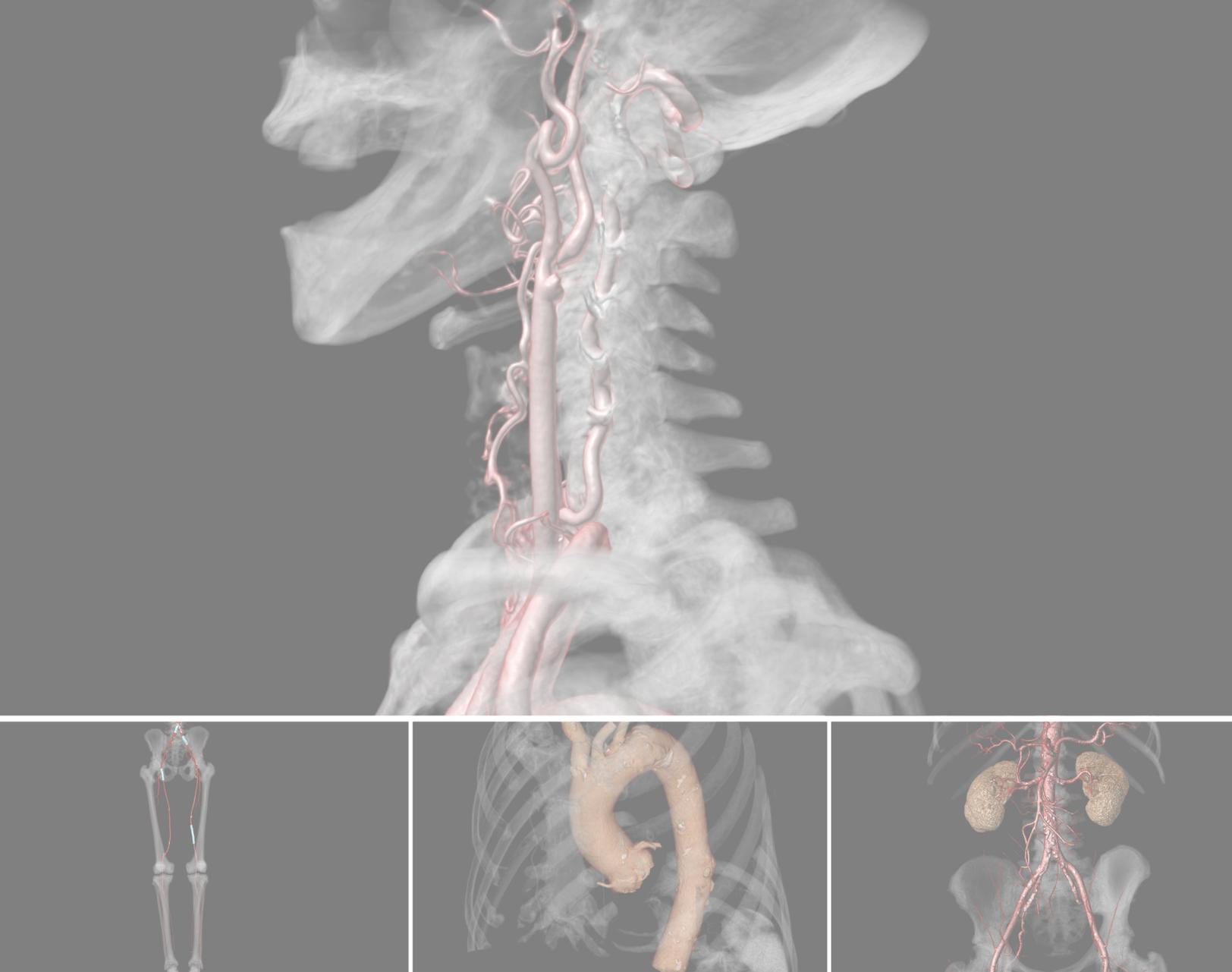
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