CT Transcatheter Aortic Valve Replacement (TAVR) Planning

VITAL U

TAVR: Overview of the Application

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.

Some key features of the application include:

- Comprehensive template of measurements, including diameter, area, angle, circumference and length.
- Automated segmentation and centerlines of aorta and aortic root for assessment and delivery approach.
- Three-point aortic valve plane definition.
- Display of C-Arm angle for device placement.
- Flexibility to enable planning for the transfemoral, subclavian and transapical delivery approaches.
- Create new, add or modify stent planning templates with the Custom Device Template Editor.
- Ability to load multiple volumes or series, allowing users to analyze diastolic, systolic and access phases with combined reporting.
- Optimized viewing for cardiac valves and calcium.

TAVR-Workflow:

The Steps:
- Select Study
- Choose Protocol and Preset
- Volume Navigation
- Set Valve Plane
- Predict the angle of implantation. (C-Arm Angles)
- Measure/Modify Annulus Diameter/Annulus Size
- Measure/Modify Sinotubular Junction (STJ) Diameter /Size
- Measure/Modify Sinus of Valsalva Width/Height
- Measure Annulus to LM and RCA Height
- Apply Aortic-Iliac Access and review Auto Centerline
- Vessel Extend
- Edit Centerline and Contours
- Measure/Modify Maximum Ascending Aorta Diameter
- Measure/Modify Minimal Abdominal Aorta Diameter
- Measure/Modify Maximum Thoracic Aorta Diameter
- Measure/Modify Aortic Neck Angle
- Measure/Modify Left/Right Common Iliac/External Iliac/Femoral Arteries
- Maximum Tortuosity Left/Right Iliac
- Add New Measurements
- Set Diameter Thresholds
- Review specialized Presets (Calcium/Leaflet view)
- Modify/Create New Templates
- Create Batch and Snapshots
- Distribute Finding and Reports

TAVR-Select Study

Launch
Vitrea®

Double-click the **TAVR application**.

OR

Select **Series** and choose a specific data set. Click on **Advanced Viewer**.

TIP: User can load up to **4** series at one time. Hold **CTRL** when selecting each series.
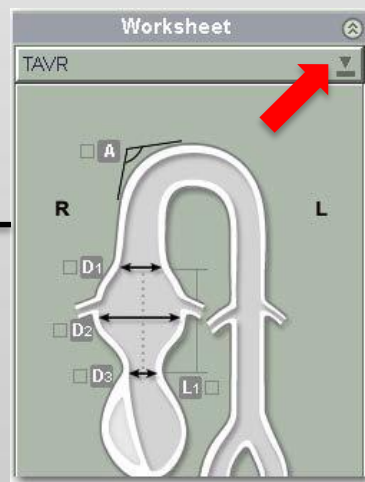
TAVR-Protocol and Preset

Select Protocol **Vascular: TAVR CT.**

Select **Pick**.
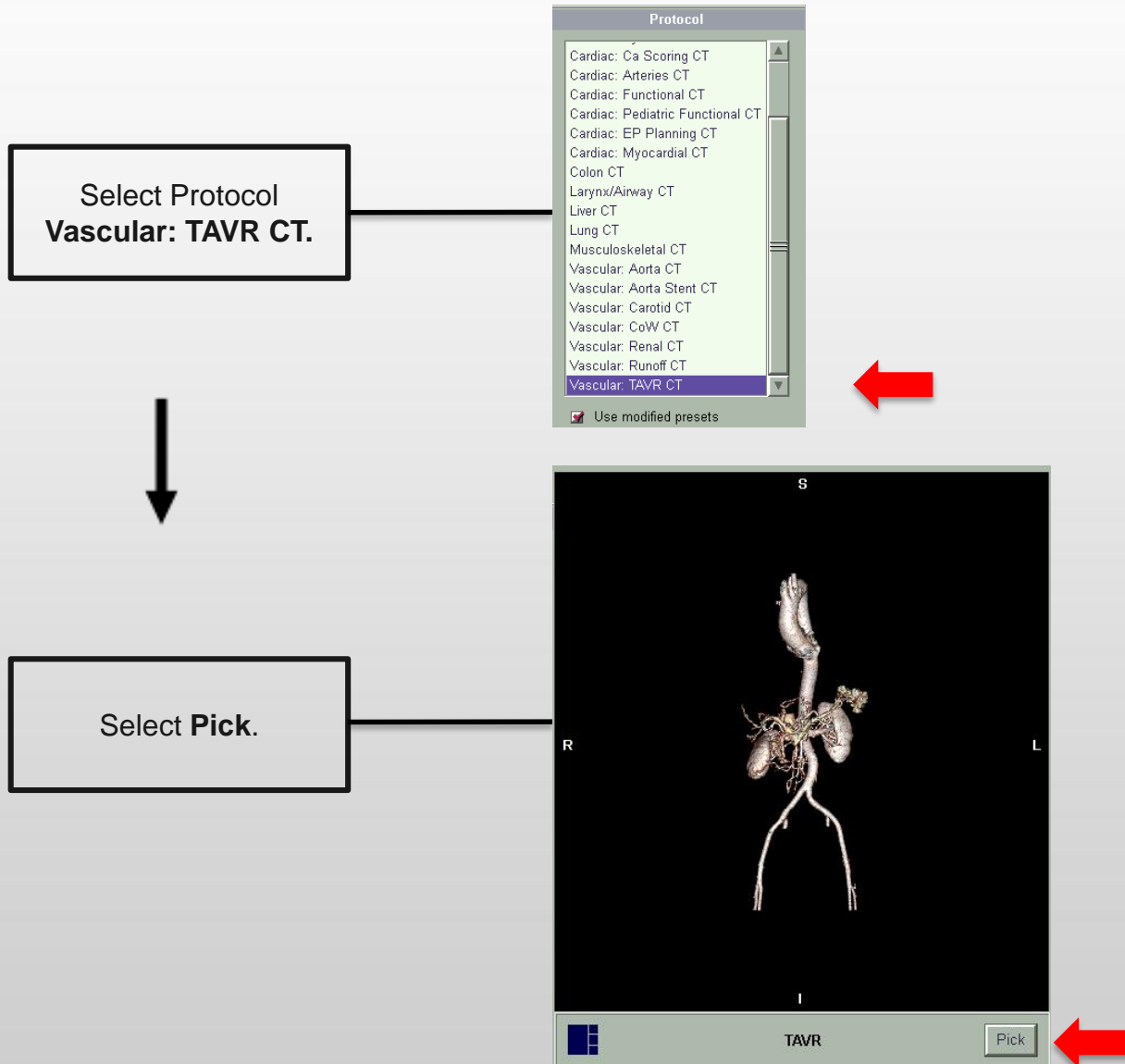
TAVR-Viewer

The viewing screen displays three oblique **MPRs** and a **3D view**.

The **TAVR** workflow **measurement list is** displayed.

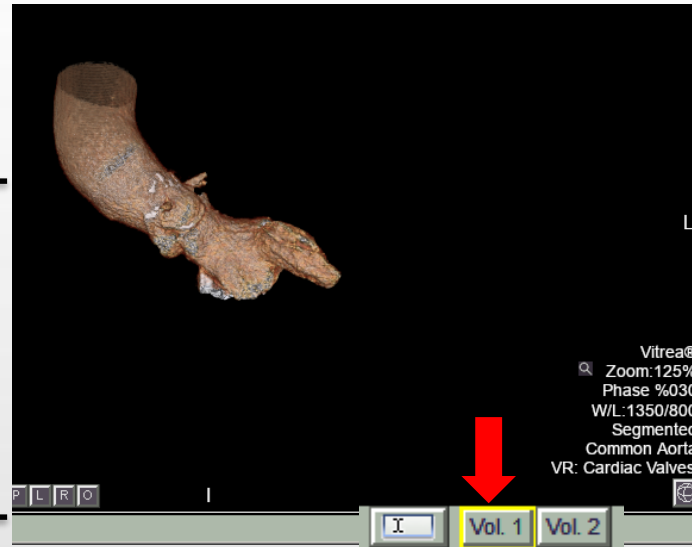**Click the arrow** next to **Worksheet** to display the **TAVR Worksheet**.

TAVR-Volume Navigation

You can **rename** the **volumes** when multiple series are loaded.

Click on the **Volume** you want to rename.
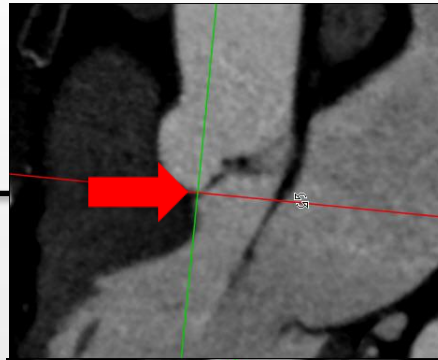Click on the icon next to **Vol. 1.**

Rename the volume.
Click **OK.**
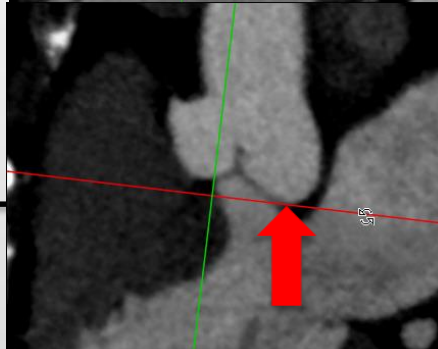Repeat for the remaining volumes.

Click Next to rename the other volumes.

TAVR-Set Valve Plane

Place the **crosshair** at the bottom of one
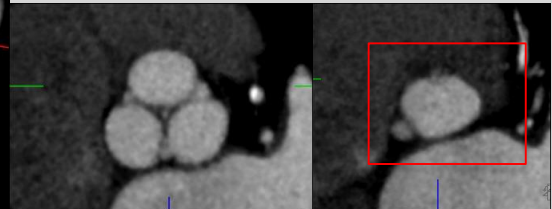of the cusps on the long axis view.

Continue within the same view and scroll to locate the bottom of the second cusp.
Rotate the **red** line until it intersects both cusps.

Move across to view the other long axis image.

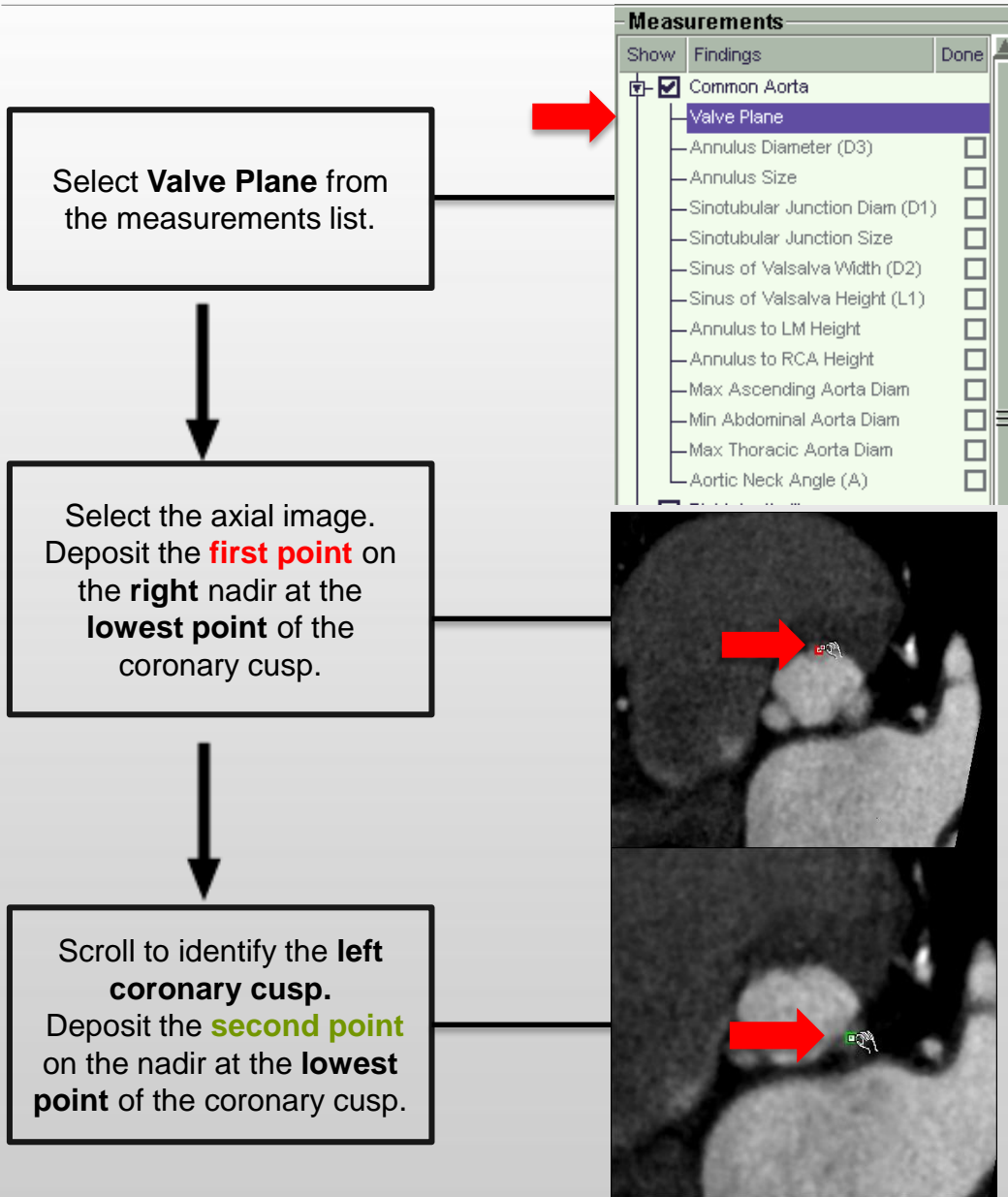**Rotate** the **red** line until it is **parallel** with the cusps.

The **short axis** view **displays the valve plane.**

Cine through valve until 3 cusps come into view. Adjust the crosshair rotation as needed.

TAVR-Set Valve Plane

Select **Valve Plane** from the measurements list.

The axial view is selected when placing the valve plane points.

Select the axial image. Deposit the **first point** on the **right** nadir at the **lowest point** of the coronary cusp.

Scroll to identify the **left coronary cusp.** Deposit the **second point** on the nadir at the **lowest point** of the coronary cusp.

TAVR-Set Valve Plane

Scroll to identify the **non coronary cusp**. Deposit the **third point** on the nadir at the lowest point of the cusp.
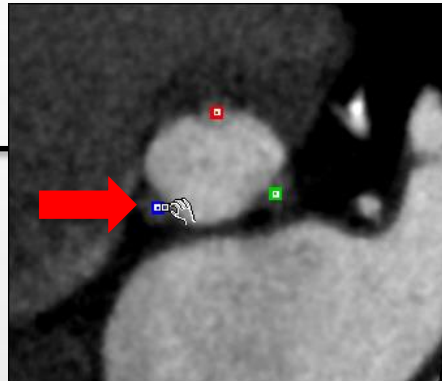
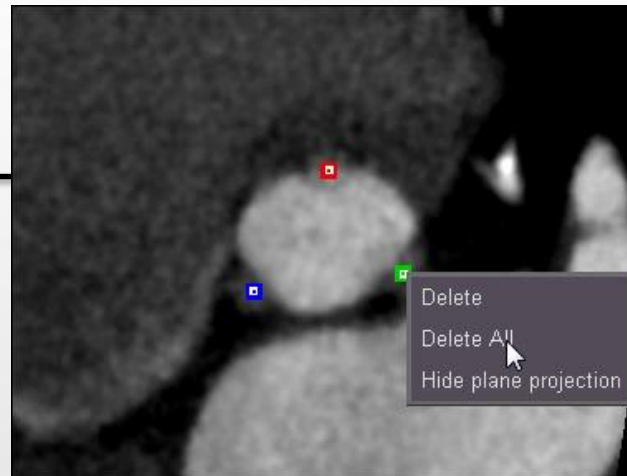The **valve plane** is now identified in **purple.**

Take a **Snapshot.**

TIP: Click on the valve points in any plane to edit.
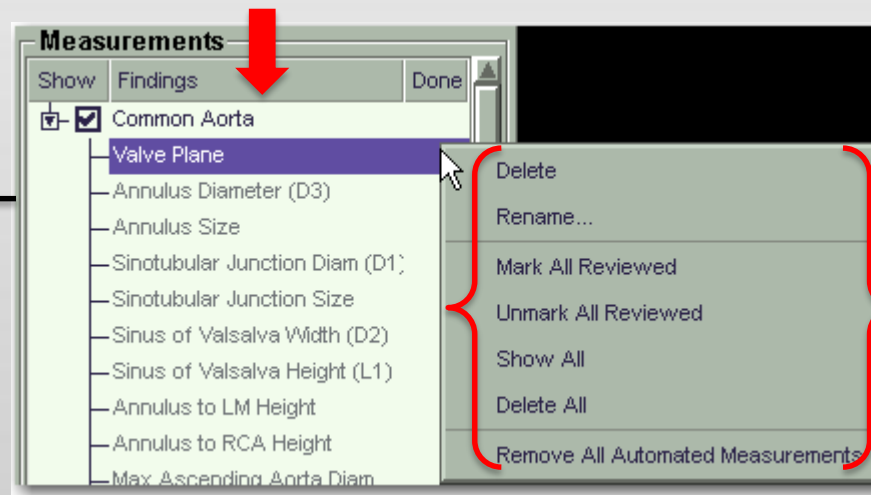
TAVR-Delete Valve Points

To **Delete** or **Delete All** valve points.
Right-click a valve point marker.
Select from the options.

OR

Hide or **Show** the plane projection

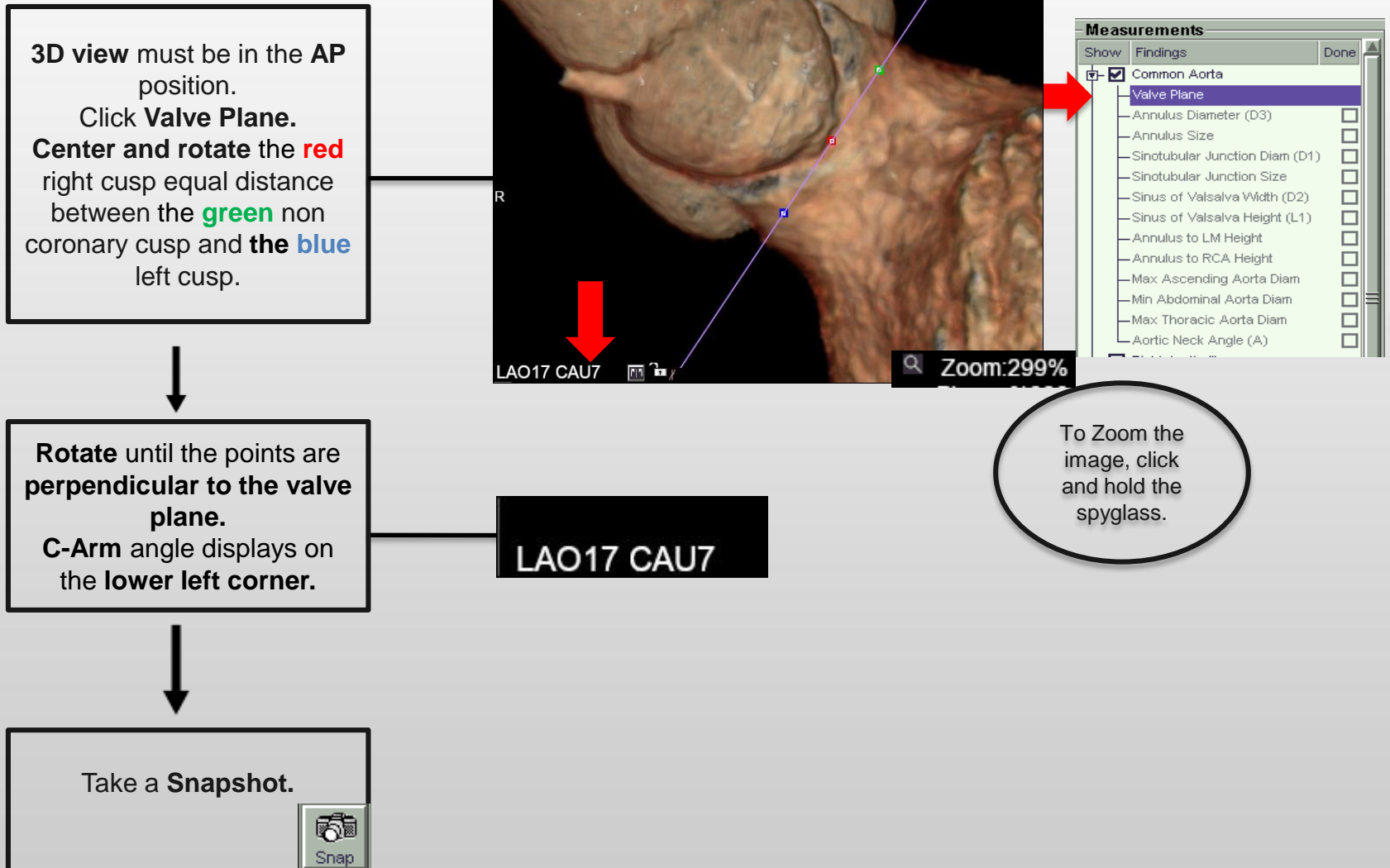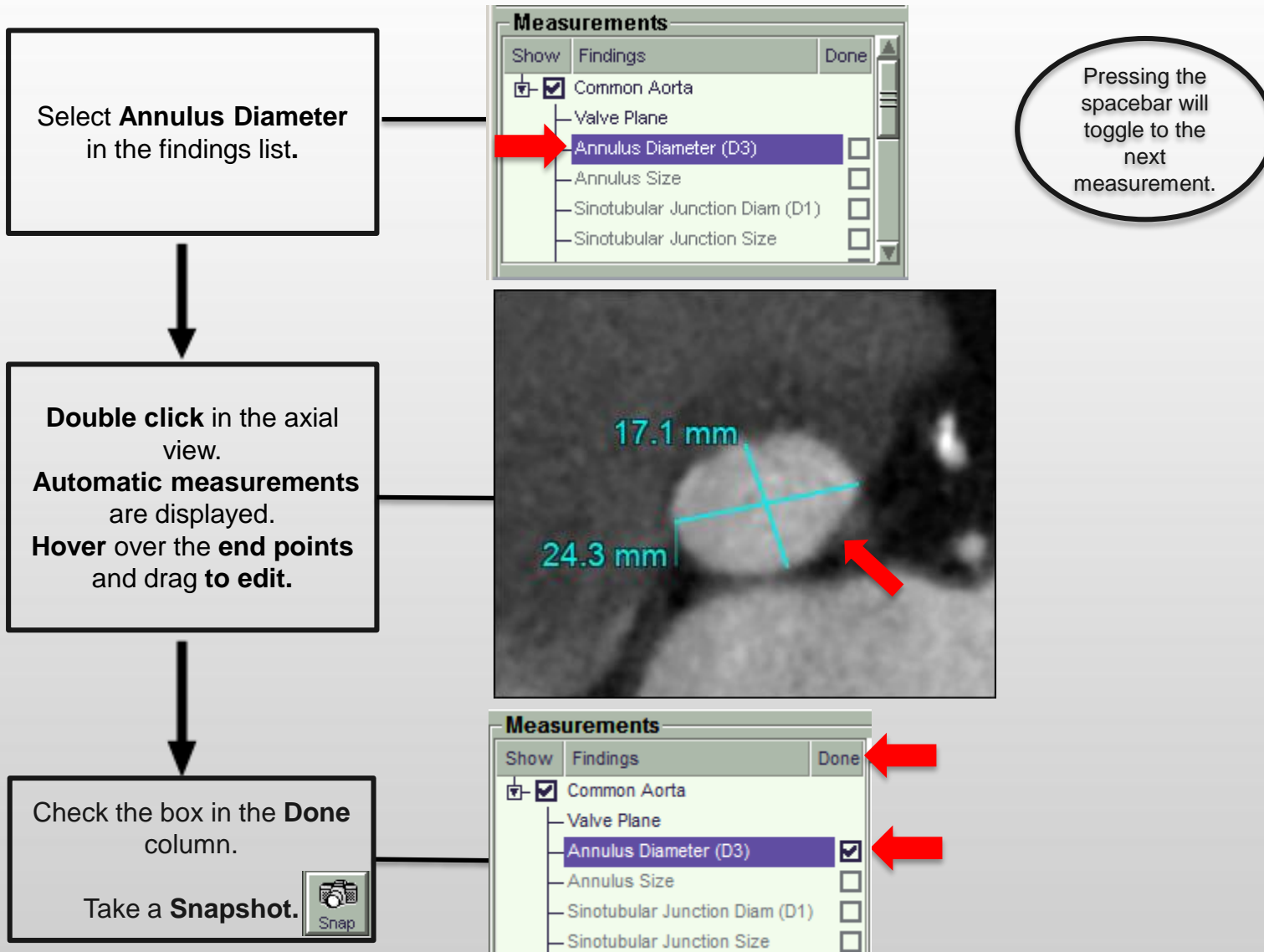Right-click on the **Measurement Findings.** Select from the options.

You can edit all measurements.

TAVR- C-Arm Angles

The valve plane is automatically generated and superimposed on the 3D images to predict the angle of implantation.

3D view must be in the **AP** position.
Click **Valve Plane.**
Center and rotate the **red** right cusp equal distance between the **green** non coronary cusp and **the blue** left cusp.

Rotate until the points are **perpendicular to the valve plane.**
C-Arm angle displays on the **lower left corner.**

Take a **Snapshot.**

Snap

LAO17 CAU7

LAO17 CAU7

Measurements

Show	Findings	Done
	Common Aorta	
	Valve Plane	
	Annulus Diameter (D3)	☐
	Annulus Size	☐
	Sinotubular Junction Diam (D1)	☐
	Sinotubular Junction Size	☐
	Sinus of Valsalva Width (D2)	☐
	Sinus of Valsalva Height (L1)	☐
	Annulus to LM Height	☐
	Annulus to RCA Height	☐
	Max Ascending Aorta Diam	☐
	Min Abdominal Aorta Diam	☐
	Max Thoracic Aorta Diam	☐
	Aortic Neck Angle (A)	☐

Zoom:299%

To Zoom the image, click and hold the spyglass.

TAVR-Measure/Modify Annulus Diameter

Select **Annulus Diameter** in the findings list**.**

Measurements

Show	Findings	Done
☑	Common Aorta	
	Valve Plane	
	Annulus Diameter (D3)	☐
	Annulus Size	☐
	Sinotubular Junction Diam (D1)	☐
	Sinotubular Junction Size	☐

Pressing the spacebar will toggle to the next measurement.

Double click in the axial view.
Automatic measurements are displayed.
Hover over the **end points** and drag **to edit.**

17.1 mm

24.3 mm

Check the box in the **Done** column.

Take a **Snapshot.**

Snap

Measurements

Show	Findings	Done
☑	Common Aorta	
	Valve Plane	
	Annulus Diameter (D3)	☑
	Annulus Size	☐
	Sinotubular Junction Diam (D1)	☐
	Sinotubular Junction Size	☐

TIP: Only measurements selected as **Done** display on the **Report.**

TAVR-Edit/Delete Measurement

Make sure the measurement is **not checked** under **Done**.
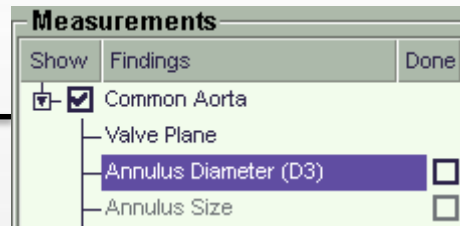
Right click the measurement and **Delete/Delete All.**
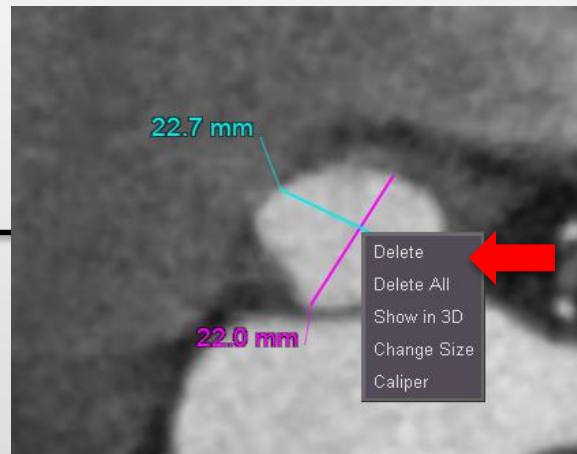
Click on the **measurement** you want to correct.
The measurement will be highlighted in **purple.**
Click **ruler** and **measure.**
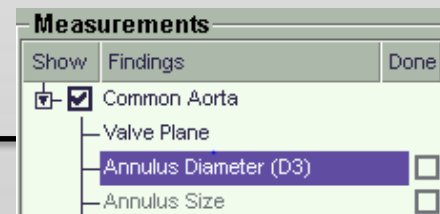
TAVR-Measure/Modify Annulus Size

Click **Annulus Size** in the findings list.
The **ROI** tool will be active by default.
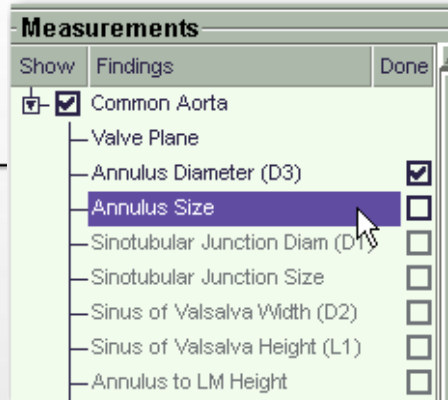
Double click in the axial image.
Edit the size by **dragging** the **pencil** around the borders.
You may **include** or **exclude** calcium.
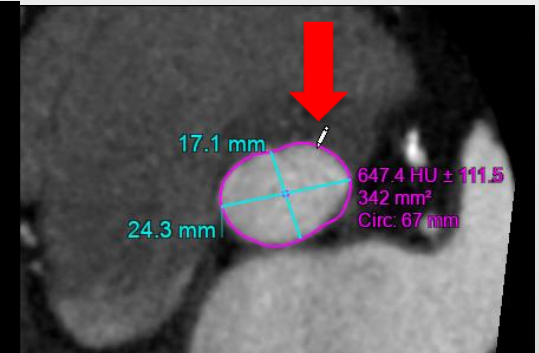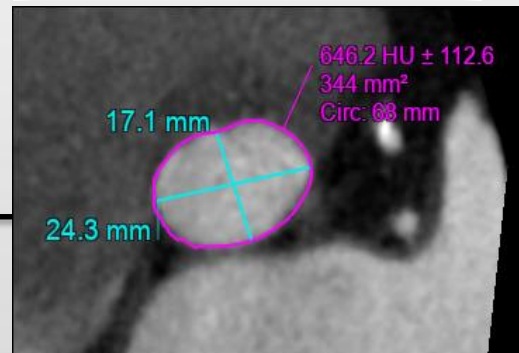
OR

Click around the **perimeter** of the area of interest placing **anchor points**.
Double click to connect the points.
To edit: re-draw with the pencil.
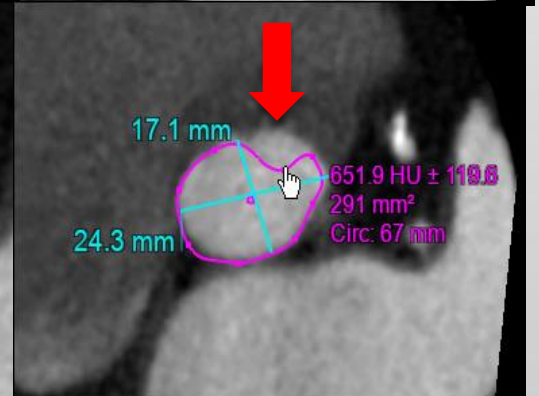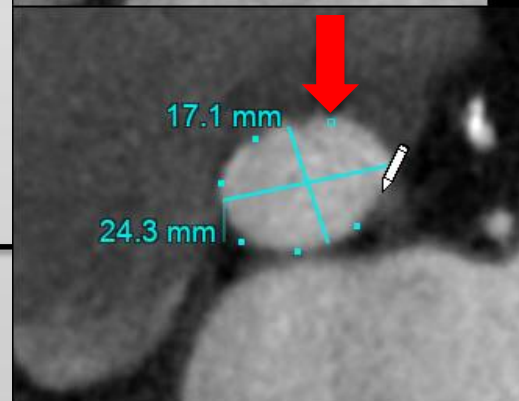
TAVR-Measure/Modify Annulus Size

Right click over the circumference measurement.
Select **Smooth**.
Reapply as many times to **smooth the contour.**

Check **Done**.

Take a **Snapshot**.

17.1 mm

645.9 HU ± 118.2
341 mm²
Circ:

24.3 mm

P

Delete
Delete All
Copy
Duplicate
Smooth
Annulus Size
Sinotubular Junction Size
Add ROI To Measurement List...

Number entered: 3

Measurements

Show	Findings	Done
▼ ☑	Common Aorta	
	Valve Plane	
	Annulus Diameter (D3)	☑
	Annulus Size	☑
	Sinotubular Junction Diam (D1)	☐
	Sinotubular Junction Size	☐
	Sinus of Valsalva Width (D2)	☐

Snap
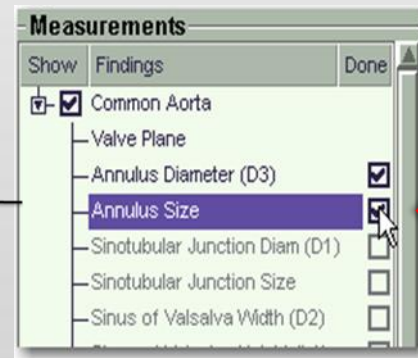
TAVR-Measure/Modify Sinotubular Junction Diameter

Close crosshair by pressing **H** on the keyboard.
Scroll and locate the Sinotubular Junction.
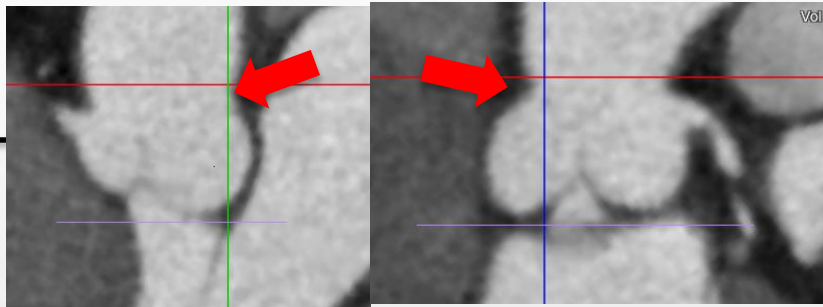
Click **Sinotubular Junction Diam.** on the Measurement list.
Ruler is active by default.
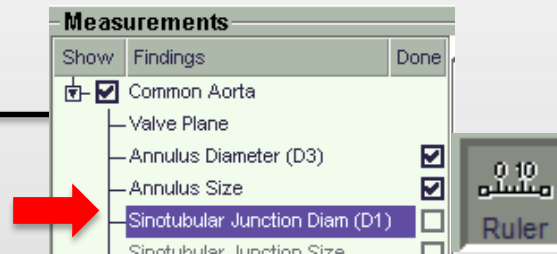
Double click in the axial image.
Modify the measurement by **moving over the end point and dragging.**
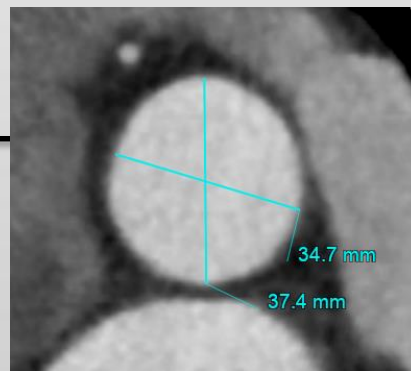
Check **Done.**

Take a **Snapshot.**
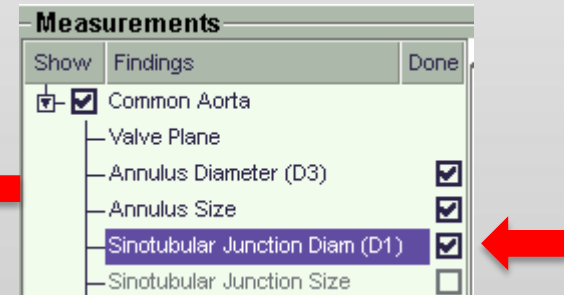
TAVR-Measure/Modify Sinotubular Junction Size

Click **Sinotubular Junction Size** on the measurement list**.**
The **ROI** tool will be active by default.

Measurements

Show	Findings	Done
	Common Aorta	
	Valve Plane	
	Annulus Diameter (D3)	☑
	Annulus Size	☑
	Sinotubular Junction Diam (D1)	☑
➡	Sinotubular Junction Size	☐
	Sinus of Valsalve Width (D2)	☐
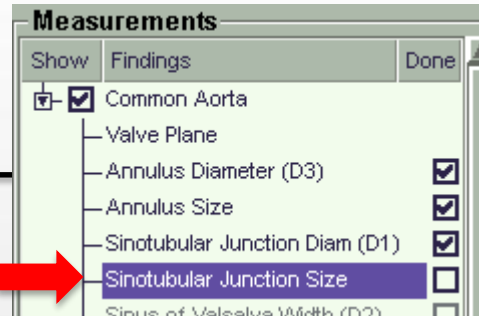
Click around the Region and plot points. Double click to end will apply the ROI.

Double click in the axial image or **plot anchor points** around the region of interest.
Edit the size by dragging the pencil. You may **include** or **exclude** Calcium.

459.3 HU ± 53.9
1008 mm²
Circ: 113 mm
34.7 mm
37.4 mm

34.7 mm
37.4 mm

Check **Done.**

Take a **Snapshot**.

Snap

Measurements

Show	Findings	Done
	Common Aorta	
	Valve Plane	
	Annulus Diameter (D3)	☑
	Annulus Size	☑
	Sinotubular Junction Diam (D1)	☑
➡	Sinotubular Junction Size	☑
	Sinus of Valsalva Width (D2)	☐

Delete
Delete All
Copy
Duplicate
Smooth
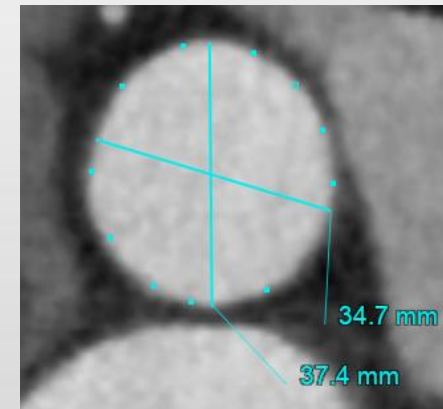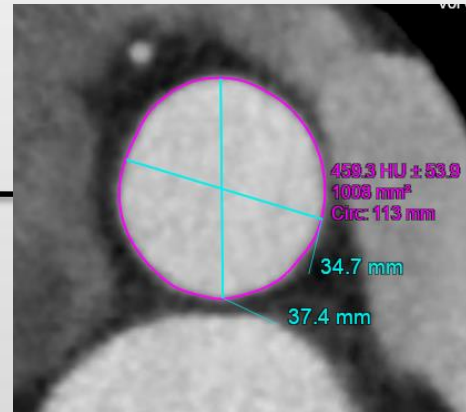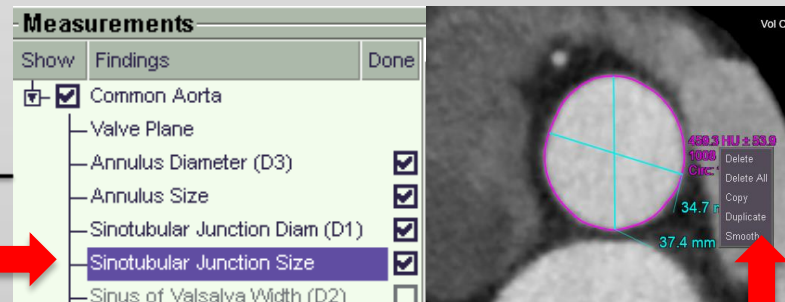
Right-click on the measurement and select **Smooth.**

TAVR-Measure/Modify Sinus of Valsalva Width

Close crosshair by pressing **H** on the keyboard.
Scroll and locate the Sinus of Valsalva.
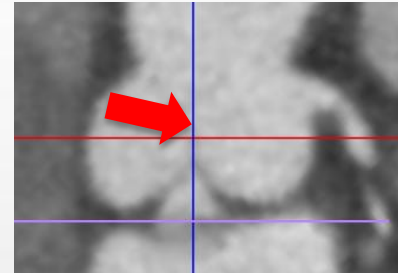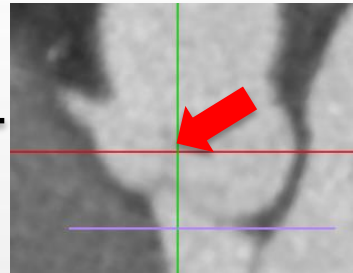
Click **Sinus of Valsalva Width** in the Measurements list.
Ruler is active by default.

Double click in the **axial image.**
Edit the measurement by moving over the end point and dragging.

Check **Done.**
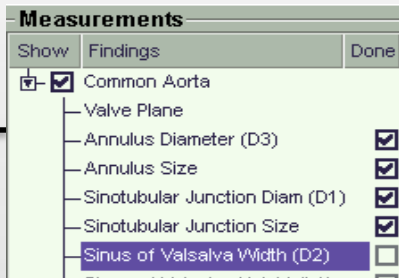
Take a **Snapshot .**

Reminder: Measure **below** the Coronary Arteries
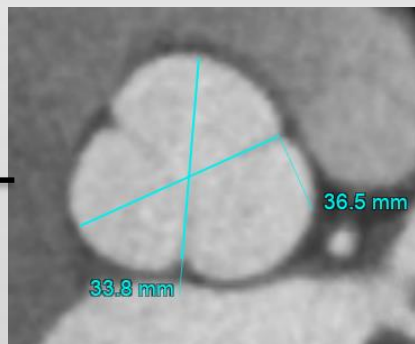
Add additional measurements by selecting the ruler.

Measurements

Show	Findings	Done
	Common Aorta	
	Valve Plane	
	Annulus Diameter (D3)	☑
	Annulus Size	☑
	Sinotubular Junction Diam (D1)	☑
	Sinotubular Junction Size	☑
	Sinus of Valsalva Width (D2)	☐

36.5 mm
33.8 mm

Measurements

Show	Findings	Done
	Common Aorta	
	Valve Plane	
	Annulus Diameter (D3)	☑
	Annulus Size	☑
	Sinotubular Junction Diam (D1)	☑
	Sinotubular Junction Size	☑
	Sinus of Valsalva Width (D2)	☑

Snap

Ruler
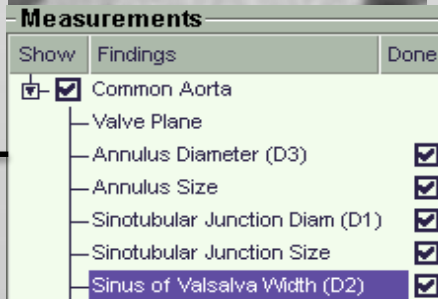
TAVR-Measure/Modify Sinus of Valsalva Height

Click on **the Sinotubular Junction Size.**
This provides alignment for the Sinus of Valsalva Height to Annulus Valve Plane.
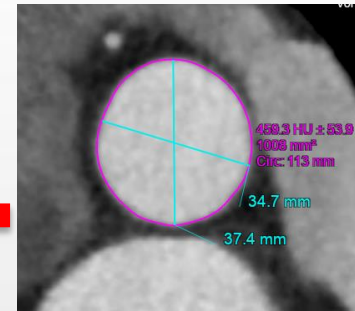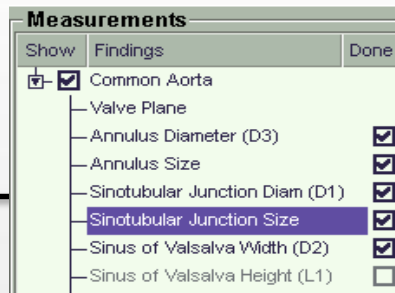
Hold the **ALT tab** down in the plane that you want to see the crosshair.
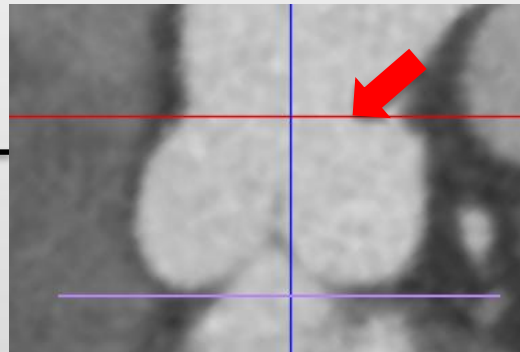
Place the mouse on the **middle** of the **crosshair.**
Press **R** on the keyboard to **enable the ruler**.
Click and drag down **to the Valve Plane.**
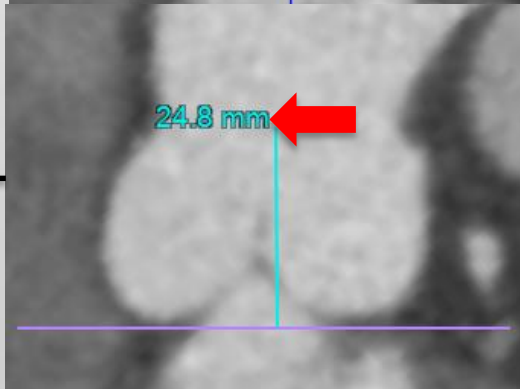
Do not move the mouse when placed on the crosshair.

TAVR-Measure/Modify Sinus of Valsalva Height

Right-click on the **measurement.** Click on **Sinus of Valsalva Height.**

Check **Done.** Take a **Snapshot**.

TAVR-Measure/Modify Annulus to LM Height

Click **Annulus to LM Height** on the measurement list**.** The **Ruler** will be **active by default.**
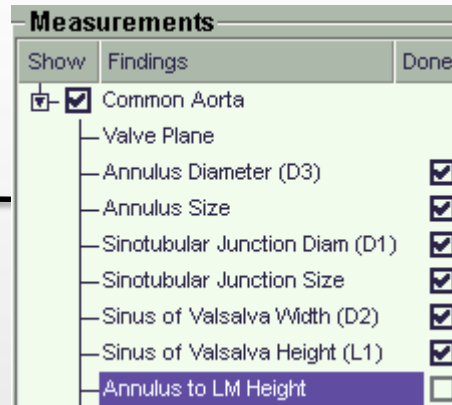
Locate the **Left Main ostia** on the coronal or sagittal view. **Click and drag** down **to** the **valve plane.** **Modify the measurement** by **moving** over **the end point and dragging.**
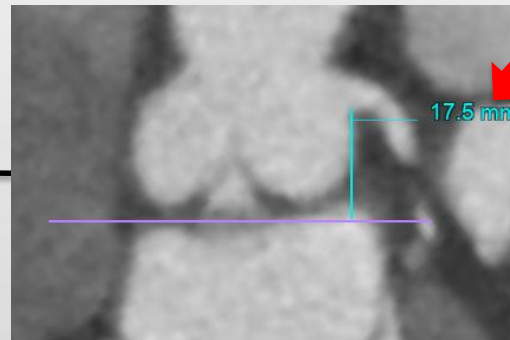
Check **Done.**

Take a **Snapshot.**
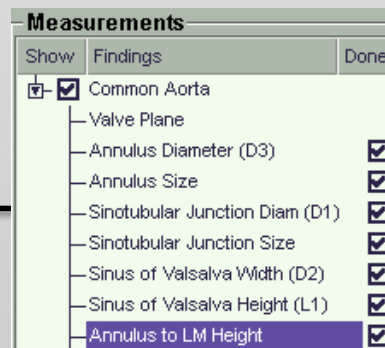
TAVR-Measure/Modify Annulus to RCA Height

Click **Annulus to RCA Height** on the measurement list.
The **Ruler** will be **active by default.**
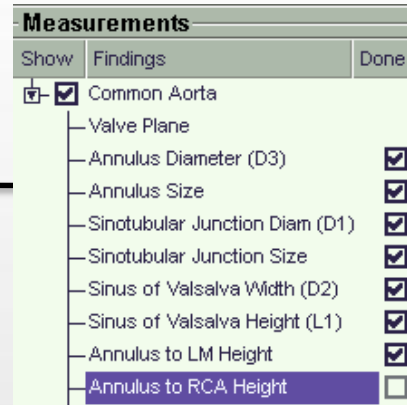
Locate the **ostia of the RCA** on the coronal or sagittal view.
Click and drag down to the **valve plane.**
Modify the measurement by **moving over the end point and dragging.**

18.0 mm

You will need to decide if you want to draw a **straight** line or **angle** towards the valve plane.

Check **Done.**

Take a **Snapshot.**
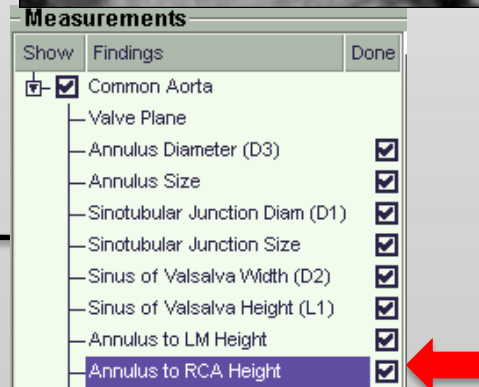
TAVR- Aortic- Iliac Access

Click the volume for the aortic-iliac measurements.

Click Show Vessel.

Click on the One-up arrow to display the CPR view and cross vessel views larger.
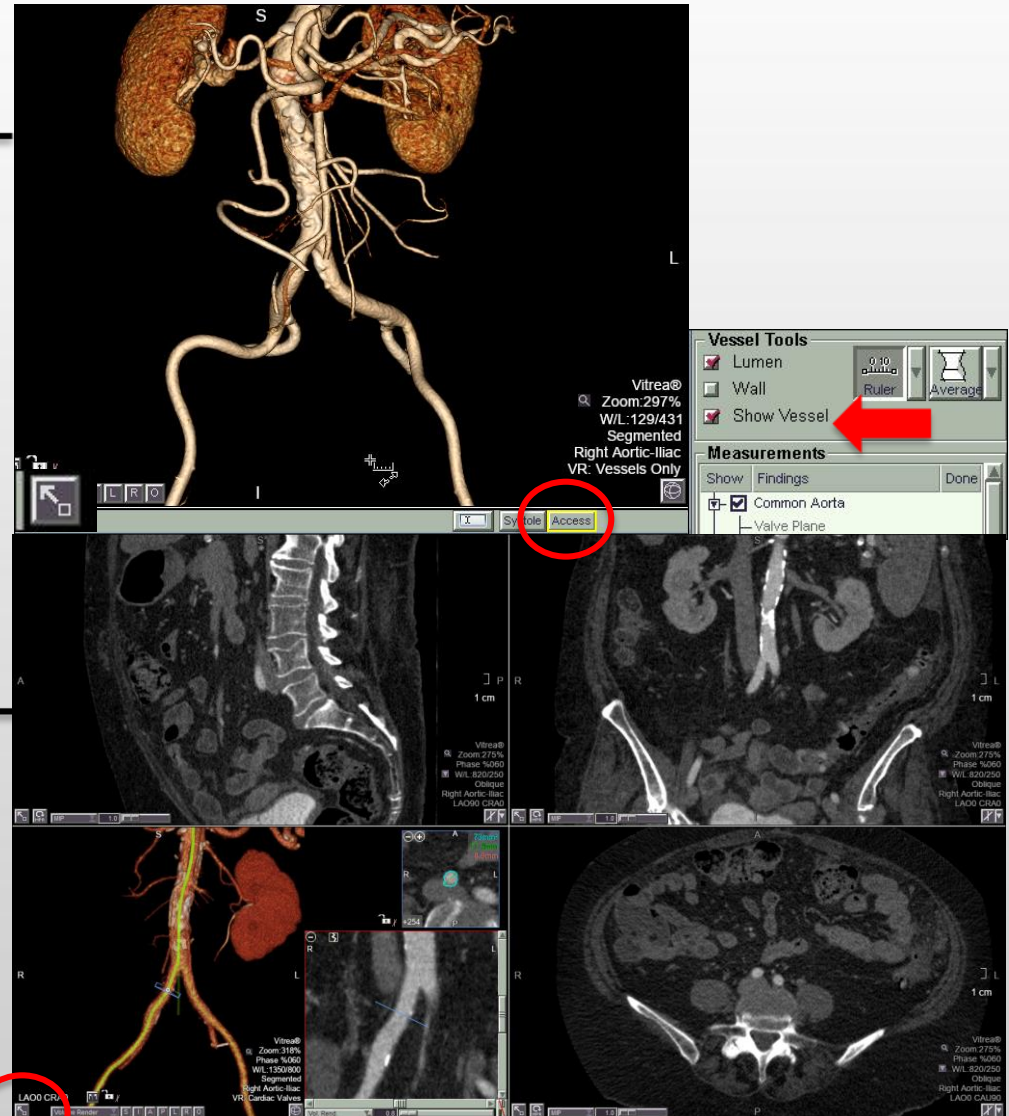
TAVR–Auto Centerline

The software automatically:
- ➤ Removes bone
- ➤ Creates a centerline for the:
  - **Common Aorta**
  - **Right-Aortic Iliac**
  - **Left-Aorta Iliac**

A 3D, curved planar reformatted view and a cross vessel view are displayed.
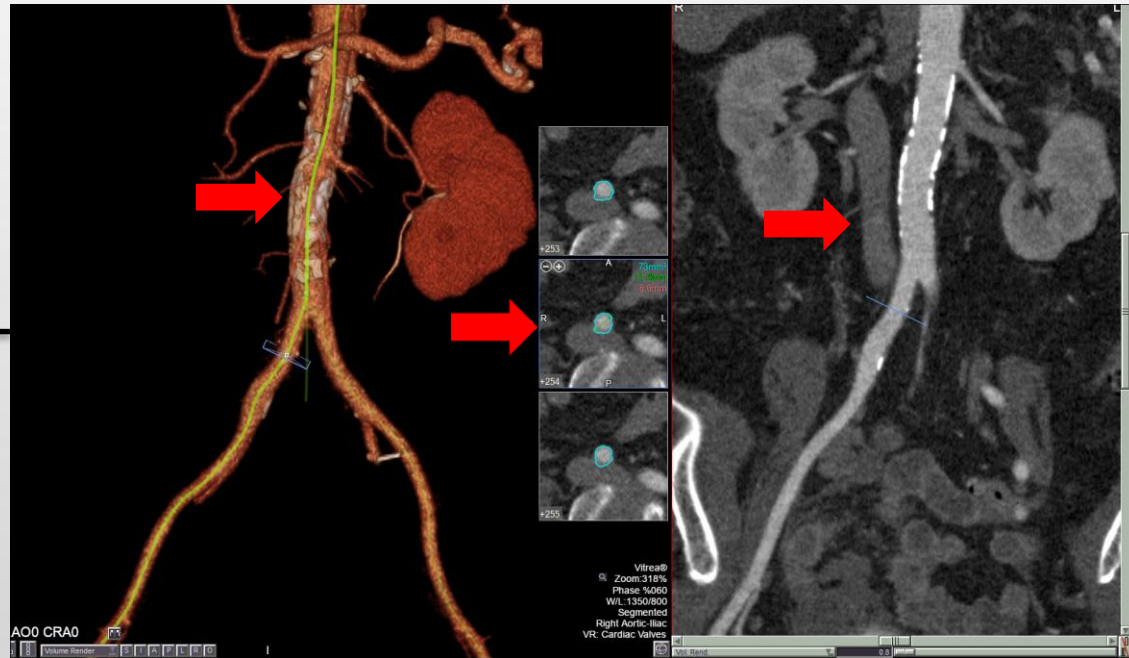
TAVR– Vessel Analysis Functions

Click the arrow next to **Batch** to expand the work list.

Vessel Analysis Tools will be visible.
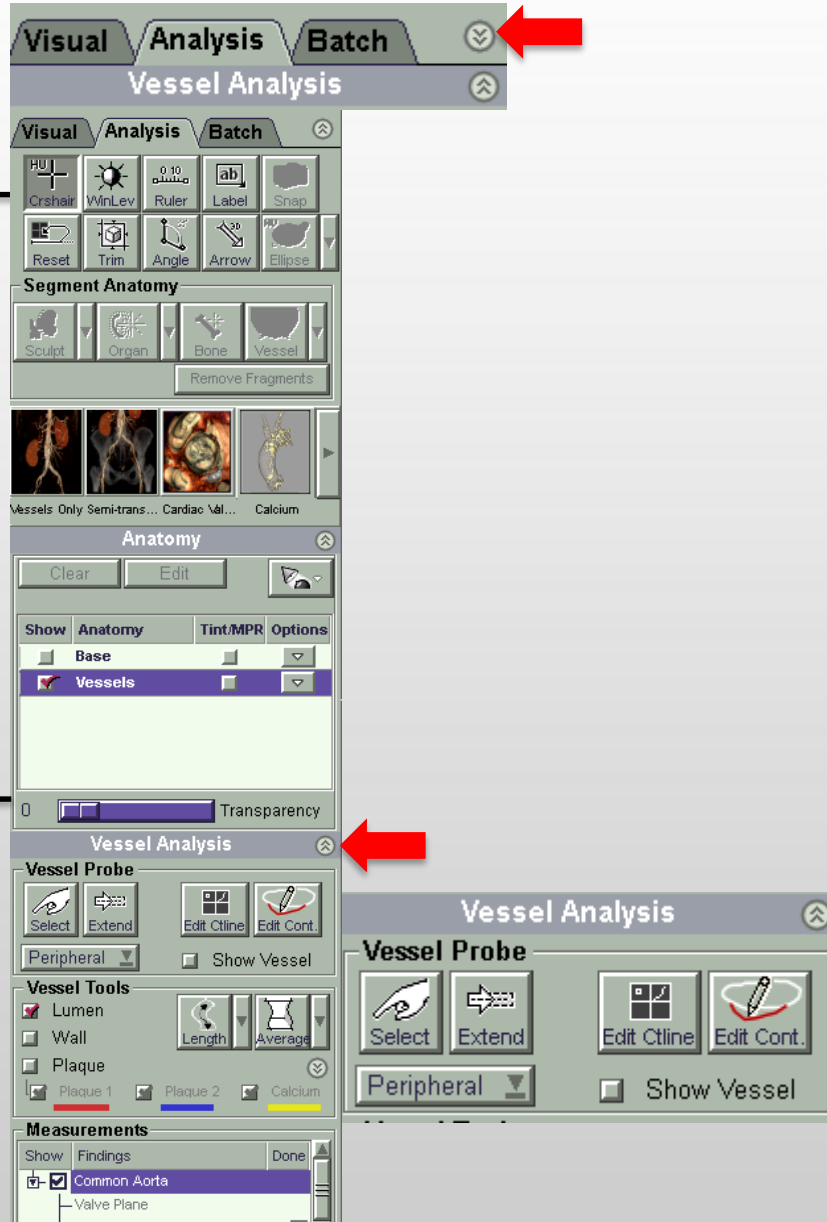
TAVR–Vessel Extend

Review the centerline for the **Common Aorta, Right Aortic-Iliac and Left Aortic-Iliac**.

It may be necessary to **extend the vessel proximal or distal. Locate the measurement** you wish to extend. **Click** on the name of the vessel.

Click **Extend**. **Click inside the lumen** of the vessel proximal or distal to the end point.
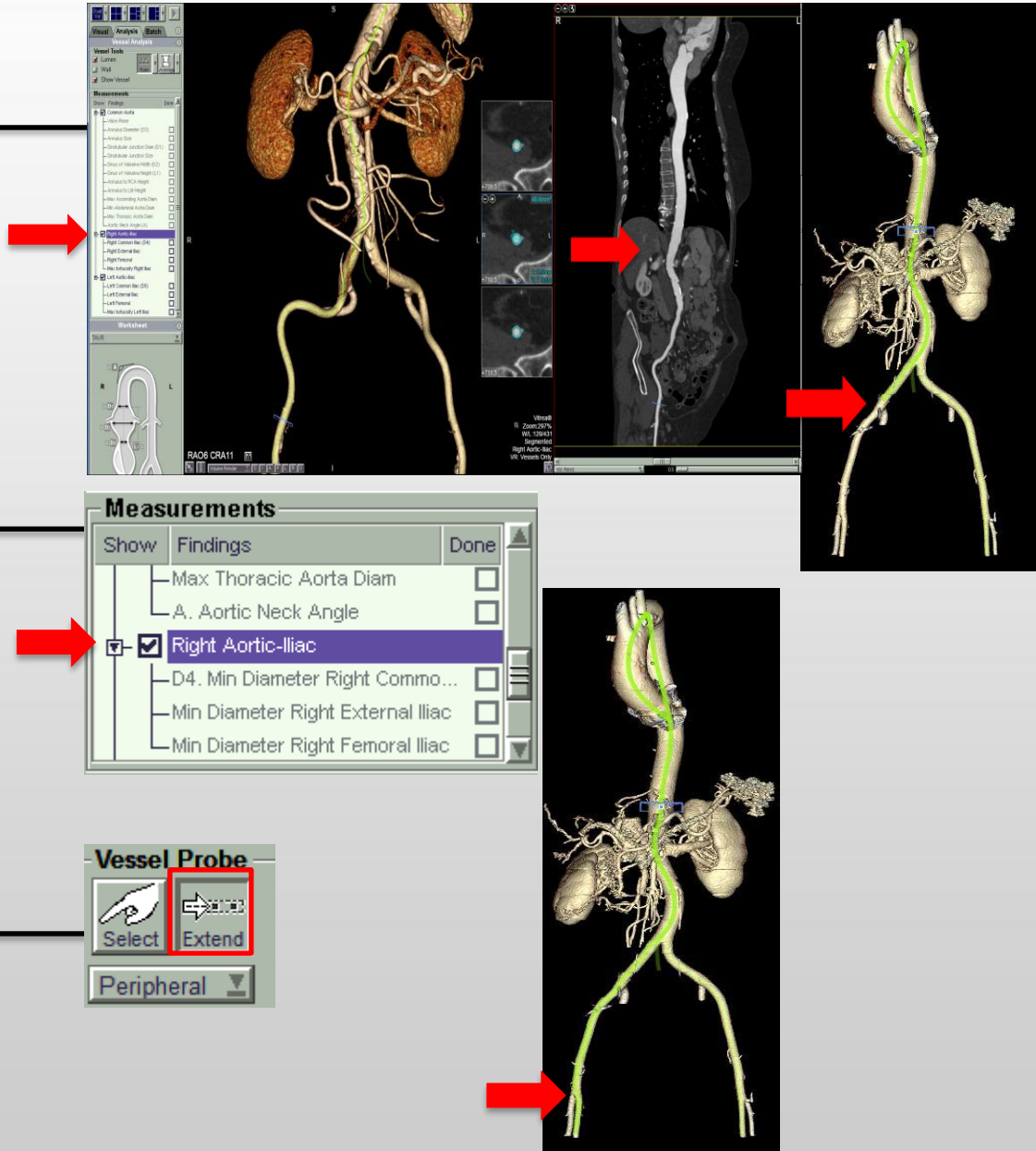
TAVR–**Verify and Edit Centerline**

Verify the Centerline for accuracy.

To edit the centerline, right-click on the CPR view. Select **Edit Centerline**.

TAVR–Edit Centerline

Click and **deposit points** to **adjust the centerline.**

Click **Apply** when complete.
Click **Close** to end**.**

Red line shows edited centerline.
Green line shows current centerline.

TAVR–Edit Contour

Right click in CPR view. Select **Edit Contours**.

Click and **drag** the **pen** to edit contours.
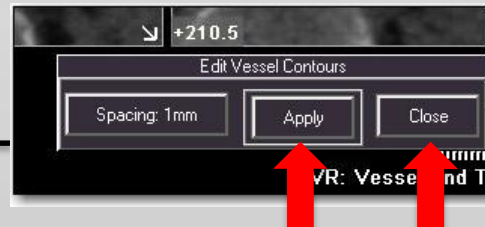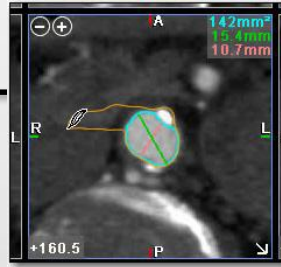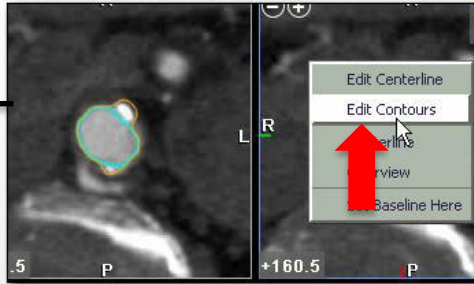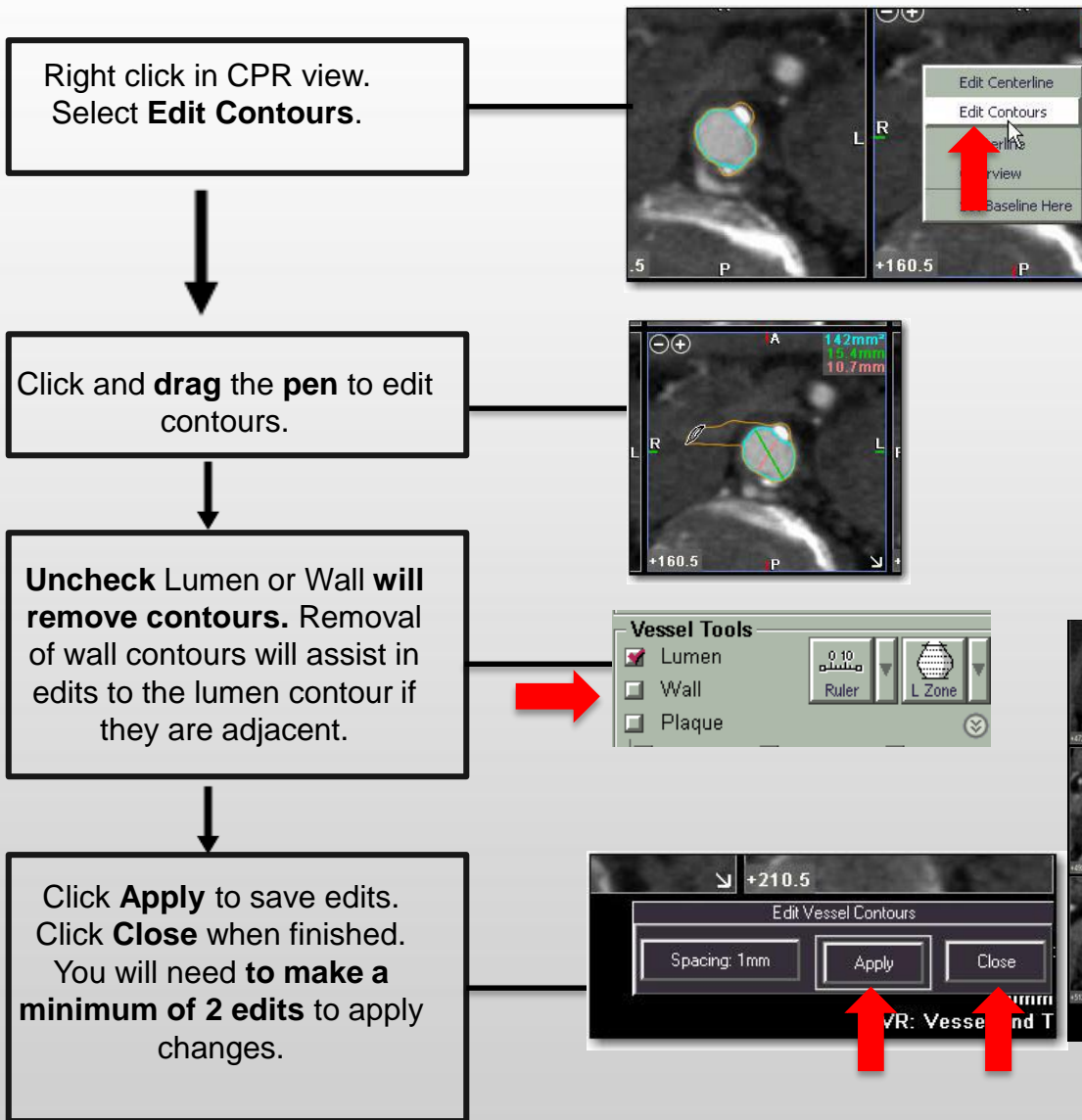
Edits to contours on every slice is not necessary. The software will interpolate between slices.

Uncheck Lumen or Wall **will remove contours.** Removal of wall contours will assist in edits to the lumen contour if they are adjacent.

Click **Apply** to save edits. Click **Close** when finished. You will need **to make a minimum of 2 edits** to apply changes.
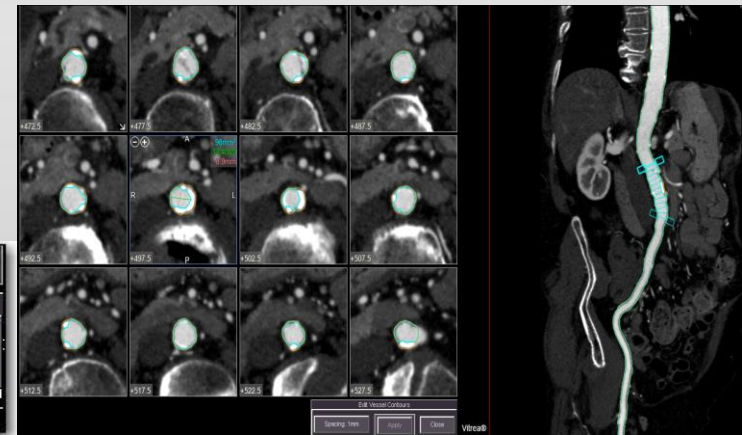
TAVR-Measure/Modify Maximum Ascending Aorta Diameter

Click on the **volume** which shows the ascending aorta.

Click
Max Ascending Aorta Diam. on the Measurements list.
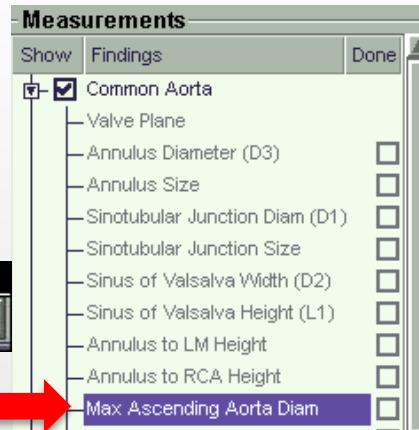
The measurements which are checked as **Done** are saved in the volume selected.

Vol. 1 | Vol. 2 | Vol. 3 | Vol. 4

Measurements

Show	Findings	Done
	Common Aorta	
	Valve Plane	
	Annulus Diameter (D3)	
	Annulus Size	
	Sinotubular Junction Diam (D1)	
	Sinotubular Junction Size	
	Sinus of Valsalva Width (D2)	
	Sinus of Valsalva Height (L1)	
	Annulus to LM Height	
	Annulus to RCA Height	
	Max Ascending Aorta Diam	

Circ: 134mm
43.2mm
41.8mm

+162.5

Vitrea®
Zoom:247%
Phase %000
W/L:1350/800
Segmented
Common Aorta
VR: Cardiac Valves

LAO11 CAU18

Volume Render   S I A P L R O

Vol. Rend.   0.8

TAVR-Measure/Modify Maximum Ascending Aorta Diameter

Click [icon] to **change** the **display mode** of the vessel to a **straight vessel view.**

The histogram will display a wide red circle.

Click and **hold the mouse** on the **blue slider.**
Move the **blue slider** up and down.
The **axial ROI** view **will update** the measurement.

Locate the maximum measurement for the **Ascending Aorta** in the ROI box.

TAVR-Measure/Modify Maximum Ascending Aorta Diameter

Ruler is activated when selecting Measurement.

Double click in the axial ROI box.
The **measurement** is **displayed** in the ROI box.

Adjust and **modify the measurement** by **moving over the end point and dragging.**

Check **Done.**

Take a **Snapshot.**

Click on the Zoom tool to view the entire vessel.

Measurements		
Show	Findings	Done
☑	Common Aorta	
	Valve Plane	
	Annulus Diameter (D3)	☐
	Annulus Size	☐
	Sinotubular Junction Diam (D1)	☐
	Sinotubular Junction Size	☐
	Sinus of Valsalva Width (D2)	☐
	Sinus of Valsalva Height (L1)	☐
	Annulus to LM Height	☐
	Annulus to RCA Height	☐
	Max Ascending Aorta Diam	☑
	Min Abdominal Aorta Diam	☐
	Max Thoracic Aorta Diam	☐
	Aortic Neck Angle (A)	☐

TAVR-Measure/Modify Minimum Abdominal Aorta Diameter

Click **Min Abdominal Aorta Diam** on the Measurement list.
The **ruler is** automatically **activated.**

Click and **hold the mouse on the blue slider.**
Move the blue slider **up and down.**
The **axial ROI** view **will update** the measurement.

Locate the **minimum** measurement for Ascending Aorta **in the ROI box.**

Check **Done.**

Take a **Snapshot.**
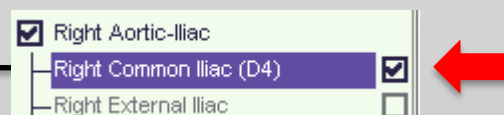
Snap

The histogram will display a small red curve.

TAVR-Measure/Modify Maximum Thoracic Aorta Diameter

Click **Max Thoracic Aorta Diam** on the findings list. The **ruler is** automatically **activated.**

Click and **hold the mouse on the blue slider. Move** the blue slider **up and down.** The **axial ROI view will update** the measurement.

Locate the **maximum** measurement for the Max Thoracic Aorta Diameter **in the ROI box.**
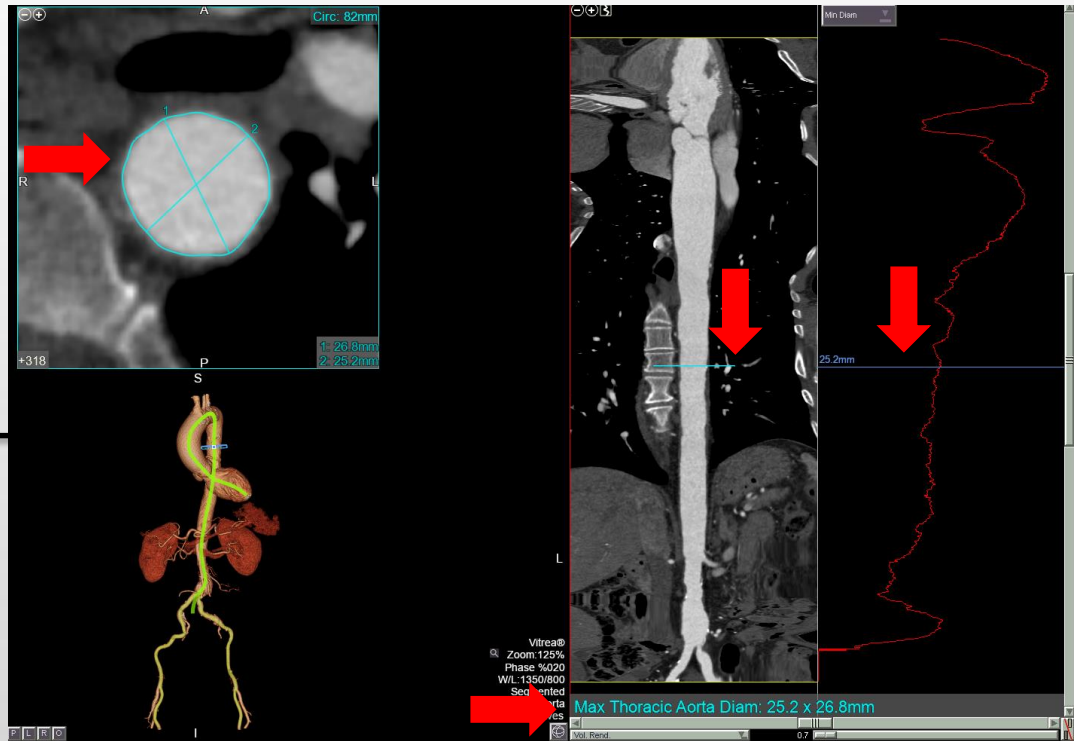
Check **Done.**

Take a **Snapshot.**

The histogram will display a wide red circle.

TAVR-Measure/Modify Aortic Neck Angle

Click **Aortic Neck Angle** on the findings list. **Angle tool** is active by default.

Click to **deposit** the **first** point in the **straightened** CPR view.
Review the angle in the 3D image and **make adjustments on the CPR vessel** by dragging the line up and down.
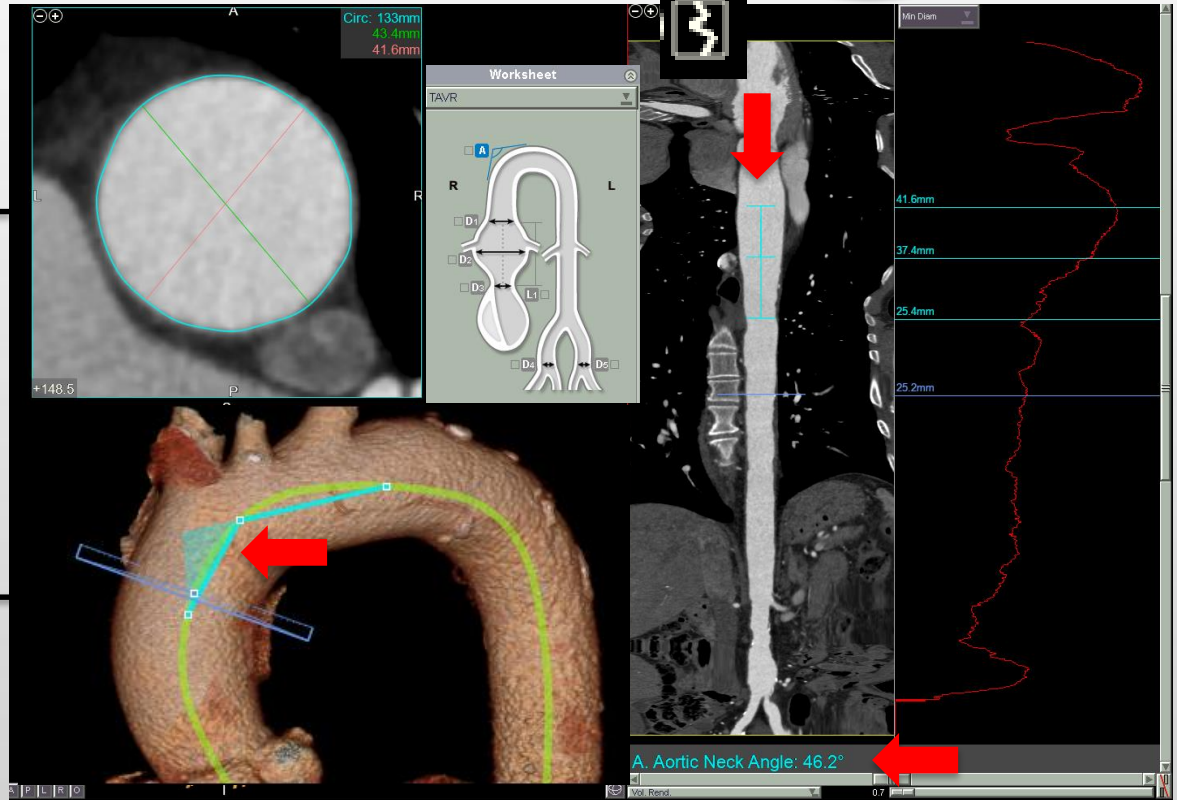
Move to **second angle** on the CPR vessel **and click.** Move to **end point** on the CPR vessel **and click.**

Check **Done.**

Take a **Snapshot.**

Zoom tool is located **on the CPR view.**

Aortic Neck Angle is displayed.

Max Ascending Aorta Diam
Min Abdominal Aorta Diam
Max Thoracic Aorta Diam
Aortic Neck Angle (A)

Circ: 133mm
43.4mm
41.6mm

Worksheet
TAVR

Min Diam

41.6mm
37.4mm
25.4mm
25.2mm

A. Aortic Neck Angle: 46.2°

Snap

Max Ascending Aorta Diam
Min Abdominal Aorta Diam
Max Thoracic Aorta Diam
Aortic Neck Angle (A)

TAVR-Right and Left Common Iliac

Click the **Right Common Iliac. Ruler** will be active by default.

Right Aortic-Iliac
Right Common Iliac (D4)
Right External Iliac

Click and **hold the mouse** on the **blue slider. Move** the blue slider **up and down.** The **axial ROI** view will **update** the measurement.

Locate the **minimum measurement** for Right and Left Common Iliac.

D4. Right Common Iliac: 6.9 x 9.3mm

Check **Done.**

Take a **Snapshot.**

Snap

Right Aortic-Iliac
Right Common Iliac (D4)
Right External Iliac
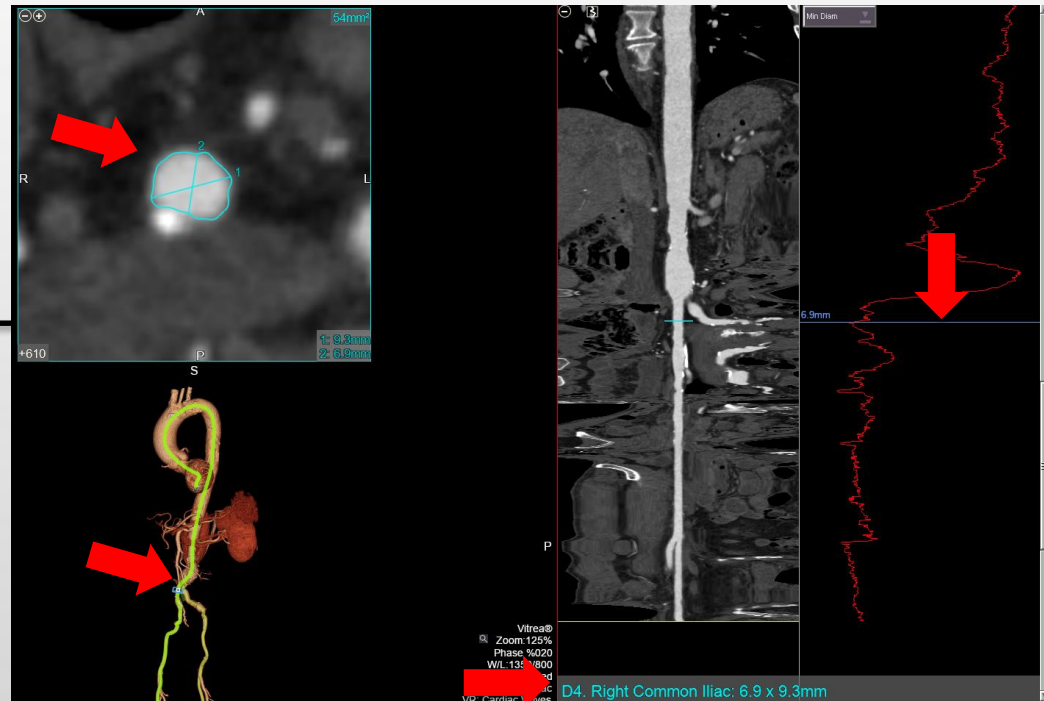
Repeat for the **Left Common Iliac.**

TAVR-Right and Left External Iliac

Click the **Right External Iliac.**
Ruler will be active by default.
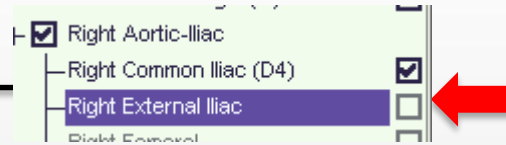
Click and **hold** the **mouse on the blue slider.**
Move the slider **up and down.**
The **axial ROI** view will **update** the measurement.

Locate the **diameter measurement** for Right or Left External Iliac in the **ROI box.**
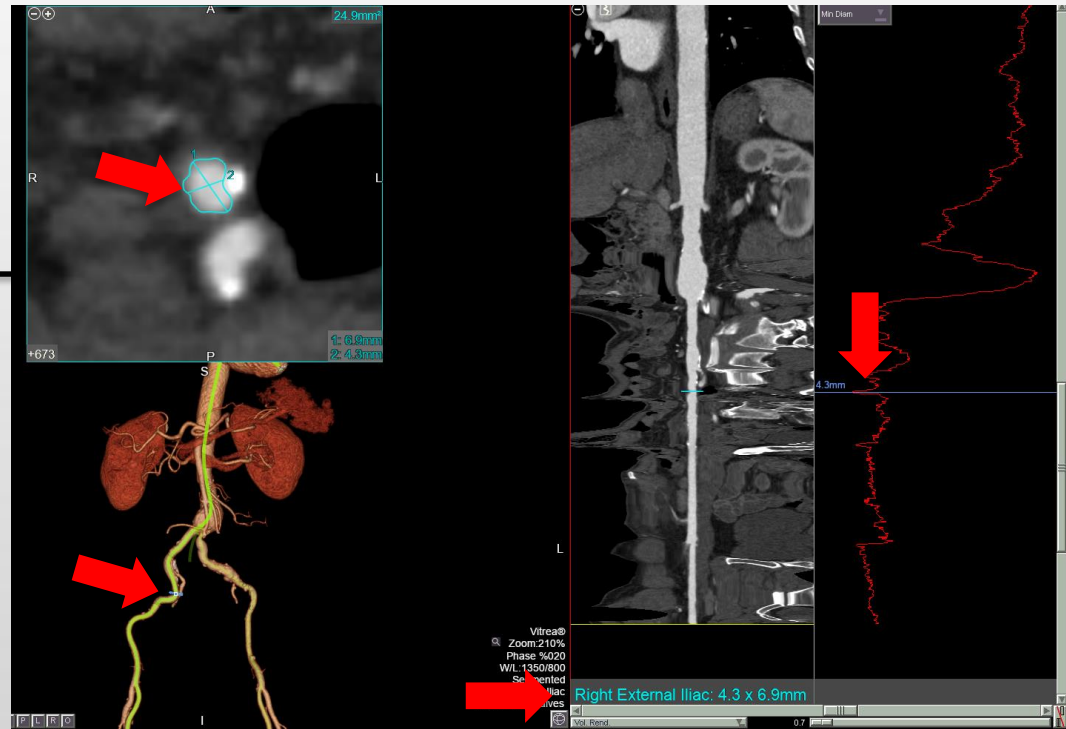
Check **Done.**

Take a **Snapshot.**

Repeat for the **Left External Iliac.**

TAVR-Right and Left Femoral

Click the **Right Femoral.**
Ruler will be active by default.
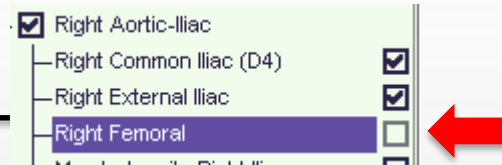
Click and **hold the mouse** on the **blue slider.**
Move the **slider up and down.**
The **axial ROI** view will **update** the measurement.

Locate the **diameter measurement** for Right or Left femoral artery in the **ROI box.**
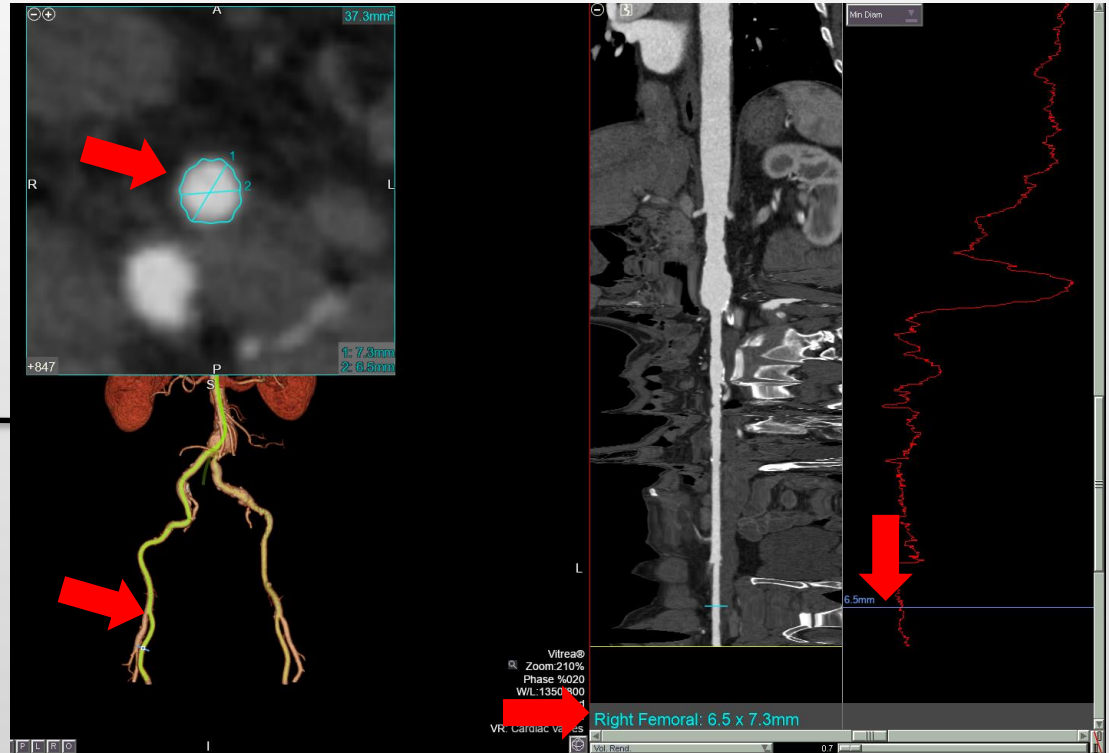
Check **Done.**

Take a **Snapshot.**
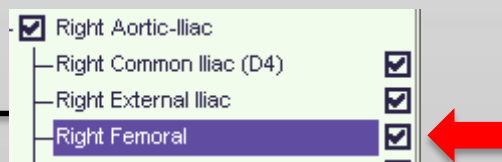
Repeat for the **Left Femoral**.

TAVR- Max tortuosity Right Iliac

Select **Tortuosity** from the **dropdown menu** on the straightened view.
Drag the **blue slider** to the maximum tortuosity of the vessel.

Min Diam
Min Diam
Area
Tortuosity

Tortuosity

13deg/cm

Click **Max tortuosity Right Iliac**.
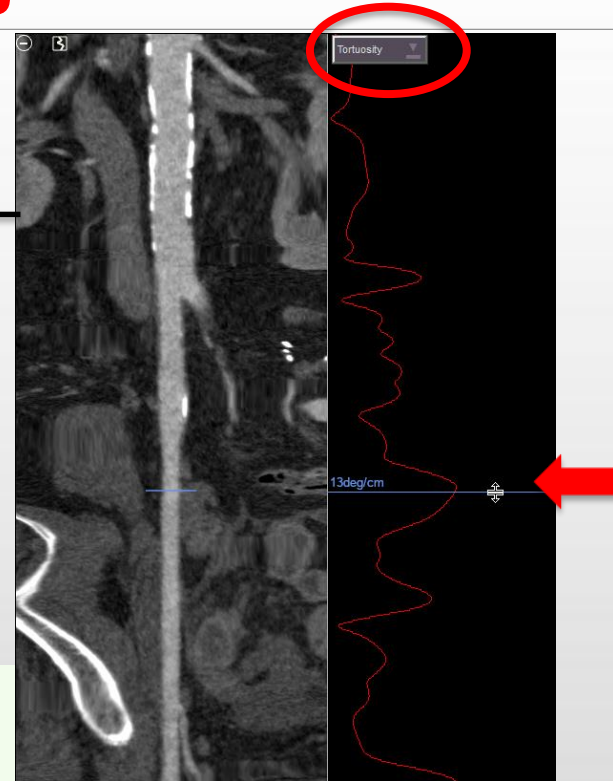
☑ Right Aortic-Iliac
— Right Common Iliac (D4)
— Right External Iliac
— Right Femoral   ☑
Max tortuosity Right Iliac ☑
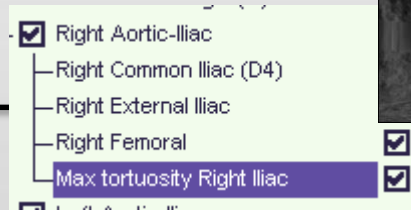
Tortuosity is automatically calculated and **only** located in the **Report.**

Repeat for the **Left Iliac**.

TAVR- Add New Measurements

To **add a new measurement** to the list click the **Ruler** or **ROI**.
Create a measurement.
Add Ruler to Measurement List.

Enter **Name** for Measurement.
Select OK.

The **new measurement** will be located on Measurements and in the **Report.**
Check **Done.**
Take a **Snapshot.**

TAVR-Diameter Threshold

Drag the blue line to look at the **minimum diameters** of the vessels.

To enter a desired threshold. **Right-click** the **inset view**.

Click **Set Threshold Line.**

Enter the **Diameter Threshold.**

Click **OK.**
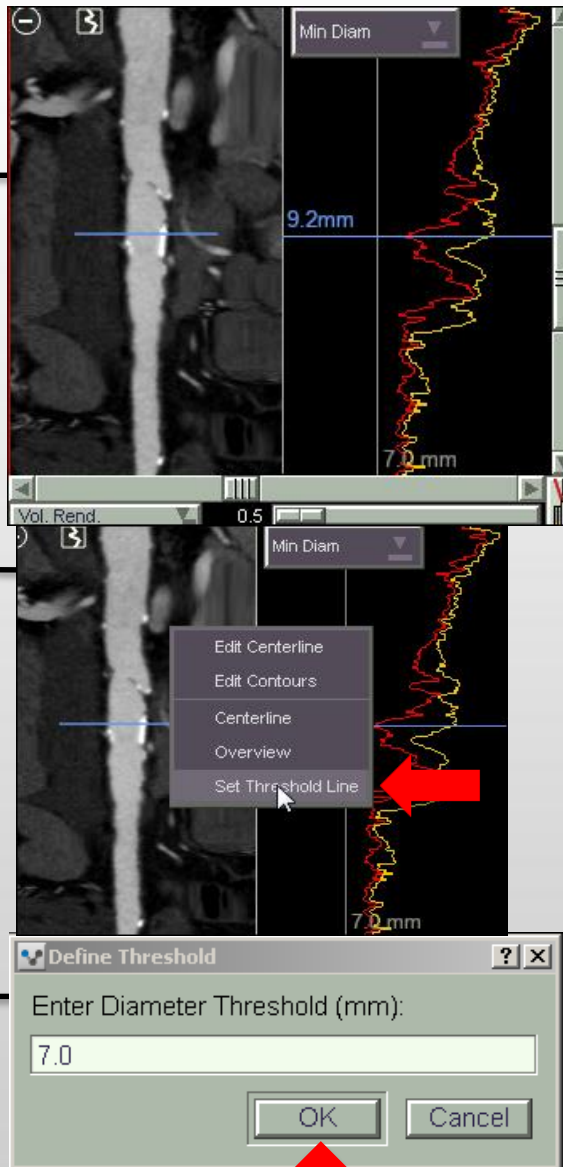
Set the threshold line to a minimum diameter. This provides a visual account of the diameter of the vessel lumen for catheter placement.

TAVR- Aortic Calcium View

Uncheck **Show Vessel**.

Click on **Win/Lev**.
The crosshair is removed from the image.

Select Preset **Calcium**.
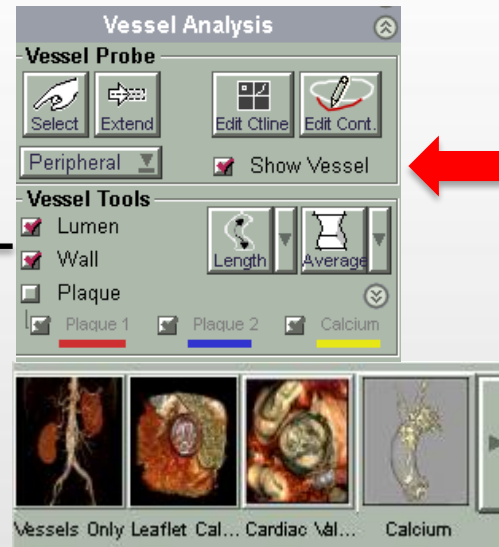
Batch the series.
AP and Oblique views are helpful.
Take a **Snapshot**.

TAVR- Leaflet Calcium View

Turn off **Show Vessel.**
Select Preset **Leaflet Calcium**.

Rotate the image **superior to inferior.**
Click crosshair on valve.
Click **Trim.**
Trim the yellow borders centering on the valve.
Rotate and **win/lev** to view valves.

Take a **Snapshot**.
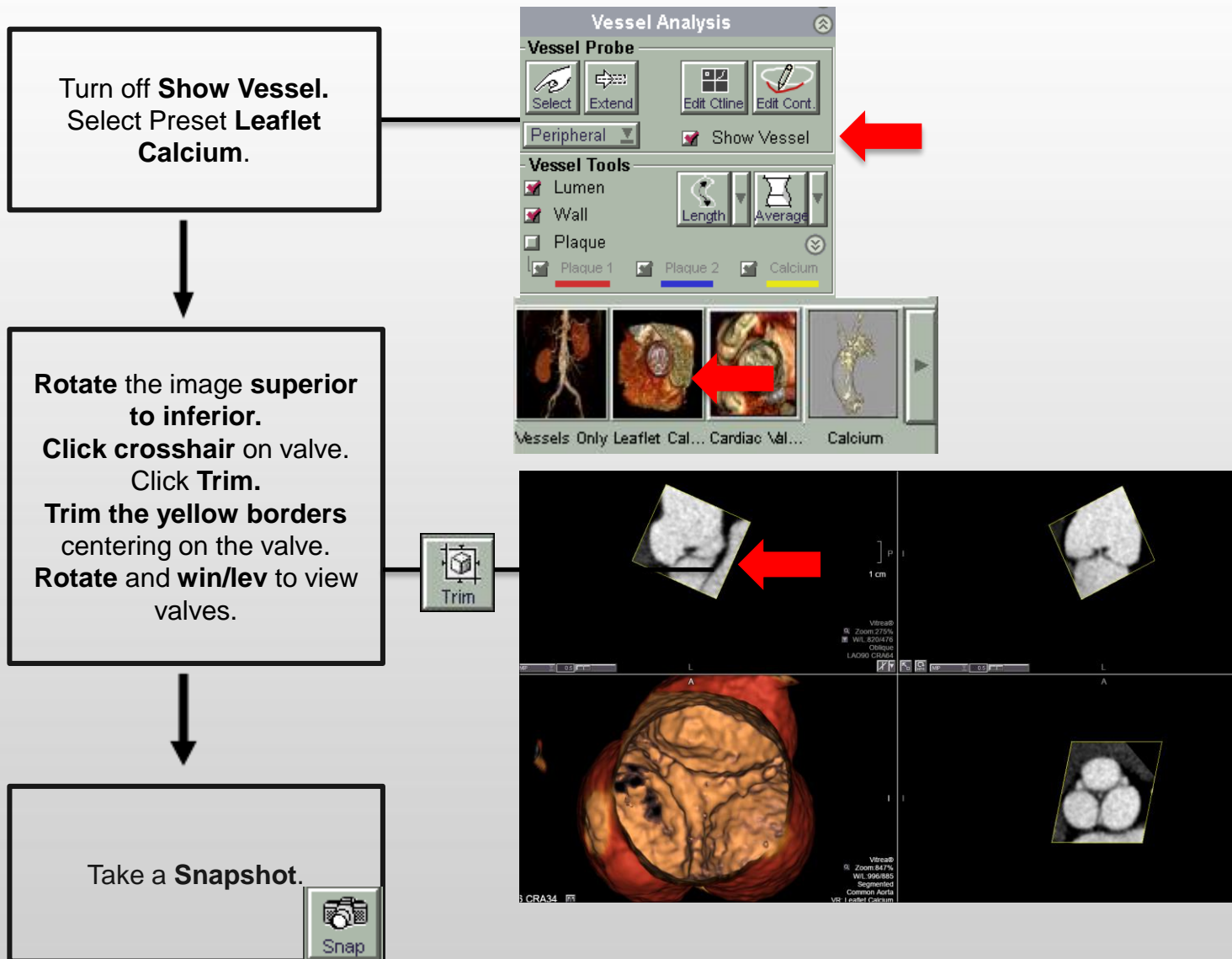
Modify/Create New Template

Right click on any measurement.

Select **Edit Measurement Lists**.
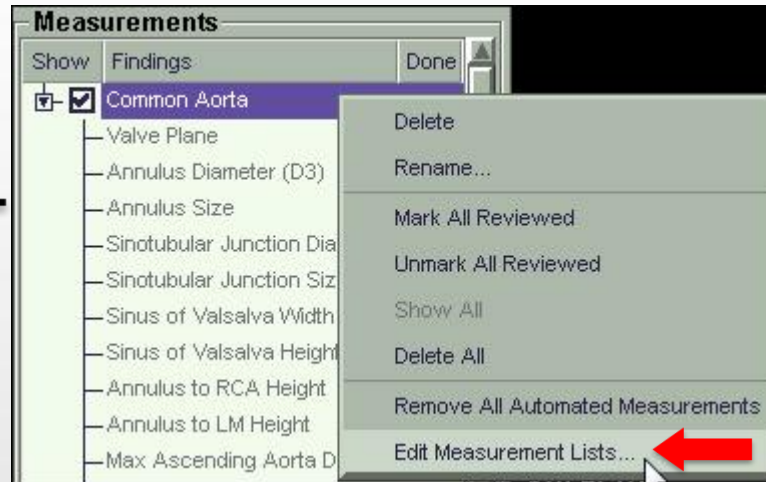
Copy current Template.

Rename the Template.

Select **OK**.
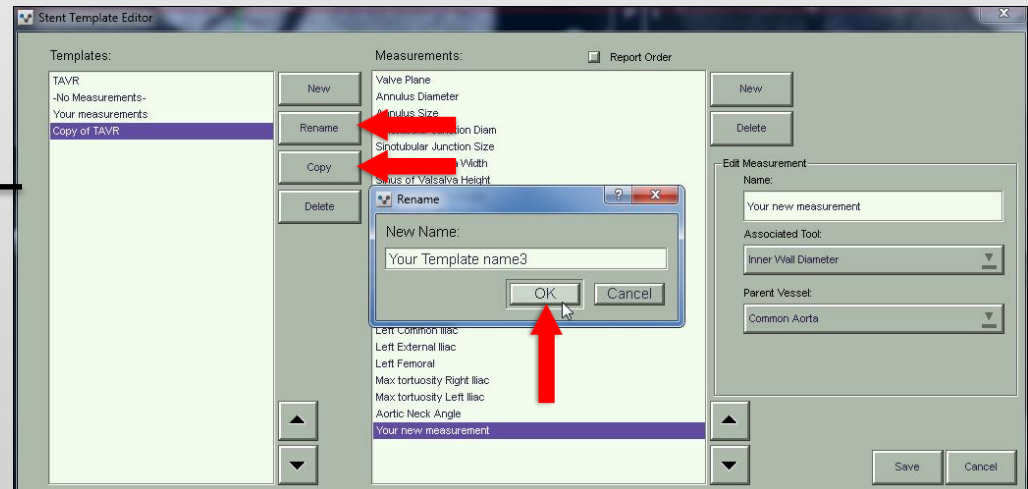
Modify/Create New Template

Select **New**.
Name your measurement.

Select the **Associated Tool**.
Select the **Parent Vessel**.

Delete any measurements you do not want to keep**.**

Click the **up** and **down arrows** to **rearrange the order** of the measurements.

Click the **Report Order** box to **rearrange the order** of the measurements **in the Report**.

Select **Save**.
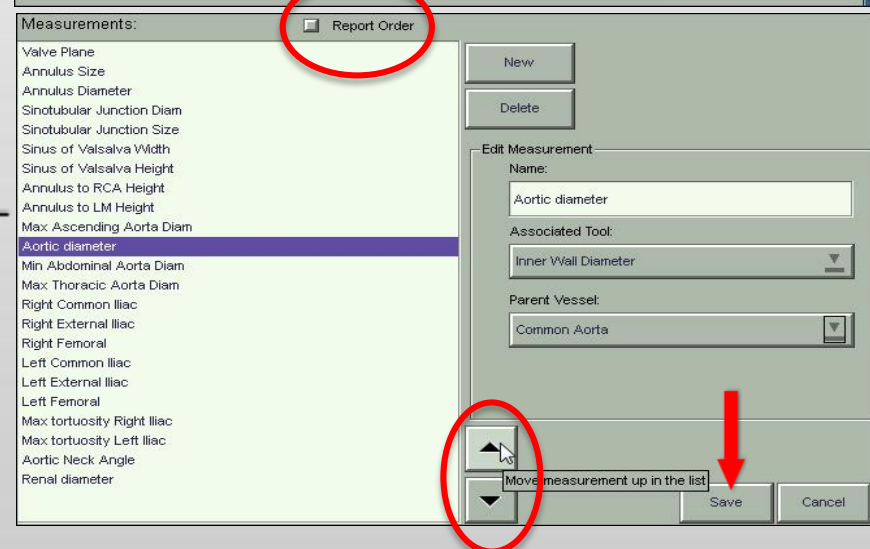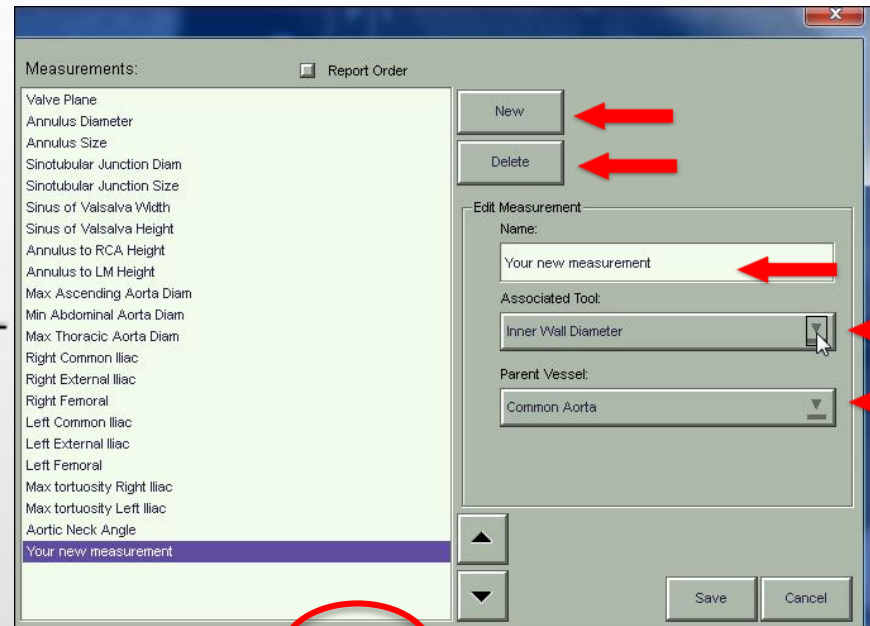
Modify/Create New Template

Modified template is located under the templates menu.

TAVR- Semi Transparent Batch Rotation

Click **Show Base.**
Move the **Transparency bar** to desired level.

Select the **Batch tab**.
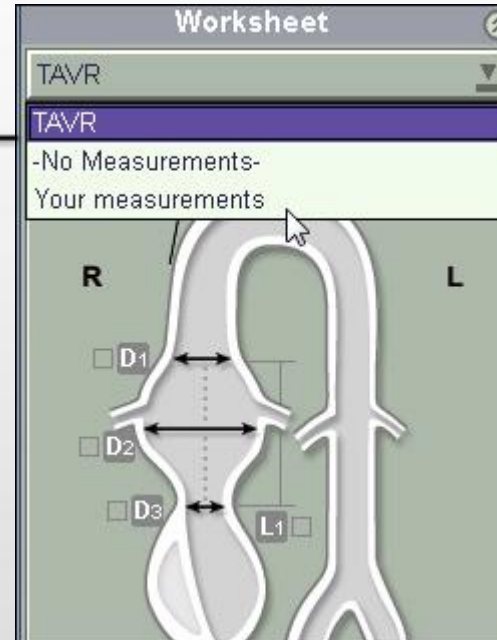
Click the **degree** of rotation. Click the **Direction** of the rotation.
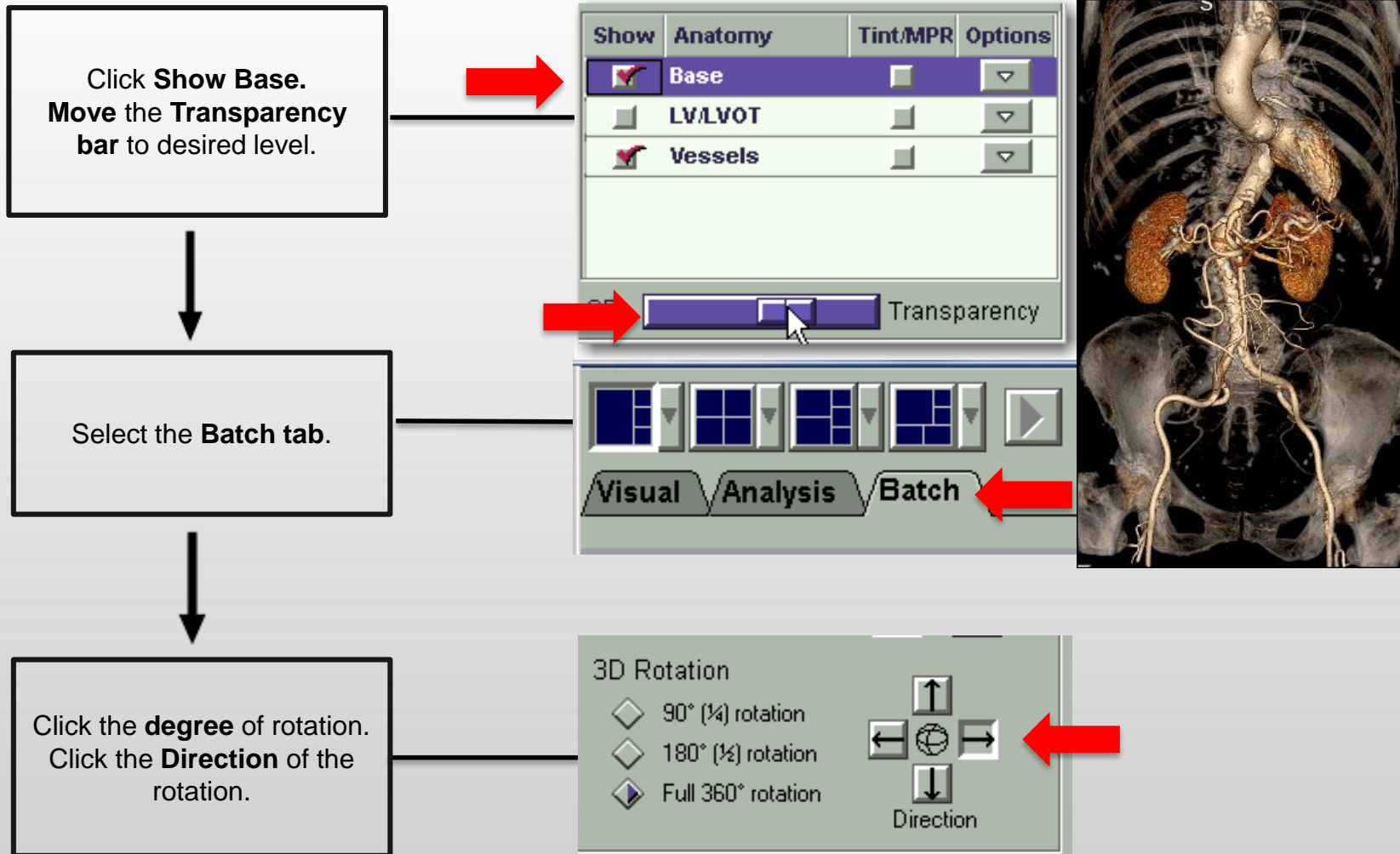
TAVR- Semi Transparent Batch Rotation

Type the name in the **Series Description.**
Click Batch for PACS.
Click **Movie** for an avi.file for presentations.

Choose **More Options** to **Modify Batch** settings.

TAVR-Distribute Findings/ Report Page

Click **Report**.

Hold down the **CTRL** Key and **highlight** selected **images** or **batches.** Click **Export**.
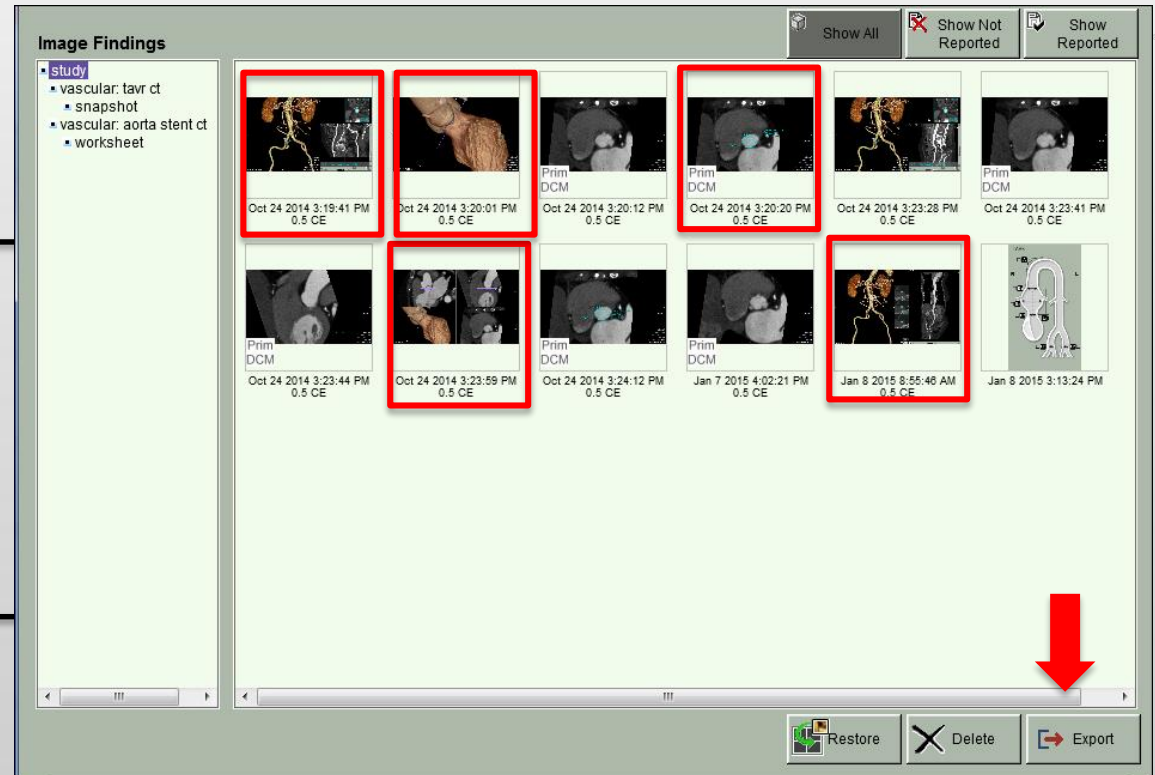
Choose Destination. Click **Export**.

TAVR-Distribute Findings/Report Template

To **Export** the **TAVR Template, click** on **Export Report.**

Choose **Destination**. Click **Export**.

Notes: