CT Transcatheter Aortic Valve Replacement (TAVR) Planning
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
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.
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.
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.
Select **Valve Plane** from the measurements list.

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.

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

- **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.**

To Zoom the image, **click** and **hold the spyglass.**
TAVR-Measure/Modify Annulus Diameter

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

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

Check the box in the **Done** column. **Take a Snapshot**.

**TIP:** Only measurements selected as **Done** display on the **Report**.
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**.
TAVR - Measure/Modify Sinotubular Junction Diameter

1. Close crosshair by pressing H on the keyboard. Scroll and locate the Sinotubular Junction.
2. Click Sinotubular Junction Diam. on the Measurement list. Ruler is active by default.
3. Double click in the axial image. Modify the measurement by moving over the end point and dragging.
4. Check Done. Take a Snapshot.
Click **Sinotubular Junction Size** on the measurement list. The ROI tool will be active by default.

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.

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

Right-click on the measurement and select **Smooth**.

Click around the Region and plot points. Double click to end will apply the ROI.
**TAVR-Measure/Modify Sinus of Valsalva Width**

1. **Close crosshair** by pressing **H** on the keyboard. Scroll and locate the Sinus of Valsalva.

2. **Click Sinus of Valsalva Width** in the Measurements list. **Ruler** is active by default.

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

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

**Reminder:** Measure **below** the Coronary Arteries.

**Add additional measurements by selecting the ruler.**
TAVR-Measure/Modify Sinus of Valsalva Height

1. Click on the Sinotubular Junction Size. This provides alignment for the Sinus of Valsalva Height to Annulus Valve Plane.

2. Hold the ALT tab down in the plane that you want to see the crosshair.

3. 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.

4. 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.
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 endpoint and dragging.

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

Check **Done**.

Take a **Snapshot**.

You will need to decide if you want to draw a **straight** line or **angle** towards the valve plane.
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.
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**.
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.
Right click in CPR view. Select **Edit Contours**.

Click and **drag** the **pen** to edit contours.

**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.

Edits to contours on every slice is not necessary. The software will interpolate between slices.
**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.
**TAVR - Measure/Modify Maximum Ascending Aorta Diameter**

Click to change the display mode of the vessel to a straight vessel view.

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.

The histogram will display a wide red circle.
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.
**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**.

The histogram will display a small red curve.
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**.

Aortic Neck Angle is displayed.
TAVR—Right and Left Common Iliac

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

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.

Check **Done.**

Take a **Snapshot.**

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

Click **Max tortuosity Right Iliac**.

**Tortuosity** is automatically calculated and **only** located in the **Report**.

Repeat for the **Left Iliac**.
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.
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**.
Modified template is located under the templates menu.
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.
To Export the TAVR Template, click on Export Report.

Choose Destination. Click Export.