materialise

innovators you can count on

Materialise Mimics Enlight Training

TMVR Workshop
Materialise Mimics Enlight 2.0

February 2nd, 2021

Clare Otto, Technical Consultant
Clare.Otto@materialise.com

materialise.com

Notices

This training handout is designed to help you get started with 3D planning for TMVR using the Materialise Mimics Enlight software. As such, this handout is not designed to be a substitute for training provided by Materialise.

Note: This familiarization-training does assume the user is familiar with Windows usage and terminology.

I hear and I forget

I see and I remember

I do and I understand

Confucius

Materialise Mimics®, and any and all Materialise brand, product, service and feature names, logos and slogans mentioned in this document are registered trademarks and/or trade names of Materialise and are protected by trademark laws in the United States or other countries. All other brand, product, service and feature names or trademarks are the property of their respective owners. No user has any right, title, or interest in those marks or names not previously expressly granted in writing to such user by Materialise.

Regulatory Information:
Materialise Mimics Enlight is intended for use as a software interface and image segmentation system for the transfer of DICOM imaging information from a medical scanner to an output file.

It is also intended as a software to aid in reading and interpreting DICOM compliant images for structural heart and vascular treatment options. For this purpose, Mimics Enlight provides additional visualization and measurement tools to enable the user to screen and plan the procedure.

The Mimics Enlight output file can be used for the fabrication of physical replicas of the output file using traditional or additive manufacturing methods. The physical replica can be used for diagnostic purposes in the field of cardiovascular applications.

Mimics Enlight should be used in conjunction with other diagnostic tools and expert clinical judgement.

Mimics Enlight is not intended to predict the performance of a medical device. Materialise Mimics Enlight is not intended for mammography imaging or diagnosis.

Materialise Mimics Enlight is a CE-marked product.
Materialise Mimics Enlight Research is not a medical device.
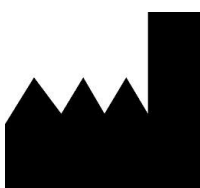
Manufactured in June 2020
Materialise NV
Technologielaan 15
3001 Leuven, Belgium
Phone: +32 16 39 66 11
www.materialise.com

materialise
innovators you can count on

Contents

Introduction to Materialise Mimics Enlight

Materialise Mimics Enlight is a desktop software used for cardiac pre-procedural screening and planning.

The software enables true 3D Planning in a step-by-step, guided workflow. 3D planning uses accurate 3D models to enable automated analysis and enhanced spatial insights. When using accurate 3D models, measurements snap to the model, which allows evaluation in all three dimensions. True 3D models also allow for automation of measurements which enables a higher level of consistency and a more efficient process.
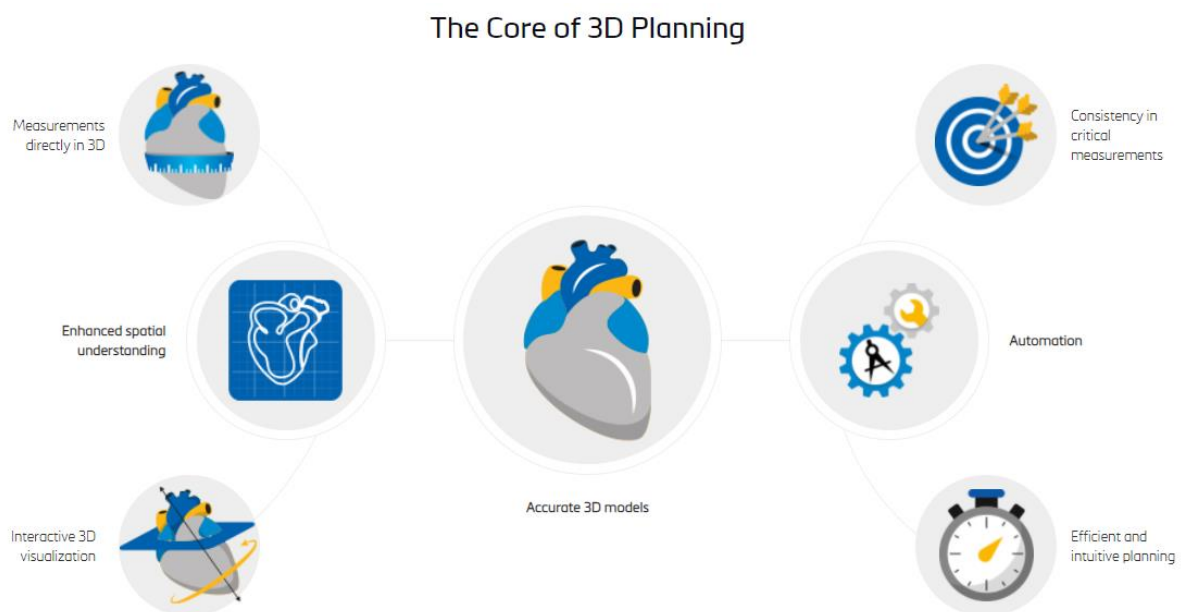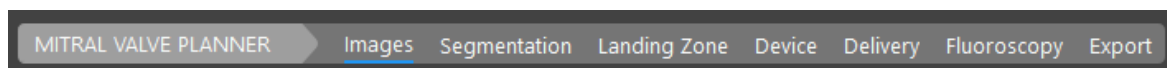
For more information, please see: https://www.materialise.com/en/medical/software/mimics-enlight.

Figure 1: The Value of 3D Planning

The TMVR workflow consists of the following steps:

Images: View multiple images series and select a cardiac phase to analyze.

Segmentation: Generate 3D models of the cardiac anatomy.

Landing Zone: Identify and measure the mitral annulus.

Device: Import a virtual device and measure the resulting neo-LVOT.

Delivery: Analyze the delivery path to the mitral valve for either apical or trans-septal access.

Fluoroscopy: Identify an optimal C-arm angle for the procedure and simulate the resulting fluoroscopic view.

Export: Export a PPT report, and files for online case sharing and/or 3D printing.

# Exercise 1: 3D Planning for TMVR

Starting Materialise Mimics Enlight Medical and opening a project.

1. Open Materialise Mimics Enlight Medical from the start menu or desktop icon.

2. Go to File and select **Open**.

3. Navigate to and select the *"Demo_Case_Mimics_Enlight_TMVR_Workshop_Feb_2 .mcs"* demo file. Click **Open**.
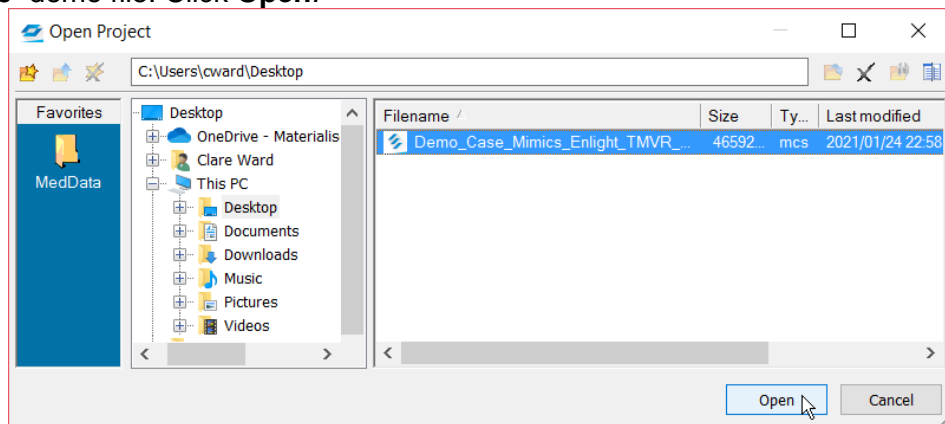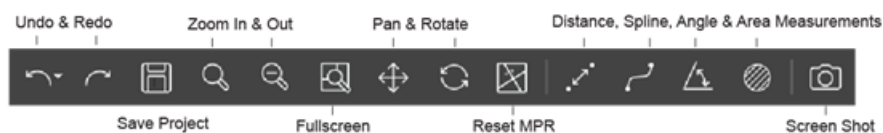

*NOTE: If you want to create a new project from DICOM images, go to File and select **New from Disk**.*

General TMVR Workflow Overview and Navigation
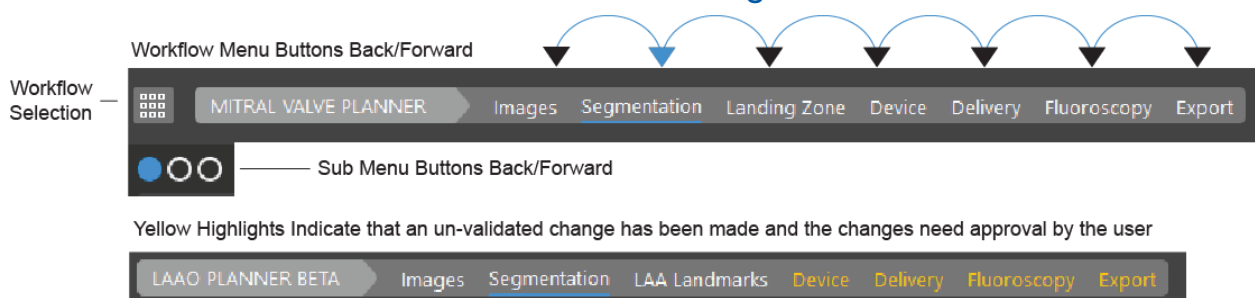
Move back and forth through the workflow by clicking the steps in the Workflow Selection and Sub-Menu buttons.

Note the shortcuts available on the top-right of the interface.

Here, you can undo/redo an action, save, navigate the images, and also perform your own distance, angle, spline, and area measurements at any time. The last icon allows you to capture a screenshot for later use in the report.

4. Navigate to *Help > Help > Mitral Valve Planner* for more workflow instruction.
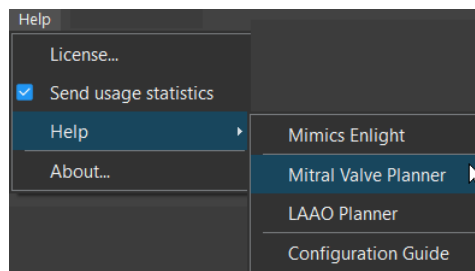
Image navigation and MPR

5. Click in the center of the mitral valve in the images and notice that the other views will update to that point.

6. Change the image view by clicking and dragging the axes to rotate them in the images. This will perform a multi-planar reslice (MPR) allowing you to obtain additional views beyond the standard axial, sagittal, and coronal views.

   To obtain an optimal reslice view of the mitral valve, rotate the red axis in both the upper left and lower left views so that is passes through the leaflet insertion points of the mitral valve in those views.

   Next, in the upper right view, rotate the green axis so that it bisects the aorta.

   Make adjustments in all views to align the view in the center of the mitral valve. It should look similar to this:
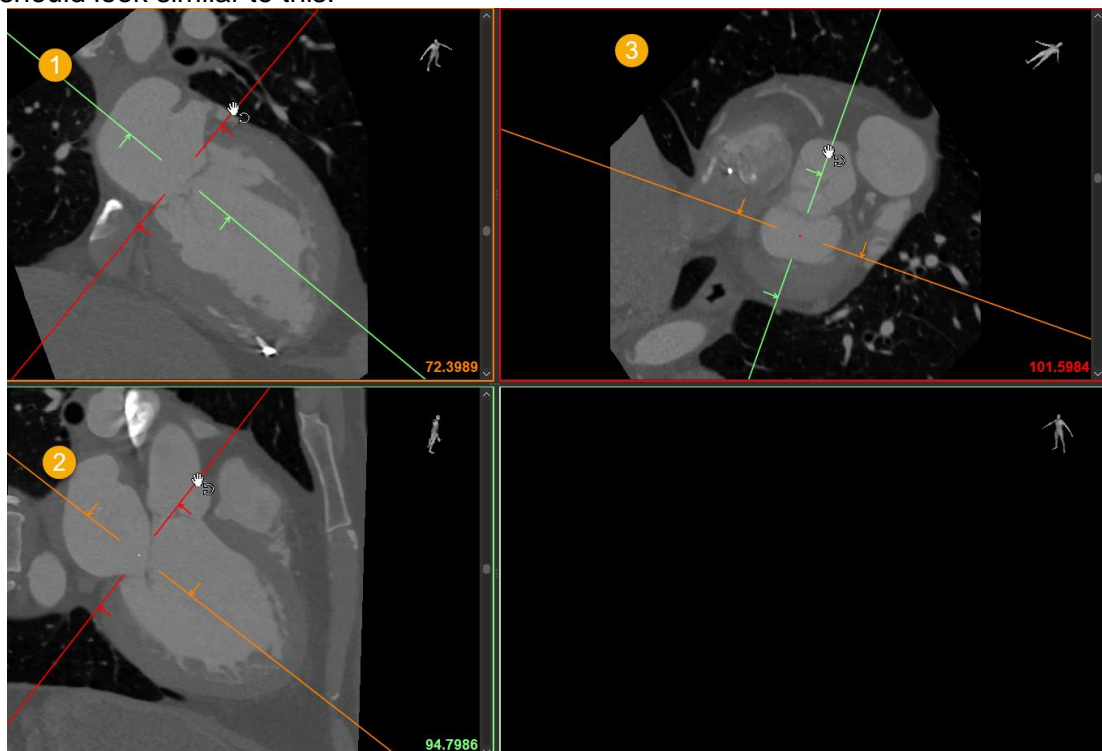
Images

7. This project contains 10 images series corresponding to 10 time points in the cardiac cycle, numbered as a percentage. View those on the left of the interface. Click the **Cine-loop** button to see the beating heart in the images.
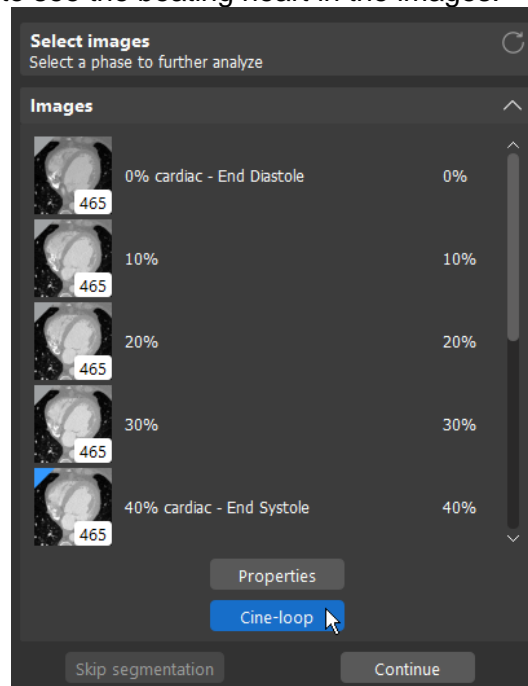

8. Double-click the "40% cardiac – End Systole" image series to select that phase for analysis, then click, **Continue**.

Segmentation

You should now be on the *Segmentation* page. During this step, 3D models of the anatomy are generated using an automatic or semi-automatic method.

9. The segmentation has already been done for you in this case. View the result in the 3D view by clicking on the 3D view shortcuts on the right side of the 3D view.
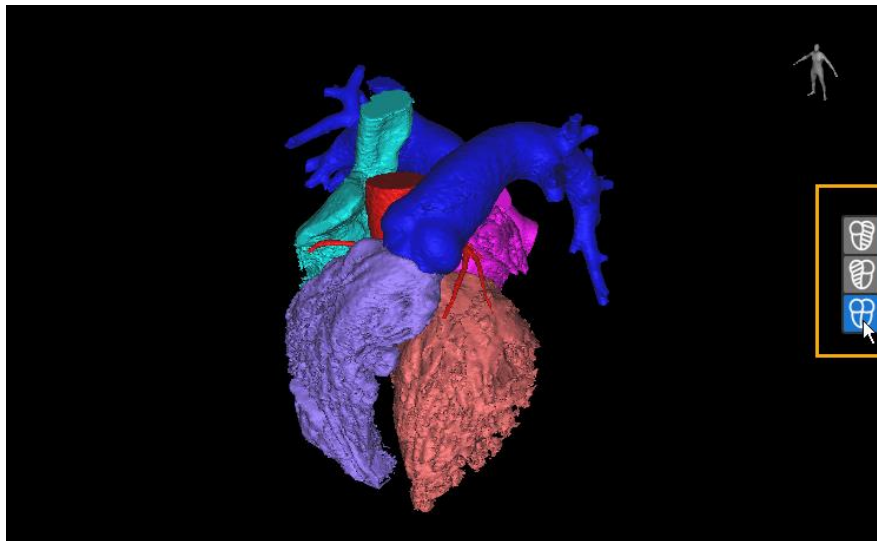
NOTE: Depending on the step in the Workflow, there will be different 3D views available. Check them out using the shortcuts on the right of the 3D View.

Shortcuts

There are several mouse and keyboard shortcuts to help you navigate the software, the 2D image views, and the 3D view.

General Shortcuts

General

Action	Shortcut	Description
Undo	Ctrl + Z	Undo the last action
Redo	Ctrl + Y	Redo the last undone action
Delete	Delete	Delete the selected point or object

2D Image View Shortcuts

2D Views*

Action	Shortcut**	Description
Zoom In	Ctrl + RMB + move mouse cursor up	Zoom 2D view
Zoom Out	Ctrl + RMB + move mouse cursor down	Zoom 2D view
Zoom	Space bar	Toggles between zoomed in and zoomed out of one viewport
Pan	Shift + Arrow keys	Pan 2D view
	Shift + RMB	
	Hold the MMB	
Scroll	Scroll wheel	Scroll through the image slices

* The above mentioned shortcuts are working on the view over which the mouse cursor is hovering.

** LMB = Left Mouse Button, RMB = Right Mouse Button, MMB = Middle Mouse Button / Scroll wheel.

Contrast Shortcuts

To adjust the grayscale of how the images are visualized, use the right mouse button:

|	
RMB + move up	Increases the width of grayscale
RMB + move down	Decreases the width of grayscale
RMB + move right	Increases the level of grayscale
RMB + move left	Decreases the level of grayscale

3D View Shortcuts

3D view*

Action	Shortcut**	Description
Zoom In	Ctrl + RMB + move mouse cursor up	Zoom 3D view
	Scroll up	
Zoom Out	Ctrl + RMB + move mouse cursor down	Zoom 3D view
	Scroll down	
Rotate	Hold the RMB	Rotate the 3D view
	Arrow keys	Rotate the 3D view left/right and up/down
Pan	Hold the MMB	Pan the 3D view
	Shift + Arrow keys	
	Shift + RMB	
Locate	Shift + LMB	Locate the point indicated in 3D on the 2D views when the cursor is in another tool mode

** LMB = Left Mouse Button, RMB = Right Mouse Button, MMB = Middle Mouse Button / Scroll wheel.

10. Practice locating and zooming in on the mitral anatomy in the images and 3D view.

11. Click **OK** to move on to the next step.
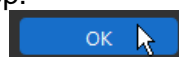
12. Select the type of case that will be processed. For this dataset, click, **Native**.
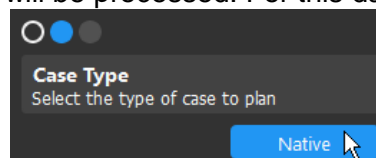
Landing Zone

In the *Landing Zone* step, you will define a curve around the annulus, or landing zone for the device, of the mitral valve.

There are two methods available for this: an automatic and a manual option. The Automatic method is a 'smart' algorithm that has been trained on a large set of datasets. It will output an

annulus curve for you that you can then edit. Note that it is intended for native, non-MAC cases.

13. Click the **Automatic** button to generate an annulus curve. This will take a minute or so.
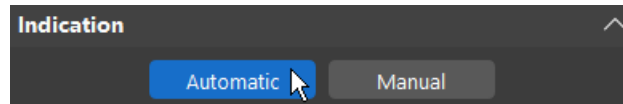

14. Next, click **Calculate** to automatically fit a plane to the annulus curve and calculate measurements of the annulus. This will also update your image views to an optimal mitral view based on the best-fit mitral plane.
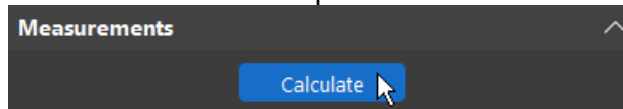
15. To edit the annulus definition, click on the points of the green spline around the annulus (in 2D or 3D) and drag them to where you would like to place them.
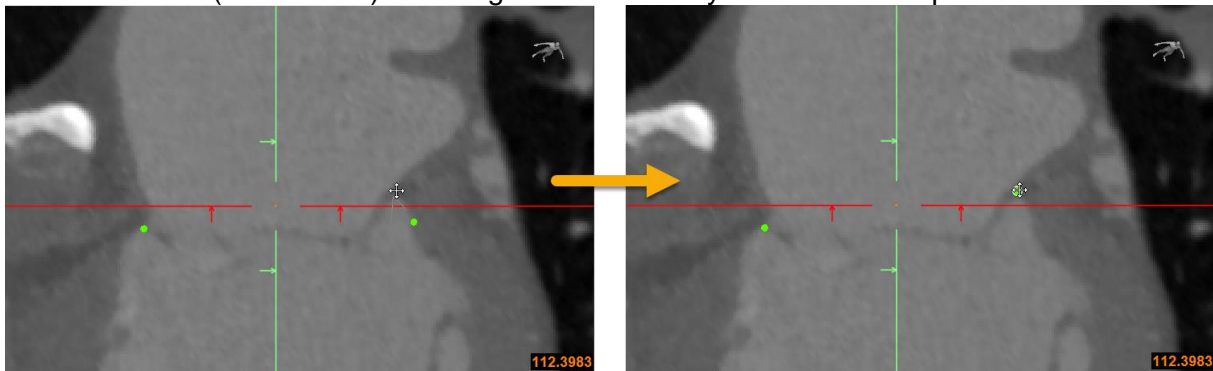
Note that you can rotate the mitral view by rotating the MPR in the top-right view:
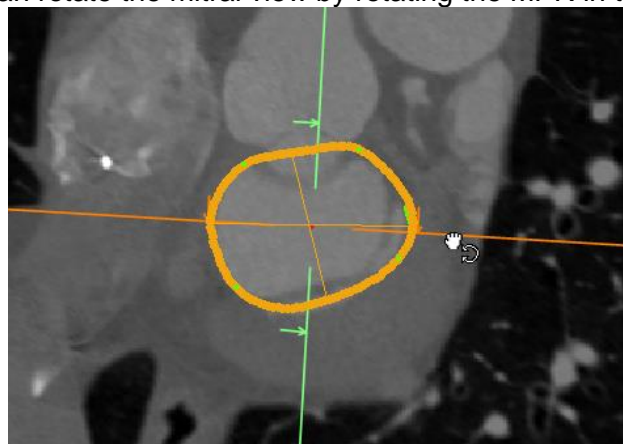
16. On the left of the interface, expand the "Objects" list. There you can show and hide various 3D models and measurements.

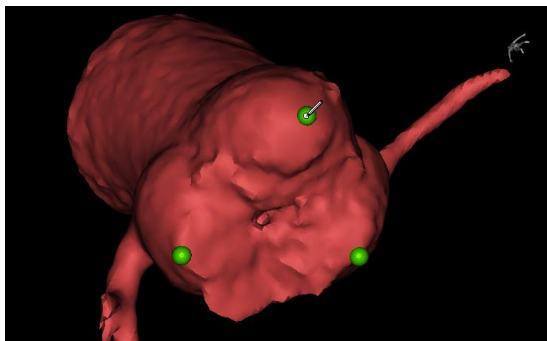Show the Left Atrium in the 3D view by clicking on the eye icon:
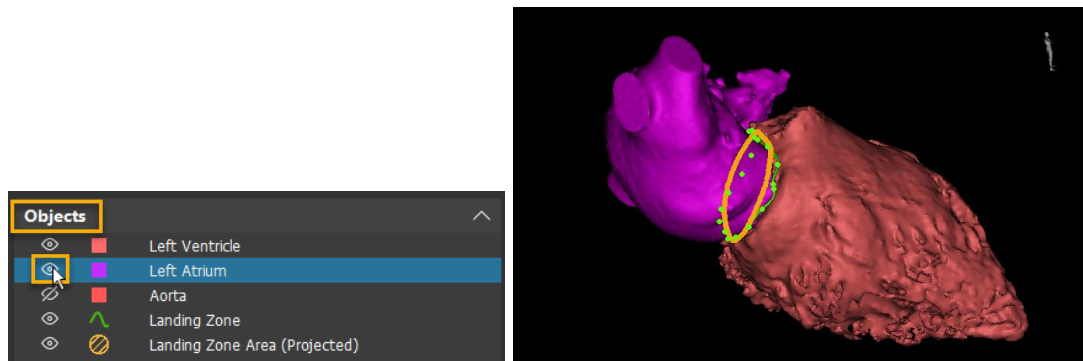
17. When you finish editing the annulus, make sure to click the **Recalculate** button to update the annulus measurements.
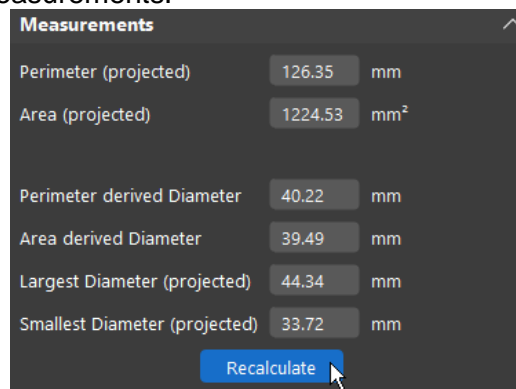
18. Click **OK** to move on to the next step.
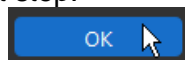
19. Next, indicate the aortic valve plane by selecting the apex of each aortic cusp on the 3D model.


Note: If you make a mistake, you can delete a point and re-select it, or click and drag a point to move it.
*You can also place the points on the 2D images views if preferred.*

Device

In the *Device* step, you will import a virtual device and quantify the potential effects on the left ventricle outflow tract.

20. From the drop-down device *Library*, choose the "Cone" example device. Under *Size*, select "42x27".
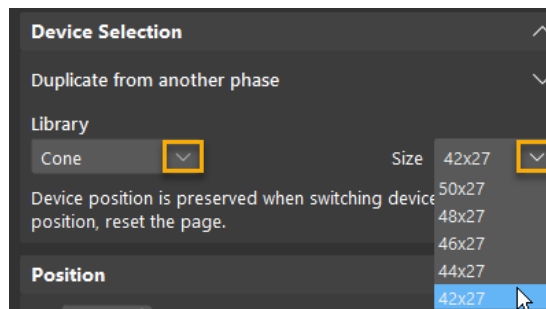
Note that this is a demo device and is not an accurate representation of an industry-available device.

21. Calculate the predicted neoLVOT by clicking the **Calculate** button. This will run an algorithm that surveys the neoLVOT space to output the smallest neoLVOT area.
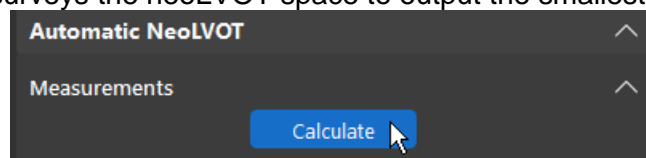
Note that there is also a Manual option to indicate the neoLVOT area on an image.

22. View the result in the 3D view using the available presets:
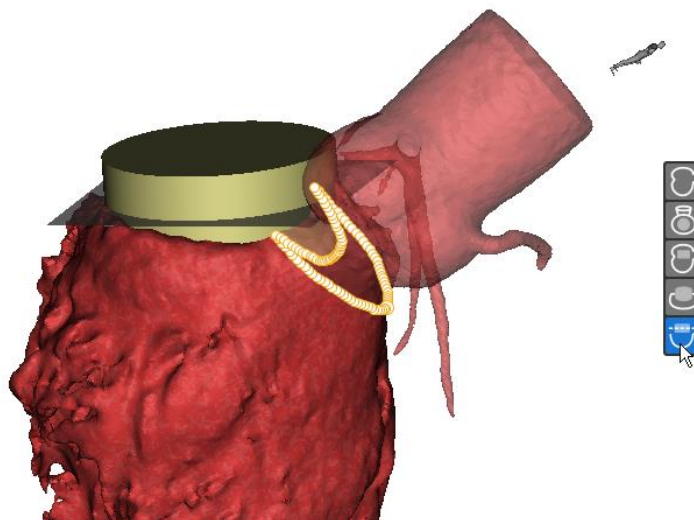
23. Change the device type and/or size, then recalculate the neoLVOT.

24. Take you own angle measurement to measure the aorto-mitral angle using the "Measure angle" tool from the top-right of the software.

25. Save a screenshot of the lower-left image view, to be added later to the report.
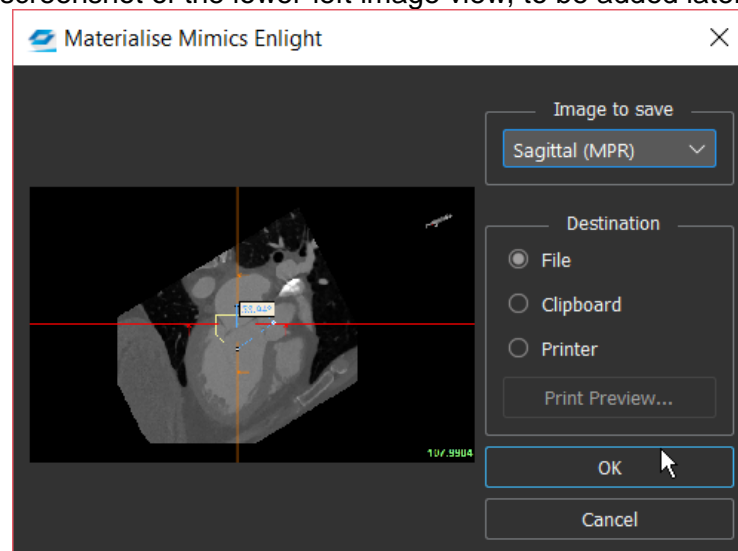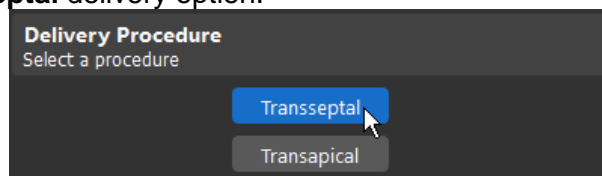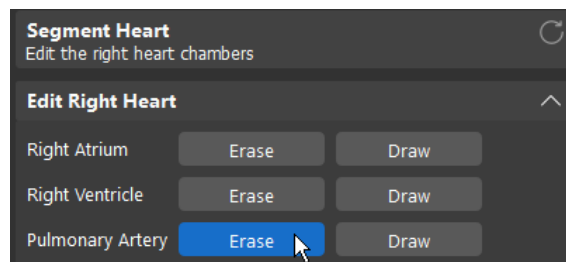

26. Click **OK** to move on to the next step.

Delivery

In the *Delivery* step, you will be able to view and quantify the predicted delivery path.
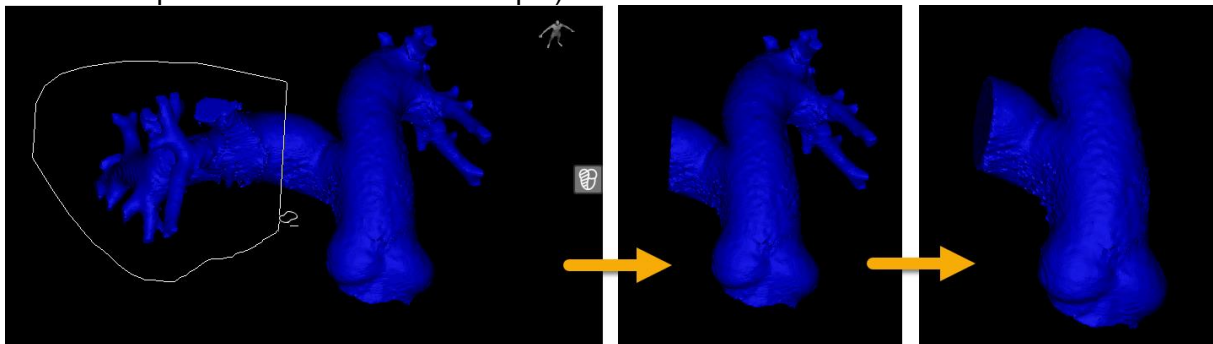
27. Select the **Transseptal** delivery option.

28. View the segmentation in the 3D View. Edit the Pulmonary Artery model by clicking the **Erase** button next to "Pulmonary Artery".
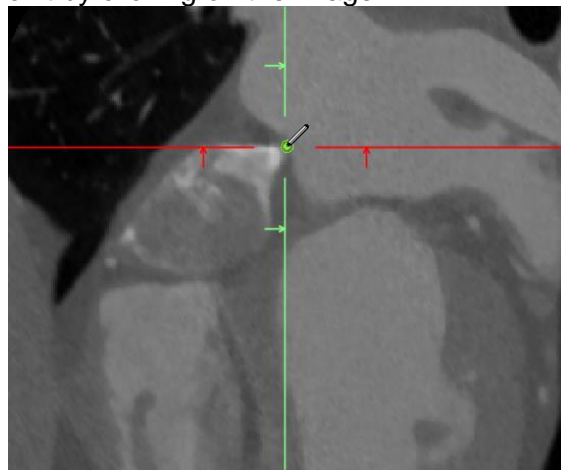
Lasso over the 3D view to trim off the pulmonary arteries. (This will help save computation time in the next steps.)
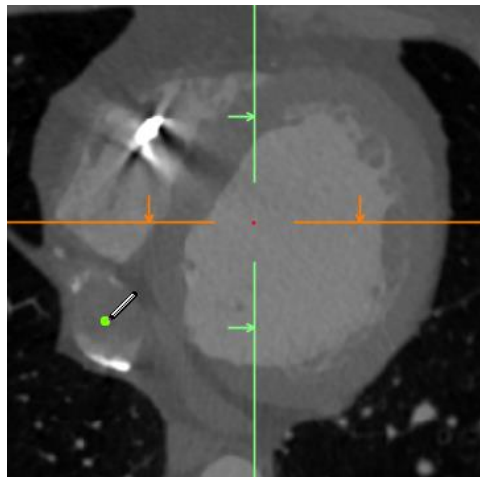

29. Click **OK**.

30. Identify the *Fossa Ovalis.*

Find the point where the left and right atria get very close in the 3D view. Hold SHIFT, then click on the point to locate it on the image views.
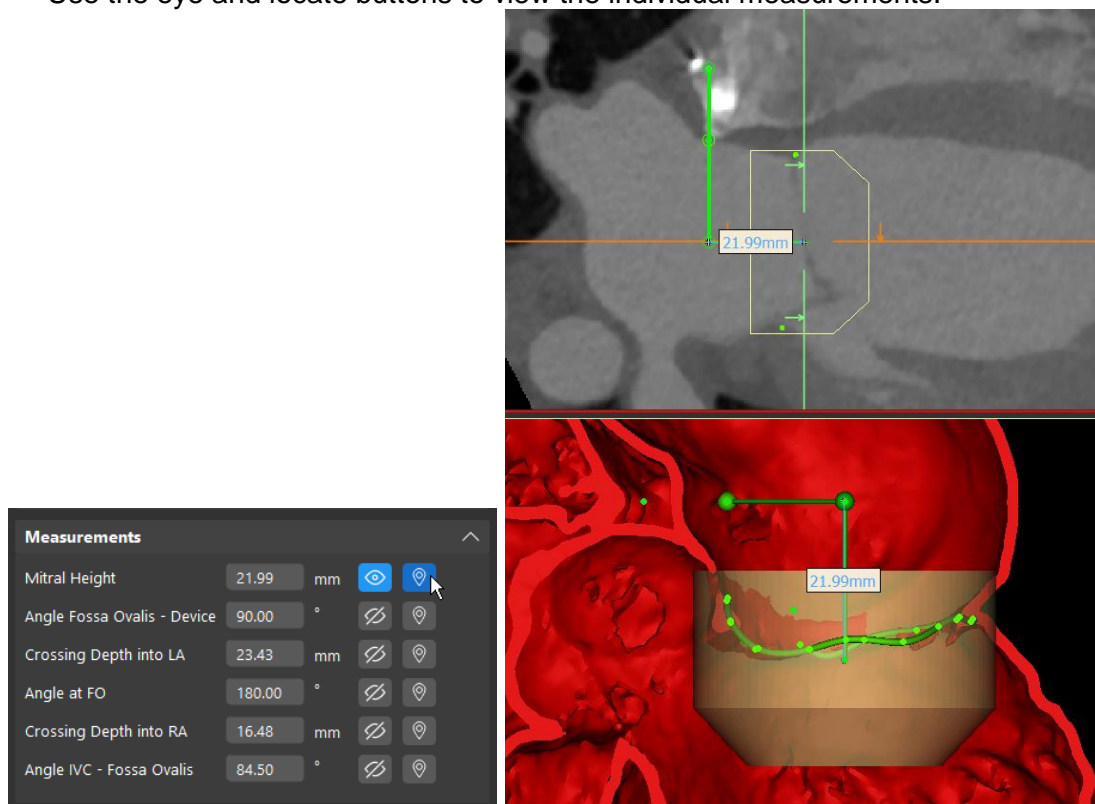Once there, place the point by clicking on the image.

31. Reset the MPR using the shortcut on the top-right, then scroll down in the axial view to identify and select the *IVC* point.

32. Click **OK**.

33. On the next page, you can visualize the delivery path and associated measurements. Use the eye and locate buttons to view the individual measurements.

Measurements				
Mitral Height	21.99	mm	👁	⊙
Angle Fossa Ovalis - Device	90.00	°	⊘	⊙
Crossing Depth into LA	23.43	mm	⊘	⊙
Angle at FO	180.00	°	⊘	⊙
Crossing Depth into RA	16.48	mm	⊘	⊙
Angle IVC - Fossa Ovalis	84.50	°	⊘	⊙

Note that you can adjust the delivery pathway by clicking and dragging the points in the 3D and in the images.

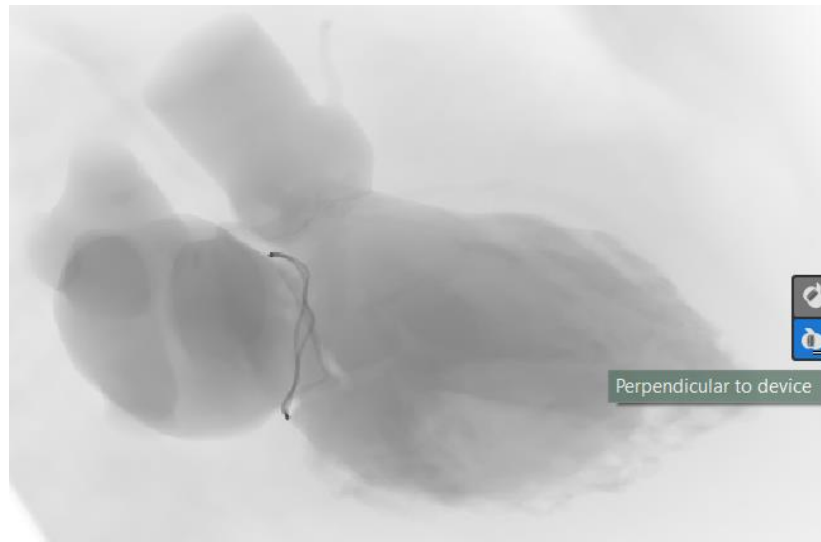34. Select **Proceed to Fluoroscopy** to move on.

Fluoroscopy

In the *Fluoroscopy* step, you will be able to generate an optimal C-arm angle and simulated fluoroscopy view.
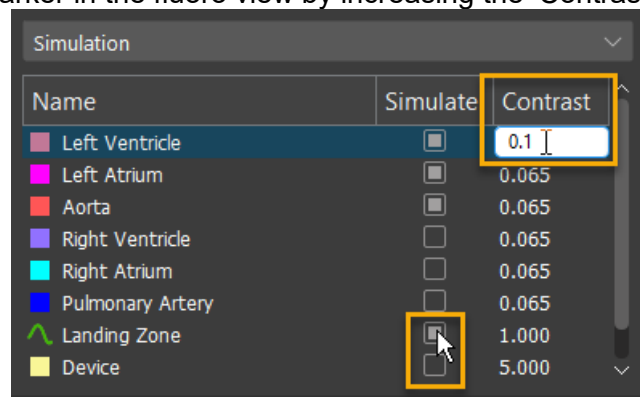
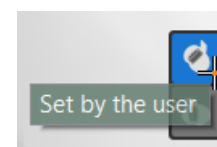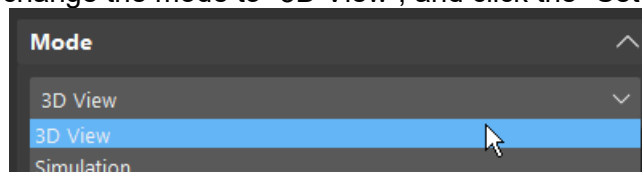35. Click on the "Perpendicular to device" icon to generate an automatic view and C-arm angle.

Hide the device and show the mitral annulus by selecting/unselecting the objects in the Simulation menu on the left.
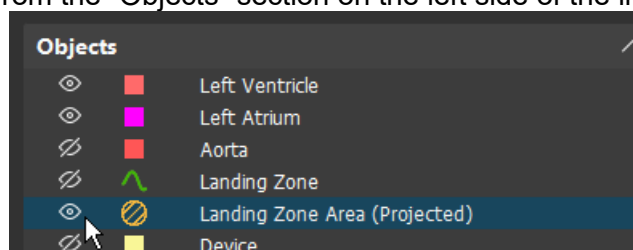Make an object darker in the fluoro view by increasing the 'Contrast' value.

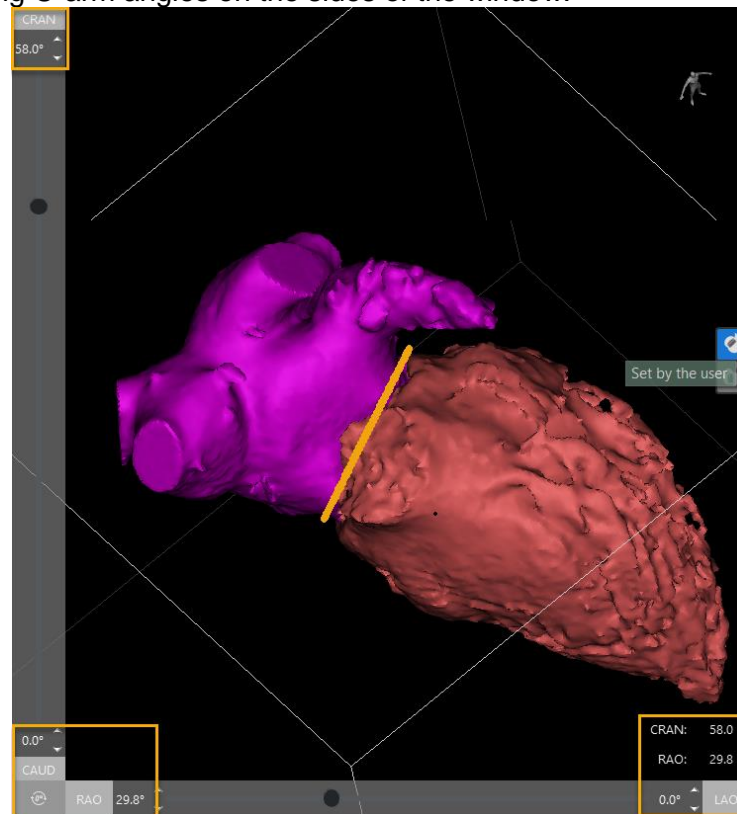36. Next, change the mode to "3D View", and click the "Set by user" view option.

Rotate the model in 3D to find an appropriate view for the intervention, showing/hiding objects as needed from the "Objects" section on the left side of the interface.
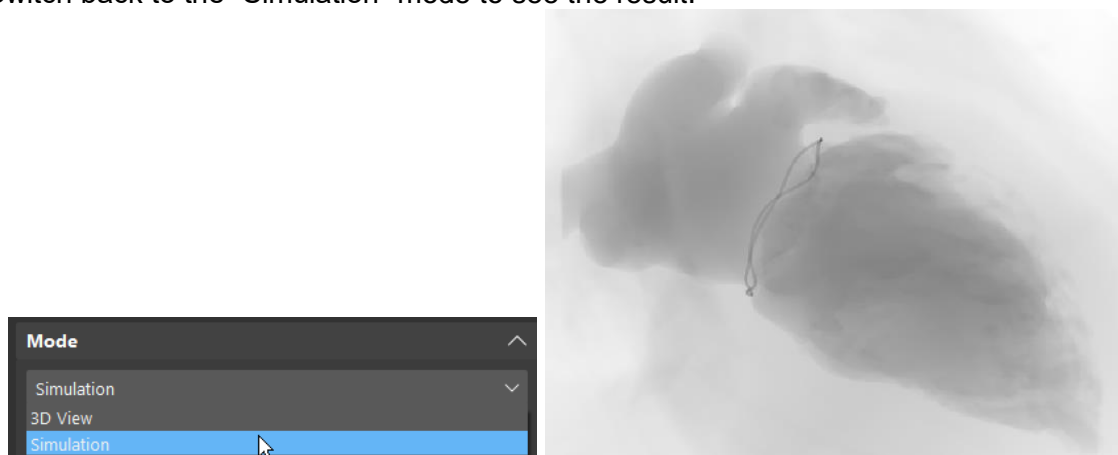
Note the resulting C-arm angles on the sides of the window.

Switch back to the "Simulation" mode to see the result.

37. Click **OK** to go to the *Export* page.

Export

In the *Export* step, you will be able to export a PPT report containing the measurements you took, as well as a file to share on the online Mimics Viewer and a file for further processing for 3D printing.

38. Click the **Create** button under the Report ppt section. This may take a minute or so.

39. Open the PPT report once exported. Create a new slide and import the screenshot saved from earlier in the workflow into the report.

40. Lastly, export a file to share in the online Mimics Viewer by clicking **Create** in the Mimics Viewer file section of the workflow.

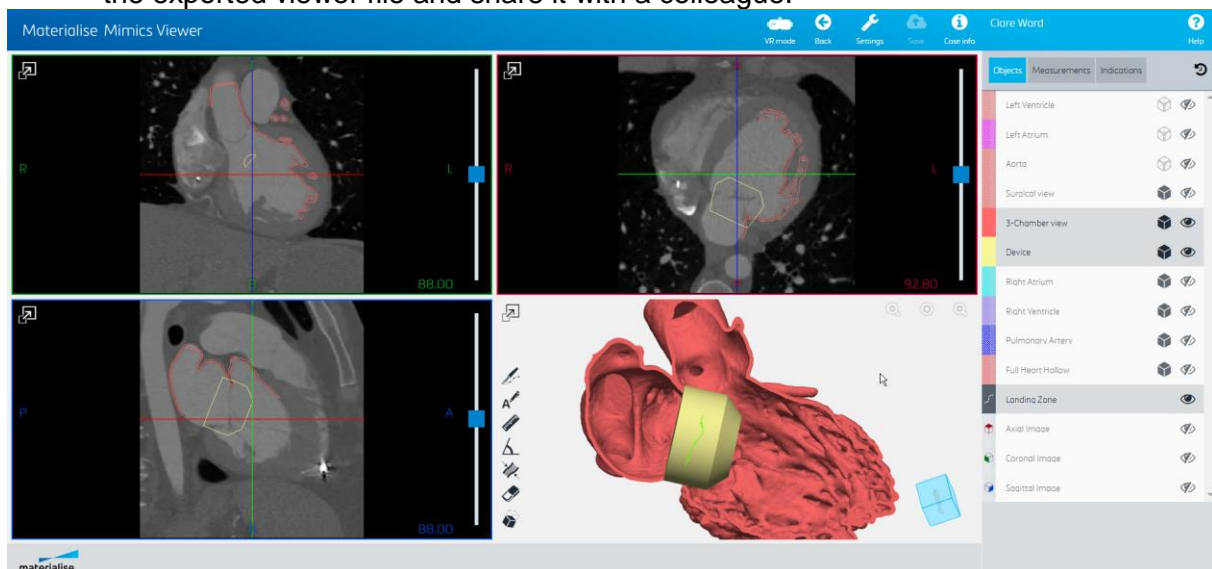41. Go to https://mimicsviewer.materialise.com, sign in, create a new case, then upload the exported viewer file and share it with a colleague.

Congratulations!

Congratulations, you have finished the workflow! Thank you for joining us!