syngo.via

Instructions for Use – *syngo*.CT Cardiac Planning
VB60

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Legend

i	Indicates a hint Is used to provide information on how to avoid operating errors or information emphasizing important details
»	Indicates the solution of a problem Is used to provide troubleshooting information or answers to frequently asked questions
■	Indicates a list item
✓	Indicates a prerequisite Is used for a condition that has to be fulfilled before starting a particular operation
◆	Indicates a one-step operation
1 2 3	Indicates steps within operating sequences
Italic	Is used for references and for table or figure titles
→	Is used to identify a link to related information as well as previous or next steps
Bold	Is used to identify window titles, menu items, function names, buttons, and keys, for example, the Save button Is used for on-screen output of the system including code-related elements or commands
Orange	Is used to emphasize **particularly** important sections of the text
`Courier`	Is used to identify inputs you need to provide
Menu > Menu Item	Is used for the navigation to a certain submenu entry
<variable>	Is used to identify variables or parameters, for example, within a string

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⚠ CAUTION	CAUTION Used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury or material damage. CAUTION consists of the following elements: • Information about the nature of a hazardous situation • Consequences of not avoiding a hazardous situation • Methods of avoiding a hazardous situation
⚠ WARNING	WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury. WARNING consists of the following elements: • Information about the nature of a hazardous situation • Consequences of not avoiding a hazardous situation • Methods of avoiding a hazardous situation

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1 *syngo*.CT Cardiac Planning

In the following sections, you find procedural information and background information on *syngo*.CT Cardiac Planning.

1.1 Legal notes

The functions described in this document are not commercially available in all countries. Some functions may be protected by a software license that is currently restricted for regulatory reasons. Some functions may be available with an optional software license. Please contact your local Siemens Healthineers Representative for further details.

1.1.1 Intended purpose

Image analysis software for evaluating image data sets and preparing them for further use in therapy.

1.1.2 Intended use

syngo.CT Cardiac Planning is an image analysis software package for evaluating contrast enhanced CT images. The software package is designed to support the physician in the qualitative and quantitative analysis of morphology and pathology of vascular and cardiac structures, with the overarching purpose of serving as input for planning of cardiovascular procedures.

1.1.3 Indications for use

syngo.CT Cardiac Planning is an image analysis software package for evaluating contrast enhanced CT images. The software package is designed to support the physician in the qualitative and quantitative analysis of morphology and pathology of vascular and cardiac structures, with the overarching purpose of serving as input for planning of cardiovascular procedures.

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1.1.4 Contraindications

There are no known specific situations that contraindicate the use of this device.

1.1.5 Clinical benefit

The use of *syngo*.CT Cardiac Planning allows evaluating contrast enhanced CT images. The *syngo*.CT Cardiac Planning software supports the physician in the qualitative and quantitative analysis of morphology and pathology of vascular and cardiac structures, with the overarching purpose of serving as input for planning of cardiovascular procedures.

1.1.6 Side-effects

There are no known side-effects.

1.1.7 Residual risk

The overall residual risk is acceptable according to the defined risk acceptance criteria. User-relevant safety information is provided in the Instructions for Use documents of the medical device.

1.1.8 Incident reporting

Any serious incident that has occurred in relation to the device should be reported to the manufacturer and the competent authority in which the user and/or patient is established.

1.1.9 Storage and handling conditions

There are no known specific storage and handling conditions for this medical device.

1.1.10 Intended patient population

The CT Cardiac Planning workflow can be used for all patient groups. Automation within the workflow is optimized for adult patients.

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1.2 User profiles

Please note that the following profiles may vary in practice depending on (hospital) organization, qualification, and personal responsibilities and can only be considered as a general guide. Customer Service Engineer and IT Administrator are not in focus of this specification that focuses on clinical applications. Therefore, these roles are not described.

The following user roles and profiles have been identified for the *syngo*.CT applications:

Technologist (Radiographer)

- Role

  Quality assurance of the images; preparation of images for reading, such as manipulation of size, position, or windowing values; creation of preliminary markers or measurements; generation of additional result series, for example, parallel ranges; (sending data for archiving).

- Knowledge and experience

  Radiation technologist training, work experience, product training certificate or comparable product experience.

Radiologist

- Role 1

  Performing the imaging examination, reporting of patient images, completing but not verifying reports, intervention, responsible for the safety of patients and employees, (sending data for archiving).

- Role 2

  All of the above, plus justifying indication (medical check) and verifying reports.

- Knowledge and experience

  Physician, consultant for radiology, work experience, product training certificate or comparable product experience.

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Clinical Administrator

- Role 1

  Configuration of application-related settings, user management, patient data administration, first support contact for radiologists and other users (e.g. technologists).

- Role 2

  Responsible for managing Dual Energy application classes and corresponding algorithm parameters.

- Knowledge and experience

  Application specialist who typically works in the radiology department, radiologist, or radiographer, with work experience, product training certificate or comparable product experience, and knowledge of the RIS/PACS workflow, configuration of DICOM nodes, archiving, management of Short Term Storage (STS), and license handling.

  In addition to the configuration information provided, the clinical administrator needs to follow the information in the *syngo*.via Administration Online Help.

  For role 2 the radiologist needs expert knowledge on Dual Energy technology.

1.3 Functionality of *syngo*.via

syngo.via is a software solution intended to be used for viewing, manipulation, communication, and storage of medical images. It can be used as a stand-alone device or together with a variety of cleared and unmodified *syngo* based software options. The functionality of the *syngo*.via software that is used in combination with a *syngo*.CT medical device is described in the *syngo*.via Basic Operator Manual. The *syngo*.via Basic Operator Manual and the *syngo*.via Administrator Manual are the Instructions for Use of *syngo*.via.

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CAUTION

Not observing the Instructions for Use and the safety information of the medical device!

Injury to the patient.

- Always observe the Instructions for Use and follow the safety instructions of the medical device.
- Always use this Instructions for Use document in conjunction with all Instructions for Use documents provided.

1.4 Image requirements and data loading of *syngo*.CT Cardiac Planning

1.4.1 Image requirements

The following image requirements must be met or else the series cannot be loaded to the application.

- Contrast-enhanced cardiac data
- No gaps
- No gantry tilt
- Axial images
- 512 x 512 or 256 x 256, contrast

If you do not see the expected number of phases in the **Phase Navigator**, ensure that all cardiac phases are reconstructed with the same matrix size, resolution, and slice distance.

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1.4.2 Data loading

To display the loaded data in the image area, the following image requirements must be met:

- Highest resolution
- Newest acquisition

Tips for data loading

If multi-phase data, the BestSystole data set is displayed by default. If the BestSystole data set is not available, the data set closest to the 20% heart phase is displayed.

Dual Energy data is only supported by loading an already created mixed series.

CT Cardiac Planning supports the mixing of reconstructions with different resolutions. You can, for example, combine the Best Phase reconstruction with 512 × 512 matrices and a functional data set reconstructed with 256 × 256 matrices. If you want to use a smaller matrix size, you can drag and drop these data sets from the Series panel.

Multiple reconstructions of the same cardiac phase cannot be loaded simultaneously.

CT Cardiac Planning supports the processing of CT datasets of one patient reconstructed with % and ms simultaneously.

1.5 Layouts in CT Cardiac Planning

The Cardiac Planning steps include:

- Overview

  Displays the buttons in the common area.

- Aortic Valve

  Provides the analysis of the aortic valve annulus for Transcatheter Aortic Valve Implantation (TAVI) when planning procedure support.

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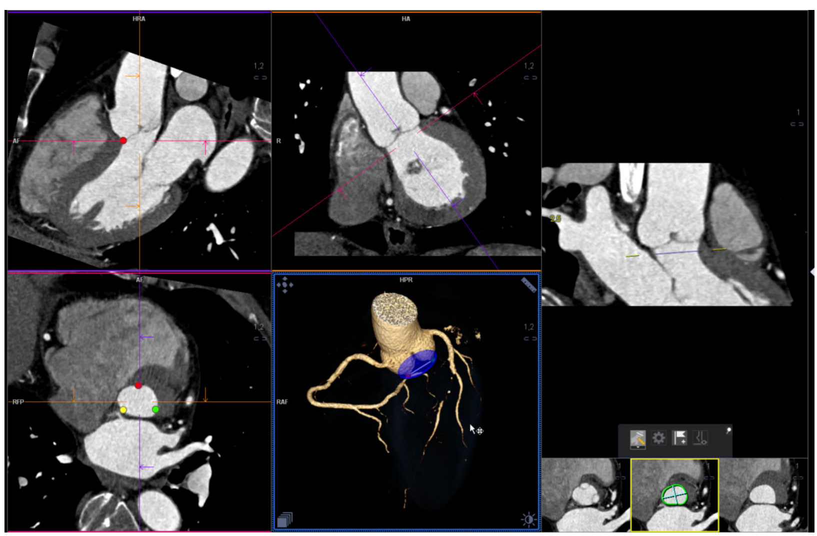
- Therapy Connect

  Provides the ability to generate and save candidates for C-Arm angulations based on the aortic valve annulus orientation for Transcatheter Aortic Valve Implantation (TAVI) when planning procedure support.

CT Cardiac Planning provides a dedicated Aortic Valve layout for the measurement of the aortic valve. This layout is available in the **Aortic Valve** step in the Case Navigator.

Apart from MPR, MIP, and VRT segments, an additional image segment type is provided, "curved planar reformation" (CPR). CPRs visualize a curved planar reconstruction of the aorta along a defined centerline.

Below the CPR segment, there is a set of cross-sectional segments. These segments show the lumen of the aorta at different positions. The segment in the middle corresponds to the yellow marker in the CPR segment. The adjacent images show the profile of the aorta at a defined distance from the yellow marker.



Aortic Valve Layout

There are two kinds of CPR segments: standard CPRs with one view on the vessel and twin CPRs with two orthogonal views on the vessel. Twin CPRs are available for multi-monitor configurations.

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In the VRT segment, the annular plane is identified by a triangle that is defined by the three hinge points of the aortic valve:

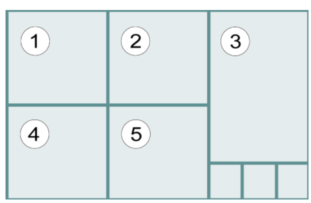
- A red dot marks the right coronary cusp.
- A yellow dot marks the non-coronary cusp.
- A green dot marks the left coronary cusp.

The rotation of VRT and MPR segments is synchronized by means of the **Toggle/Define Sychronization** icon in the common tools area.

Default layout

The provided layouts depend on your current monitor configuration. There are dedicated layouts for single-monitor and dual-monitor configurations, and for different aspect ratios (4:3, 16:10, and portrait orientation).

- **Aortic Valve**



(1) MPR (orthogonal view)
(2) MPR (orthogonal view)
(3) CPR with cross-sectional segments
(4) Annular plane MPR (main segment)
(5) VRT

Depending on the selected layout and the current monitor configuration, additional segments may be provided.

There are two layouts in Cardiac Planning:

- Overview (used for the Overview and Therapy Connect steps)
- TAVI Reading (used for the Aortic Valve step).

The Overview (used for the Overview and Therapy Connect steps) layout consists of a 2x2 MPR/VRT layout on the main monitor. The second monitor is not used in this layout. By default, the Overview layout shows a cardiac plane-oriented view in the 3 MPR segments.

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1.6 Preprocessing hints

CT Cardiac Planning performs several preprocessing steps to facilitate your work. In the VRT segment, the data is displayed with secondary structures around the heart removed. A mesh representing the aortic root is calculated. From this mesh, the hinge points defining the annular plane as well as the aortic centerline are derived. The centerline is constrained to be always perpendicular to the annular plane.

Before you start reading the images, check the results of the preprocessing:

- Quality of the calculated annular plane. See (➔ Page 24 *Redefining the hinge points*).

To ensure that the aorta centerline is always perpendicular to the annular plane, it is not possible to edit this centerline.

1.7 Measurement accuracy

The measurement tools provided by *syngo*.via are developed using established mathematical and scientific methods. However, the accuracy of a measurement is primarily determined by the image data to which the measurement tools are applied.

The following factors influence measurement accuracy:

- Accuracy and calibration of the CT scanner used to acquire the images
- Image reconstruction settings, such as reconstruction kernel, slice thickness, spacing, resolution, and Field of View (FoV)
- If applicable, quantity of contrast media and injection protocol used
- Scan protocol used
- Patient compliance during image acquisition, for example, breathhold and motion
- Patient anatomy
- Patient orientation and position during image acquisition
- Zoom factor and image orientation when the measurements are performed

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- Placement of the end points of the measurement; placement is more accurate when the image is zoomed in
- User skills

1.7.1 Display accuracy in *syngo*.CT Cardiac Planning

The following table shows the unit and the accuracy of the specific measurement tools in *syngo*.CT Cardiac Planning:

Tool	Property	Unit	Display accuracy
Cardiac Planning	Vessel Length	mm	0.01 mm
	Vessel Diameter	mm	0.01 mm
	Vessel Area	mm^2	0.1 mm^2

General factors that influence the measurements:

- Heart rate
- Image artefacts

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2 Safety information

Follow the safety information in this document.

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i To ensure the safe use of your product and the safety of people, you must adhere to the safety information provided in the Instructions for use documents. In addition, also observe your country-specific regulations and guidelines.

Safety information is located in the safety section and repeated within context where a hazardous situation may occur. To make sure safety information is understood, always read it in context of the situation.

WARNING and CAUTION are highlighted in the text:

⚠ WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

WARNING and CAUTION have the same structure. The following example CAUTION instructs you how to read a WARNING or a CAUTION:

⚠ CAUTION

This text describes the hazardous situation: Images with lossy compression are used for diagnosis!

This text describes the hazard: **Wrong diagnosis.**

- **This text describes how to avoid the hazardous situation:** Always verify your evaluation results with the original DICOM images (first reader duty).
- Never use lossy ...

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2.1 General safety information

For the secure operation of your medical device, it is the responsibility of the system owner to ensure that each person who operates the system reads and understands the provided Instructions for Use.

CAUTION

Not observing the Instructions for Use and the safety information of the medical device!

Injury to the patient.

- Always observe the Instructions for Use and follow the safety instructions of the medical device.
- Always use this Instructions for Use document in conjunction with all Instructions for Use documents provided.

2.2 Safety information on training

CAUTION

Operation of the medical device by non-trained users!

Injury to the patient.

- Only trained and qualified users, certified in accordance with country-specific regulations, are authorized to operate the system. For example, physicians, radiologists, or technologists.

  For appropriate training, contact your Representative at Siemens Healthineers.

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2.3 Safety information on patient data

CAUTION

Displayed information about changed patient data is not observed!

Wrong diagnosis due to patient data that has not been updated.

- Always read and observe the displayed information about changed patient data.

  Follow the instructions provided with the displayed information.

  Check all results and delete results that include patient data that has not been updated.

CAUTION

Patient data is changed using the correct and rearrange function while a time-critical workflow for this patient is in progress!

Delayed diagnosis due to restart of workflow.

- Do not perform correct and rearrange actions while time-critical cases are in progress. Always check the **Workflows** section in the **Job View** for time-critical workflows.

CAUTION

Loading image data sets of different patients!

Mix-up of patients and incorrect diagnosis.

- When loading two or more reference series or model series, make sure that you select the data of the same patient.

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2.4 Safety information on lossy compressed images

CAUTION

Images with lossy compression are used for diagnosis!

Wrong basis for diagnosis.

- Always verify your evaluation results with the original DICOM images (first reader duty).
- Never use lossy compressed images for primary diagnosis.
- Check the image text for information on lossy compression before starting an evaluation.

2.5 Safety information on monitor usage

CAUTION

Use of a black and white monitor for this CT workflow!

Wrong diagnosis due to wrong image information.

- Only use a color monitor for this CT workflow.

2.6 Safety information on algorithms

CAUTION

Incorrect input data set used with algorithms leads to incorrect results!

Wrong basis for diagnosis.

- Make sure that you use the specified input data.
- Verify algorithm results with the original data set.

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CAUTION

Algorithms may return inaccurate results or incomplete anatomy information!

Wrong basis for diagnosis or treatment.

- Before diagnosis or further processing, check and correct algorithm results. For example, results from segmentation or masking.

CAUTION

Incomplete data is used for diagnosis!

Wrong basis for diagnosis.

- Verify that the input data is sufficient for the creation of automatically generated results.
- Verify the correctness of automatically generated results.

2.7 Safety information on modified images

CAUTION

Diagnosis is based on modified images only!

Wrong basis for diagnosis.

- Use modified images as supplemental information only. Make sure that your diagnosis is based on original acquired images. These are images that are not modified in any regard.
- Always verify modified images. For example, verify the results of contrast agent enhancement images with original images.

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2.8 Safety information on findings

CAUTION

Wrong mapping of findings to form fields in measurement protocol!

Wrong information in measurement form.

- Check consistency of values in measurement form with Findings Navigator.

2.9 Safety information on Rapid Results Technology

CAUTION

Automatically generated or saved results may be results are not reviewed and sent to another DICOM node!

Wrong diagnosis due to wrong information.

- Always review automatically generated results before sending them to other DICOM nodes.

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3 The CT Cardiac Planning workflow

The *syngo*.CT Cardiac Planning algorithms are optimized on adults with acquired valve diseases as this is the main patient population for interventional valve replacement procedures. For other patient populations, such as pediatric patients, either the localization of the aortic root or the proposed diameter measurements might not be calculated correctly. To achieve the required results during a cardiac contours calculation, certain standard anatomical prerequisites must be met. For example, if pediatric data is loaded, the automatically created contours may not be satisfactory. In such cases, it is easier to create new contours instead of editing the proposed contours. If the localization of the aortic root fails completely, this is clearly indicated as you are asked to manually localize the aortic root. If the aortic hinge points are found but are wrongly localized by the algorithm, or the diameter measurements are incorrect, you can manually correct them. The corresponding procedures are described in the Instructions for Use for *syngo*.CT Cardiac Planning under Redefining the hinge points and Modifying lumen contours in the section Measuring diameters. For your reference, these topics are also available in the IFU for *syngo*.CT Cardiac Planning.

The CT Cardiac Planning workflow provides dedicated tools to determine the anatomical parameters required for the selection of adequate implant devices as part of the preoperative planning of transcatheter aortic valve implantations (TAVI).

It is important to perform accurate measurements in order to choose the proper implant size. Improper implant sizes may lead to critical complications, for example, an obstruction of the coronary blood flow may occur if the ostia are covered by the implant or blood leaks may occur between the implant and the aorta. The following measurements are examples that are typically required to be performed:

- diameter, area and perimeter of the annulus
- Maximum and minimum diameter of the annulus
- Distance between the coronary ostia and the annular plane

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Most of the required measurements are based on the annular plane. This plane is defined by three hinge points. Perpendicular to this plane, a centerline is calculated through the aorta. You can perform all measurements using this centerline as a basis.

syngo.via also provides a dedicated workflow for TAVI planning called **CT TAVI Planning**. This workflow combines *syngo*.CT Vascular and *syngo*.CT Cardiac Planning. *syngo*.CT Vascular is used for the assessment of the access path for transcatheter aortic valve implantations.

In the CT Vascular workflow step, you can perform the following TAVI planning tasks:

- Evaluate the access path
- Measure the angulation of the aortic arch

In CT Cardiac Planning, you can perform the following tasks:

- Specify the annular plane
- Measure the aortic annulus dimensions
- Measure the aortic root
- Measure the distance between the coronary ostia and the annular plane
- Save images with C-arm angulation for the cath lab
- Document the measurements

3.1 Navigating to a specific cardiac phase

✓ A multi-phase heart data set is loaded.

1 Use the **Phase Navigator** for navigation between different cardiac phases.

2 From the list, select a cardiac phase.

The selected cardiac phase is displayed in all segments.

3.2 Stepping through cardiac phases

✓ A multi-phase heart data set is loaded.

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◆ Use the scroll wheel of the mouse keeping the **Alt** key pressed.

– or –

Drag the mouse horizontally with the right mouse button pressed.

3.3 Redefining the hinge points

The hinge points are the basis for the calculation of the annular plane. They are detected during the preprocessing. If the detected hinge points are not correct or if the detection of the hinge points failed, you can redefine them.

The aortic centerline is always computed in a way that is perpendicular to the annular plane. Therefore, when you modify the hinge points, the centerline is recomputed. Measurements that are based on the previous centerline are deleted.

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1 In an MPR segment, navigate to a slice that shows the annular plane.

2 To hide the hinge points, click the **Show Points** icon in the **Aortic Valve** step.

3 Rotate the reference lines in the other MPR segments until you can see all cusps in the main MPR segment.

4 In the **Aortic Valve** step, click the **Redefine Points** icon.

The VRT segment is replaced by a guiding segment. The guiding segment illustrates the position of the next requested hinge point marker.

5 In an MPR segment, navigate to the position of the right coronary cusp and click to define the corresponding hinge point.

A red dot marks the right coronary cusp hinge point.

6 In an MPR segment, navigate to the position of the left coronary cusp and click to define the corresponding hinge point.

A green dot marks the left coronary cusp hinge point.

7 In an MPR segment, navigate to the position of the non-coronary cusp and click to define the corresponding hinge point.

A yellow dot marks the non-coronary cusp hinge point.

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The guidance dialog is closed and the annular plane is calculated on the basis of the new hinge points. The aorta centerline is recomputed on the basis of the new annular plane.

Under certain conditions, the algorithm may not be able to accept the defined positions. In this case, you will have to redefine the hinge points.

At any time, you can cancel the redefinition of hinge points by pressing **Esc**.

3.4 Resetting the hinge points

You can reset the manually performed hinge points in the MPR segments.

✓ You have redefined the manually performed hinge points.

◆ In the **Aortic Valve** step, click the **Reset Points** icon.

The hinge points are reset to the original location. The created findings are deleted.

3.5 Navigating in CPRs

You can navigate through a vessel that is displayed in the CPR and cross-sectional segments. Depending on the current mode, one or several markers are shown in the CPR. The position of the marker is aligned with the corresponding cross-sectional segments.

◆ In the CPR, drag a reference marker up or down.

– or –

In a cross-sectional segment that is framed by a colored border, use the scroll wheel to navigate up or down.

– or –

To accelerate the navigation in cross-sectional segments, right-click and drag the mouse-pointer up or down to navigate along the centerline.

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3.6 Isolating the heart

During preprocessing, the heart is isolated from the surrounding tissue and structures around the left atrium obscuring the left coronary tree are removed. The **Isolate Heart** icon is activated by default. To view the complete anatomy, deactivate the **Isolate Heart** icon.

CAUTION

Diagnosis is based on modified images only!

Wrong basis for diagnosis.

- Use modified images as supplemental information only. Make sure that your diagnosis is based on original acquired images. These are images that are not modified in any regard.
- Always verify modified images. For example, verify the results of contrast agent enhancement images with original images.

1 From the upper left corner menu of the VRT segment, choose **Isolate Heart**.

– or –

In the **Case Navigator**, click the **Isolate Heart** icon.

2 If the result of the **Heart Isolation** segmentation is not satisfactory, use the **Punch** tool.

3.7 Removing the blood pool

The **Blood Pool Removal** allows for the extraction of the remaining blood within the chambers of the heart, except for the coronary arteries and the ascending aorta.

Blood Pool Removal is automatically preprocessed. To allow you to get an unobstructed view onto the aorta and coronaries, the **Remove Blood** icon is activated by default.

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CAUTION

Diagnosis is based on modified images only!

Wrong basis for diagnosis.

- Use modified images as supplemental information only. Make sure that your diagnosis is based on original acquired images. These are images that are not modified in any regard.
- Always verify modified images. For example, verify the results of contrast agent enhancement images with original images.

- From the upper left corner menu of the VRT segment, choose **Blood Pool Removal**.

  – or –

  In the **CT Cardiac Planning** workflow step, click the **Remove Blood** icon.

When **Blood Pool Removal** is activated, you can get a better view by either using a VRT preset in which the myocardium is not visualized or by manually adapting the windowing of the heart so that the myocardium is not visible.

3.8 Aligning MPR views with cardiac planes

To better assess the myocardial movement or the function of the aortic and the mitral valves, you can align the MPR views with the short axis and the long axis of the heart.

The image planes are shifted and rotated to match the three standard cardiac planes:

- Short-axis view
- Two-chamber view (long-axis view)
- Four-chamber view

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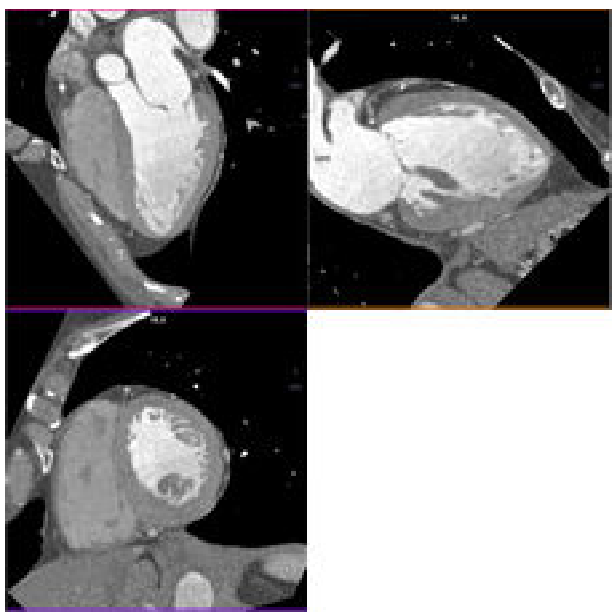
syngo.via calculates the orientation of the standard cardiac planes on the best diastolic phase or using the phase that is the closest to 70%.

Further reading on this topic: Weustink AC, Mollet NR, Pugliese F, Meijboom WB, Nieman K, Heijenbrok-Kal MH, Flohr TG, Neefjes LA, Cademartiri F, de Feyter PJ, Krestin GP. Optimal electrocardiographic pulsing windows and heart rate: effect on image quality and radiation exposure at dual-source coronary CT angiography. Radiology. 2008 Sep; 248(3):792–8.

In the **CT Cardiac Planning** workflow step, click the **Cardiac Planes** icon.

The following example shows an alignment of the MPR views with the cardiac planes.



If the calculated orientation does not meet your requirements, adjust the views by moving the reference lines in the respective images.

3.9 Aligning MPR views with valve planes

To better assess myocardial movement or the function of the aortic and the mitral valves, you can align the MPR views with the orientation of the aortic or the mitral valve plane.

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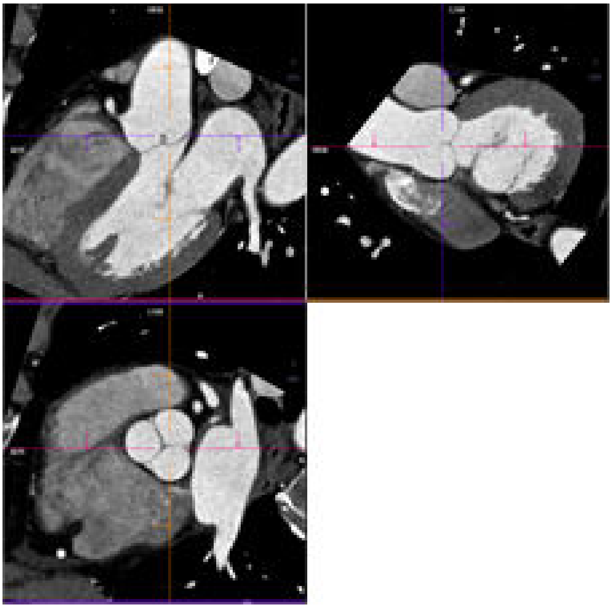
In the **CT Cardiac Planning** workflow step, click the **Aortic Valve Plane** icon or the **Mitral Valve Plane** icon.

The following example shows an alignment of the MPR views with the aortic valve plane.



If the calculated orientation does not meet your requirements, adjust the views by moving the reference lines in the images.

3.10 Aligning MPR views with the annular plane

To get a view on the aortic annulus from all sides, you can align the image segments according to the calculated annular plane.

✓ The hinge points are set.

◆ In the **Aortic Valve** step, click the **Annulus Plane** icon.

– or –

Press **Alt+6**.

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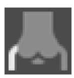
The MPR and VRT segments display the annular plane in orthogonal axes. The cross-sectional segment displays the lumen in the annular plane. The reference marker of the CPR moves to the annular plane.

3.11 Aligning MPR views with the coronary ostium planes

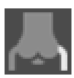
To get a view on one of the coronary ostia from all sides, you can align the image segments accordingly. These views allow you to measure the distance between the coronary ostia and the annular plane.

✓ The hinge points are set.



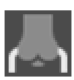
◆ In the **Aortic Valve** step, click the **Right Coronary Ostium Plane** icon.

– or –



In the **Aortic Valve** step, click the **Left Coronary Ostium Plane** icon.

– or –



In the **Aortic Valve** step, click the **Dual Ostia** icon.

The orientation of the MPR and CPR segments is adjusted to display the selected coronary ostium or both coronary ostia. The reference lines align with the annular plane and the centerline.

If the calculated orientation does not fit your needs, adjust the views by moving the reference lines in the respective images.

For the Dual Ostia view, the CPR segment remains unchanged.

3.12 Showing the hinge points

By default, the three hinge points are displayed in VRT and MPR segments. If the hinge point visualization blocks the view on structures of interest, you can hide them.

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- In the **Aortic Valve** step, click the **Show Points** icon.

3.13 Measuring diameters

You can measure the diameter of the aorta at arbitrary locations along the centerline. The required measurments depend on the selected implant type. Refer to the information provided by the manufacturer.

1. In the mini toolbar of the CPR segment, click the **Vessel Diameter Measurement** icon.

   – or –

   Press the **Alt** + **D** keys.

   A yellow-blue marker appears in the CPR segment and the corresponding position is marked by a blue disk in the VRT. The measured diameter is displayed in the lower left corner of the CPR segment.

   In the cross-sectional segments, the lumen contour is displayed. The measured lumen area (**A**) and the minimum/maximum lumen diameters (**D**) are displayed as image text.

   In the CPR segment, the effective diameter on basis of the area (**Eff. Diam. (Area)**) and on basis of the perimeter (**Eff. Diam. (Perim.)**), as well as area and perimeter, are displayed as image text.

2. In the CPR segment, drag the measurement marker up or down or click on a position along the centerline.

   – or –

   In the VRT segment, drag the corresponding disc along the vessel or click on a position along the centerline.

   – or –

   In the cross-sectional segment framed by a yellow border, use the scroll wheel or drag the mouse while keeping the right mouse button pressed.

   The measurement marker moves to the new position.

3. Edit the contour, if the displayed contour does not fit the anatomy. See (➔ Page 32 *Modifying lumen contours*).

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4 In the CPR segment, click the measurement marker.

– or –

Click the **Create Finding** icon in the CPR mini toolbar.

The measurement results are displayed in different ways:

- In the **Findings Navigator**:

  The finding is named with a consecutive number and Vessel Diameter, for example, **[1] Vessel Diameter**.

  Press the **Alt** + **D** keys.

  In addition, a combined multiple snapshot of each related CPR and cross-sectional segment is stored with the finding.

- In a segment:

  The label of the finding consists of a consecutive number and a **vD**.

3.13.1 Modifying lumen contours

If the automatic segmentation is not satisfactory, you can modify the lumen contours manually by drawing freehand lines, multi-click lines, or a combination of both.

✓ The vessel diameter measurement tool is activated in the CPR segment.

1 In a cross-sectional segment displaying the lumen contour, double-click the segment to expand it.

2 Right-click and choose **Edit Contour** from the context menu.

The contour is displayed in magenta.

3 Click the starting point of the contour section to be changed.

4 Drag the mouse pointer to draw a lumen contour.

– or –

Insert straight line segments by dragging and clicking the mouse alternately.

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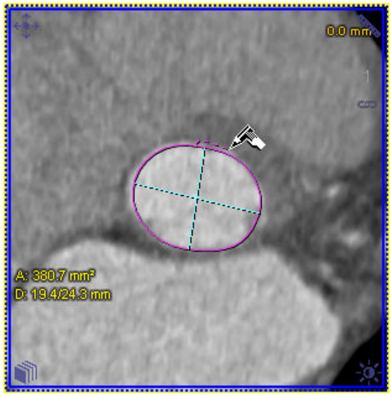

5 Finish the new contour section by double-clicking.

The newly drawn contour section must intersect with the existing lumen contour at both ends.

A new lumen contour is displayed. Editing the lumen contour only affects the currently displayed slice.

3.14 Measuring length

You can measure curved distances along the aorta.

1 In the mini toolbar of the CPR segment, click the **Vessel Length Measurement** icon.

– or –

Press the **Alt** + **G** keys.

In the CPR segment, a green and a red marker appear and represent the upper and lower border of the measurement. These markers are visualized by squared discs in the VRT. The measured section is highlighted by a blue line in the VRT and the CPR segments. The measured length between both reference markers is displayed in the lower left corner of the CPR segment.

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2 In the CPR segment, drag a measurement marker up or down or click on a position along the centerline.

– or –

In the VRT segment, drag the corresponding disc along the vessel or click on a position along the centerline.

– or –

In the cross-sectional segment framed by a green or a red border, use the scroll wheel or drag the mouse while keeping the right mouse button pressed.

The measurement marker moves to the new position.

3 To show or hide the blue line that marks the measured section, click the **Distance** label in the lower left corner of the CPR segment.

4 If you want to store the current measurement as a finding, click the **Create Finding** icon in the CPR mini toolbar.

The measurement results are displayed in different ways:

- In the **Findings Navigator**:

  The finding is named with a consecutive number and Vessel Length, for example, **[1] Vessel Length**.

  In addition, a combined multiple snapshot of each related CPR and cross-sectional segment is stored with the finding.

- In a segment:

  The label of the finding consists of a consecutive number and a **vL**.

3.15 Measuring the distances to the ostia

To ensure that the ostia are not covered by the implant, you need to know the exact distance between the annular plane and the ostia.

To measure the distance, you can use either the **Vessel Length Measurment** tool or the **Distance Line** tool. The following description uses the **Distance Line** tool. For a description of the **Vessel Length Measurement** tool, see (➔ Page 33 *Measuring length*).

✓ The hinge points are defined.

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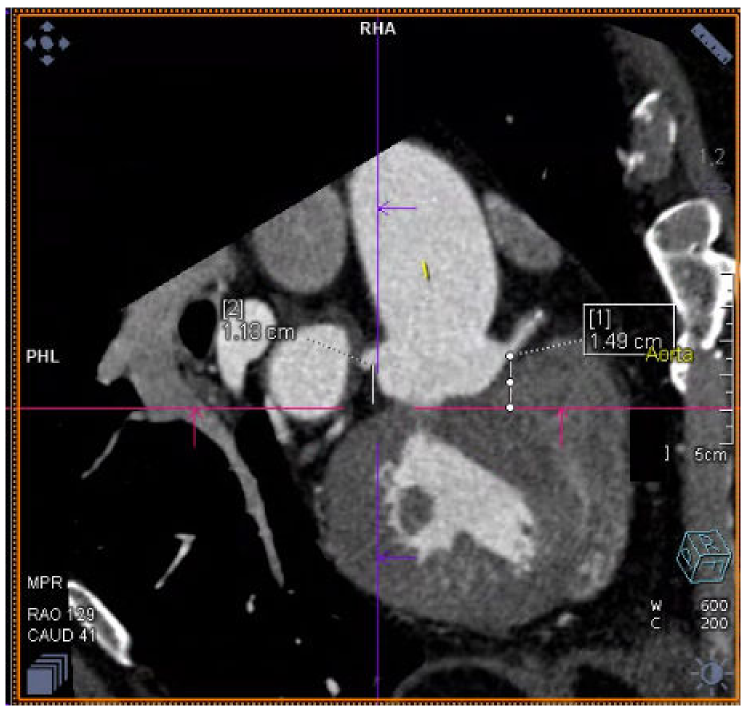
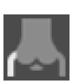
1 In the **Aortic Valve** step, click the **Dual Ostia** icon.

The MPR rotates to a view that is optimized for displaying the dual ostia. The **Dual Ostia** icon does not update the CPR segment. The reference lines align with the annular plane. You get a view where the annular plane is horizontal and the reference line is aligned with it.

2 From the upper right corner menu, choose **Distance Line**.

3 Create a **Distance Line** measurement from a coronary ostium to the aortic annulus. Make sure that the distance line is orthogonal to the annular plane. You can directly draw two distance lines in the same view to measure both ostia distances.





4 In the **Aortic Valve** step, click the **Right Coronary Ostium Plane** icon.

The MPR and CPR rotate to a view that is optimized for displaying the right coronary ostium. The reference lines align with the annular plane.

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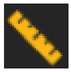

5 From the upper right corner menu, choose **Distance Line**.

6 Create a **Distance Line** measurement from the right coronary ostium to the aortic annulus. Make sure that the distance line is orthogonal to the annular plane.

7 In the **Aortic Valve** step, click the **Left Coronary Ostium Plane** icon.

The MPR and CPR rotate to a view that is optimized for displaying the left coronary ostium. The reference lines align with the annular plane.

8 Create a **Distance Line** measurement from the left coronary ostium to the aortic annulus. Make sure that the distance line is orthogonal to the annular plane.

Alternatively, you can use the **Vessel Length Measurement** provided by the CPR segment. See (➔ Page 33 *Measuring length*).

Depending on the implant type, further distances have to be known. Refer to the information provided by the manufacturer. These distances can also be measured using the **Distance Line Measurement** tool or the **Vessel Length Measurement** tool.

3.16 Evaluating the access path

If the patient data is loaded to the TAVI Planning workflow, you can use the CT Vascular workflow step to evaluate an access path for transcatheter aortic valve implantations.

✓ The CT Vascular workflow step is opened.

The measurement tools of the CPR segment can be used to evaluate the left and right iliac artery.

1 Select a runoff centerline.

The corresponding vessel is displayed in the CPR segment.

2 In the mini toolbar of the CPR segment, click the **Vessel Diameter Measurement** icon.

– or –

Press the **Alt** + **D** keys.

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A yellow-blue marker appears in the CPR segment and the corresponding position is marked by a blue disk in the VRT. The measured diameter is displayed in the lower left corner of the CPR segment.

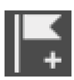
In the cross-sectional segments, the lumen contour is displayed. The measured lumen area (**A**) and the minimum/maximum lumen diameters (**D**) are displayed as image text.

In the CPR segment, the effective diameter on basis of the area (**Eff. Diam. (Area)**) and on basis of the perimeter(**Eff. Diam. (Perim.)**), as well as area and perimeter, are displayed as image text.

By default, the lumen diameter is provided with its maximum and minimum values, marked by **D**. Click the diameter value to switch to the effective diameter values, marked by **D eff**.

---

3 In the CPR segment, drag the measurement marker to the thinnest area of the vessel.



4 To store the current measurement position as a finding, click the **Create Finding** icon in the CPR mini toolbar.

The measurement results are displayed in different ways:

- In the **Findings Navigator**:

  The finding is named with a consecutive number and Stenosis, for example, **[1] Stenosis**.

  In addition, a combined multiple snapshot of each related CPR and cross-sectional segment is stored with the finding.

- In a segment:

  The label of the finding consists of a consecutive number and an **S**.

5 Repeat the measurement for the other runoff centerline.

Refer to the instructions for use of your selected implant device for required minimal lumen diameters along the access path.

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3.17 Measuring the angulation of the aortic arch

If the patient data are loaded to the TAVI Planning workflow, you can use the CT Vascular workflow step to evaluate an access path for transcatheter aortic valve implantations.

✓ The CT Vascular workflow step is opened.

1 In the axial MPR segment, scroll to the aortic valve plane.

2 In the **CT Vascular** workflow step, click the **Manual Plane** icon. Alternatively, press the **Alt** + **P** keys.

3 Draw a line from the ascending aorta to the descending aorta.

An MPR view congruent to the manually defined plane is displayed in the best plane segment.

4 From the upper right corner menu, choose **Angle**.

5 Draw two lines to measure the angle from the ascending aorta to the aortic arch and from the descending aorta to the aortic arch. The ends of the lines are indicated by identification numbers and by arrows.

The angle is measured between the first line and the second line, taking into account the drawing direction of both lines.

- The maximum angle that can be measured is 180˚.
- The two lines do not have to intersect.

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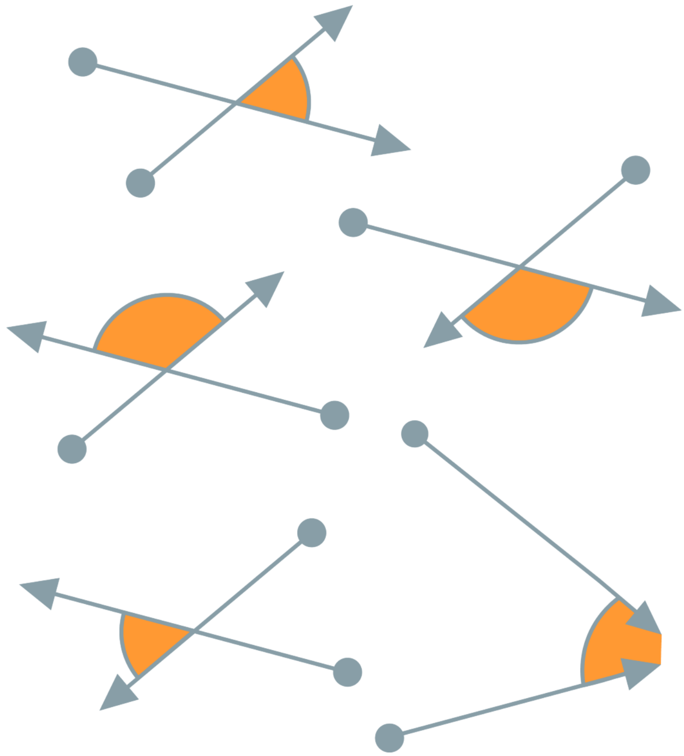

To edit an angle, drag the endpoint handles of either line to the new position. To move a single line, drag the middle of the line to the new position. To move the whole object, click on a part of one of the lines that has no handle and drag it to the new position.

3.18 Documenting results

Cardiac Planning provides tools for measuring and documenting anatomical parameters needed for the selection of implant devices in the context of transcatheter aortic valve implantations (TAVI).

You can create Radial CPR ranges to save a stack of images containing multiple CPR views of the displayed vessel from different viewing directions around the vessel.

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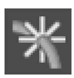
You can also create Parallel CPR ranges to save a stack of images containing cross-sectional images along the corresponding vessel path.

In addition to individual markers and measurements, the Multiple Snapshot function creates a snapshot finding of the selected CPR segment together with its cross-sectional MPRs. Also, the Multiple CPRs Snapshot function creates a combined snapshot finding of all currently visible CPR segments.

3.18.1 Radial CPR Ranges

To document condition of vessels, you can create series of images along the CPR. Radial CPR ranges save a stack of images containing multiple CPR views of the displayed vessel from different viewing directions around the vessel.



1 From the upper left corner menu of the CPR segment, choose **Radial CPR Ranges**.

The **Radial CPR Ranges** window opens. This window provides the following parameters:

- **Degree Steps**

  Defines the angle between pairs of images. The value also defines the total number of images (360° ÷ [degree steps]).

- **High Resolution**

  Defines the resolution of DICOM images. The resolution may vary from 512 x 512 pixels to 2048 x 2048 pixels. The image resolution will be set automatically to the same physical resolution as given in the input image.

- **Image Comment**

  Defines a text that is written into the DICOM image comment.

- **Ranges Series Name**

  Defines the name of the result series. The default name uses the name of the selected centerline followed by “Curved Range Radial” and the display type that is currently applied to the CPR.

You can select another centerline or segment while the **Radial CPR Ranges** window is open.

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2 Modify the values in the **Radial CPR Ranges** window according to your needs.

3 Click the **Start** button.

A new series containing the radial CPR range is created, based on the currently selected centerline.

3.18.2 Parallel CPR Ranges

To document condition of vessels, you can create series of images along the CPR. Parallel CPR ranges save a stack of images containing cross-sectional images along the corresponding vessel path. One curved MPR image provides the reference location for the corresponding cross-sectional images.

1 From the upper left corner menu of the CPR segment, choose **Parallel CPR Ranges**.

The **Parallel CPR Ranges** window opens. This window provides the following parameters:

- **Distance**

  Defines the distance between pairs of images of the series in mm.

- **Image Comment**

  Defines a text that is written into the DICOM image comment.

- **Ranges Series Name**

  Defines the name of the result series. The default name uses the name of the selected centerline followed by “CrossSections” and the display type that is currently applied to the cross-sectional segements.

You can select another centerline or segment while the **Parallel CPR Ranges** window is open.

---

2 Modify the values in the **Parallel CPR Ranges** window according to your needs.

3 Click the **Start** button.

A new series containing the parallel CPR range is created, based on the currently selected centerline.

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If the vessel length measurement is activated, the **Parallel CPR Ranges** creates a stack of cross-sectional images along the corresponding centerline, but limits the range to the region between the reference markers.

3.19 Saving measurements as findings

After measuring a stenosis, a vessel length, or a vessel diameter, you can directly save the result as a finding.

✓ One of the measurement tools in the CPR mini toolbar is activated and the results are satisfactory.

◆ In the CPR mini toolbar, click the **Create Finding** icon to finish the measurement and to store the current measurement results as a new finding.

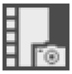
– or –

Press the **Alt** + **W** keys.

The new finding is listed in the **Findings Navigator** including snapshot images for the Image Gallery in the **Findings details** window.

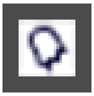
3.20 Creating multiple snapshots

The **Multiple Snapshot** function creates a snapshot finding of the selected CPR segment together with its cross-sectional MPRs. If the current layout uses Twin CPRs, two CPRs per vessel are incorporated into the snapshot.



1 From the lower right corner menu of the CPR segment, choose **Multiple Snapshot**.

A snapshot finding is added to the **Findings Navigator**.



2 In the **Findings Navigator**, double-click the corresponding snapshot icon to check the image.

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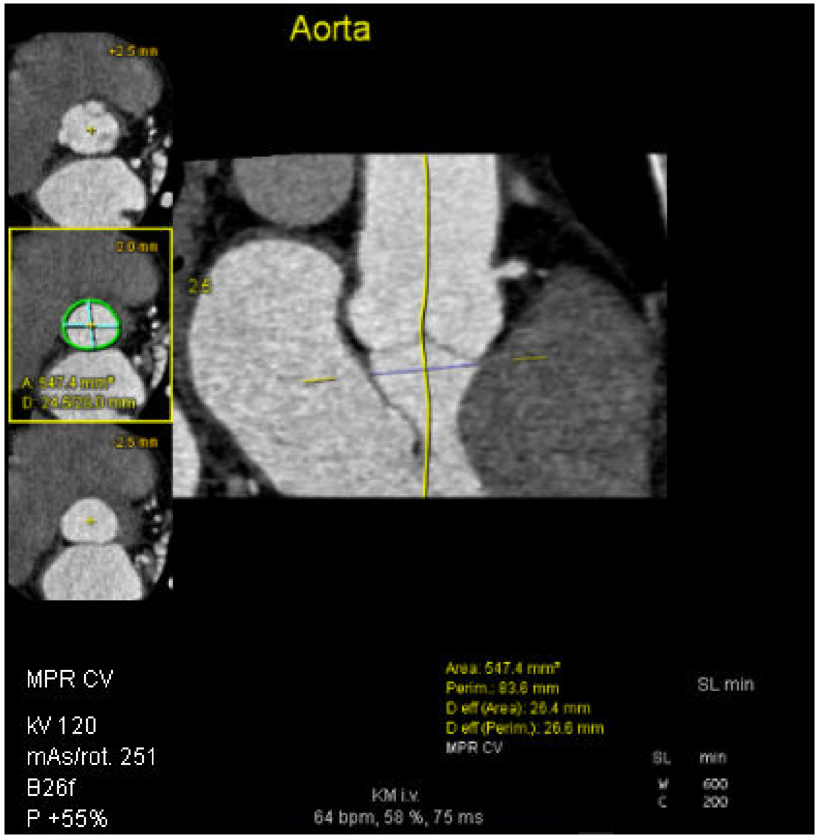
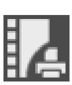


3.21 Printing multiple snapshots

The **Print Multiple Snapshot** function sends a snapshot of the selected CPR segment together with its cross-sectional MPRs to the film sheet. If the current layout uses Twin CPRs, two CPRs per vessel are incorporated into the snapshot.



- From the lower right corner menu of the CPR segment, choose **Print Multiple Snapshot**.

A snapshot is added to the film sheet of the **Print** workflow.

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3.22 Storing C-arm angulations for cath lab interventions

CT Cardiac Planning allows you to generate a result series consisting of VRT or MIP images that rotate parallel to the annular plane. The LAO/RAO angulations are incremented in 5 degree steps between the images.

The C-arm angulations are included in the DICOM header for later use in the cath lab. You can use the images to drive the C-arm to the corresponding orientations (requires a *syngo* X Workplace supporting this feature).

1 In the Therapy connect step of the Cardiac Planning workflow, click the **Create Views** icon.

   The **C-arm Angulations** window opens.

2 In the **Finding Name** field, define a name for the result series and click **OK**.

   The result series is created. The result is displayed in a floating window.

3 Check the images in the floating window and close the window.

The result series is listed in the Findings Navigator and in the **Series** panel.

You can set the filter type of the VRT segment to MIP and invert the display to create images that look similar to angiographic views.

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4 Glossary

cross-sectional segment
A segment type that displays the cross-section of a vessel along a defined centerline.

curved planar reformation (CPR)
A segment type that displays a curved planar reconstruction of a vessel along a defined centerline.

hinge points
The three lowest points of the aortic valve cusps that define the annulus plane.

multiple snapshot
A combined snapshot of all the currently visible CPR segments that displays the course of the examined vessels.

Parallel CPR ranges
A snapshot finding of the selected CPR and its cross-sectional MPRs used to document the condition of the vessel.

Radial CPR ranges
A series of images that contains multiple CPR views from different viewing angles around the vessel centerline.

Rapid Results
Standardized workflow-specific protocol that allows the automation of typically recurring sequential tasks, such as snapshot creation from different viewing angles or creation of different range results.

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Manufacturer's note:

The CE marking applies only to Medical Devices which have been put on the market according to the EC Regulation.

Unauthorized changes to this product are not covered by the CE mark and the related Declaration of Conformity.

Caution: Federal law restricts this device to sale by or on the order of a physician, dentist, or veterinarian (21 CFR 801.109(b)(1)).

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