PHILIPS

Instructions for Use

English

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Philips SmartCT

Release 3.0

Contents

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1 Introduction

1.1 About these Instructions for Use

These Instructions for Use are intended to assist operators in the safe and effective operation of the product described. The "responsible organization" is considered to be the body with authority over the product and "operators" are those persons who actually use the product.

To identify the Instructions for Use and the software tool for which they are intended to be used, the product can be identified using the **About** box of the related software tool. The **About** box indicates the following:
- Name of the product
- Release number
- Date of manufacture
- Unique device identifier (UDI)

All Instructions for Use supplied with the software tool are identified using the name and release number (first two digits) of the software tool, as indicated in the footer of the document or on the **Home** page of the Electronic Instructions for Use. Before using these Instructions for Use with your system, ensure that it corresponds with the software tool installed.

The following Instructions for Use are supplied with the software tool:
- SmartCT Instructions for Use
- Interventional Workspot Instructions for Use

These Instructions for Use may describe some products or features that are not available in all countries. Please contact your local sales representative for the availability of products and features in your region.

These Instructions for Use describe the most extensive configuration of SmartCT, including any options that may be available. Depending on the configuration of your system, some of the features described may not be available.

Before attempting to operate the product, you must read these Instructions for Use, noting and strictly observing all **WARNING** and **CAUTION** notices.

Pay special attention to all the information given and procedures described in the Safety section.

WARNING
A warning alerts you to a potential serious outcome, adverse event, or safety hazard. Failure to observe a warning may result in death or serious injury to the operator or patient.

CAUTION
A caution alerts you when special care is necessary for the safe and effective use of the system. Failure to observe a caution may result in moderate injury to the operator or patient, or damage to the equipment, and presents a remote risk of more serious injury or environmental pollution.

NOTE
A note highlights unusual points to assist you when using the system.

Information about the acquisition of images with the correct protocol is contained in the relevant Instructions for Use of the compatible X-ray equipment. The operator is expected to have received training for the correct operation of the X-ray equipment.

1.2 Electronic Instructions for Use

These Instructions for Use are available to view on the screen while you are using the system.

Opening the Electronic Instructions for Use

1   To open the Electronic Instructions for Use, do one of the following:
    • On the **Help** menu, click **Help**.
    • Press F1 on the keyboard.

2   Click the drop down list in the upper-left corner of the window containing the Electronic Instructions for Use and select SmartCT.

Using the Electronic Instructions for Use
• To move the window containing the Electronic Instructions for Use, drag the header bar to the desired location on the screen.
• To browse topic headings, use the table of contents in the left pane of the viewing window.
• To expand and close topic headings, click the arrow next to the heading. If a heading does not have an arrow next to it, it cannot be expanded further.
• To go directly to a topic, click the corresponding heading in the table of contents. The topic is displayed in the right pane of the viewing window.
• To move backward or forward through your browsing history, click **Back** or **Forward**.
• To close the Electronic Instructions for Use, click **Close**.
• To change the language of the Electronic Instructions for Use, click **Language** in the upper-right corner and select a language from the list.

NOTE
You can change the language of the Electronic Instructions for Use independently of the language that the product uses.

Searching the Electronic Instructions for Use
You can search the Electronic Instructions for Use using keywords to help you find topics of interest.

1   Click inside the search box and enter the keywords for your search query.

2   Click **Search** or press Enter to display the search results in the search window.

3   To view a topic, click it in the search results.

1.3 Intended Use

This Philips product is intended to be installed, used, and operated only in accordance with the safety procedures and operating instructions given in these Instructions for Use for the purposes for which it was designed.

The purposes for which the product is intended are given below. However, nothing stated in these Instructions for Use reduces operators' responsibilities for sound clinical judgment and best clinical procedure.

Installation, use, and operation of this product are subject to the law in the jurisdictions in which the product is being used. Operators must only operate the product in such a way as to not conflict with applicable laws, or regulations that have the force of law.

Uses of the product for purposes other than those intended and expressly stated by Philips, as well as incorrect use or operation, may relieve Philips (or its agent) from all or some responsibility for resultant non-compliance, damage, or injury.

⚠️ **WARNING**
Images created by the viewing application are artificially reconstructed images and the selected viewing settings may affect the image visualization. Diagnosis or treatment cannot be solely based on these images. All findings, decisions, and diagnoses must be confirmed by the use of conventional (2D) X-ray imaging.

⚠️ **CAUTION**
In the United States, Federal law restricts this device to sale, distribution, and use by, or on the order of, a physician.

1.3.1 Intended Use of SmartCT

Product Description
SmartCT is a 3D image visualization and analysis software product (Interventional Tool) intended to provide fast and high-resolution 3D visualization of vasculature, hemorrhages, soft tissue and bone structures, thereby helping the physician to identify pathologies and supporting the physician to define and plan the intervention strategy.

SmartCT runs on a software platform called the Interventional Workspot, and is intended to be used with a Philips Interventional X-Ray System.

SmartCT supports 3D Rotational Angiography (3DRA), Cone Beam CT (CBCT) and VasoCT acquisition protocols, and it includes 3D roadmap functionality. The CBCT and VasoCT protocols are only available for the 20" detector of the Interventional X-Ray system. The 3DRA protocols are available for all detectors.

The 3DRA protocols are available with SmartCT Angio, the CBCT protocols with SmartCT Soft Tissue and the VasoCT protocols with SmartCT Vaso. The 3D roadmap functionality (SmartCT Roadmap) comes in combination with SmartCT Angio, SmartCT Soft Tissue or SmartCT Vaso.

SmartCT includes filters to improve the image quality of the reconstruction by reducing the noise caused by metal objects or other objects that absorb high levels of X-ray radiation.

SmartCT provides overlays of live 2D fluoroscopic images with a 3D reconstruction of the vessel tree.

SmartCT offers tools to manually measure sizes and volumes of anatomical structures such as lesions, aneurysms or vessels. It also offers a vessel analysis tool that provides semi-automatic measurements of the diameter of a segmented vessel.

SmartCT can be controlled from both the control room and the examination room.

SmartCT provides workflow guidance to support the physician in the workflow of acquiring and processing 3D images.

Indications for Use / Medical Purpose
SmartCT assists physicians during vascular and non-vascular procedures, with diagnosis, treatment planning, interventional procedures and treatment follow-up by creating 3D views from sets of 2D images created during rotational acquisitions.

SmartCT provides high-speed and high-resolution 3D visualizations of vasculature, hemorrhages, soft tissue and bone structures.

SmartCT provides live image guidance for navigating endovascular devices through vascular structures anywhere in the body.

SmartCT helps to assess anatomical information intra-procedurally, such as the estimate of a vessel or lesion size, diameter or volume, and anatomical distances between relevant structures.

SmartCT is intended to be used for human patients that have been elected for the procedures as described in these Indications for Use.

Intended Operator Profile
SmartCT is intended to be used and operated by a physician who is fully skilled and responsible for sound clinical judgment and for applying the best clinical procedure, for example (but not limited to):

- Interventional radiologist
- Interventional cardiologist
- Vascular surgeon

SmartCT can also be used and operated by a skilled radiology technician (or nurse) assisting the physician.

Clinical environment
SmartCT is intended to be used in the control room and in the examination room of an interventional suite or (hybrid) operating room.

General safety and effectiveness
To facilitate safe and effective operation of the system by a trained healthcare professional, instructions for use are provided as part of the device labeling.

Contraindications
The images made with SmartCT use X-ray imaging as the source data, obtained from compatible X-ray equipment. All contra-indications that apply for X-ray procedures (as described in the Instructions for Use for the compatible X-ray equipment) also apply for SmartCT.

Operating principle
SmartCT is a software tool, connected to a Philips Interventional X-ray system. The control mechanisms are the mouse and keyboard and/or touch screen module in the control room and the touch screen module and optionally mouse in the examination room.

1.4 Compatibility

SmartCT can be used with the following systems:
- Philips Azurion release 2.1 (or 2.1.x)
- Philips Azurion release 2.2 (or 2.2.x)
- Philips Azurion release 3.0 (or 3.0.x)
- Philips Interventional Workspot release 1.8 (or higher)

NOTE
For details of compatible systems in China, contact Philips.

The product described in these Instructions for Use should not be used in combination with other products or components unless such other products or components are expressly recognized as compatible by Philips. A list of such products and components is available from Philips.

Changes or additions to the product should only be carried out by Philips or by third parties expressly authorized by Philips to do so. Such changes or additions must comply with all applicable laws and regulations that have the force of law within the jurisdictions concerned, and with best engineering practice.

SmartCT is only intended to be used with the PC hardware configuration on which it is initially installed by Philips. SmartCT may only be installed or reinstalled by authorized service personnel.

1.5 Training

Operators of this product must have received adequate training on its safe and effective use before attempting to operate the product described in these Instructions for Use.

Training requirements for this type of device vary from country to country. Operators should ensure that they receive adequate training in accordance with local laws or regulations. As a minimum level of training, operators should read and understand these Instructions for Use.

NOTE
Do not use the product with patients or for any application until you have met the following conditions:
- *You have read, understood, and know all the safety information, safety procedures, and emergency procedures contained in the Safety section.*
- *You have received adequate and proper training in the product's safe and effective operation. If you are unsure of your ability to operate this product safely and effectively, do not use it.*

Additional training resources may be available from Philips. For more information about the availability of application training, including information on the duration and frequency of training, contact your local Philips representative.

1.6 Help and Guidance

Help and guidance are available in the user interface while you are using the system.

Help Button
The **Help** button is available in the task panel. When you click the button, a help box is displayed containing information for using associated functions.

If multiple help boxes are available, only one help box can be displayed at a time. If you open a second help box, the first box is automatically closed.

To close a help box, click **Close**.

Electronic Instructions for Use
To open the Electronic Instructions for Use, do one of the following:
- On the **Help** menu, click **Help**.
- Press F1 on the keyboard.

Click the drop down list in the upper-left corner of the window containing the Electronic Instructions for Use and select SmartCT.

You can also download the Instructions for Use from the following website:

www.philips.com/doc_library

Task Guidance
Guidance for performing tasks may sometimes be displayed as instructions on the screen.

Tooltips
Pause the pointer over a button to display a tooltip that provides information about the function.

1.7 Contacting Philips

You can contact Philips by post or using the Philips website.

Contact details	
Postal address	Philips Medical Systems Nederland B.V.
	Veenpluis 6
	5684 PC Best
	The Netherlands
Website address	www.philips.com/healthcare

1.8 Third-Party Software

This product uses other software, including open-source software. Details of this software can be found in the following location on the installation medium:

Installer\OpenSource\

2 Safety

All Philips products are designed to meet stringent safety standards. To safeguard human safety all medical device software requires proper installation, use, and maintenance.

It is vital that you read, note, and where applicable, strictly observe all **DANGER** notices and safety markings on the outside of the IT equipment on which the medical device software has been installed.

To help ensure the safety of both patients and operators, it is vital that you strictly follow all directions under the heading Safety and all **WARNINGS** and **CAUTIONS** given throughout these Instructions for Use or displayed on the user interface.

Only qualified and authorized personnel may operate this product. In this context, qualified means those legally permitted to operate this type of medical electrical product in the jurisdictions in which the product is being used, and authorized means those authorized by the user of the product.

Personnel operating the product and personnel in the examination room must observe all laws and regulations which have the force of law within the jurisdictions concerned. If you are in any doubt about the laws and regulations which apply to the operation of this product, do not use it.

⚠️ **WARNING**
Images created by the viewing application are artificially reconstructed images and the selected viewing settings may affect the image visualization. Diagnosis or treatment cannot be solely based on these images. All findings, decisions, and diagnoses must be confirmed by the use of conventional (2D) X-ray imaging.

Emergency Procedures
Due to the nature of this product, there are no emergency procedures. For information about emergency procedures related to the X-ray equipment, refer to the Instructions for Use supplied with the X-ray system.

Radiation Safety
For information about radiation safety refer to the **Safety** section of the Instructions for Use supplied with the X-ray system.

Side Effects
SmartCT has no known side effects.

Product Symbols
For information about the symbols that are used with this product, refer to the following website:

www.symbols.philips.com

2.1 Reporting a Serious Incident

If a serious incident occurs in relation to the device, it should be reported to Philips and the competent authority of the country where you are located.

A serious incident means any incident that directly or indirectly led to, might have led to, or in case of recurrence, could lead to, any of the following:
• The death of a patient, user, or other person.
• The serious deterioration of the state of health (temporary or permanent) of a patient, user, fetus, or other person.
• A serious public health threat.

For contact details, see Contacting Philips (page 11).

2.2 Symbols

The following symbols may be used on the device, its packaging, or any other related materials.

Symbol	Description
	Manufacturer
	This symbol indicates the manufacturer of the medical device or accessory. The date of manufacture may also be displayed with this symbol, displayed as four digits for the year and, where appropriate, two digits for the month and two digits for the day.
	Date of Manufacture
	This symbol indicates the date when the medical device was manufactured. The date of manufacture is displayed as four digits for the year and, where appropriate, two digits for the month and two digits for the day. It is displayed on the system label.
LOT	**Batch Code**
	This symbol indicates the manufacturer's batch code so that the batch or lot can be identified.
SN	**Serial Number**
	This symbol indicates the manufacturer's serial number so that a specific medical device can be identified.
#	**Model Number**
	This symbol indicates the model number or type number of the product.
	Consult the Instructions for Use
	This symbol indicates the need for the user to consult the Instructions for Use.
	Caution
	This symbol indicates that caution is necessary when operating the device or control close to where the symbol is placed, or that the current situation needs operator awareness or operator action to avoid undesirable consequences.
MD	**Medical Device**
	This symbol indicates that the item is a medical device.
UDI	**Unique Device Identifier**
	This symbol indicates a carrier that contains unique device identifier information.
F1	**Electronic Instructions for Use**
	This symbol indicates that you can access the electronic Instructions for Use by pressing F1.
CE	**European Conformity**
	This symbol indicates that the equipment complies with applicable European directives and regulations. The number of the notified body is indicated, if applicable.
Rx only	**Prescription Device**
	In the United States, Federal law restricts this device to sale by or on the order of a physician.
XX REP	**Authorized Representative**
	This symbol indicates the authorized representative in the region indicated by XX.
UK CA	**UK Conformity Assessed**
	This symbol indicates that the equipment complies with applicable regulations in the United Kingdom. The number of the notified body is indicated, if applicable.

3 Overview of SmartCT

3.1 SmartCT Workflow

The SmartCT application provides step-by-step guidance through the workflow using a series of tasks that can be integrated with the overall procedure.

The tasks described below can be selected from the task selection panel in SmartCT. The SmartCT workflow can be performed at the tableside in the examination room, using the mouse option on the X-ray system (if installed). Many functions in the workflow can also be performed on the touch screen module.

NOTE
Depending on the procedure being performed, some tasks may not be required. For example, if the initial reconstruction is suitable for the procedure, it may not be necessary to use the Series and Reconstructions task.

Step		Description	More Information
1	Acquire a 3D rotational scan	• Select a procedure and configure the acquisition settings. • Acquire a 3D rotational scan using on-screen guidance. • A reconstruction of the 3D rotational scan is created.	Acquiring a 3D Rotational Scan (page 22)
		If SmartCT is configured as the default interventional tool in the ProcedureCard, the reconstruction of the 3D rotational scan is sent to SmartCT. SmartCT starts automatically and the workflow continues with step 3 below. If the SmartCT Dual Viewer option is installed, dual phase scans are automatically opened in SmartCT Dual Viewer. If SmartCT is not configured as the default interventional tool, a reconstruction is automatically created and you can open it manually with SmartCT from the **Patients** activity. The workflow continues with step 3 below or, if the data had been opened previously with SmartCT, in the task that was last used for the data.	
2	**Series and Reconstructions** task	• Reconstruct a new volume from the current series. • Select a different series or reconstruction for investigation. • SmartCT Dual Viewer: Open an additional volume from the same patient. • SmartCT Dual Viewer: Register the volumes.	Series and Reconstructions Task (page 35)
3	**Segmentation** task	• View and assess the volume. • Make quick measurements and 3D measurements. • Segment and measure lesions and vessels. • Add landmarks to indicate relevant anatomical features.	Segmentation Task (page 40)
4	**Projections** task	• Plan and define viewing angles that can be recalled on the X-ray system using automatic position control during the intervention. • Follow C-arc functionality can be enabled in this task.	Projections Task (page 66)
5	**Live** task	• Display the 3D overlay on X-ray images and recall planned viewing angles to assist with navigation during the intervention. • Store X-ray series.	Live Task (page 68)
6	Acquire a post-treatment scan to assess the treatment.	• Repeat the 3D acquisition procedure. • View and assess the volume to decide whether further treatment is necessary. • Store X-ray series.	Assessing the Treatment (page 70)
7	Archive the resulting data.	• Capture images (this can be done at any stage during the procedure). • Store movies.	Capturing Images (page 72)

NOTE
During a procedure, other interventional tools may be used to assess the anatomy in the volume.

Interacting with the Application
You can use SmartCT in the following ways:
- At the tableside, using the touch screen module.
- In the control room, using the Interventional Workspot.
- In the examination room, using the mouse option for the X-ray system (if installed).

NOTE
A small number of functions are not available on the touch screen module. This restriction is indicated where appropriate in these instructions for use.

3.2 SmartCT on the Interventional Workspot

Full control of SmartCT is available on the Interventional Workspot in the control room.
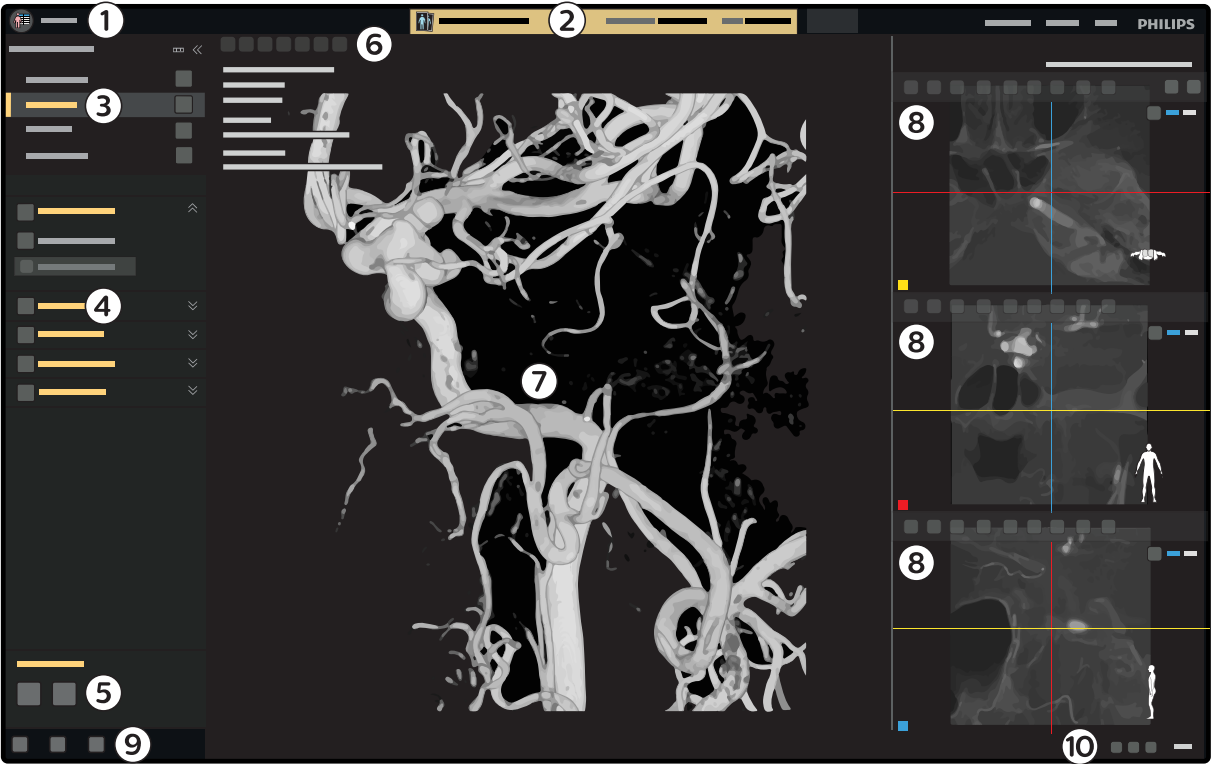
Figure 1   SmartCT on the Interventional Workspot

Legend			
1	Display the **Patients** screen	6	Toolbar
2	Patient information bar	7	Main view
3	Task selection panel	8	Minimized views
4	Task panel	9	Global tools
5	Layout options	10	Status area

Patient Information Bar
Indicators are displayed in the patient information bar if the selected patient is not the same as the patient currently selected on the X-ray system.

Indicator	Patient
	The patient is currently selected for acquisition on the X-ray system.
	The patient is not currently selected for acquisition on the X-ray system. In this case, the following functionality is not available: • Viewing and interaction on the touch screen module • Follow C-arc • Automatic position control • Live overlay

3D View
The 3D view displays the reconstructed volume with any objects that you have created, such as vessel and lesion segmentations, landmarks, and measurements.

2D Slab Views
The 2D slab views display orthogonal slabs of the volume with any objects that you have created, such as vessel and lesion segmentations, landmarks, and measurements. Each 2D slab view has a color associated with it, indicated in the lower-left corner of the view. Corresponding colored lines in each 2D slab view indicate the position of the other slabs.

Changing the Layout
To change the layout of views, select a layout option below the task panel.

Option	Layout
	1+3 view If SmartCT Dual Viewer (option) is enabled, this layout option displays the volumes in overlay view.
	2x2 view If SmartCT Dual Viewer (option) is enabled, this layout option displays the volumes in overlay view.
	Side-by-side view (SmartCT Dual Viewer option) This layout option is available in the **Segmentation** task when SmartCT Dual Viewer is enabled. When this layout option is selected, it is not possible to switch off volume visibility for either volume.

The layout cannot be changed while vessel analysis is active (vessel analysis uses a dedicated layout).

Live View
During device navigation in the **Live** task, the live view is displayed. The live view displays X-ray images combined with the volume as an overlay.

3.3 SmartCT on the Touch Screen Module

You can use the touch screen module to control SmartCT in the examination room.
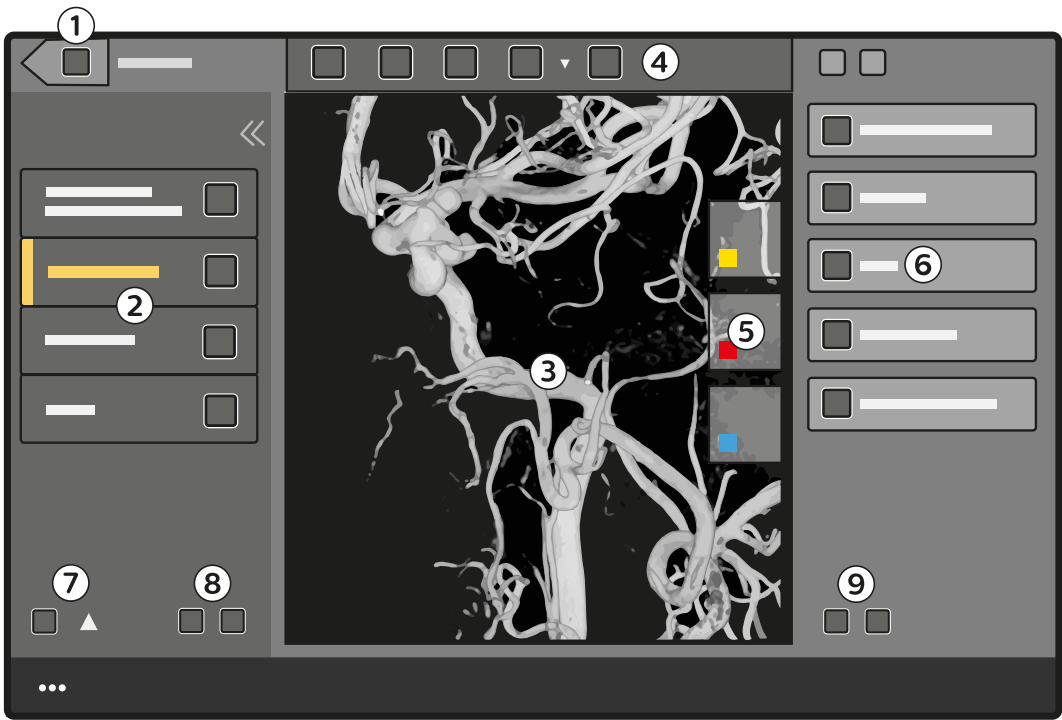
Figure 2 SmartCT on the touch screen module

Legend			
1	Close SmartCT	6	Task panel
2	Task selection panel	7	Global tools
3	Main view	8	Volume visibility (SmartCT Dual Viewer option)
4	Toolbar	9	Layout options
5	Thumbnail views		

Main View and Thumbnail Views

The main view can display the volume or one of three orthogonal 2D slab views. The view that is shown by default depends on the type of scan that was used to create the reconstruction. The thumbnail views display the views not currently displayed in the main view, allowing you to swap any of the thumbnail views with the main view to view it in detail. Each 2D slab view has a color associated with it, indicated in the lower-left corner of the view. Lines with corresponding colors indicate the position of the slabs displayed in the other 2D slab views. The volume displays any annotations that you have created, such as vessel segments, lesion segmentations, landmarks, and measurements. Annotations are also displayed in the 2D slab views when they are visible in the slab.

You can swap a thumbnail view with the main view by tapping the thumbnail view.

During device navigation in the **Live** task, the main view displays the live view. The live view displays X-ray images combined with the volume as an overlay.

NOTE
The views on the touch screen module should not be used for clinical procedures. It can be used to make adjustments to the image (for example, changing the opacity, contrast, or brightness). For clinical procedures, use the image on the main display in the examination room.

Task Panel

The task panel on the touch screen module provides buttons for the main functions that are available for the task that is selected in the task selection panel.

When you tap a main function, the task panel displays a new sub-panel containing all the functions that are dedicated to the selected main function. By default, this sub-panel covers the other main functions in the task panel.

To return to the main functions in the task panel, tap **Close** in the upper-right corner of the sub-panel.

Changing the Layout
You can change the layout on the on the Interventional Workspot using layout options on the touch screen module. These options do not change the layout of the touch screen module.

The layout on the Interventional Workspot cannot be changed while vessel analysis is active (vessel analysis uses a dedicated layout).

3.3.1 Using Gestures on the Touch Screen Module

You can use the following gestures in the viewing area of the touch screen module.

Gesture	Action
Pinch open	Zoom in
Pinch close	Zoom out
Double-tap when zoomed out	Zoom in and center the view on the tapped location
Double-tap when zoomed in	Reset the zoom and pan settings
Two-finger drag	Pan
Two-finger rotate	In-plane rotation

NOTE
In-plane rotation cannot be used in the Live task.

3.4 Global Tools

Global tools are available in all tasks and can be found in the lower-left corner of the SmartCT window.

Tool	Function
	Image Overlays
	Use this function to change the display options. For more information, see Display Options and User Preferences (page 31).
	(This function is not available on the touch screen module.)
	Snapshot
	Use this function to store a snapshot of the viewing area. For more information, see Making a Snapshot (page 72).
	Click the arrow next to **Snapshot** to access the following additional function:
	Copy to Ref
	Use this function to store a snapshot of the viewing area and then display the image in a reference view. For more information, see Sending a Snapshot to a Reference View (page 50).
	Depending on the configuration of the X-ray system, up to three references views may be available:
	Movie
	Use this function to record a movie of manual or automatic interactions in the viewing area. For more information, see Recording a Movie (page 72).
	(This function is not available on the touch screen module.)

3.5 Customizing the ProcedureCard

You can customize the ProcedureCard that you intend to use for a procedure to include SmartCT in the workflow.

1 Open the ProcedureCards Manager on the X-ray system and select the ProcedureCard that you want to use.

For more information about using the ProcedureCard Manager, refer to the instructions for use of the X-ray system.

2 Select the **Interventional Tools** tab in the **ProcedureCard Details** section of the ProcedureCards Manager.

3 Select SmartCT as the **Default Application** to be used for opening 3D rotational scans.

If neither 3D-RA or XperCT Dual are installed on the Interventional Workspot, SmartCT is automatically selected.

4 Configure the injector protocols as needed.

A set of injector protocol suggestions are pre-installed on the system. These pre-installed suggestions are derived from clinical practice.

If not otherwise indicated in the protocol comments, the injection protocols are applicable to normal-sized adult patients (55 – 70 kg) with a normal cardiac output (4 – 8 l/min).

Patient conditions, vascular anatomy, and technical factors such as catheter length, size, and type, may influence the effect of the injection protocol and hence the results on the images. It is recommended to use these injection protocols after good consideration and you may deviate from the protocols where needed. Philips does not endorse the use nor the disuse of these protocols suggestions. The injector protocol suggestions can be customized in the Azurion **ProcedureCards Manager**.

3.6 Image Acquisition

Image acquisition is performed with the rotational scan feature of the X-ray equipment. The stand is positioned in the head or side position (either nurse or doctor side). Depending on the X-ray equipment in use, either one or both side positions may be calibrated for acquisition.

⚠ **CAUTION**
For optimal image quality when acquiring a neuro CBCT rotational scan, CBCT calibration should be performed before acquisition on each day that neuro CBCT acquisition is planned.

For information about calibration, see CBCT Calibration (page 75).

⚠ **CAUTION**
For optimal image quality when acquiring a contrast-enhanced scan, use the correct injection protocol so that vessels are properly filled with contrast agent for the entire duration of the rotational scan.

⚠ **CAUTION**
For optimal image quality when acquiring a neuro CBCT rotational scan, an X-ray compatible headrest should be used.

⚠ **CAUTION**
For optimal image quality when using a headrest, ensure that you position the headrest according to the manufacturer's instructions.

⚠ **CAUTION**
For optimal measurement results, ensure that the 3D rotational scan is of sufficient quality by preventing movement of the anatomy and, if applicable, by using the correct injection protocol so that vessels are properly filled with contrast agent. It is the operator's responsibility to provide appropriate patient supports and straps.

⚠ **CAUTION**
Rotational scans acquired with a tilted or cradled table are not supported for live guidance.

For more information, see Image Acquisition with a Tilted or Cradled Table (page 21).

NOTE
It is the operator's responsibility to select the appropriate contrast agent depending on the clinical application. For more information about the indications for use of the contrast agent, refer to the instructions for use of the applicable contrast agent.

NOTE
For more information about image acquisition for the pediatric population, refer to the instructions for use of the X-ray system.

NOTE
When using biplane X-ray systems, only the frontal stand is supported.

NOTE
The pivot angle (if applicable) can be 0 degrees or 180 degrees, depending on the X-ray equipment in use. For 3DRA scans, this is not applicable if you are using a table that does not have a geometric data communication link (tracking). Do not use a reverse table top with a pivot angle of 180 degrees as this would result in an incorrect patient orientation.

NOTE
The reliability of vessel reconstruction might be affected when anatomical structures with high X-ray absorption qualities are in the field of view (for example, when viewing arteries in the base of the skull or vessels between dense ear bone structures).

NOTE
Be aware that metal objects such as cables, coils or tooth repairs may cause streaked artifacts in the image. Objects with high X-ray absorption may also cause artifacts to appear.

NOTE
For CBCT scans, ensure that the spectrum filters and collimator cover of the X-ray system are clean before acquisition of a series. Dust, contrast medium, or blood on the X-ray window may cause ring artifacts to appear when acquiring series using the Abdomen protocol. It is recommended to use sterile covers to prevent such artifacts.

NOTE
The image quality of 3D scans can be affected by shutters and wedges.
- *For 3DRA scans, we recommend that you do not use shutters or wedges.*
- *For CBCT scans, only the top and bottom shutters can be used. Using shutters for scans with a helical trajectory significantly affects the field of view. Wedges and the left and right shutters are unavailable because they reduce the image quality of CBCT scans.*
- *For VasoCT scans, shutters and wedges are unavailable.*

To acquire series with the highest possible image quality, select the correct application protocol. This ensures the following settings are used:
- Most appropriate detector format
- Detector in landscape mode

You should also ensure that the following acquisition items are configured:
- The anti-scatter grid
- The region of interest must be placed in the center of the detector's view

Regular calibration is essential to maintain image quality. For more information, see Maintenance (page 75).

If you notice artifacts in CBCT acquisitions, you should perform CBCT calibration. For more information, see CBCT Calibration (page 75).

You can configure how the initial reconstruction is processed when it is received by the Interventional Workspot including the size, resolution, and smoothness/optimization of the reconstruction. Refer to the "User preferences" section of the Interventional Workspot Instructions for Use for details.

3.6.1   Image Acquisition with a Tilted or Cradled Table

You can acquire a rotational scan for use with SmartCT with a tilted or cradled table. However, some functions in the application are not available when viewing the reconstruction.

The reconstruction can always be viewed in SmartCT if the rotational scan was acquired with a tilted or cradled table, but the following functions are not available:

- Live overlay
- 3D APC
- Rotation and angle information

A subtracted reconstructed series can be created, but only if the tilt and cradle angles are the same for both reconstruction series.

To use SmartCT Dual Viewer (option), the latest of the two scans should not be acquired with a tilted or cradled table.

3.6.2   Acquiring a 3D Rotational Scan

The following task describes the standard 3D rotational scan acquisition procedure.

If you are using a NeuroHQ CBCT application protocol, use the following procedure instead: Acquiring a NeuroHQ CBCT Rotational Scan (page 25).

1   If you are using a biplane system, park the lateral stand.

Parking the lateral stand allows space for movement of the frontal stand. For more information, refer to the Instructions for Use of the X-ray system.

2   Display the Interventional Workspot window on the monitor in the examination room.

3   On the touch screen module, select the **X-ray Acquisition** application.

4   Select the **X-ray Settings** task.

5   In the task panel, select the 3D rotational scan procedure that you want to perform.

The acquisition process consists of the following steps:
- **Selected acquisition protocol and settings**
- **Isocenter**
- **Check path is clear**
- **Acquisition**

NOTE
You can advance through these steps using the touch screen module, which also directs you to detailed, step-by-step information for performing the acquisition in the 3D Acquisition Guidance window on the SmartCT display in the examination room.

6   Settings step: Verify that the displayed settings are correct for the intended procedure.

The settings are displayed on the touch screen module and in the **3D Acquisition Guidance** window.
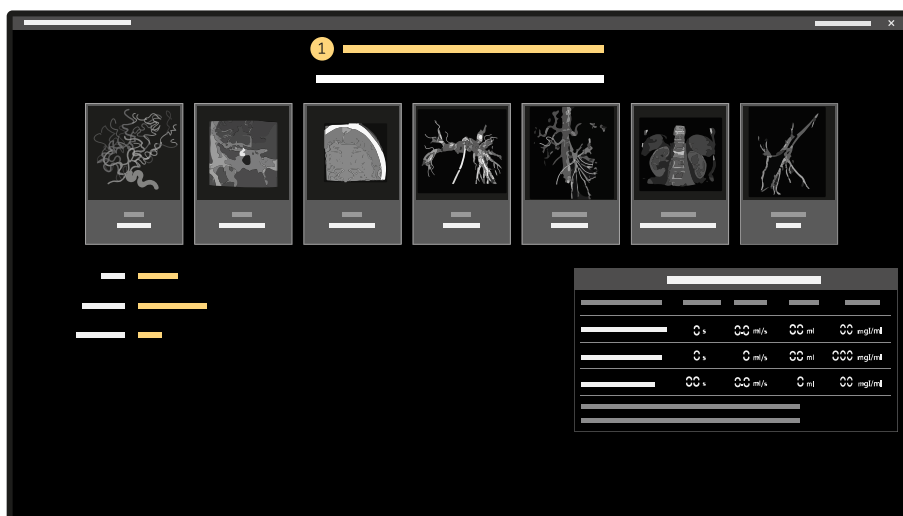
Figure 3   Settings step in the **3D Acquisition Guidance** window

a   To change any of the settings, change them directly on the touch screen module.

To change the settings after you have already moved to the next steps in the acquisition process, tap **Edit** in the **Settings** step, change the settings, and then continue with the acquisition process.

b   When the settings are configured as desired, tap **Next** on the touch screen module.

7   Isocenter step: Ensure that the region of interest is in the isocenter.

If suitable images have already been acquired and are available in the study, they are displayed automatically and one or both isocenter acquisitions can be skipped. In this case, check that the patient has not moved since the images were acquired and that the region of interest is still in the isocenter.

a   Acquire a fluoroscopy image from the frontal position.

b   View the isocentering status in the **3D Acquisition Guidance** on the SmartCT display.
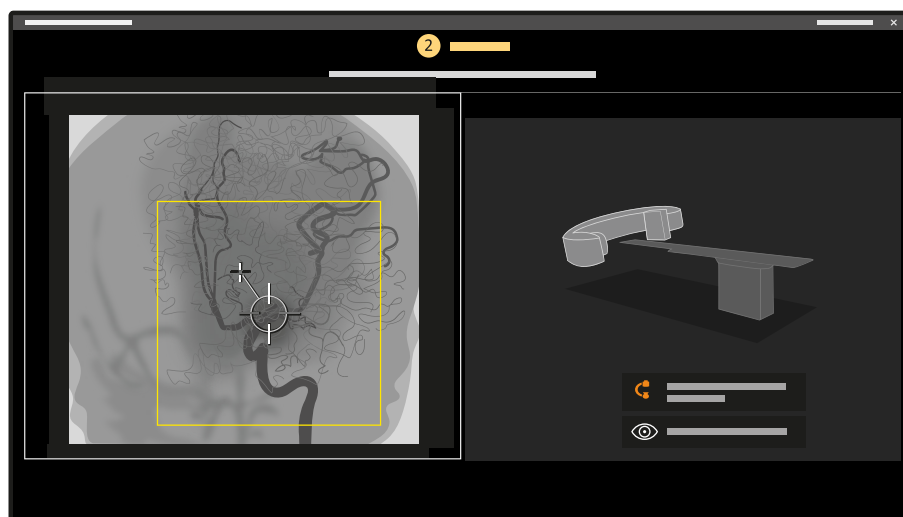
Figure 4   Isocenter step in the **3D Acquisition Guidance**

   c Pan the table, adjust the table height, or move the stand until the region of interest is displayed inside the isocenter region on the monitor.

NOTE
If the X-ray system is equipped with the image beam rotation function or the FlexMove option, the stand should be kept in the lateral 0 position.

To assist you, a reconstruction cube is displayed in the images. The center of the reconstruction cube is indicated with a cross.

NOTE
The reconstruction cube is not displayed if you are using an untracked table.

   d Acquire another fluoroscopy image from the lateral position or a position with a difference of more than 30 degrees from the first image.

   e Pan the table, adjust the table height, or move the stand until the region of interest is displayed inside the isocenter region on the monitor.

   f Tap **Next** on the touch screen module or press **Accept** on the control module.
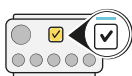
8 **Check path is clear** step: Verify that the path of the rotational scan is clear of obstructions so that a collision does not occur during the acquisition.

   a Press and hold **Accept** on the control module to move the stand to the end position of the rotational scan.

Keep the button pressed until the end position is reached.
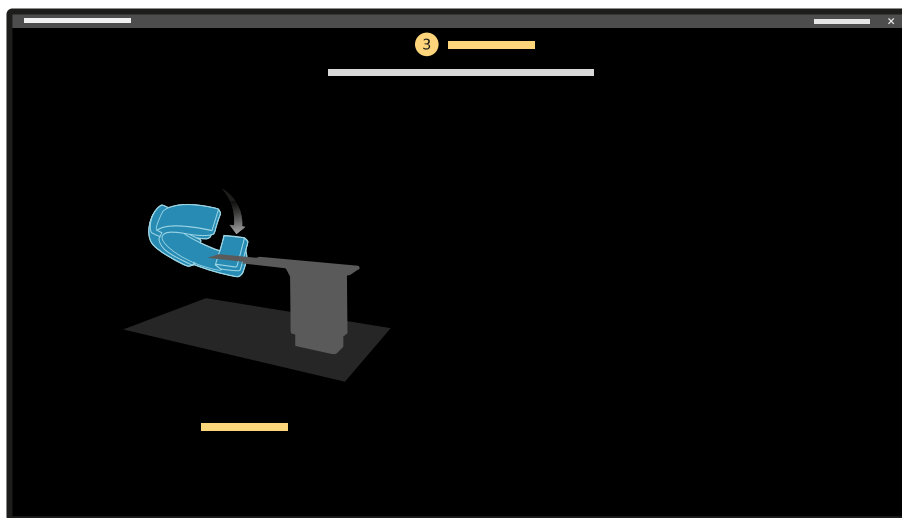
Figure 5   Moving the stand to the end position in the **3D Acquisition Guidance**

If the patient has moved, you should repeat the **Isocenter** step. Tap **Unlock table** on the touch screen module and start the **Isocenter** step from the beginning.

b Press and hold **Accept** on the control module to move the stand to the start position of the rotational scan.

Keep the button pressed until the start position is confirmed on the touch screen module or in the **3D Acquisition Guidance** on the SmartCT display.
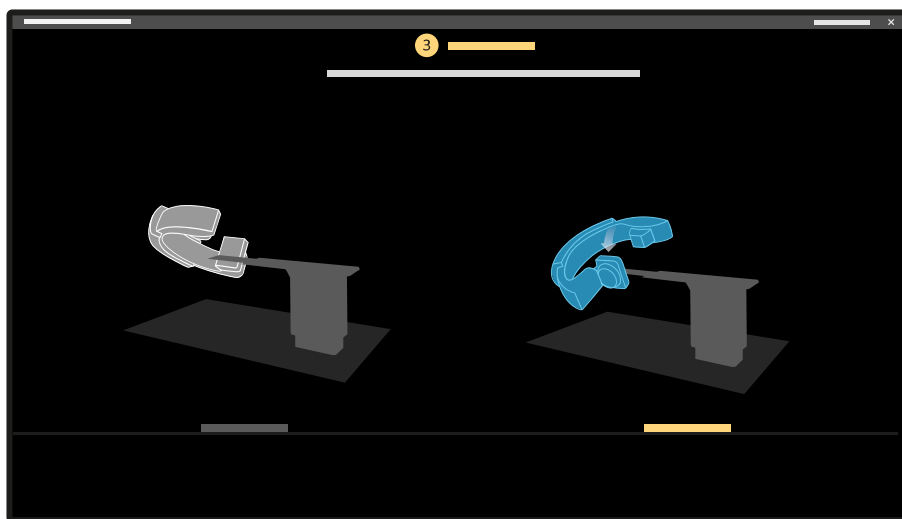
Figure 6 Moving the stand to the start position in the **3D Acquisition Guidance**

NOTE
If the BodyGuard system indicates a collision, do the following:
- *Tap Unlock table on the touch screen module and start the Isocenter step from the beginning.*
- *Adjust the table position or the position of the patient on the table.*
- *Repeat the Isocenter step to verify that the region of interest is in the isocenter.*
- *Repeat the Check path is clear step to verify that the path of the rotational scan is clear.*

9 Before starting acquisition in the next step, check that the patient has not moved.

If the patient has moved, you should repeat the **Isocenter** step before starting the acquisition. Tap **Unlock table** on the touch screen module and start the **Isocenter** step from the beginning.

10 **Acquisition** step: Press and hold the **Exposure** button to start acquisition of the rotational scan.

Follow the guidance in the **3D Acquisition Guidance** to complete the acquisition.
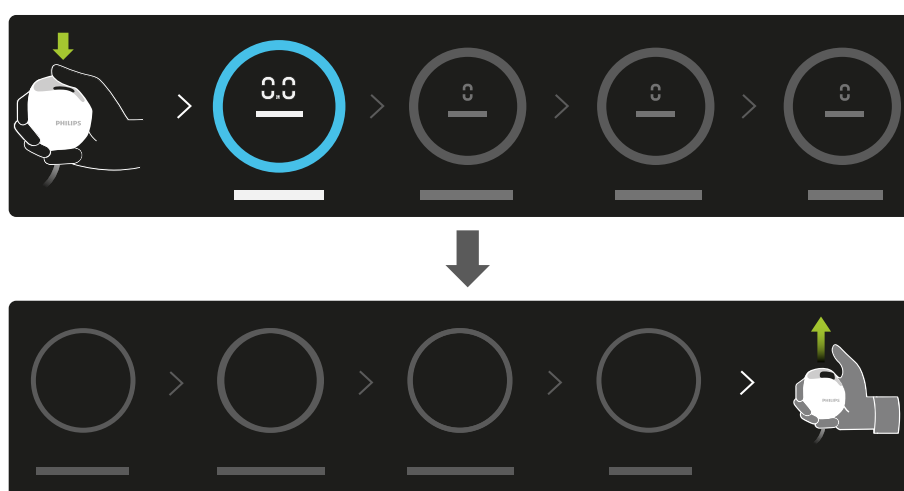
Figure 7 **Acquisition** step in the **3D Acquisition Guidance**

3.6.3 Acquiring a NeuroHQ CBCT Rotational Scan

WARNING
NeuroHQ CBCT images should not be used for detailed brain tissue assessment, such as ASPECTS scoring.

The following task includes optional steps to acquire a NeuroHQ CBCT rotational scan without contrast or with contrast using the Bolus Watch method.

1 If you are using a biplane system, park the lateral stand.

Parking the lateral stand allows space for movement of the frontal stand. For more information, refer to the Instructions for Use of the X-ray system.

2 Display the Interventional Workspot window on the monitor in the examination room.

3 On the touch screen module, select the **X-ray Acquisition** application.

4 Select the **X-ray Settings** task.

5 In the task panel, select the NeuroHQ CBCT procedure that you want to perform.

The acquisition process consists of the following steps:
- **Selected acquisition protocol and settings**
- **Isocenter**
- **Check path is clear**
- **Inject Contrast** (if applicable)

NOTE
You can advance through these steps using the touch screen module, which also directs you to detailed, step-by-step information for performing the acquisition in the 3D Acquisition Guidance window on the SmartCT display in the examination room.

6 **Settings** step: Verify that the displayed settings are correct for the intended procedure.

The settings are displayed on the touch screen module and in the **3D Acquisition Guidance** window.
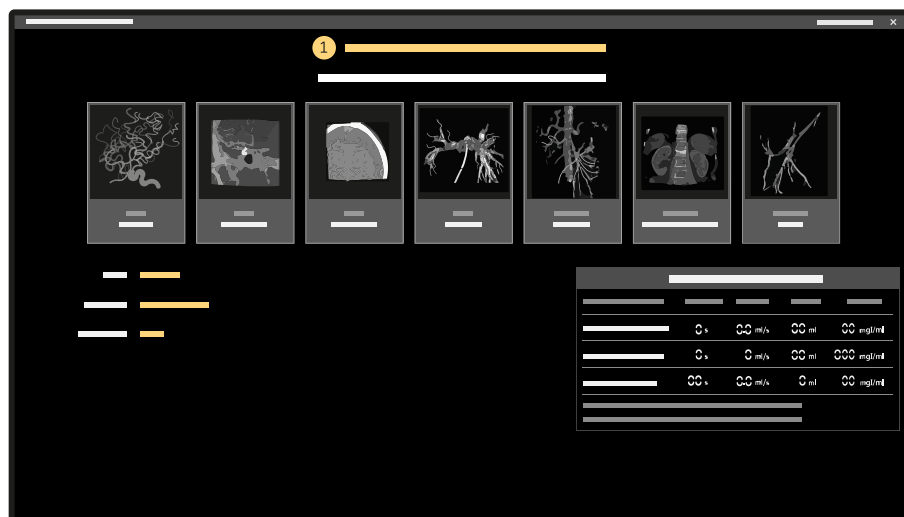
Figure 8 **Settings** step in the **3D Acquisition Guidance** window

  a To change any of the settings, change them directly on the touch screen module.

To change the settings after you have already moved to the next steps in the acquisition process, tap **Edit** in the **Settings** step, change the settings, and then continue with the acquisition process.

  b When the settings are configured as desired, tap **Next** on the touch screen module.

7 **Isocenter** step: Ensure that the region of interest is in the isocenter.

If suitable images have already been acquired and are available in the study, they are displayed automatically and one or both isocenter acquisitions can be skipped. In this case, check that the patient has not moved since the images were acquired and that the region of interest is still in the isocenter.

a   Acquire a fluoroscopy image from the frontal position and view the isocentering status in the **3D Acquisition Guidance** on the SmartCT display.

NOTE
The stand should be within 5 degrees of the exact frontal position.

Lines are displayed in the AP (anterior-posterior) view to indicate the alignment of the anatomy with the isocenter:
- Orange lines indicate that the anatomy is not aligned with the isocenter.
- Green lines and a green check mark indicate that the anatomy is correctly aligned with the isocenter.

The goal of the **Isocenter** step is to move the patient table so that the orange lines move toward the gray lines and switch to green. The length of the gray lines increase as you approach the isocenter position.
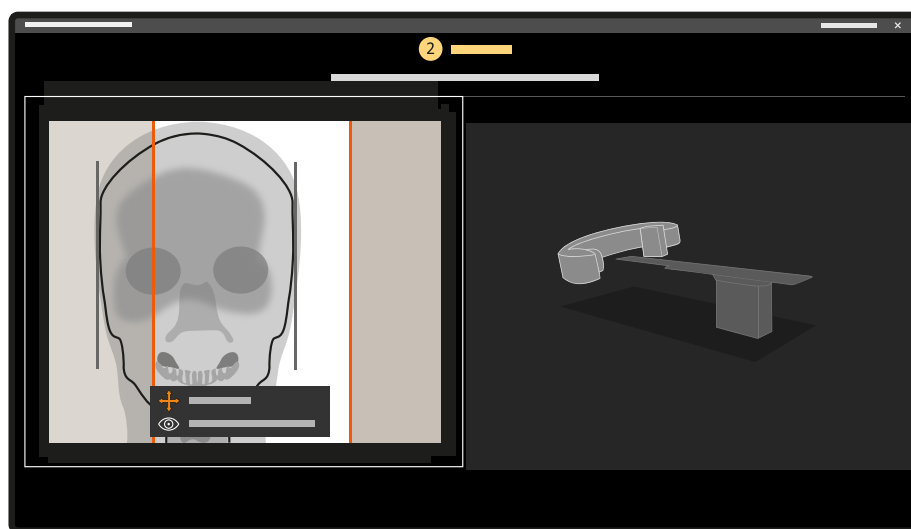
Figure 9   Isocenter step in the **3D Acquisition Guidance**: the anatomy is not aligned

b   Follow the guidance in the **3D Acquisition Guidance** to position the anatomy in the isocenter.
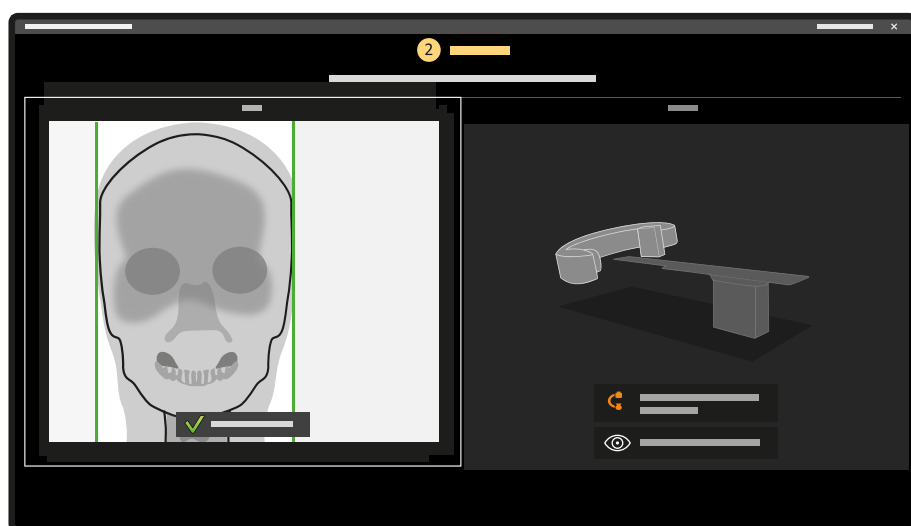
Figure 10   Isocenter step in the **3D Acquisition Guidance**: the anatomy is correctly aligned

NOTE
In some cases, the gray lines may still be visible when the correct alignment is reached.

c   Acquire another fluoroscopy image from the lateral position and view the isocentering status in the **3D Acquisition Guidance** on the SmartCT display.

NOTE
The stand should be within 5 degrees of the exact lateral position.

Lines are displayed in the lateral view to indicate the alignment of the anatomy with the isocenter:
*   Orange lines indicate that the anatomy is not aligned with the isocenter.
*   Green lines and a green check mark indicate that the anatomy is correctly aligned with the isocenter.

The goal of the **Isocenter** step is to move the patient table so that the orange lines move toward the gray lines and switch to green. The length of the gray lines increase as you approach the isocenter position.
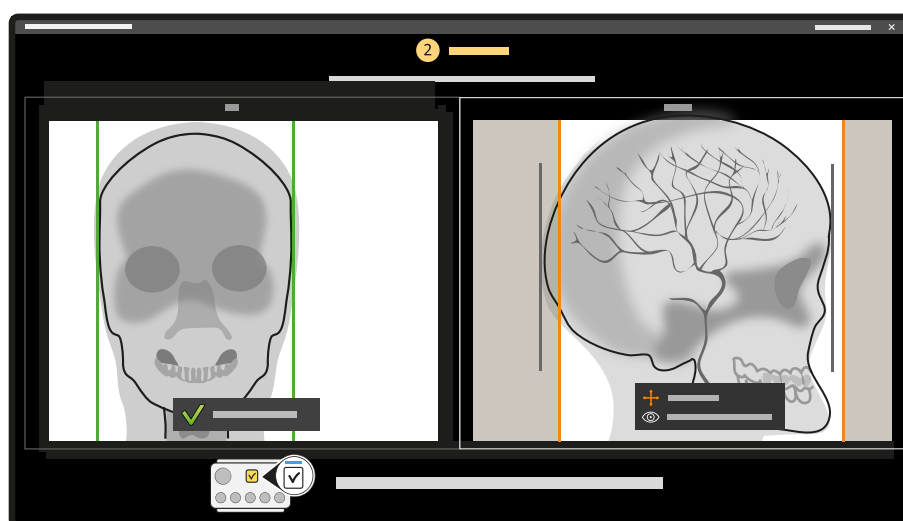
Figure 11   Isocenter step in the **3D Acquisition Guidance**: the anatomy is not aligned

d   Follow the guidance in the **3D Acquisition Guidance** to position the anatomy in the isocenter.
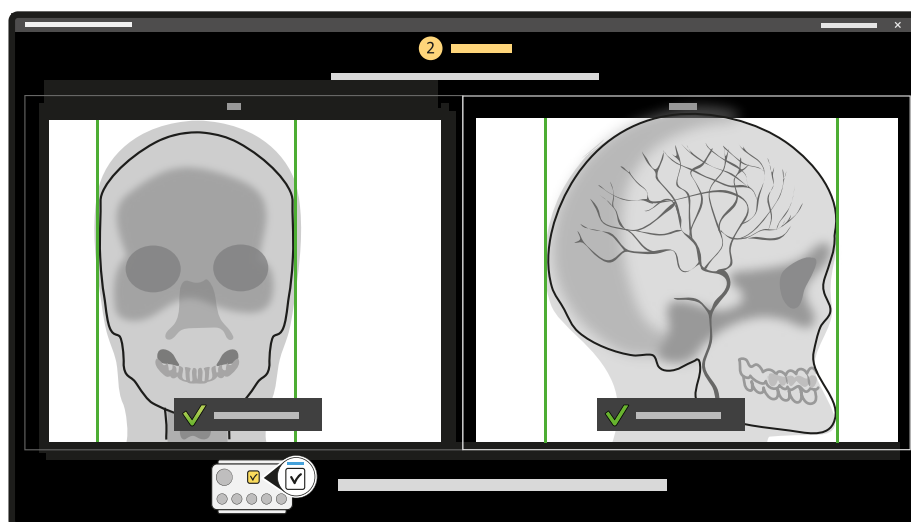
Figure 12   Isocenter step in the **3D Acquisition Guidance**: the anatomy is correctly aligned

NOTE
In some cases, the gray lines may still be visible when the correct alignment is reached.
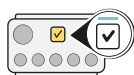
e   Tap **Next** on the touch screen module or press **Accept** on the control module.

8   **Check path is clear** step: Verify that the path of the rotational scan is clear of obstructions so that a collision does not occur during the acquisition.
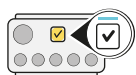
a Press and hold **Accept** on the control module to move the stand to the end position of the rotational scan.

Keep the button pressed until the end position is reached.
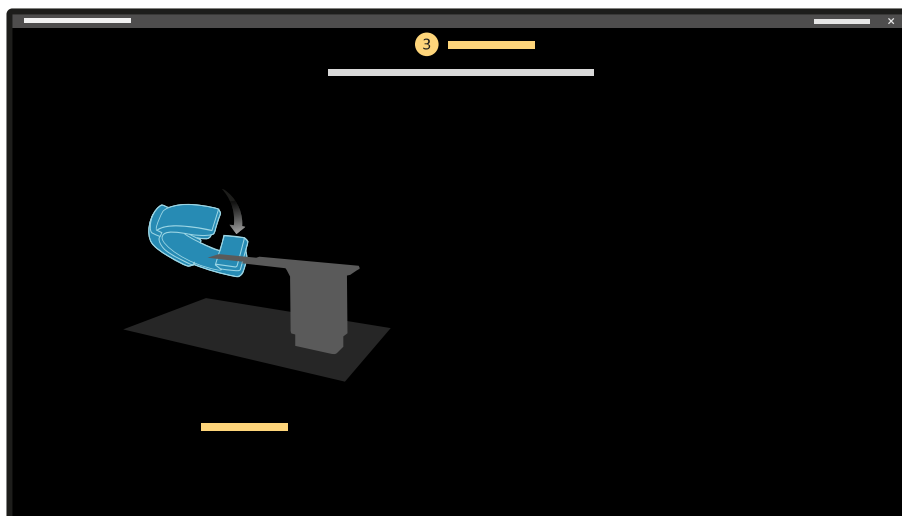
Figure 13 Moving the stand to the end position in the **3D Acquisition Guidance**

If the patient has moved, you should repeat the **Isocenter** step. Tap **Unlock table** on the touch screen module and start the **Isocenter** step from the beginning.

NOTE
After the end position is confirmed, the Roadmap function is enabled on the X-ray system.
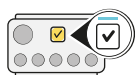
b Press and hold **Accept** on the control module to move the stand to the start position of the rotational scan.

Keep the button pressed until the start position is confirmed on the touch screen module or in the **3D Acquisition Guidance** on the SmartCT display.
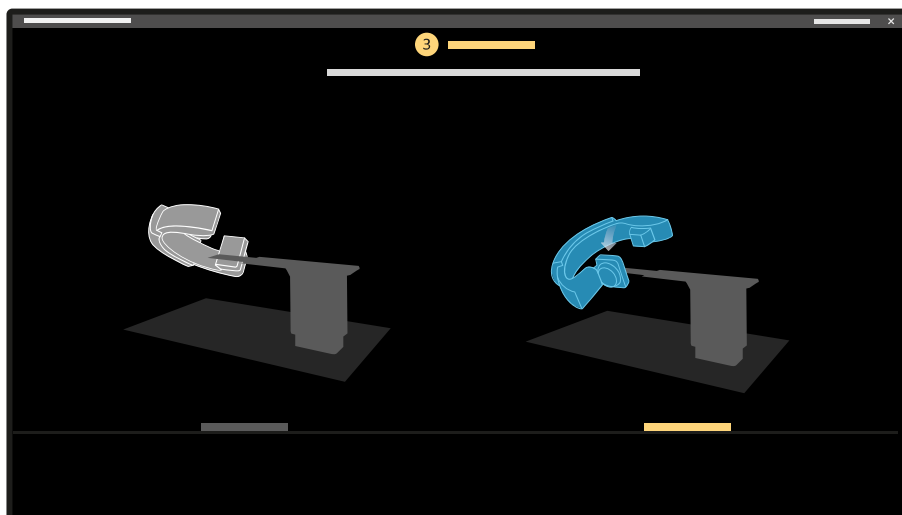
Figure 14 Moving the stand to the start position in the **3D Acquisition Guidance**

NOTE
If the BodyGuard system indicates a collision, do the following:
- ***Tap Unlock table on the touch screen module and start the Isocenter step from the beginning.***
- ***Adjust the table position or the position of the patient on the table.***
- ***Repeat the Isocenter step to verify that the region of interest is in the isocenter.***
- ***Repeat the Check path is clear step to verify that the path of the rotational scan is clear.***

9 Before starting acquisition in the next step, check that the patient has not moved.

If the patient has moved, you should repeat the **Isocenter** step before starting the acquisition. Tap **Unlock table** on the touch screen module and start the **Isocenter** step from the beginning.

10 *Optional step for acquisition without contrast.* **Acquisition** step: Press and hold the **Exposure** button to start acquisition of the rotational scan. (For details of using contrast with the Bolus Watch method, skip this step and go to the next step.)

Follow the guidance in the **3D Acquisition Guidance** to complete the acquisition.
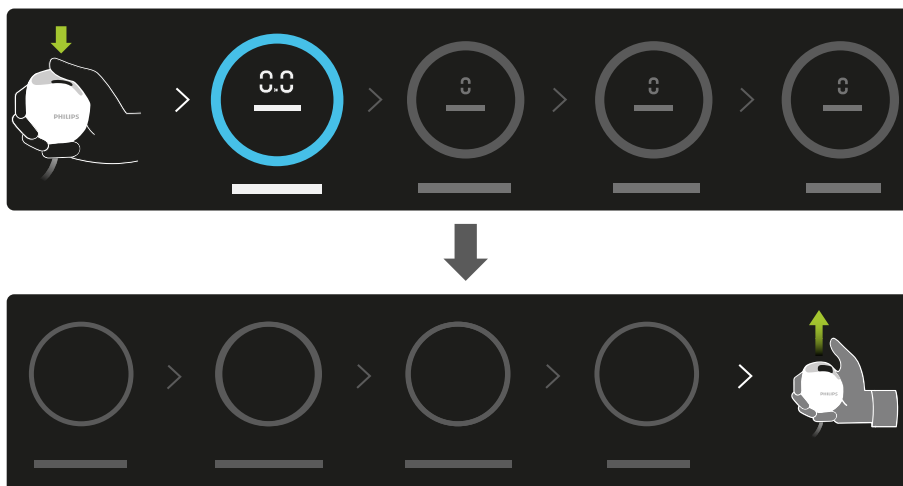
Figure 15   Acquisition step in the **3D Acquisition Guidance**

11 *Optional step for acquisition with contrast using Bolus Watch.* **Inject Contrast** step: Follow the guidance in the **3D Acquisition Guidance** to perform the contrast injection and acquisition.

The Bolus Watch method consists of the following actions in the **Inject Contrast** step:
- Starting the contrast injection.
- Starting fluoroscopy acquisition.
- Viewing the contrast bolus.
- Starting exposure acquisition when the contrast bolus reaches the region of interest.
- Stopping exposure acquisition when the forward and backward scans are completed.

The **3D Acquisition Guidance** guides you through these actions.
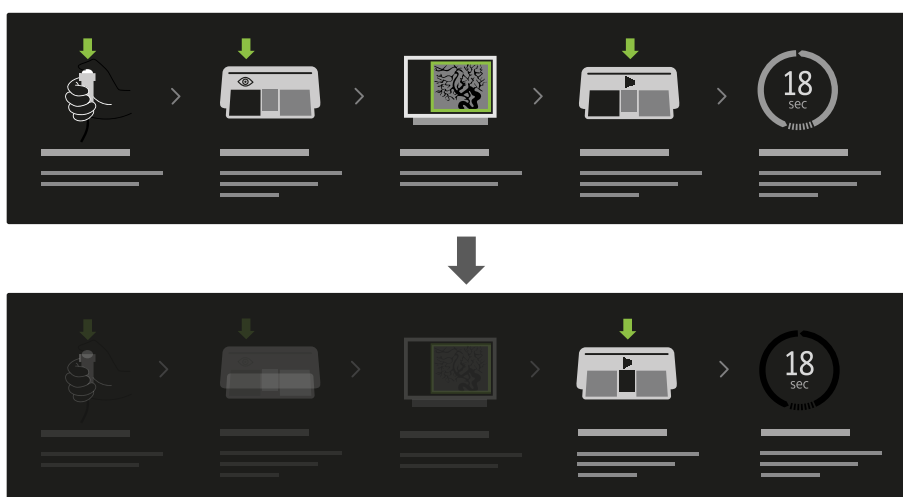
Figure 16   Inject Contrast step in the **3D Acquisition Guidance**
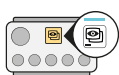
If the **Roadmap** function has been switched off, you are instructed to switch it on again on the control module.

3.7 Display Options and User Preferences

The following functions can be accessed using the mouse. They are not available on the touch screen module.

1 To change the display options, do the following:

 a In the global tools area, click **Image Overlays**.

 b Configure the following settings as desired:
   - Image information level
   - Angle flavor
   - Visibility of the orientation indicator
   - Visibility of annotation labels in the views.

2 To change the user preferences, do the following:

 a On the **System** menu, click **Customization**.

 b Configure the status of automatic motion compensation for relevant scan types (applicable for the Roadmap option).

 c Adjust the gamma setting for the normal visualization preset.

3.8 SmartCT Dual Viewer (Option)

SmartCT Dual Viewer allows you to compare two series from the same patient, either side-by-side or overlaid.

SmartCT Dual Viewer in Side-by-Side View
In side-by-side view, the two volumes are displayed as 2D slab views next to each other. The last-acquired volume is always displayed on the right side of the main display.
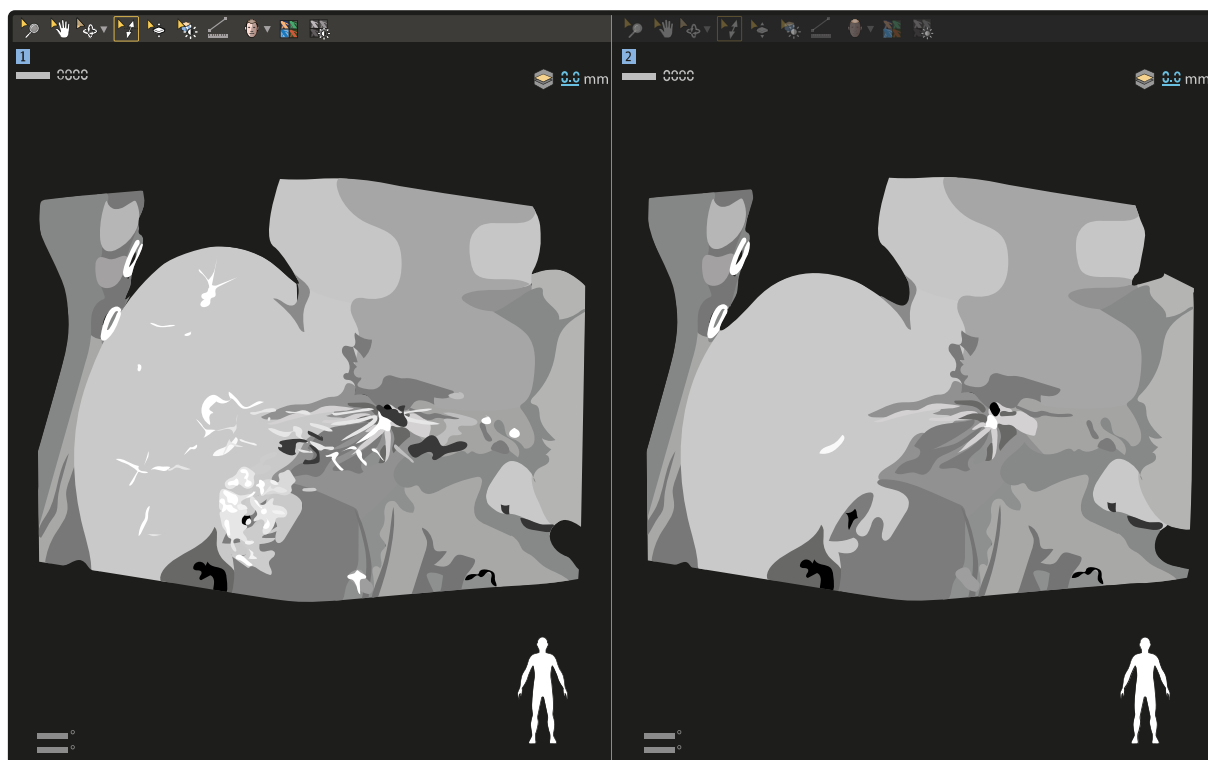
Figure 17   SmartCT Dual Viewer in side-by-side view

Interaction tools are linked in each view, except for volume windowing and windowing presets. It is not possible to record an automatic movie in side-by-side view.

SmartCT Dual Viewer in Overlay View
In overlay view, the two volumes are overlaid in the 3D view and the 2D slab views. To assist with volume identification in these views, each volume is colored differently by default. You can change these colors, if desired. For more information, see the following sections.
• Changing the Visualization of the 3D View (page 45)
• Changing the Visualization of a Slab View (page 46)

You can also switch the visibility of each volume on or off independently and at any time.
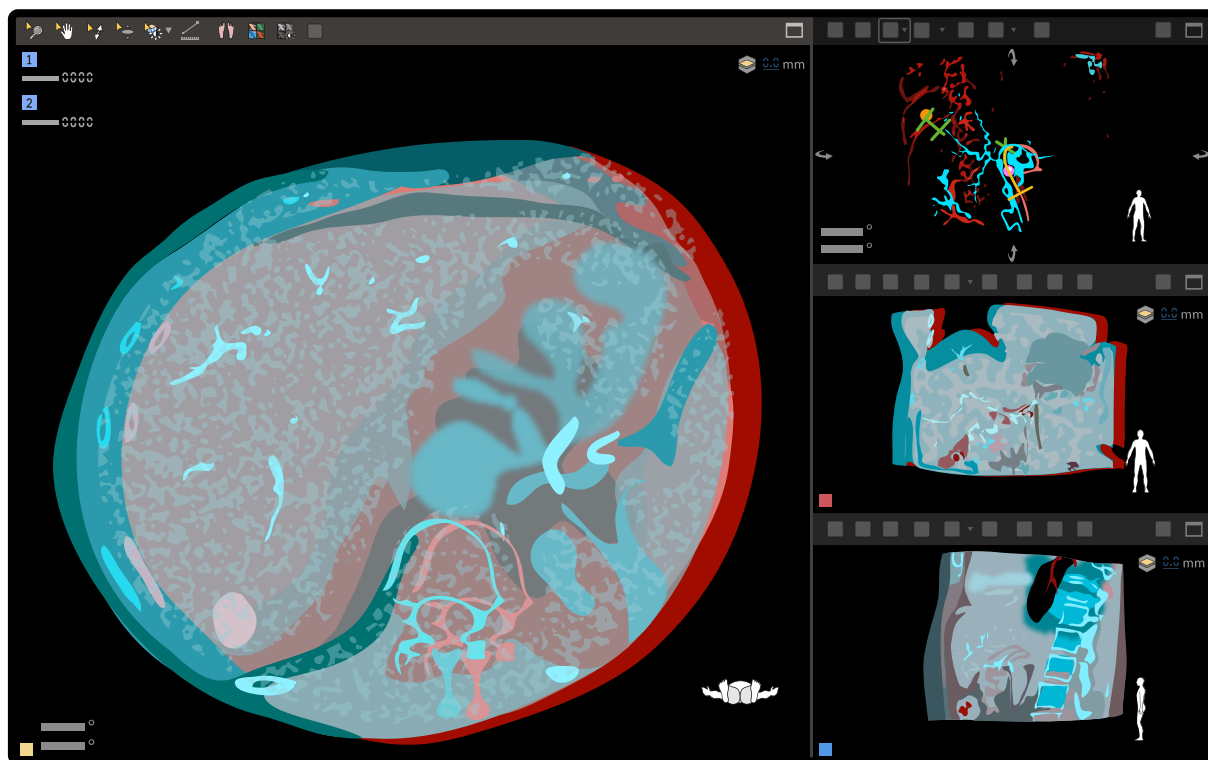
Figure 18   SmartCT Dual Viewer in overlay view

Interaction tools are linked in each view, with the following exceptions:
• Volume visualization is not linked, but slab visualization is linked.
• Windowing presets are not linked.
• Volume windowing provides tools to adjust both volumes together (linked) or just one volume.

Volume numbers are displayed in the upper-left corner of the 3D view. Depending on the selected level of patient information, the series number of each volume may also be displayed.
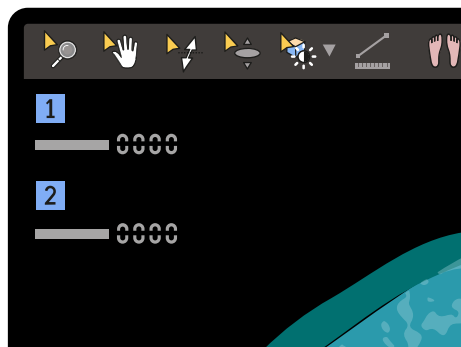
Figure 19   Volume numbers in SmartCT Dual Viewer

If a volume's visibility is switched off, the volume and series information in the upper-left corner is dimmed.

Volume Visibility

Volume Visibility tools are available at the bottom of the task panel on the left side of the main display area when SmartCT Dual Viewer is enabled.

Use these functions to switch the visibility of either volume on or off. The volume number is highlighted when the volume is visible.

Cloning a Volume

You can clone a volume by creating a new reconstruction of an existing volume. You can then open both volumes in SmartCT Dual Viewer.

Cloning allows you to apply different histogram settings to the original volume and the clone volume. You can also make different cuts on each of the volume to focus on the region of interest.

4 Starting and Stopping SmartCT

4.1 Starting SmartCT

SmartCT starts automatically after a rotational scan is acquired and SmartCT is configured as the viewing application in the ProcedureCard for the acquisition.

If SmartCT is configured as the viewing application and the SmartCT Dual Viewer option is installed, dual phase acquisitions are automatically opened in SmartCT Dual Viewer.

If SmartCT is not configured as the viewing application in the ProcedureCard, you can start SmartCT manually from the Interventional Workspot or from the touch screen module.

1 To start SmartCT from the Interventional Workspot, open the **Patients** activity and do one of the following:
- Double-click the series pictorial that you want to open and select SmartCT in the application selector.
- Select the series pictorial that you want to open, go to **File**, select **View With**, and then select SmartCT.
- Right-click a series pictorial and select **View With** in the shortcut menu, and then select **SmartCT**.
- If the series that you want to open has SmartCT session data, double-click the session data pictorial.

2 To start SmartCT from the touch screen module, do the following:

a Tap **Applications** in the lower-left corner of the module, and then tap **Interventional Workspot** in the **Applications** window.

  NOTE
  There may be multiple pages in the Applications window.

b Tap **SmartCT**.

4.2 Stopping SmartCT

1 To exit SmartCT on the Interventional Workspot, click the patient selector in the upper-left corner of the window.

2 To exit SmartCT on the touch screen module, tap **Home** in the upper-left corner of the module.

5 Series and Reconstructions Task

5.1 Selecting a Different Series

You can open a different series from the patient currently open in SmartCT.

1   To open a different series, do one of the following:
   • In the main display area, select **Change**.
   • In the **Select Series** section of the task panel, select **Change**.
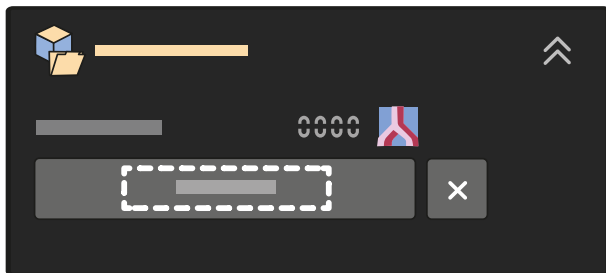
Figure 20   Changing the series in the **Select Series** section of the task panel

2   Select a series in the **Select Series** dialog box.

   Series are arranged vertically and reconstructions are arranged horizontally next to the corresponding series.

3   Select **Open**.

   The previously opened series is closed. Any changes that you made to the series are saved.

NOTE
Opening one series from a dual phase scan does not automatically enable SmartCT Dual Viewer (option). Both series should be opened separately. For more information, see Starting SmartCT Dual Viewer (Option) (page 37).

5.2 Making a New Reconstruction

A 3D reconstruction is created automatically after you acquire a 3D rotational scan. You can also make a new reconstruction from the rotational scan.

To view the region of interest in better detail, it is useful to create a new, operator-defined reconstruction. This allows you to choose a new center of reconstruction, a new volume size and a new resolution setting.

NOTE
This function is not available in the following situations:
• *The current reconstruction is a subtracted reconstruction.*
• *SmartCT Dual Viewer (option) is enabled.*

⚠ **CAUTION**
The following reconstruction settings are assumed for accurate vessel analysis:
• *For 3DRA and VasoCT volumes, the maximum voxel size is 0.5 mm.*
• *For CBCT volumes, the maximum voxel size is 0.5 mm for diameters ≥ 2.0 mm and < 4.0 mm.*
• *For CBCT volumes, the maximum voxel size is 0.65 mm for diameters ≥ 4.0 mm.*
• *For 3DRA volumes, the Smoothness settings Smooth or Very Smooth should not be used.*
• *For CBCT and VasoCT volumes, the Optimize for setting Soft Tissue should not be used.*

When reconstructions are made of a smaller volume, the resulting reconstruction is enlarged as the size of the volume display surface remains the same. It is therefore often also called reconstructive zooming. In general, reconstructive zooming is preferred to zooming with the **Zoom** tool because it enhances the definition of the volume.

NOTE
Cuts, landmarks, vessel segments, lesions, or measurements that have been applied to the initial reconstruction are not applied to the new reconstruction.

1   In the **Series and Reconstructions** task, select **New Reconstruction** to display the reconstruction settings.

A yellow reconstruction cube is displayed on the volume to show the limits of the new reconstruction.

2   To set the size of the reconstruction, do one of the following:
   • Drag the **Cube Size** slider.
   • Drag a corner of the cube. (This function is not available on the touch screen module.)

After you set a cube size, the estimated dimensions of the reconstruction cube are shown in the **New Reconstruction** panel.

3   Drag the reconstruction cube to the desired position.

a   To center the reconstruction cube on a particular location, double-click the location. ((This function is not available on the touch screen module.))

4   Select the **Resolution** box and select a resolution.

5   **3DRA**: Select the **Smoothness** box and select a setting.

6   **CBCT/VasoCT**: Select the **Optimize for** box and select a setting.

7   Select optional settings, if available (depending on the options installed on your system):
   • **Use Metal Artifact Reduction** (CBCT/VasoCT scans only)
   • **Use BMI Noise Reduction** (CBCT abdomen scans only)

8   Click **Create** to start the reconstruction.

A progress bar is displayed during the reconstruction process.

The new reconstruction is displayed in the **Segmentation** task.

Each new reconstruction that you create is added to the patient study as a new reconstruction series. To delete a reconstruction series, use the **Patients** screen.

5.3 Making a New Subtraction

You can subtract two 3D-RA series and reconstruct a volume from the resulting subtracted series.

The series that is currently open in SmartCT is used as the contrast series.

NOTE
This function is not available if SmartCT Dual Viewer (option) is enabled.

1   In the **Series and Reconstructions** task, select **Select Mask** to choose a mask series.

Alternatively, if a subtracted reconstruction is already open, selecting another mask series remasks the current contrast series.

Compatible mask series are shown In the **Select Mask** dialog box. A mask series is considered compatible if it is acquired at the same position and with the same rotational scan settings as the current contrast series.

2   Select a mask series pictorial.

3   Select **Create** to start the subtracted reconstruction.

The reconstruction settings of the contrast series are applied to the subtracted reconstruction.

Each new subtraction that you create is added to the patient study as a new reconstruction series. To delete a subtracted reconstruction, use the **Patients** activity.

5.4 Starting SmartCT Dual Viewer (Option)

When you perform a dual phase acquisition and the following items are configured, the dual phase series are automatically opened in SmartCT Dual Viewer:
- SmartCT is configured as the default interventional tool in the ProcedureCard.
- The SmartCT Dual Viewer option is installed.

To start SmartCT Dual Viewer manually when a single volume is displayed, use the following task.

1 To enable SmartCT Dual Viewer, do one of the following:
   - In the main display area of the **Series and Reconstructions** task, select **Add Series**.
   - In the **Select Series** section of the task panel, select **Add Series**.

2 Select a series in the **Select Series** dialog box.

   Series are arranged vertically and reconstructions are arranged horizontally next to the corresponding series.

3 Select **Open**.

   The additional series is opened and is displayed with the series that is already open in SmartCT Dual Viewer. Depending on the series and volumes selected, the following task is displayed:
   - If you select two volumes from different series that have not previously been registered, the **Series and Reconstructions** is displayed.
   - If you select two volumes that have been registered previously, or two volumes from the same acquisition, the **Segmentation** is displayed.

   SmartCT Dual Viewer uses colors to differentiate the two volumes. By default, the oldest volume (volume 1) is colored blue and the last-acquired volume (volume 2) is colored red. If desired, you can change these colors. For more information, see the following sections:
   - Changing the Visualization of the 3D View (page 45)
   - Changing the Visualization of a Slab View (page 46)

   While SmartCT Dual Viewer is enabled, it is not possible to create a new reconstruction or a new subtraction.

4 To change one of the series after you have enabled SmartCT Dual Viewer, select the corresponding **Change** button in the **Select Series** section of the task panel.
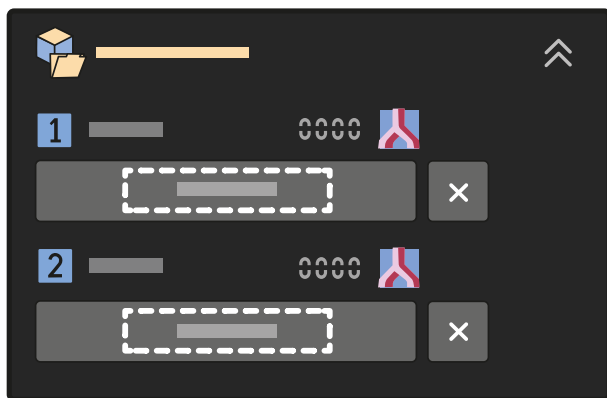
Figure 21   Changing series in SmartCT Dual Viewer

NOTE
The last-acquired series of the two series open in SmartCT Dual Viewer is always labeled volume 2. Therefore, if you change volume 2 to a series that was acquired before volume 1, the volume labels will be switched.

5 To close one of the series after you have enabled SmartCT Dual Viewer, select the corresponding **Close** button.

   After closing one of the series, SmartCT Dual Viewer is no longer enabled.

5.4.1 Performing Volume Registration in SmartCT Dual Viewer (Option)

When you open two volumes in SmartCT Dual Viewer that are not already registered, you should register them before continuing to the **Segmentation** task. You can perform this procedure from the Interventional Workspot or the touch screen module.

Automatic and manual registration functions are available in the **Select Series** section of the **Series and Reconstructions** task. All manual registration actions are performed on volume 1 (the oldest volume) to match it with volume 2 (the last acquired volume), which most closely represents the current situation of the patient.

1 To register the volumes automatically, select **Automatic** in the task panel.

If the registration is satisfactory, you can continue to the **Segmentation** task

If the registration is not satisfactory, continue with this procedure and register the volumes manually.

2 To pan volume 1, select **Pan** in the task panel and drag the volume in a 2D view in the desired direction.

3 To rotate volume 1 in the viewing plane, select **Rotate** in the task panel and do one of the following:
- On the Interventional Workspot, drag in a 2D view in the direction that you want to rotate. If desired, drag the rotation point to a different position before rotating.
- On the touch screen module, rotate a 2D view using two fingers. The rotation point is automatically set to the point between your fingers.

4 To navigate through slices in volume 1, select **Scroll Slice** in the task panel and do the following:
- Drag up in a 2D view to move upward through the volume.
- Drag down in a 2D view to move downward through the volume.

5 To undo an action, select **Undo** in the task panel.

6 To reset all registration actions and return to the initial situation, select **Reset**.

5.4.2 Creating Annotations in SmartCT Dual Viewer (Option)

When SmartCT Dual Viewer is enabled, you create annotations, such as lesion segmentations, vessel analysis, landmarks or 3D measurements, on one volume or the other.

NOTE
It is not possible to create an annotation on both volumes simultaneously. Additionally, if you start creating an annotation such as a 3D measurement or a lesion segmentation on one volume, it is not possible to continue the annotation on the other volume.

Creating Annotations in Overlay View
When creating annotations on a volume in overlay view, you need to switch off the visibility of one of the volumes in the global tools panel before you can proceed. The volume that remains visible is the volume on which the annotation will be created. Until the visibility of one of the volumes is switched off, annotation tools cannot be used. This allows you to be sure of where you are creating annotations.

To switch volume visibility on or off, use the **Volume Visibility** tools at the bottom of the task panel on the left side of the main display area.

When the visibility of a volume is switched off, any annotations that have been created on that volume remain visible. Annotations on a hidden volume can be selected to focus reference lines on center of the annotation, but they cannot be edited while the volume is not visible.

Creating Annotations in Side-by-Side View
When creating annotations on a volume in side-by-side view, volume visibility is not an issue (it is not possible to switch volume visibility off in side-by-side view).

When creating an annotation on a volume using the Interventional Workspot, the mouse pointer position is also indicated on the other volume. This indicator is for reference only, and does not create an annotation. This can assist you in locating the appropriate position for the annotation.

Annotation Lists in the Task Panel
Annotations, such as lesion and vessel segmentations, measurements, and landmarks, are saved with the volume on which they were created. Annotations are displayed in annotation lists in the task panel along with corresponding volume numbers. Annotation lists are ordered by volume number and then by creation time.
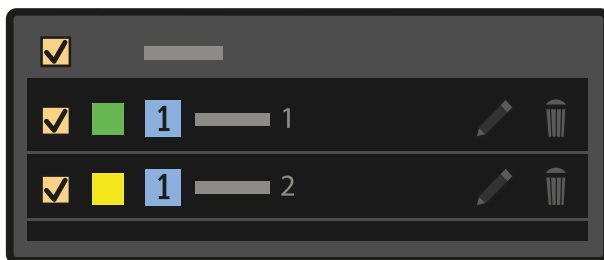
Figure 22 Volume number indicators in annotation lists

6 Segmentation Task

The goal of this task is to use the volume to assess the relevant anatomy. This assists you with device selection and treatment strategy.

If SmartCT is configured as the viewing application in the ProcedureCard for the acquisition, the **Segmentation** task is displayed automatically after acquiring a 3D rotational scan.

If the **Segmentation** task is not displayed, you can select it in the task selection panel.

The **Segmentation** task provides tools that allow you to prepare and plan a procedure by marking and measuring relevant anatomical structures in the volume:
- Viewing the volume to verify that the 3D reconstruction is correct.
- Removing parts of the anatomy that obstruct the view of the region of interest.
- Analyzing the volume to gain insight:
  - Making quick measurements or 3D measurements.
  - Segmenting lesions and vessels to make them more visible in the 3D model during treatment and to enable measurements.
  - Making measurements on lesions or vessel segments to understand the size of the anatomy to be treated.
  - Adding landmarks to the volume to indicate a specific point in the anatomy.

Annotation Lists in the Task Panel
Annotations that you create, such as lesion and vessel segmentations, measurements, and landmarks, are saved with the volume. Annotations are displayed in annotation lists in the task panel and are ordered by creation time.
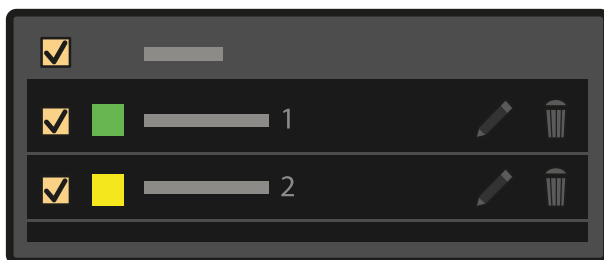
Figure 23   Volume number indicators in annotation lists

6.1 Viewing Options

After acquiring a 3D rotational scan, you can view and assess the volume at the tableside using SmartCT on the touch screen module.

The volume can also viewed in SmartCT on the Interventional Workspot in the control room and on a monitor in the examination room. If the mouse option is installed on the X-ray system, you can control SmartCT using the mouse in the examination room.

NOTE
Verify that the 3D reconstruction is correct before continuing with further tasks.

After viewing and assessing the volume using the tools described in this section, you may also decide to perform the following actions:
- Create a new reconstruction of the region of interest.
- Open the volume in another interventional tool, such as EmboGuide or XperGuide (if available).

6.1.1 Adjusting the Viewing Area

1 To change the layout of the views displayed in the main display area on the Interventional Workspot, select an option from the **Select Layout** section in the task panel or from the layout options on the touch screen module:

Option	Layout
	1+3 view
	If SmartCT Dual Viewer (option) is enabled, this layout option displays the volumes in overlay view.
	2x2 view
	If SmartCT Dual Viewer (option) is enabled, this layout option displays the volumes in overlay view.
1 2	Side-by-side view (SmartCT Dual Viewer option)
	This layout option is available in the **Segmentation** task when SmartCT Dual Viewer is enabled. When this layout option is selected, it is not possible to switch off volume visibility for either volume.

2 To enlarge a view on the Interventional Workspot, click **Maximize** in the toolbar of the view.

a   To restore the view to its normal size, click **Restore** in the toolbar.

3 To swap the view in a viewport with the main view, do one of the following:
- On the Interventional Workspot, click **Swap with Main View** in the toolbar of the view. This function is available when the layout is set to 1+3 view.

- On the touch screen module, tap one of the thumbnail views.

4 To enlarge the viewing area, click or tap the arrows above the task selection panel.

Click or tap the arrows again to display the panel.

5 To show or hide labels next to annotations as you create them, click **Image Overlays** in the global tools area on the Interventional Workspot, and then select or clear **Show Labels**.

If labels are hidden, you can temporarily display the label of a specific annotation by pausing the pointer over the annotation. Labels are not displayed while **Edit** mode is enabled.

6.1.2 Using Viewing Tools

Interaction tools are available on the toolbar and in the view to assist with inspecting the volume. Some functions can also be performed directly in the touch screen module.

1 To zoom the image using the mouse, select **Zoom** and do one of the following:

- Drag up to zoom in.
- Drag down to zoom out.
- To reset the zoom factor, right-click the view and click **Reset Pan/Zoom**.

2 To zoom the image using the touch screen module, do one of the following:

- Pinch out to zoom in.
- Pinch in to zoom out.
- Double-tap the view:
  - If the image is zoomed out, the image is zoomed in. The view is centered on the tapped point.
  - If the image is zoomed in, the image is zoomed out. This also resets the panning movements.

3 To move the image in the view using the mouse, select **Pan** and do one of the following:

- Drag in the view to move the image.
- To center the view on a specific point, right-click at that point and click **Center Here**.
- To reset the panning movements, right-click the view and click **Reset Pan/Zoom**.

4 To move the image in the view using the touch screen module, do one of the following:

- Drag with two fingers to move the image.
- To reset the panning movements, double-tap the view. This also resets the zoom factor.

5 To roll or rotate the volume in a view, select **Roll/Rotate** and do one of the following:

- Drag the middle of the view to roll the volume in any direction.
- Drag the edge of the view to rotate the volume in the viewing plane.

NOTE
If you roll or rotate the volume during device navigation in the live view, the volume snaps back to the previous orientation when you release it. This also applies to the following rotate functions.

6 To rotate the volume in the viewing plane using the mouse, select **Rotate In Plane** and drag the volume clockwise or counter-clockwise.

7 To rotate the volume in the viewing plane using the touch screen module, rotate the volume with two fingers.

8 To rotate the volume around an axis, select **Rotate Around Axis** and do one of the following:

- Drag left or right to rotate the volume around the vertical axis.
- Drag up or down to rotate the volume around the horizontal axis.

9 To rotate the volume 90 degrees left, right, up, or down in the 3D view, select a rotation arrow at the edge of the view corresponding to the desired rotation direction.

Figure 24   90-degree rotation arrows at the edge of the 3D view

10 To select a preset visualization setting, see one of the following sections:

11 To change the position of the slab in a 2D view, select **Slab Position** and do one of the following:

- Drag up to display the slab behind the currently viewed slab.
- Drag down to display the slab in front of the currently viewed slab.
- Drag the reference lines in the 2D views.
- Drag the intersection of two reference lines in a 2D view to move both reference lines together.
- Drag the rotation marker at either end of a reference line to rotate the reference line.
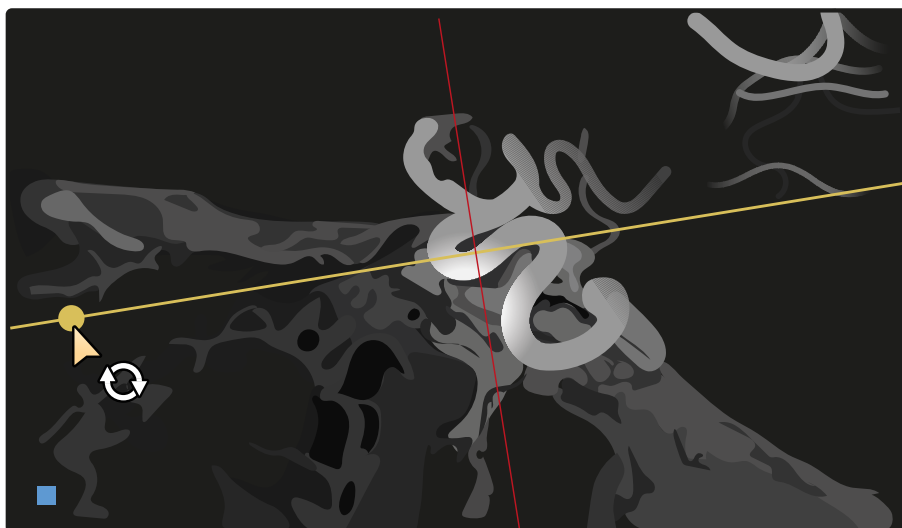
Figure 25   Rotating a reference line using the rotation marker

12 To show or hide reference lines in the 2D views, use the **Reference Line Visibility** tool:
- Select **Reference Line Visibility** to show reference lines.
- Clear the selection to hide reference lines.

13 To change the thickness of the slab in a 2D view, select **Slab Thickness** and do one of the following:

- Drag up to increase the slab thickness.
- Drag down to decrease the slab thickness.
- Select the **Slab Thickness** value in a 2D view and enter a new value. (This function is not available on the touch screen module.)
- Rotate the wheel button over the **Slab Thickness** value in a 2D view to change the value. (This function is not available on the touch screen module.)

Thicker slabs are averaged across a greater depth of data from the series, resulting in reduced noise in the image. Thinner slabs display more noise, but also display more detail. Therefore, it is recommended to use a thin slab thickness when defining and viewing landmarks and 3D measurements, and especially when defining, editing, and viewing lesions.

14 To adjust the window level and window width in the 3D view or the 2D views, select **Volume Windowing** and do one of the following:

- Drag up to increase the window level (decrease the brightness).
- Drag down to decrease the window level (increase the brightness).
- Drag right to increase the window width (decrease the contrast).
- Drag left to decrease the window width (increase the contrast).

a To reset the windowing, do one of the following:

- On the touch screen module, tap **Reset**.
- With the mouse, right-click the view and click **Reset Volume Windowing**.

b To select a preset windowing setting, see Changing the Windowing of a Slab View (page 47).

c To adjust the window level and window width when SmartCT Dual Viewer (option) is enabled, select the arrow next to the **Volume Windowing** tool and select one of the following options:

Option	Function
	Adjust the windowing of both volumes.
	Adjust the windowing of volume 1.
	Adjust the windowing of volume 2.

15 To adjust the histogram directly for the selected view, do the following:

a Select **Volume Windowing** in the 3D view or the 2D views.

The histogram is displayed in the lower-left corner of the view.
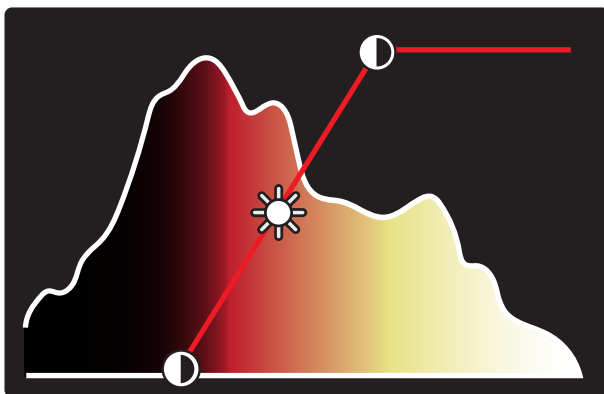
Figure 26 Histogram

NOTE
When SmartCT Dual Viewer (option) is enabled, the histogram of each visible volume is displayed.

b Do any of the following:

- Drag one of the indicated points on the slope of the histogram.
- Drag the middle part of the histogram to set the window level.
- Drag the upper or lower part of the histogram to set the window width.

16 To adjust the contrast and brightness of the X-ray image in the **Live** task, select **Contrast/Brightness** and do one of the following:

- Drag up to decrease the brightness.
- Drag down to increase the brightness.
- Drag right to idecrease the contrast.
- Drag left to increase the contrast.

a To reset the contrast and brightness, do one of the following:

- On the touch screen module, tap **Reset**.
- With the mouse, right-click the view and click **Reset Contrast/Brightness**.

6.1.3 Changing the Orientation

Tools are available to quickly change the orientation of a view to standard orientations.

1 To reset the 3D view to the last-selected standard orientation, select **Standard Orientation** on the toolbar.

2 To select a different standard orientation, select the arrow next to **Standard Orientation**, and then select an orientation.

Standard Orientations	
Default Orientation	
AP (Anterior-Posterior)	
PA (Posterior-Anterior)	
Lateral Left	
Lateral Right	
Caudo Cranial	
Cranio Caudal	

3 To reset a 2D view to its preset orientation, select **Reset Orientation** on the toolbar.

Depending on which 2D view that you want to reset, the **Reset Orientation** displays one of the following icons:

6.1.4 Changing the Visualization of the 3D View

1 To change the render mode for the 3D view, select **Volume Visualization Presets**.

2 In the **Volume Visualization Presets** dialog box, select a visualization preset.
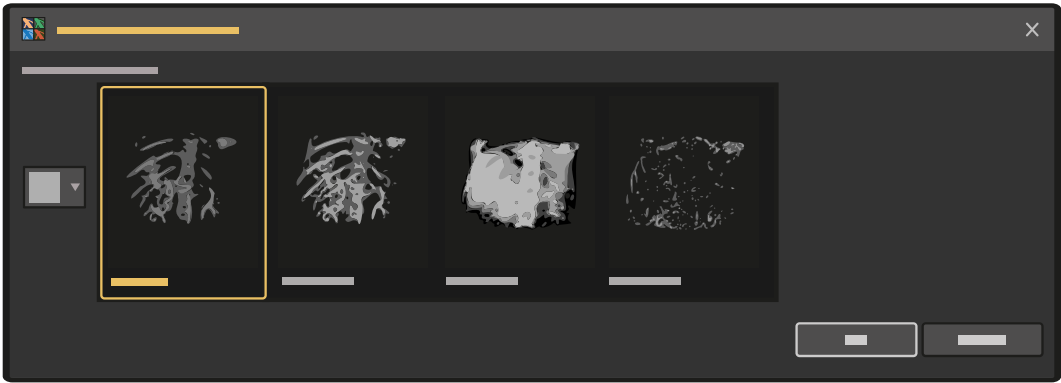
Figure 27   Volume Visualization Presets dialog box

3 To change the color for the 3D view, select the color chip on the left side of the visualization preset options, and then select a color in the drop-down menu.

The default color for the 3D view is gray in all tasks except for the **Live** task. In the **Live** task, the default color is red.

4 To change the render mode and color when SmartCT Dual Viewer (option) is enabled, select options for each volume.

Options for both volumes are displayed in the **Volume Visualization Presets** dialog box. A volume number indicator is displayed on the left side of the visualization preset options to indicate the settings that are applicable for each volume. The default color for volume 1 is blue and the default color for volume 2 is red.
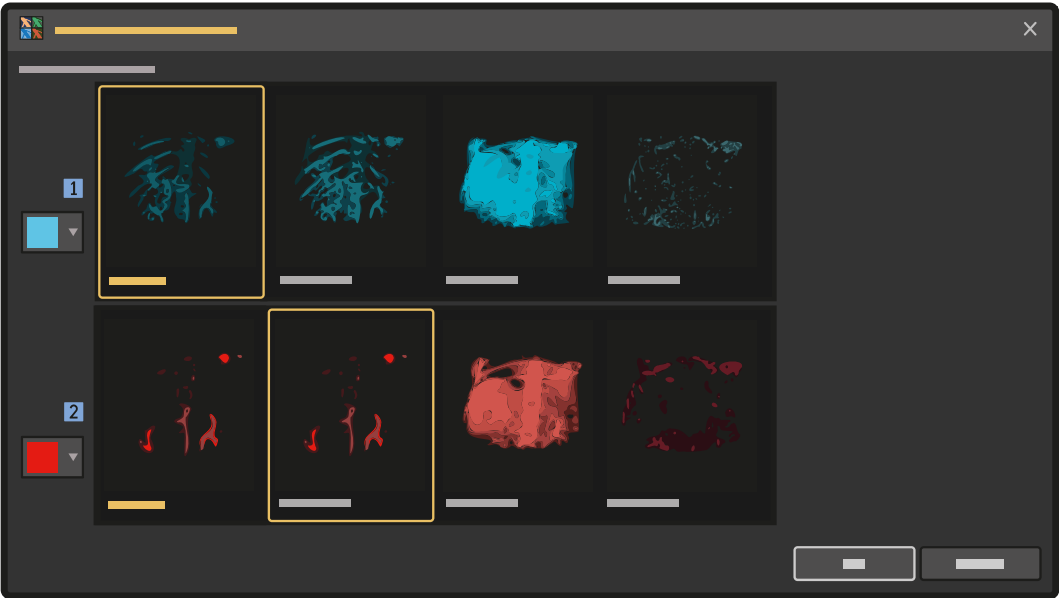
Figure 28   Volume Visualization Presets dialog box when SmartCT Dual Viewer is enabled

6.1.5 Changing the Visualization of a Slab View

1 To change the render mode for a slab view, select **Slab Visualization Presets**.

2 In the **Slab Visualization Presets** dialog box, select a visualization preset.
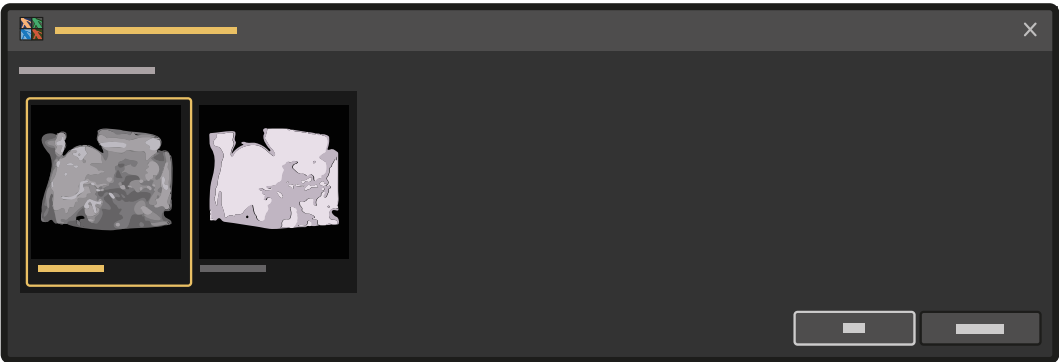
Figure 29   Slab Visualization Presets dialog box

3 To change the render mode when SmartCT Dual Viewer (option) is enabled, select options for each slab.
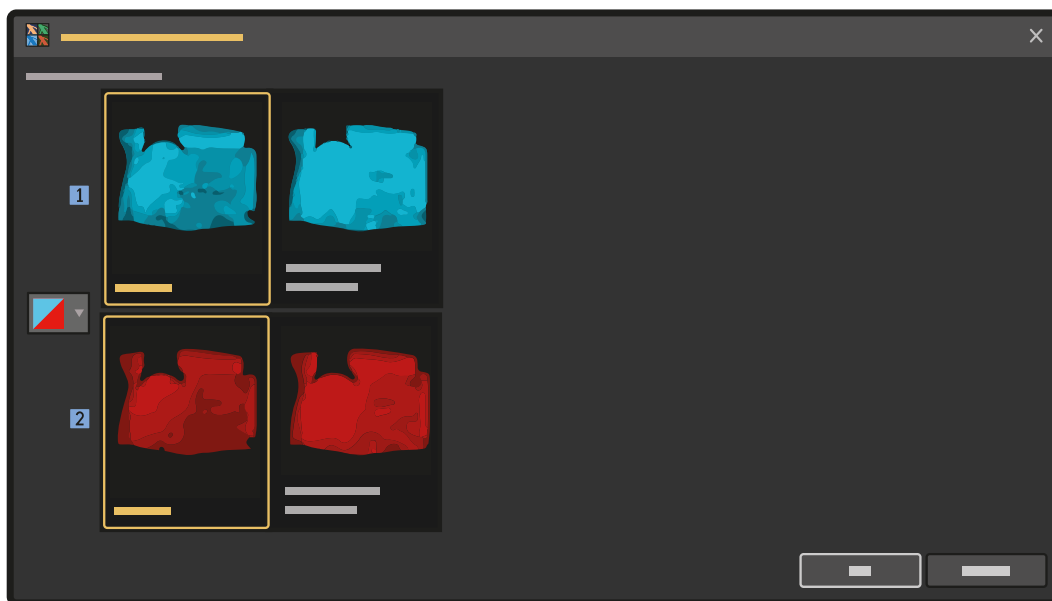
Figure 30 **Slab Visualization Presets** dialog box when SmartCT Dual Viewer is enabled

When SmartCT Dual Viewer is enabled, options for both slabs are displayed in the **Slab Visualization Presets** dialog box. A volume number indicator is displayed on the left side of the visualization preset options to indicate the settings that are applicable for each volume.

NOTE
The selected render mode is used for both slabs.

When SmartCT Dual Viewer is enabled, slabs are displayed in different colors.

4 To change the color combination in SmartCT Dual Viewer (option), select the color chip on the left side of the visualization preset options, and then select a color in the drop-down menu.

NOTE
Slab colors can be selected in preset combinations. It is not possible to select a slab color for each volume independently. In the side-by-side view layout, slabs are always displayed in gray.

6.1.6 Changing the Windowing of a Slab View

When viewing CBCT or VasoCT volumes, you can select a preset windowing setting that is appropriate for the anatomy that you are viewing.

NOTE
When you change the windowing preset, the slab thickness may also change, as appropriate for the selected setting.

1 To change the windowing for a slab view, select **Slab Windowing Presets**.

2 In the **Slab Windowing Presets** dialog box, select a windowing preset.
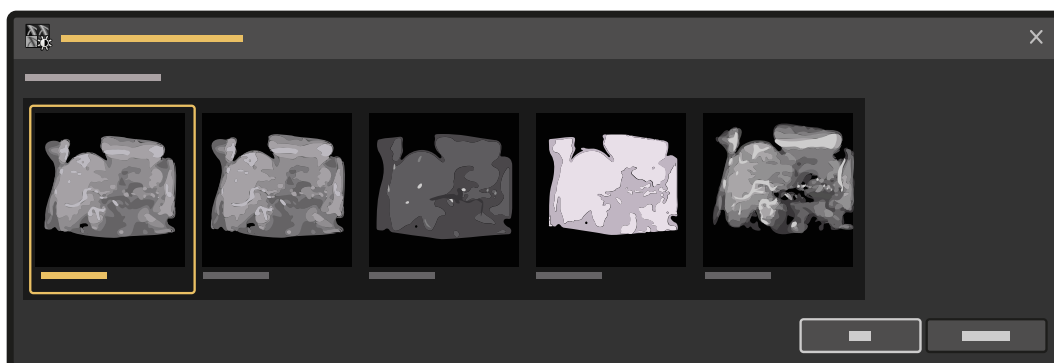
Figure 31 Slab Windowing Presets dialog box

3 To change the windowing when SmartCT Dual Viewer (option) is enabled, select options for each slab.

Figure 32 Slab Windowing Presets dialog box when SmartCT Dual Viewer is enabled

When SmartCT Dual Viewer is enabled, options for both slabs are displayed in the **Slab Windowing Presets** dialog box. A volume number indicator is displayed on the left side of the visualization preset options to indicate the settings that are applicable for each volume.

6.1.7 Cutting Anatomy from the Volume

You can cut parts of the anatomy in the 3D view to obtain a clearer view of anatomical structures in the region of interest. You can use this function to remove anatomical parts that are not relevant for the procedure.

If SmartCT Dual Viewer (option) is enabled and both volumes are visible, cuts that you make are applied to both volumes at once. Alternatively, if you switch the visibility of a volume off, any cuts that you make are only applied to the visible volume.

1 Select the 3D view.

Cuts cannot be performed on the 2D views.

2 Select **Roll/Rotate** to rotate the volume so that the anatomy that you want to remove does not overlap the anatomy that you want to retain.

3 Select **Remove Anatomy** in the task panel.

4 Select **Cut Anatomy**.

5 Draw a contour in the 3D view.

6 Do one of the following to cut inside or outside the contour:
- To cut the anatomy inside the contour, tap or click inside.
- To cut the anatomy outside the contour, tap or click outside.

Cuts are made through the whole depth of the volume.

7 Make multiple cuts, if desired.

a Rotate the volume between cuts by selecting **Roll/Rotate** on the toolbar after each cut.

8 To undo a cut, select **Undo** at the top of the task panel.

a To redo a cut that you have undone, select **Redo** at the top of the task panel.

9 To undo all cuts, select **Reset Cuts**.

If SmartCT Dual Viewer (option) is enabled, cuts are reset on both volumes, whether they are visible or hidden.

6.1.8 Hiding the Skull (Neuro Cases)

In neuro cases, you can hide the skull in the 3D view to obtain a clearer view of anatomical structures in the region of interest. This function is only available for VasoCT scans.

NOTE
The skull removal feature is not intended to be used with pediatric patients.

1 To hide the skull, select **Hide Skull**.

The effects of skull removal are only visible in the 3D view.

NOTE
If SmartCT Dual Viewer (option) is enabled, you can hide the skull in either volume independently. A Hide Skull button is provided for each volume.

The skull can only be hidden if the following conditions are met:
- The cube size should be at least 104 mm x 104 mm x 104 mm.
- The reconstruction size should be at least 256^3.
- The optimization setting should be either **Exam Preset** or **Stent**.

2 To show the skull again after hiding it, select **Hide Skull** again.

6.1.9 Sending a Snapshot to a Reference View

You can create a snapshot and send it to a reference view on the X-ray system for review during the procedure.

1 Click or tap the arrow next to **Snapshot** in the global tools panel.

2 Select **Copy to Ref** to create a snapshot and send it to the desired reference view.

Depending on the configuration of the X-ray system, up to three references views may be available:

The snapshot is stored with the study in the patient database.

6.2 Segmenting a Lesion

If a lesion is present in the anatomy, you can segment the lesion to measure its volume and assist with navigation during the procedure.

You segment a lesion in one of the 2D views. It is not possible to segment a lesion in the 3D view. Segmenting a lesion increases its visibility in the volume.

CAUTION
For optimal measurement results, ensure that the 3D rotational scan is of sufficient quality by preventing movement of the anatomy and, if applicable, by using the correct injection protocol so that vessels are properly filled with contrast agent. It is the operator's responsibility to provide appropriate patient supports and straps.

CAUTION
When making manual measurements, ensure that the window width and window level (WW/WL) settings are configured to provide an optimal view of the object to be measured.

For information about the accuracy of measurements, see Accuracy of Measurements (page 63).

You can segment lesions using the Interventional Workspot or the touch screen module. However, you cannot show or edit the label or change the color of a lesion using the touch screen module.

1 If SmartCT Dual Viewer (option) is enabled in overlay view, switch off the visibility of the other volume using the **Volume Visibility** tools at the bottom of the task panel on the left side of the main display area.

Alternatively, switch to side-by-side view layout option.

2 Select one of the 2D views.

3 Select **Scroll** and drag vertically in the 2D view to display the lesion.

4 Select **Lesions** in the task panel.

5 Select **Define Lesion**.

6 Use your finger or the mouse to drag from the center of the lesion to the edge of the lesion.

NOTE
Position the dotted line of the lesion definition so that the middle of the dotted line is on the contour of the lesion.

When a lesion is defined, it is added to the list of lesions in the task panel. The volume of the lesion is also displayed in the list.

CAUTION
Verify that the lesion segmentation is correct by viewing it in multiple slab positions and orientations.

NOTE
Verify that the displayed volume of the lesion is within expectations.

NOTE
After defining a lesion, Edit mode is automatically enabled on the Interventional Workspot to allow you to make corrections if needed. You can only edit a lesion using the mouse. For more information, see Editing a Lesion Segmentation (page 51).

7 **Interventional Workspot**: To edit a lesion's label, do the following:

a Click the lesion's label in a view or double-click the lesion name in the list of lesions in the task panel.

b Type a new label and press Enter.

When entering text in a label, do not include information that could identify the patient.

8 To change the color of a lesion, select the color icon next to the lesion in the list of the lesions in the task panel, and then select a new color.

9 To show or hide a lesion, select or clear the check box next to the lesion in the list of lesions in the task panel.

10 To delete a lesion, select the lesion in the list of lesions in the task panel, and then select **Delete**.

6.2.1 Editing a Lesion Segmentation

You can edit a lesion segmentation using SmartCT on the Interventional Workspot in the control room. If the mouse option is available in the examination room, you can also perform this task in the examination room.

1 If SmartCT Dual Viewer (option) is enabled in overlay view, ensure that only the volume containing the annotation that you want to edit is visible.

Alternatively, switch to side-by-side view layout option.

2 In the list of lesions in the task panel, select the lesion that you want to edit.

3 If the **Edit** tool is not already selected, select **Edit** next to the lesion.

4   Drag or push the edge of the segmentation so that it fits the shape of the lesion in the image.

NOTE
Position the dotted line of the lesion definition so that the middle of the dotted line is on the contour of the lesion.
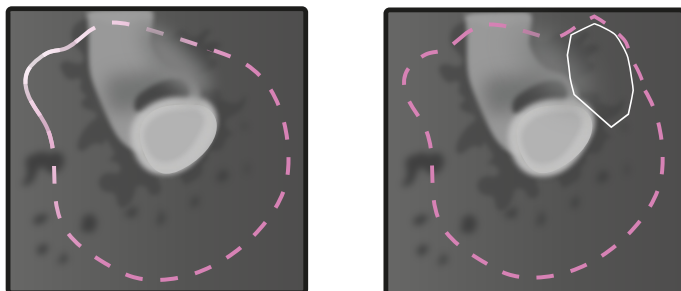
Figure 33   Editing a lesion by dragging the edge or pushing the edge

CAUTION
Verify that the lesion segmentation is correct by viewing it in multiple slab positions and orientations.

When verifying a lesion segmentation in a 2D view, use a very thin slab thickness. With a thick slab, the lesion outline may not match the visible tissue. Use the **Slab Thickness** to adjust the slab. For more information, see Using Viewing Tools (page 41).

5   To undo an edit, select **Undo**.

6   To stop editing, select **Edit** again to switch the function off.

7   To delete a lesion, select the lesion in the list of lesions in the task panel, and then select **Delete**.

6.3 Segmenting a Vessel

You can segment a vessel to analyze its shape, to measure its length and diameter, and to assist with navigation during the procedure.

Segmenting a vessel assists you with planning a procedure in the following ways:
- Inspect the vessel segment and intra-vascular devices.
- Assess the endpoint of the treatment.
- View the relationship of the vessel segment to the surrounding vascular anatomy.
- Measure the length and diameter of any vessel segment to select an appropriate device.
- Define a path to a treatment area.

NOTE
Vessels that you intend to be segment should have been properly filled with contrast medium during acquisition.

NOTE
The image quality of the reconstruction series should be sufficient. Any motion of the anatomical region of interest should have been avoided during acquisition and the rotational scan should not contain excessive noise.

NOTE
If the vessel to be traced is very close to other vessels, the vessel trace may jump from one vessel to the other. This can be corrected manually.

NOTE
3DRA and VasoCT scans only: ensure that the vessel is clearly visible in the viewport by adjusting the WW/WL setting.

NOTE
You can create a vessel segment to analyze any vessel in the volume, including vessels containing, for example, aneurysms or stents. However, optimal results may be achieved with vessel segments that start and end on healthy vessel parts, and that avoid bifurcations, aneurysms, stents, or catheters.

You can segment vessels using the Interventional Workspot or the touch screen module. However, you cannot show or edit the label or change the color of a vessel segment using the touch screen module.

1 If SmartCT Dual Viewer (option) is enabled in overlay view, switch off the visibility of the other volume using the **Volume Visibility** tools at the bottom of the task panel on the left side of the main display area.

   Alternatively, switch to side-by-side view layout option.

2 Display the vessel that you want to segment.

   You can create a vessel segment in a 2D view or the 3D view.

3 Select **Vessels** in the task panel.

4 Select **Define Vessel**.

5 Select the start of the vessel segment, and then select the end of the vessel segment.

   It is recommended to place the start point at the proximal point and then place the end point at the distal point.

   NOTE
   Between placing the start point and the end point, you can use the basic interactions to adjust the view (zoom, pan, roll, or scroll). Separate vessel segments cannot be merged.

   a When creating a vessel segment using the touch screen module, you can adjust the start point or end point before completing the segment:

   • Tap the start point or end point. A ring is displayed around the point to indicate that you can move it.
   • Move the point to a new position.
   • When the start point and end point are positioned as desired, tap **Done** at the top of the view.

   NOTE
   Verify that the vessel segment is correct and does not incorrectly include or exclude tissue.

   When you create a vessel segment, measurement markers are displayed at either end of the segment. These markers are displayed as a yellow ring and a green ring. Additionally, a magenta navigation marker is displayed in the middle of the vessel segment.
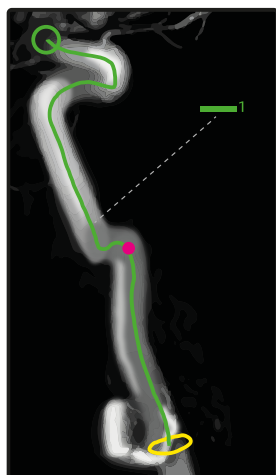
Figure 34 Vessel markers

Measurement markers are used to analyze the vessel segment (see Analyzing a Vessel Segment (page 55)), but you can also use the measurement markers at any time to indicate a region of interest in the vessel. Additionally, dragging the navigation marker in the 3D view moves all 2D slab views to the navigation marker's position.

For more information, see Analyzing a Vessel Segment (page 55).

6 To change the visualization of a vessel segment, do the following:

a Select the vessel segment in the list of vessels, if it is not already selected.

b Select an option in the **Vessel Visualization** section in the task panel.

Option	Visualization
	Centerline visualization
	Surface visualization
	Outline visualization
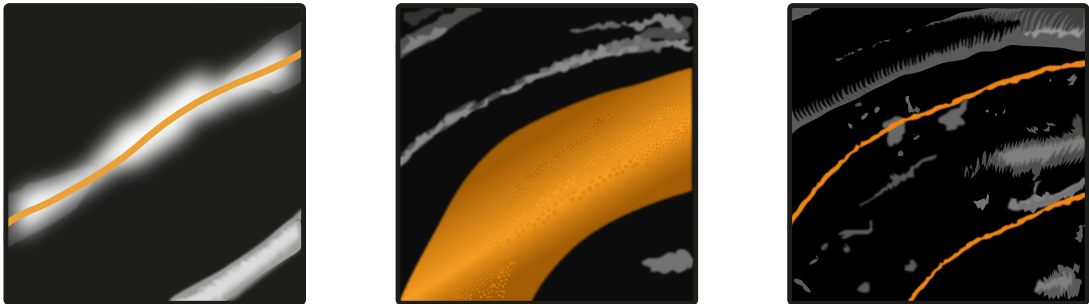
Figure 35   Vessel visualization in the 3D view: centerline, surface, and outline

Figure 36   Vessel visualization in 2D views: centerline, surface, and outline

In a 2D view that is set to centerline visualization, the whole centerline is visible, and the part that is inside the slab is highlighted. For 2D views that are set to one of the other visualization settings, only the part of the vessel segment that is inside the slab is visible.

7 To show or hide the ring markers in the vessel segment, select **Show Ring Markers** in the **Vessel Visualization** section in the task panel.

8 **Interventional Workspot**: To edit a vessel segment's label, do the following:

a Click the vessel segment's label in a view or double-click the vessel name in the list of vessels in the task panel.

b Type a new label and press Enter.

When entering text in a label, do not include information that could identify the patient.

9 To change the color of a vessel segment, select the color icon next to the vessel segment in the list of the vessels in the task panel, and then select a new color.

10 To show or hide a vessel segment, select or clear the check box next to the vessel segment in the list of vessels in the task panel.

11 To delete a vessel segment, select the vessel segment in the list of vessels in the task panel, and then select **Delete**.

6.3.1 Editing a Vessel Segment

NOTE
This function can only be performed using the mouse.

1 If SmartCT Dual Viewer (option) is enabled in overlay view, ensure that only the volume containing the annotation that you want to edit is visible.

Alternatively, switch to side-by-side view layout option.

2 In the **Vessels** list in the task panel, select the vessel segment that you want to edit.

3 Select **Edit** next to the vessel segment.

4 To adjust the start point or end point, drag the point to a new position in the 3D view.

5 To adjust the centerline, drag the centerline to a new position in any of the available views.

    a To perform a detailed edit of the centerline inside a vessel segment, use the curved reformat view in **Vessel Analysis**.

       NOTE
       If you edit the centerline using the curved reformat view in Vessel Analysis, and then subsequently edit the centerline by dragging it in the volume view or one of the 2D views, the edits made in the curved reformat view are discarded.

       NOTE
       Verify that the vessel segment is correct and does not incorrectly include or exclude tissue.

6 To undo an edit, select **Undo**.

7 To stop editing, select **Edit** again to switch the function off.

8 To delete a vessel segment, select the vessel segment in the list of vessels in the task panel, and then select **Delete**.

6.3.2 Analyzing a Vessel Segment

CAUTION
For optimal measurement results, ensure that the 3D rotational scan is of sufficient quality by preventing movement of the anatomy and, if applicable, by using the correct injection protocol so that vessels are properly filled with contrast agent. It is the operator's responsibility to provide appropriate patient supports and straps.

CAUTION
The following reconstruction settings are assumed for accurate vessel analysis:
- *For 3DRA and VasoCT volumes, the maximum voxel size is 0.5 mm.*
- *For CBCT volumes, the maximum voxel size is 0.5 mm for diameters ≥ 2.0 mm and < 4.0 mm.*
- *For CBCT volumes, the maximum voxel size is 0.65 mm for diameters ≥ 4.0 mm.*
- *For 3DRA volumes, the Smoothness settings Smooth or Very Smooth should not be used.*
- *For CBCT and VasoCT volumes, the Optimize for setting Soft Tissue should not be used.*

In addition to the preconditions and restrictions for vessel tracing mentioned in Segmenting a Vessel (page 52), the following should be taken into account for diameter measurements to obtain the stated accuracy:

- In the presence of aneurysms or at vessel bifurcations, the lumen of a vessel is not clearly defined, affecting the diameter measurement.
- In the presence of foreign bodies, such as stents or catheters, the diameter measurement can be overestimated or underestimated.

For length measurements (measuring the length of the segment between the two measurement markers), the minimal length of the segment to be measured should cover at least 2 cm on the monitor.

For information about the accuracy of measurements, see Accuracy of Measurements (page 63).

Vessel analysis provides a dedicated layout containing the following views.
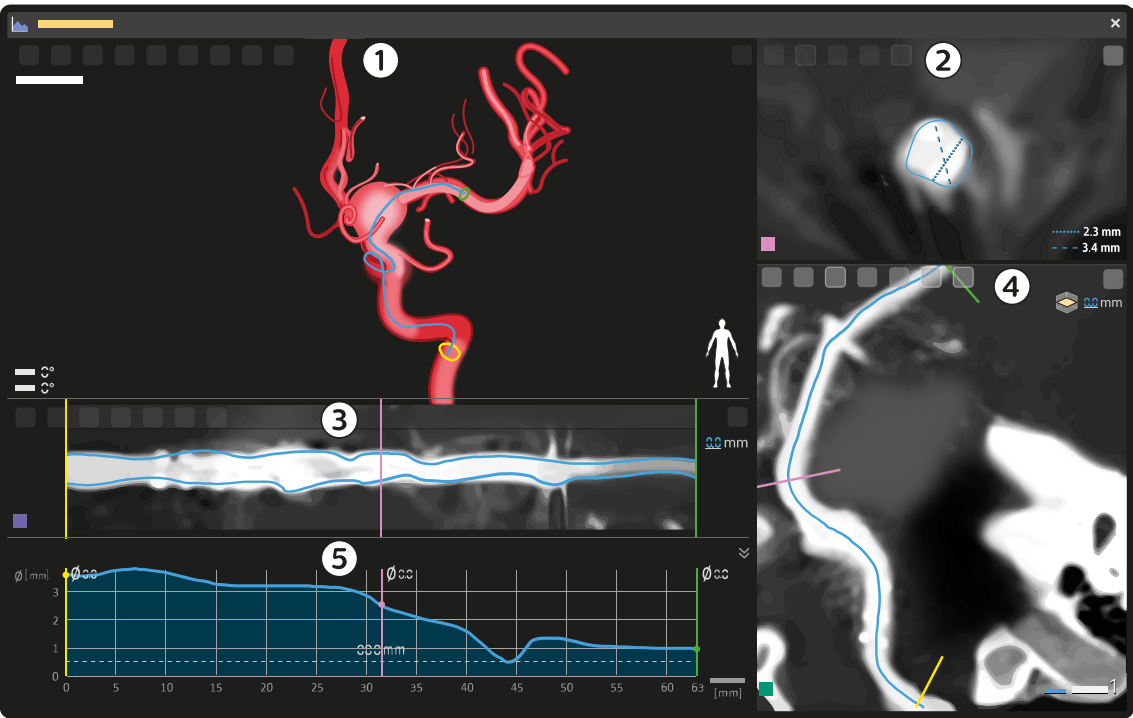
Figure 37   Vessel analysis layout

Legend			
1	3D view	4	Curved reformat view
2	Cross-section view	5	Measurement graph
3	Straightened reformat view		

The measurement markers (yellow and green) and the navigation marker (magenta) are visible in all views except the cross-section view. The measurement markers indicate the start point and end point of the vessel segment. The start point is always located on the left of the straightened reformat view and at the bottom of the curved reformat view.

NOTE
Depending on how the start point and end point were placed, the straightened reformat view and the curved reformat view may appear flipped or upside down.

The cross-section view displays an indication of the minimum and maximum diameters at the position of navigation marker.

The curved reformat view may contain small shaded areas, which represent reflections of the vessel.
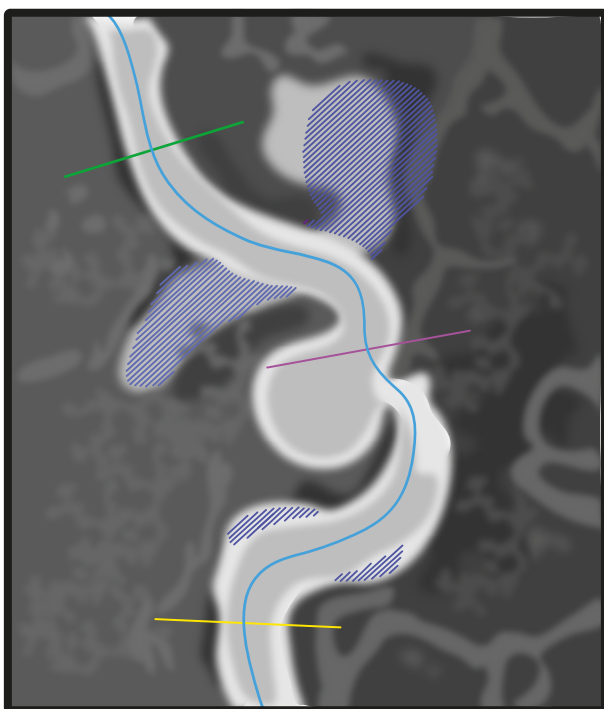
Figure 38 Vessel reflections (shaded areas) in the curved reformat view

The measurement graph indicates the length of the segment between the measurement markers, and the average diameter of the vessel segment along the length of the analyzed segment. The average diameter at each marker position is also displayed.

1 To select a vessel segment for analysis, do the following:

   a Select **Vessels** in the task panel.

   b Select the segment that you want to analyze.

   c Select **Vessel Analysis**.

2 To measure a distance within the vessel segment, drag the yellow and green markers so that they contain the distance to be measured.

The measured distance is displayed in the measurement graph.

NOTE
Verify that the displayed distance value is within expectations.

The position of the magenta marker is displayed in the cross-section view. You can scroll in the cross-section view to move this marker.

3 To rotate the vessel segment around the centerline in the straightened reformat view and curved reformat view, select **Rotate** on the toolbar and drag in one of the reformat views.

Rotation of the vessel segment in these views is linked.

4 To link the orientation of the 3D view with the curved reformat view, select **Link Orientation** on the toolbar of the 3D view.

5 To show or hide the measurement graph, click the arrows in the upper-right corner of the measurement graph view.

6.4 Adding Landmarks

You can add landmarks to the volume to indicate anatomical parts that are relevant to the procedure. This assists with navigation during the procedure.

You can add landmarks and adjust their position using the Interventional Workspot or the touch screen module. However, you cannot show or edit the label or change the color of a landmark using the touch screen module.

1   If SmartCT Dual Viewer (option) is enabled in overlay view, switch off the visibility of the other volume using the **Volume Visibility** tools at the bottom of the task panel on the left side of the main display area.

Alternatively, switch to side-by-side view layout option.

2   Display the location where you want to place a landmark.

You can place a landmark in a 2D view or the 3D view.

3   Select **Landmarks** in the task panel.

4   Select **Add Landmark**.

5   Tap or click in one of the views on the desired location for the landmark.

When you add a landmark to the 3D view, the landmark snaps to the anatomy. When you add a landmark to a 2D view, the landmark snaps to the 2D plane.

When viewing landmarks in 2D views, the landmark symbol indicates whether it is in front of or behind the currently viewed slab.
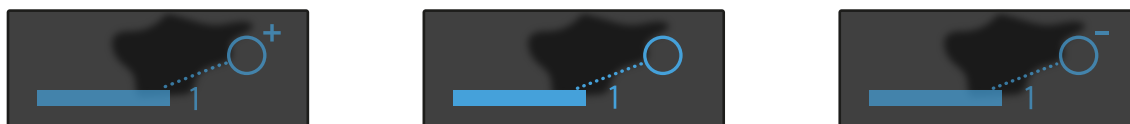
Figure 39   Landmark visualization before the slab, in the slab, and behind the slab

6   Verify that the landmark is correctly positioned by viewing it in all views (3D view and 2D views).

7 To move a landmark, do one of the following:
  • On the Interventional Workspot, drag the landmark to a new position.

  NOTE
  If SmartCT Dual Viewer (option) is enabled in overlay view, landmarks cannot be moved. First, switch off the visibility of the other volume using the Volume Visibility tools at the bottom of the task panel on the left side of the main display area, and then move the landmark.

  • On the touch screen module, tap and hold the landmark until a ring is displayed around it, then drag it to a new position.
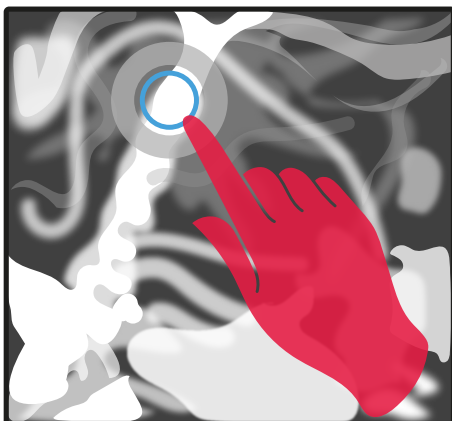
Figure 40 Moving a landmark on the touch screen module

8 **Interventional Workspot**: To edit a landmark's label, do the following:

  a Click the landmark's label in a view or double-click the landmark name in the list of landmarks in the task panel.

  b Type a new label and press Enter.

  When entering text in a label, do not include information that could identify the patient.

9 To change the color of a landmark, select the color icon next to the landmark in the list of the landmarks in the task panel, and then select a new color.

10 To show or hide a landmark, select or clear the check box next to the landmark in the list of landmarks in the task panel.

11 To undo an edit, select **Undo**.

12 To delete a landmark, select the landmark in the **Landmarks** list in the task panel, and then select **Delete**.

6.5 Making 3D Measurements

You can make a 3D point-to-point measurement on the 3D view and the 2D slab views. Measurements provide an indication of the size of anatomical structures or devices. 3D measurements can only be made using the mouse.

NOTE
This function can only be performed using the mouse.

⚠ **CAUTION**
For optimal measurement results, ensure that the 3D rotational scan is of sufficient quality by preventing movement of the anatomy and, if applicable, by using the correct injection protocol so that vessels are properly filled with contrast agent. It is the operator's responsibility to provide appropriate patient supports and straps.

⚠️ **CAUTION**
When making manual measurements, ensure that the window width and window level (WW/WL) settings are configured to provide an optimal view of the object to be measured.

NOTE
Verify that the measurement is correctly applied and displays a value that is within expectations. If the image quality of the 3D reconstruction is poor, the measurement may not be accurate. You may also compare the measurement value with other measurements in SmartCT or with measurements from pre-procedure scans or X-ray.

NOTE
The minimal length of the object to be measured should cover at least 2 cm on the monitor.

For information about the accuracy of measurements, see Accuracy of Measurements (page 63).

1 If SmartCT Dual Viewer (option) is enabled in overlay view, switch off the visibility of the other volume using the **Volume Visibility** tools at the bottom of the task panel on the left side of the main display area.

Alternatively, switch to side-by-side view layout option.

2 Display the object or anatomy that you want to measure.

You can make a measurement in a 2D view or the 3D view.

3 Select **3D Measurements** in the task panel.

4 Select **Define 3D Measurement**.

5 Select the start of the measurement, and then select the end of the measurement.

NOTE
Between placing the start point and the end point, you can use the basic interactions to adjust the view (zoom, pan, roll, or scroll).
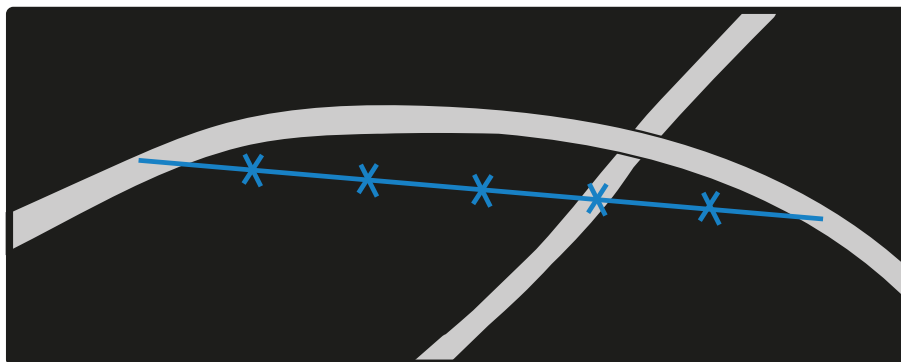
Figure 41 3D measurement

Markers are displayed on the measurement at intervals of 1 cm.

For information about editing a 3D measurement, see Editing a 3D Measurement (page 61).

6 To edit a measurement's label, do the following:

   a Click the measurement's label in a view or double-click the measurement name in the list of measurements in the task panel.

   b Type a new label and press Enter.

When entering text in a label, do not include information that could identify the patient.

7 To change the color of a measurement, select the color icon next to the measurement in the list of the measurements in the task panel, and then select a new color.

8   To show or hide a 3D measurement, select or clear the check box next to the measurement in the list of the measurements in the task panel.

9   To delete a measurement, select the measurement in the list of measurements in the task panel, and then select **Delete**.

6.5.1 Editing a 3D Measurement

You can edit a 3D measurement using SmartCT on the Interventional Workspot in the control room. If the mouse option is available in the examination room, you can also perform this task in the examination room.

1   If SmartCT Dual Viewer (option) is enabled in overlay view, ensure that only the volume containing the annotation that you want to edit is visible.

Alternatively, switch to side-by-side view layout option.

2   In the **3D Measurements** list in the task panel, select the 3D measurement that you want to edit.

3   Select **Edit** next to the measurement.

4   Drag the start point or end point to a new position in the 3D view or in one of the 2D views.

5   To undo an edit, select **Undo**.

6   To stop editing, select **Edit** again to switch the function off.

7   To delete a measurement, select the measurement in the list of measurements in the task panel, and then select **Delete**.

6.6 Making Quick Measurements

You can make a 2D point-to-point measurement on the 3D view and the 2D slab views. Measurements provide an indication of the size of anatomical structures or devices.

⚠ **CAUTION**
For optimal measurement results, ensure that the 3D rotational scan is of sufficient quality by preventing movement of the anatomy and, if applicable, by using the correct injection protocol so that vessels are properly filled with contrast agent. It is the operator's responsibility to provide appropriate patient supports and straps.

⚠ **CAUTION**
When making manual measurements, ensure that the window width and window level (WW/WL) settings are configured to provide an optimal view of the object to be measured.

NOTE
Verify that the measurement is correctly applied and displays a value that is within expectations. If the image quality of the 3D reconstruction is poor, the measurement may not be accurate. You may also compare the measurement value with other measurements in SmartCT or with measurements from pre-procedure scans or X-ray.

NOTE
A quick measurement is a 2D measurement on a 3D image. Be aware that this measurement method does not take into account any vessel tortuosity and possible cross section anomalies. To achieve maximum measurement accuracy, orient the 3D image in such a way that the measurement has minimal 2D distortion (foreshortening).

NOTE
The minimal length of the object to be measured should cover at least 2 cm on the monitor.

For information about the accuracy of measurements, see Accuracy of Measurements (page 63).

You can make quick measurements and adjust their position using the Interventional Workspot or the touch screen module. However, you cannot change the color of a quick measurement using the touch screen module.

1 Display the object or anatomy that you want to measure.

You can make a measurement in a 2D view or the 3D view.

2 Select **Quick Measurement** on the toolbar.

3 Do one of the following to make a quick measurement in a view:
   • Tap or click at the start point of the measurement and then tap or click at the end point.
   • Drag from the start point of the measurement to the end point.

A measurement line is displayed with a label indicating the length of the measurement in millimeters.
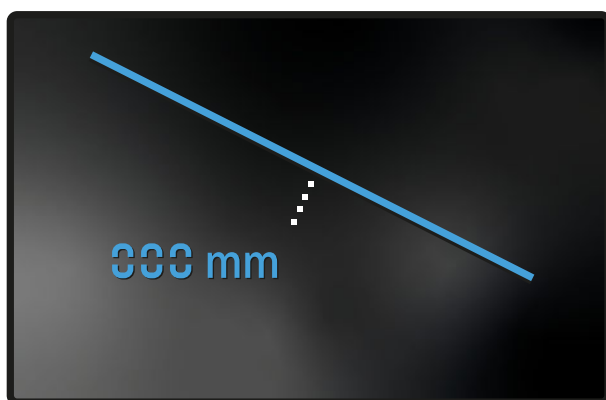
Figure 42   Quick measurement

4 To move the start point or end point of the measurement line, do one of the following:
   • On the Interventional Workspot, drag the start point or end point to a new position.
   • On the touch screen module, tap and hold the start point or end point until a ring is displayed around it, then drag it to a new position.
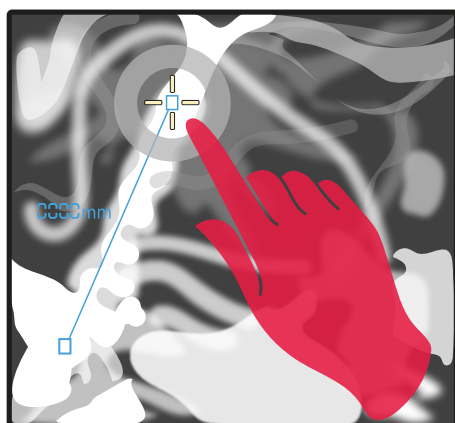
Figure 43   Moving the start point or end point on the touch screen module

5 To move the measurement label, drag it to the desired position.

6 To change the color of a measurement, right-click the measurement, pause the pointer over **Change Measurement Color**, and then select a color.

7 To delete a measurement, right-click the measurement and click **Delete Measurement**.

8 To delete all measurements on the volume in one step, right-click in a view and click **Delete All Measurements**.

Quick measurements are deleted if you perform any of the following actions:
- Display a different slab
- Roll or rotate the slab or volume
- Switch to a different task

Actions such as panning and zooming do not delete quick measurements.

6.7 Accuracy of Measurements

You should only perform measurements on volumes of sufficient quality with appropriate histogram settings. The quality of a volume is influenced by the resolution (voxel size), movement of the anatomical region during the 3D rotational scan, and, if applicable, correct contrast filling.

Quick Measurements
If the length of the object to be measured covers at least 2 cm on the monitor, the accuracy is as follows:
- ±0.2 mm for lengths ≥ 2.0 mm and ≤ 4.0 mm
- ±5% for lengths > 4.0 mm

NOTE
The accuracy of a measurement is determined by the accurate placement of the start and end point of the measurement in the viewport. This is the responsibility of the clinical user.

NOTE
To achieve the stated accuracy, it is assumed that the measurement is performed on the 2D slab views.

NOTE
It is the responsibility of the user to set the correct windowing settings and to use a volume of sufficient quality before performing a measurement.

3D Measurements
If the length of the object to be measured covers at least 2 cm on the monitor, the accuracy is as follows:
- ±0.2 mm for lengths ≥ 2.0 mm and ≤ 4.0 mm
- ±5% for lengths > 4.0 mm

NOTE
The accuracy of a measurement is determined by the accurate placement of the start and end point of the measurement in the viewport. This is the responsibility of the clinical user.

NOTE
To achieve the stated accuracy, it is assumed that the measurement is performed on the 2D slab views.

NOTE
It is the responsibility of the user to set the correct windowing settings and to use a volume of sufficient quality before performing a measurement.

Vessel Measurements
For vessel measurements on a 3DRA or VasoCT volume, the following accuracies apply:

Type of Measurement	Accuracy
Diameter	±0.2 mm for diameters ≥2.0 mm and ≤4.0 mm
(The vessel diameter is shown as average diameter in a graph.)	±5% for diameters >4.0 mm and ≤14.0 mm
Length	±1.0 mm for lengths ≥10.0 mm and ≤20.0 mm
	±5% of the total length for lengths ≥20.0 mm

For vessel measurements on a CBCT volume, the following accuracies apply:

Type of Measurement	Accuracy
Diameter	±0.5 mm for diameters ≥2.0 mm and ≤10.0 mm
(The vessel diameter is shown as average diameter in a graph.)	±5% for diameters >10.0 mm and ≤14.0 mm
Length	±2.0 mm for lengths ≥10.0 mm and ≤40.0 mm
	±5% of the total length for lengths ≥40.0 mm

The following reconstruction settings are assumed for accurate vessel analysis:
- For 3DRA and VasoCT volumes, the maximum voxel size is 0.5 mm.
- For CBCT volumes, the maximum voxel size is 0.5 mm for diameters ≥ 2.0 mm and < 4.0 mm.
- For CBCT volumes, the maximum voxel size is 0.65 mm for diameters ≥ 4.0 mm.
- For 3DRA volumes, the **Smoothness** settings **Smooth** or **Very Smooth** should not be used.
- For CBCT and VasoCT volumes, the **Optimize for** setting **Soft Tissue** should not be used.

Next to the average diameter, also an indication of the minimum and maximum diameter can be shown at any point along the segmented vessel in the cross section view. The measurement values of these two diameters represent the length of two lines with start and end points on the contour of the segmented vessel. The accuracy of these measurements is the same as for the average diameter described above. Because these measurement lines are shown on a slab of the volume, the user can relate these indicative measurements to the actual anatomy.

In addition to the preconditions and restrictions for vessel tracing mentioned in Segmenting a Vessel (page 52), the following should be taken into account for diameter measurements to obtain the stated accuracy:
- In the presence of aneurysms or at vessel bifurcations, the lumen of a vessel is not clearly defined, affecting the diameter measurement.
- In the presence of foreign bodies, such as stents or catheters, the diameter measurement can be overestimated or underestimated.

For length measurements (measuring the length of the segment between the two measurement markers), the minimal length of the segment to be measured should cover at least 2 cm on the monitor.

NOTE
It is the responsibility of the user to set the right windowing and to use a volume of sufficient quality for the vessel measurement and to set the markers of the start and end point for the vessel length correctly.

Lesion Volume Measurements
The accuracy of a lesion volume measurement for an object with a minimal diameter of at least 2 cm as viewed on the monitor is as follows:
- ±20% for volumes >0.1 ml

Accuracy is determined by the accurate contour definition of the measurement in the viewport.

NOTE
It is the responsibility of the user to set the correct windowing settings and to use a volume of sufficient quality before performing a measurement.

6.8 Adding a Text Annotation

You can add a text annotation to a 2D view or a 3D view in the **Segmentation** task.

This function can be combined with the **Snapshot** function to assist with reporting tasks.

Note the following guidance for adding text annotations:
- Text annotations can only be added and viewed on the Interventional Workspot.
- Text annotations can be added when SmartCT Dual Viewer (option) is enabled, including when either one or two volumes are visible and in side-by-side view.

- Text annotations cannot be added to the straightened reformat view, curved reformat view, or cross-section view in the vessel analysis layout.
- It is not possible to change the color of text annotations.

1 Use the viewing tools to display the detail that you want to annotate in a view.

NOTE
If you pan or zoom the view, text annotations are not moved or resized with the view.

2 On the toolbar of the view, select **Text Annotation**.

3 Select the location in the view where you want to place the text annotation.

A text annotation is created with default text.

4 To edit the text of the annotation, do the following:

a Select the text annotation and type the text that you want to display.

b To create a line break in the text annotation, press Shift+Enter and continue typing.

c To save the text annotation, press Enter.

5 To move a text annotation, drag it to a new position.

A text annotation can only be positioned within the view where it was created.

6 To hide all text annotations in a view, right-click in the view and clear the check box next to **Show Text Annotations** in the shortcut menu.

a To show text annotations again after hiding them, right-click in the view and select **Show Text Annotations**.

Adding a new text annotation when text annotation are hidden automatically displays all text annotations again.

NOTE
It is not possible to hide individual text annotations.

7 To delete a text annotation, right-click the annotation and select **Delete Text Annotation** in the shortcut menu.

If you are creating text annotations for reporting tasks, use the **Snapshot** function to capture the view. For more information, see Making a Snapshot (page 72).

Text annotations are saved with the volume when you close it.

7 Projections Task

In the **Projections** task, you can use the volume to determine optimal viewing angles for the stand and store them for recall during the procedure.

7.1 Storing a View

You can store a view of the volume for recall while planning treatment or during the navigation phase of the intervention.

The stand view displays the orientation of the stand for the view of the volume displayed in the 3D view.

Figure 44   Stand view

1   If desired, set the visibility of annotations using the annotations list in the task panel.

This may assist you with obtaining the desired view by indicating landmarks or anatomy of interest.

2   Select **Roll/Rotate** on the toolbar and manipulate the volume in the 3D view to display the desired view.

3   Select **Store Angle** in the task panel.

The viewing angle is stored and displayed in the list of viewing angles.

If the current viewing angle is unreachable, the angle information is displayed in red.

The viewing angle is stored in the list of angles. When you pause the pointer over the angle in the list, a thumbnail of the 3D view according that angle is displayed.

NOTE
If SmartCT Dual Viewer (option) is enabled, viewing angles are always stored with the last-acquired volume.

4   To rename a stored viewing angle, double-click its name in the list and type a new name.

5   To delete a stored viewing angle, select the viewing angle in the **Viewing Angles** list in the task panel, and then select **Delete**.

7.2 Moving the Stand to a Stored Viewing Angle

NOTE
This function is not available if the reconstruction series was acquired with a tilted or cradled table or if the patient is not selected for acquisition on the X-ray system.

1   In the list of viewing angles in the task panel, select the viewing angle that you want to recall.

    If the patient is positioned nose down, surgical view should be enabled on the X-ray system. This ensures that automatic position control functions as expected.

2   On the control module, press and hold **Accept**.

The stand moves to the requested viewing angle. If the viewing angle is not reachable, the stand moves to the opposite projection if possible, or as close as possible to the requested angle.

NOTE
When a viewing angle is recalled, the volume is oriented to the top of the view, such that it is aligned with the X-ray image when the system is in the specified rotation and angulation. The view may differ to the moment when the viewing angle was stored in a rotation around an axis perpendicular to the display (in-plane rotation). However, the projection is the same.

7.3 Follow C-arc

When the **Follow C-Arc** function is enabled, the orientation of the volume follows the orientation of the stand. **Follow C-Arc** is disabled by default.
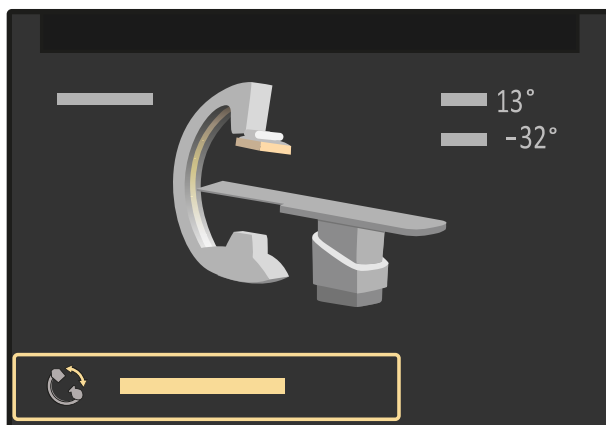
NOTE
This function is not available if the patient is not selected for acquisition on the X-ray system.

NOTE
If SmartCT Dual Viewer (option) is enabled, viewing angles are linked to volume 2 (the last-acquired volume).

1   To enable or disable **Follow C-Arc**, select **Follow C-Arc** below the stand image in the task panel.

Figure 45   Follow C-Arc function

2   If you change the projection of the stand, the orientation of the 3D view matches the projection.

    A label is applied to the 3D view to indicate that **Follow C-Arc** is active.

3   If you change the orientation of the 3D view using the **Roll/Rotate** tool or if you recall a stored viewing angle, the orientation of the 3D view no longer matches the projection of the stand.

    A label is applied to the stand image in the task panel to indicate that the view displayed in the 3D view is a preview. The label in the 3D view indicating that **Follow C-Arc** is active is removed. However, **Follow C-Arc** is still enabled, and if you change the projection of the stand, the orientation of the 3D view will match the projection again.

8 Live Task

The **Live** task overlays live X-ray images with the 3D view, including vessel and lesion segmentations, and landmarks and 3D measurements that are contained in the volume. This assists you with navigating a catheter or guidewire toward the treatment area.

NOTE
The Live task is only available if the Roadmap option is installed on your system and the reconstruction series was not acquired with a tilted or cradled table.

When you acquire X-ray images during the **Live** task, the system registers the 3D overlay with the live images (2D-3D registration).

2D-3D registration is performed automatically in the following situations:
- The patient orientation of each new 2D live series is equal to the patient orientation of the primary volume.
- For systems without image beam rotation:
  - The L-arm is not moved from the position where the 3D acquisition was acquired.
- For systems with image beam rotation:
  - The L-arm is moved to any of the following positions: -135, -90, -45, 0, 45, 90, or 135 degrees.
  - The difference between the current L-arm position and the L-arm position from where the 3D rotational scan was acquired must be ≤90 degrees.

If the L-arm is moved, a message is displayed to inform you that the alignment must be checked and correction performed manually, if necessary.

If the patient moves during the intervention and there is a mismatch between the 3D view and the live images, you can apply manual motion compensation.

NOTE
Verify that the overlay is correctly displayed and provides a view that is within expectations.

NOTE
If SmartCT Dual Viewer (option) is enabled, the X-ray series, viewing angles, and 2D-3D registration are linked to volume 2 (the last-acquired volume).

NOTE
Table movements that are not tracked may cause a mismatch between the 3D overlay and the live images.

NOTE
Stand movements that are outside the calibrated area may cause a mismatch between the 3D overlay and the live images.

NOTE
Patient movements during live guidance may cause a mismatch between the 3D overlay and the live images.

Available functionality in the **Live** task:
- Navigate and deliver the treatment guided by X-ray images overlaid with the volume, including any lesions and vessels that you have segmented and any landmarks and 3D measurements that you have placed.
- Select a stored angle for recall with automatic position control on the X-ray system.
- Manually correct the match between the overlay image and the fluoroscopy image, if required.
- Store, recall, and review X-ray series.

8.1 Overlay Settings

During the **Live** task, you can adjust the visualization of the 2D image, the volume, and segmentations as desired.

1 Select **Overlay Settings** in the task panel to display the overlay tools.

2 To change the opacity of the volume, adjust the **Volume Opacity** slider with the mouse or use the +/- buttons on the touch screen module.

This is useful if the volume obscures your view of live images.

This function is also available on the toolbar. Select the tool on the toolbar and drag up or down in the view.

3 To change the opacity of the 2D image outside the volume, adjust the **Landmarking** slider with the mouse or use the +/- buttons on the touch screen module.

This function is also available on the toolbar. Select the tool on the toolbar and drag up or down in the view.

4 To enhance the visibility of the catheter in the 2D image, select **Catheter Boost** in the **X-ray Visualization** options.

5 To invert the gray values of the 2D image, select **Invert** in the **X-ray Visualization** options.

6 To show or hide an annotation, select **Set Annotations Visibility** in the task panel and then select or clear the corresponding check box.

7 To change the render mode for the volume, select **Visualization Preset** on the toolbar of the 3D view, and then select a render mode.

8.2 Motion Compensation

When you acquire X-ray images during the **Live** task, the system automatically registers the 3D overlay with the live images. If the patient moves during the procedure and there is a mismatch between the 3D view and the live images, you can apply motion compensation.

Automatic motion compensation is available for neuro interventions, and can correct small movements. If it is available, it is enabled by default. If automatic motion compensation is not available, you can make manual corrections to the registration of the 3D overlay and the X-ray images.

NOTE
Manual registration correction can only be applied if the X-ray series is the last acquired series. Manual registration correction cannot be applied to a recalled series.

1 To switch automatic motion compensation on or off, select **Motion Compensation** in the task panel and then select **Automatic**.

The accuracy of the match of automatic motion compensation is within ±1 mm for a maximum mismatch of 10 mm. The maximum mismatch of 10 mm is only valid if the following conditions are met:
- The rotational scan is acquired using a procedure from the **Head** application and with a field of view of at least 22 cm.
- The volume is reconstructed at full size.
- The 2D X-ray series is acquired with a field of view of at least 22 cm.

If the field of view is too small, automatic motion compensation may not function correctly.

2 To correct the registration manually, select **Motion Compensation** in the task panel and do the following:

   a   Select **Registration Translate** in the task panel.

   b   Drag in the view to align the volume with the 2D image.

The correction is applied to all new series.

3 To reset motion compensation, select **Reset** in the task panel.

8.3 Moving the Stand to a Stored Viewing Angle

1 In the list of viewing angles in the task panel, select the viewing angle that you want to recall.

If the patient is positioned nose down, surgical view should be enabled on the X-ray system. This ensures that automatic position control functions as expected.

2 On the control module, press and hold **Accept**.

The stand moves to the requested viewing angle. If the viewing angle is not reachable, the stand moves to the opposite projection if possible, or as close as possible to the requested angle.

NOTE
When a viewing angle is recalled, the volume is oriented to the top of the view, such that it is aligned with the X-ray image when the system is in the specified rotation and angulation. The view may differ to the moment when the viewing angle was stored in a rotation around an axis perpendicular to the display (in-plane rotation). However, the projection is the same.

8.4 Assessing the Treatment

After performing treatment, you can acquire a post-treatment rotational scan and assess the result of the treatment in SmartCT.

1 Acquire a post-treatment 3D rotational scan.

For details, see Acquiring a 3D Rotational Scan (page 22).

NOTE
If the region of interest is still in the isocenter, you can skip the Isocenter step.

2 View and interpret the volume using the viewing tools in SmartCT.

For details, see Segmentation Task (page 40).

a   Create a new reconstruction or a new subtraction.

   For details, see the following sections:
   - Making a New Reconstruction (page 35).
   - Making a New Subtraction (page 36)

b   Analyze the volume.

   For details, see Segmentation Task (page 40).

3   Assess the treatment.

4   If further treatment is needed, the following tasks can be performed:

a   Plan optimal viewing angles.

   For details, see Projections Task (page 66).

b   Navigate and deliver the treatment guided by X-ray images overlaid with the volume.

   For details, see Live Task (page 68).

8.5 Managing X-ray Series

1   While live X-ray is not enabled, you can use the movie controls at the bottom of the view to review the X-ray series:
   - **Play**
   - **Pause**
   - **Next Image**
   - **Previous Image**
   - **Next Series**
   - **Previous Series**

2   To store an X-ray series, select **Store X-ray Series** on the toolbar of the view.

   The X-ray series is stored in the patient database on the Interventional Workspot.

3   To open a previously stored X-ray series for overlay, select **Recall X-ray Series** on the toolbar of the view.

   This function can only be performed using the mouse. A stored series cannot be recalled if acquisition is in progress.

9 Capturing Images

SmartCT provides several options for capturing images during an intervention for review, archival and training purposes.

You can capture images using the touch screen module in the examination room during a procedure, or on the Interventional Workspot in the control room while assessing the treatment after a procedure.

NOTE
X-ray series can only be stored during the Live task.

The following options are available :
- Making snapshots
- Recording movies
- Storing X-ray series

While reviewing the 3D reconstruction to capture images, you can add annotations. For more information, see Segmentation Task (page 40).

Exporting Captured Images
For information about exporting images captured using SmartCT, refer to the Interventional Workspot Instructions for Use.

9.1 Making a Snapshot

NOTE
When you make a snapshot or a movie, any personal information in the patient information overlay is removed.

1 Configure the information in the view according to your needs.

For example, you can do any of the following:

a Add landmarks.

For details, see Adding Landmarks (page 58).

b Create measurements.

For details, see the following:
- Making 3D Measurements (page 59)
- Making Quick Measurements (page 61)

2 Select **Snapshot** in the global tools panel.

Snapshots and movies are stored with the study and are available in the **Export** activity of the Interventional Workspot.

NOTE
If SmartCT Dual Viewer (option) is enabled, snapshots and movies are always stored with the last-acquired volume.

9.2 Recording a Movie

NOTE
This function can only be performed using the mouse.

The following movie types are available:
- Automatic movie: a preset movie that records the volume as a stacked slab, a 3D rotation, or an X-ray series with overlay.
- Free-format movie: a movie that records your interactions in the user interface.

When you record a movie while SmartCT Dual Viewer (option) is enabled, both volumes are captured in the movie if their visibility is switched on.

NOTE
When you make a snapshot or a movie, any personal information in the patient information overlay is removed.

1   Configure the information in the view according to your needs.

For example, you can do any of the following:

- Segmenting a Lesion (page 50)
- Segmenting a Vessel (page 52)
- Adding Landmarks (page 58)
- Making 3D Measurements (page 59)
- Making Quick Measurements (page 61)

2   To record an automatic movie, do the following:

a   Click **Movie** in the global tools panel.

b   Select the type of movie interaction that you want to create:

- Stacked slab movie (2D view): This option creates a movie that moves through the volume and records images of the volume according to the slab thickness. The number of frames that are created in the movie depends on the slab thickness. Reduce slab thickness for more frames. You can select to scroll in or scroll out.
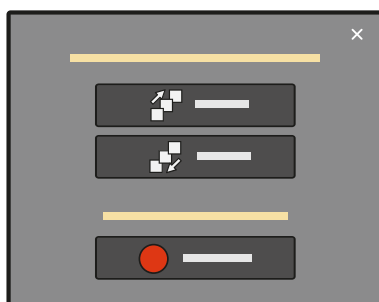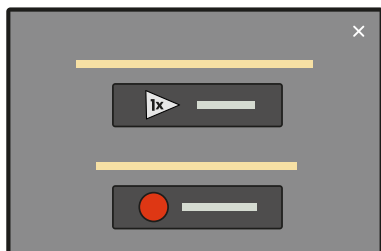

Figure 46   Stacked slab movie (2D view)

- Rotational 3D movie (3D view): This option creates a movie of the 3D model rotating through 360 degrees. You can select the direction of the rotation.
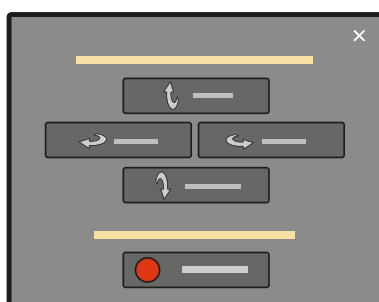
Figure 47   Rotational 3D movie (3D view)

- X-ray series movie with overlay: This option creates a movie of the displayed X-ray series overlaid with the 3D reconstruction.

Figure 48   X-ray series movie with overlay

Recording starts automatically after you select an option.

c   To stop recording an automatic movie before the preset action completes, press Esc.

3   To record a free-format movie, do the following:

a   Click **Start Recording**.

b   Interact with the view or the 3D reconstruction as desired.

Recording stops automatically after 120 seconds. A countdown timer is displayed in the task panel.

c   To stop recording before the time limit expires, click **Stop Recording** in the global tools panel.

Snapshots and movies are stored with the study and are available in the **Export** activity of the Interventional Workspot.

NOTE
If SmartCT Dual Viewer (option) is enabled, snapshots and movies are always stored with the last-acquired volume.

10 Maintenance

Clinical application is not allowed during maintenance and service.

Planned Maintenance
Planned maintenance is performed by qualified and authorized personnel. The frequency of planned maintenance depends on the X-ray equipment in use. The following program represents the minimum frequency:
• Geo verification should be performed every 12 months.

Philips provides a full planned maintenance and repair service on both a call basis and a contract basis. Full details are available from your Philips representative.

User Maintenance
CBCT calibration can be performed by the operator without assistance from technical support. The following schedule is recommended:
• CBCT calibration should be performed on each day that CBCT image acquisition is planned.
• CBCT calibration should be performed in the morning, prior to CBCT image acquisition.

For information about performing CBCT calibration, see the following section.

When you perform maintenance as the operator, you should always take all practical steps to make sure that the planned maintenance program is fully up to date before using the product with a patient.

10.1 CBCT Calibration

You can perform CBCT calibration without assistance from technical support. For example, if you notice artifacts in CBCT acquisitions, you should perform CBCT calibration. Calibration should not be performed from inside the examination room.

⚠ **CAUTION**
For optimal image quality when acquiring a neuro CBCT rotational scan, CBCT calibration should be performed before acquisition on each day that neuro CBCT acquisition is planned.

⚠ **CAUTION**
During CBCT daily calibration, move the table out of the X-ray beam. If parts of the table are inside the X-ray beam, the image quality will be compromised.

NOTE
The following procedure is automated. Follow the instructions provided on-screen, and interact with the system when instructed to do so.

1 On the **System** menu of the X-ray system, click **CBCT Calibration**.

2 In the **CBCT Calibration** dialog box, select a **Scan Type**:
   • **Propeller**
   • **Roll**

3 Follow the instructions provided in the **CBCT Calibration** dialog box to position the stand and table for the calibration procedure.

4 Click **Start Calibration** and press and hold the acquisition hand switch or foot switch.

   The system performs the calibration procedure.

5 Release the acquisition hand switch or foot switch when the system indicates that the calibration procedure is finished.

   NOTE
   If you release the hand switch or foot switch before the calibration procedure is complete, press the switch again to continue the procedure.

6 To stop the calibration procedure while it is in progress, click **Abort**.

10.2 System and Error Messages

Additional information is provided in this section for the following system and error messages. Other system and error messages that are self-explanatory are not included here.

Message	Additional Information
Geometry positioning function is being used at a different workspot.	An angle is selected for automatic position control (APC) in another application. Reselect the angle in SmartCT to be able to recall the angle using the **Accept** button.
No connection with the X-ray system.	Connection with the X-ray system has been lost. If the problem persists, contact technical support.
Skull segmentation failed.	An unknown problem has occurred. If the problem persists, contact technical support.
The patient orientation of the rotational scan differs from the X-ray system.	Correct the patient orientation on the X-ray system. If there is a mismatch in patient orientation, the live guidance functionality is not available.
Unable to load session data. The data will be removed and the SmartCT application will close.	An unknown problem has occurred. If the problem persists, contact technical support.
Unable to load the previously stored volume series. The SmartCT application will close.	An unknown problem has occurred. If the problem persists, contact technical support.
Add space at the top of the head for best image quality.	Even if the head is correctly isocentered, this message may be displayed to indicate that there is insufficient space at the top of the head, which can negatively affect image quality. If this message is displayed, add space at the top of the head until the message is no longer displayed.

10.3 Disposing of SmartCT

SmartCT may contain personal data, which presents a security risk. Personal data should be handled in a secure way.

For information about exporting or deleting personal data from the patient database, refer to the Export activity section of the instructions for use for the Interventional Workspot.

Contact Philips for information about how to dispose of SmartCT securely. See Contacting Philips (page 11).

11 Security

This section describes your responsibilities regarding the security of SmartCT.

11.1 Customer Role in the Product Security Partnership

Philips recognizes that the security of its products is an important part of your facility's in-depth security strategy. However, these benefits can only be realized if you implement a comprehensive, multi-layered strategy (including policies, processes, and technologies) to protect information and systems from external and internal threats.

Following industry-standard practice, your strategy should address physical security, operational security, procedural security, risk management, security policies, and contingency planning. The practical implementation of technical security elements varies by site and may employ a number of technologies, including firewalls, virus-scanning software, and authentication technologies.

As with any computer-based system, protection must be provided such that firewalls or other security devices are in place between the medical system and any externally accessible systems. The USA Veterans Administration has developed a widely used Medical Device Isolation Architecture for this purpose. Such perimeter and network defenses are essential elements in a comprehensive medical device security strategy.

The latest information on security and privacy, including recommended customer actions, can be found on the following website:

www.philips.com/productsecurity

NOTE
You should check the system's published cyber security status regularly on this website.

11.1.1 Risks Related to Security

To ensure the confidentiality, integrity, and availability of the device and related data, you should assess the risks to security based on the following recommendations.

- Implement network and physical access controls to limit the likelihood of compromise. For more information, see Customer Role in the Product Security Partnership (page 77).
- Monitor the product security recommendations issued by Philips on a regular basis. For more information, see Malware Protection (page 78).

The assessment should be repeated whenever changes are made to the network. Such changes include:
- Changes in the network configuration
- Connection of additional items to the network
- Disconnection of items from the network
- Updates or upgrades to items that are connected to the network

11.1.2 Detecting Security Failures

SmartCT is designed to handle errors, including security failures, and restricts user access to the application level only. The system provides logging capabilities for local and remote services that support diagnostics and forensics.

Security failures arising from user actions display error messages for the user and create audit events according to the IHE ATNA integration profile.

Network communication failures are audited. An error message is displayed for the user when user interaction is required.

System failures are handled depending on the nature and severity of the failure and may result in changes to the workflow, error messages, logging, or audit events. For example, software that is not on the whitelist is not executed and the failure is logged.

A number of security features have been implemented in this product. It is recommended to contact technical support to activate these features, in cooperation with the IT specialist of the hospital. These features are described below.

Encryption of Personal Data
When personal data is stored on the system, this feature ensures that the media cannot be misused when removed from the system or site.

Secure DICOM Transfer
When medical images or data are transmitted over a network, this feature ensures that the data is not modified by intruders during transmission, as well as ensuring that the data cannot be read if it is intercepted and displayed.

This feature can be switched on or off for each network node, if required.

Audit Trail
Any user action involving personal data is logged to allow analysis as to whether any hostile action has been performed on the personal data.

Network Time Synchronization
This function ensures that every device on the network uses the same clock so that all relevant user actions and data transmissions, including audit trail actions, can be checked in chronological order.

This function can be configured by the service engineer during installation.

11.2 Malware Protection

Philips systematically analyzes sources of information related to cyber security vulnerabilities to assess the equipment's cyber security risk. To ensure the proper functioning of the medical device, Philips may recommend specific customer or service actions, or issue service recommendations to update, alter, or even replace the equipment's protection mechanisms.

The latest information, including the Product Security Policy Statement and recommended customer actions, can be found on the following website:

www.philips.com/productsecurity

NOTE
You should regularly check the published equipment's cyber security status on the website mentioned above.

Despite preventive measures already implemented, a remote possibility remains that the equipment may become infected with malware. When malware is detected, or when you notice that unfamiliar behavior or degraded performance occurs repeatedly, including after switched off and on again, you should contact technical support for an inspection. When the inspection confirms the infection, be sure to take measures to contain and remove the source of infection. Technical support will reinstall the equipment's software to bring the equipment back into specification. Technical support can also assist in accessing the equipment's event log, which may provide information useful for the investigation.

11.2.1 Security Updates

This equipment incorporates protection mechanisms against the intrusion of malware such as viruses. Without proper cyber security maintenance, the effectiveness of these provisions may degrade over time, since malware is continuously altered to target newly discovered vulnerabilities.

The systematic analysis on cyber security vulnerabilities includes an assessment on the applicability and need for applying security updates taking into account mitigating circumstances in the intended use and design of this equipment.

Security updates alter the equipment's design and thus require proper validation and approval by Philips. Security updates are deployed by the Philips Service organization and are only to be installed by authorized service engineers according to Philips maintenance procedures for medical devices.

The latest information, including recommended customer actions, can be found on the following website:

www.philips.com/productsecurity

11.2.2 Whitelist Protection

Whitelist protection software is installed on this equipment. The whitelist identifies all trusted software, which is allowed to execute on the equipment.

The protection software prohibits the execution of untrusted software, thus effectively blocking malware before damage is done. Instead of relying on frequent updates, as for antivirus software, it offers proactive protection against a wide spectrum of malware and malware alterations.

Since only known trusted software is allowed to run, no regular updates are required.

12 Glossary

The following sections provide information about the terms and abbreviations used with SmartCT.
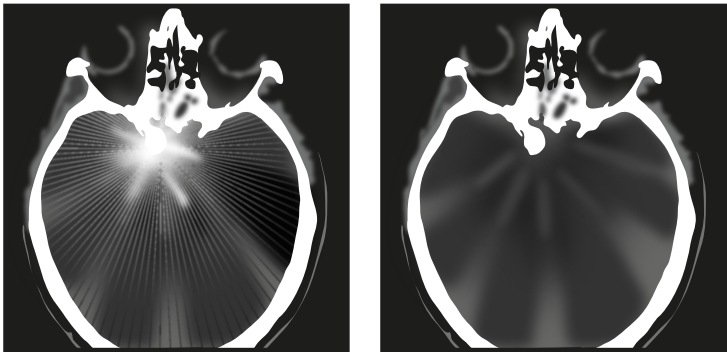
12.1 Definitions

Term	Description
3D acquisition protocols	3DRA: This acquisition protocol is available with SmartCT Angio and provides high-speed and high-resolution 3D visualizations of vasculature and bone structures. The relatively low kVs of the protocol are optimized to provide the best representation of contrast-enhanced vasculature and bone structures.
	CBCT: This acquisition protocol is available with SmartCT Soft Tissue and provides high-speed and high-resolution 3D visualizations of vasculature, hemorrhages, and soft tissue. The relatively high kVs of the protocol are optimized to provide the best representation of soft tissue and vasculature, such as hypervascular tumors with diluted contrast.
	VasoCT: This acquisition protocol is available with SmartCT Vaso and provides very high-resolution 3D visualizations of vasculature, hemorrhages, soft tissue, and bone structures. The relatively low kVs of the protocol are optimized to provide the best representation of vasculature and intracranial stents with diluted contrast.
3D view	A scene containing the volume, an optional overlay image, and functional tool objects. The volume can be a 3DRA/CBCT/VasoCT volume, an overlay image can be an X-ray image and functional tool objects include, for example, landmarks.
3D-3D registration	Registration is the process of finding the spatial relation between two volumes. Registration is necessary in order to be able to compare or overlay data.
3DRA volume	A 3DRA volume is a volume reconstructed from a 3DRA series. The volume consists of a set of voxels in a cubical space or rectangular space and has the following attributes: • A resolution, defining the number of voxels in the volume. • A size, defining the physical space that is covered. • An orientation. • A location. The voxels in a 3DRA volume are typically cubical.
Angle flavor	The angle flavor can be either *vascular* using Rot and Ang to indicate the angle or *cardio* using LAO/RAO and CRAN/CAUD.
Annotation	Annotations are Lesions, vessels, landmarks and 3D measurements in the volume.
Automatic Motion Compensation (AMC)	The AMC algorithm is an image based method that compares features in the 2D image with features in the 3D data while translating and rotating the volume data until the similarity between the features is maximized. The algorithm is tuned for neuro interventions and should be able to correct mismatches up to 1 cm in the overlay of the 2D X-ray image with the volume. However, note that local deformations, for example caused by insertion of a catheter, are not compensated for.
Average (Render mode)	Rendering which uses normal rendering with the average value of a number of voxels along one line.
BMI noise reduction	Body Mass Index noise reduction is a filter applied to improve image quality when a 3D reconstructed volume is impacted by excessive noise caused by photon starvation. Photon starvation occurs frequently in pelvic and shoulder scans of obese patients. The figure on the left below shows a reconstructed volume with BMI noise reduction disabled. Noise is present throughout the reconstructed volume. The figure on the right shows the same reconstructed volume with BMI noise reduction enabled. The reconstructed volume appears smoother.

Term	Description
CBCT Open	CBCT Open is a different flavor of the CBCT protocol for which only the start and stop angles are different, all other parameters remaining the same (same rotation range, same speed, etc.)
CBCT volume	A CBCT volume is a volume reconstructed from a CBCT series. The volume consists of a set of voxels in a cubical space or rectangular space and has the following attributes: • A resolution, defining the number of voxels in the volume. • A size, defining the physical space that is covered. • An orientation. • A location. The voxels in a CBCT volume are typically cubical.
Contrast series	A contrast series is a 3DRA series that has been made on a vessel with contrast agent.
Cube size	The cube size is expressed as a cube edge percentage. For the initial cube size, 100% is defined in the figure on the left below, where the circle represents the area visible on all images of the 3DRA/CBCT/VasoCT series and the square represents the reconstructed area. 100% 140%
Exposure	An acquisition method that uses a pulsed, relatively-high dose X-ray technique intended to support diagnostic and documentation purposes.
Fluoroscopy	An acquisition method that uses a continuous or pulsed, relatively-low dose X-ray technique intended for positioning of the beam, searching through the patient's body, or catheter navigation.
Gradient (render mode)	Rendering which shows the boundary of a vessel, while the vessel itself is transparent.
Last-acquired volume	When SmartCT Dual Viewer (option) is enabled, two series are displayed together as volumes. The last-acquired volume is considered as the primary volume. If both volumes are created from the same origin (for example, when both volumes are a reconstruction of the same volume) the volume with the latest creation time is the last-acquired volume.
Lesion	A lesion is any abnormality in the tissue, usually caused by disease or trauma.
Manual/Automatic Motion Compensation	Registration is the process of finding the spatial relation between different sets of data. Registration is necessary in order to be able to compare or overlay data obtained from (different) modalities. Registration can be achieved and corrected as follows: • Machine based registration automatically matches the volume to an X-ray series using Roadmap calibration. • Automatic motion compensation automatically corrects small mismatches (small patient or table movements) in the registration between the live X-ray image and the volume. • Manual correction allows you to correct mismatches in the registration between the live X-ray image and the volume.
Mask series	A mask series is a 3DRA series that has been made on the same vessel as for a contrast series, but without the use of contrast agent. Mask series are used to create subtracted volumes.
Maximum Intensity Projection (MIP) (Render mode)	MIP rendering allows the clinical user to relate volume data to the 2D images of an X-ray modality, showing only the maximum voxel values along the projection.

Term	Description
Metal artifact reduction	Metal artifact reduction is a filter applied to improve image quality when 3D reconstructed volume is negatively influenced by streak artifacts caused by high attenuating objects, such as metal objects in the patient's body. Examples of such objects are coils and teeth fillings. The figure on the left below shows a reconstructed volume with metal artifact reduction disabled. A metal object is present just above the center of the picture, which emits streaks across the reconstructed volume. The figure on the right shows the same reconstructed volume with metal artifact reduction enabled. The shape of the metal object is more defined and the streaks have diminished.
NeuroHQ CBCT	Improved neuro CBCT acquisition protocols introduced with SmartCT release 3.0.
Overlay volume	A volume that is used to overlay another volume. This allows you to combine the information of both volumes in one visualization. If SmartCT Dual Viewer (option) is enabled, the overlay volume is the older of the two volumes.
Primary volume	The first opened volume. If SmartCT Dual Viewer (option) is enabled, the primary volume is the last-acquired volume.
Reconstruction	A method to generate a volume from the raw images of a compatible 3D rotational X-ray series.
Session data	Data stored in the database containing relevant settings and segmentations the user made in the viewing application.
SmartCT Dual Viewer (option)	SmartCT Dual Viewer allows you to load two series from a patient and compare them side-by-side or overlaid.
Volume	The following types of volumes can be distinguished: • 3DRA volume • CBCT volume • VasoCT volume
Voxel	A voxel is a volume element, representing a value on a grid in 3D space. This is analogous to a pixel, which represents 2D image data in a bitmap.
X-ray image	An X-ray image is a single 2D image acquired using exposure or fluoroscopy X-ray techniques.
X-ray series	An X-ray series is a 2D series that can be used with a volume overlay for live guidance. An X-ray series can also be used to register a volume with the geometry of the X-ray system if there calibration is not available.

13 Appendix

13.1 3D Image Quality

The information in this section supersedes the information about 3D image quality described in the Instructions for Use of Azurion release 2.1, release 2.2, and release 3.0.

13.1.1 CBCT Image Quality

Low-Contrast Resolution
CBCT (cone-beam CT) reconstruction is used for the visualization of soft tissue and hemorrhages. Low-contrast phantoms with water-equivalent thickness of 16 cm diameter for head procedures and 31 cm diameter for abdomen and thorax procedures are used for measurement of the low-contrast resolution of non-angio head and body procedures. These phantoms have elements of different HU-equivalent contrast inserts at different diameters (mm). For head procedures, a contrast resolution of at least 100 HU mm is achieved. For abdomen and thorax procedures, a contrast resolution of at least 270 HU mm is achieved. The evaluation is done with a slice thickness of 5 mm and optimal WW/WL settings.

In addition, the MITA CCT189 phantom has been used to evaluate the visibility of specific low-contrast objects:
*   7 HU / 5 mm and 5 HU / 7 mm for the Cone Beam CT HQ 30fps - 21s protocol
*   7 HU / 5 mm, 5 HU / 7 mm and 3 HU / 10 mm for the CBCT Circular 10s Normal protocol

Uniformity
Uniformity within an axial single slice (near the plane of rotation) is dependent on the type of object scanned. Philips has measured uniformity using the Catphan 500 phantom (slice CTP486). For more information about the Catphan 500 phantom, refer to the following website:

www.phantomlab.com

Uniformity with head procedures is observed to be better than 2%. Uniformity with abdomen and thorax procedures is approximately 10%, mainly limited by scatter and truncation. The evaluation is done with a slice thickness of 5 mm.

Spatial Resolution
As a practical approach for measuring the MTF, the spatial resolution can be determined using a Catphan 500 phantom. Here, slice CTP528 is used to determine the spatial resolution of CBCT reconstructions for both angio and non-angio procedures. The evaluation is done with a slice thickness of 1 mm and optimal WW/WL settings.

CBCT Protocol	Spatial Resolution in Line Pair / cm
Head 48 cm / 19 in	6
Head 27 cm / 10.5 in	13
Head 22 cm / 8 in	15
Thorax/Abdomen/Lung	6

13.1.2 3D-RA Image Quality

High-Contrast Resolution
3D-RA (3D rotational angiography) reconstructions provide high-speed and high-resolution 3D visualization of vessels and bones anatomy.

A high-contrast phantom is used in the evaluation of 3D-RA head and body procedures. Philips uses a CsI C-delta (cesium-iodine contrast-difference) phantom.

The CsI C-delta phantom consists of 2 cm thick, 10 cm in diameter circular cylinders of water equivalent plastic containing CsI rods representing 8 different contrast groups. The contrast groups represent: >2700, 1160, 562, 274, 116, 53, 27, and 14 HU.

For each slice two different contrast groups are present each containing rods of 8 different diameters: 11.3, 8.0, 5.6, 4.0, 2.8, 2.0, 1.4, and 1.0 mm. The discs are inserted in elliptical (or circular) containers of water equivalent plastic depending on procedure used (head or body).
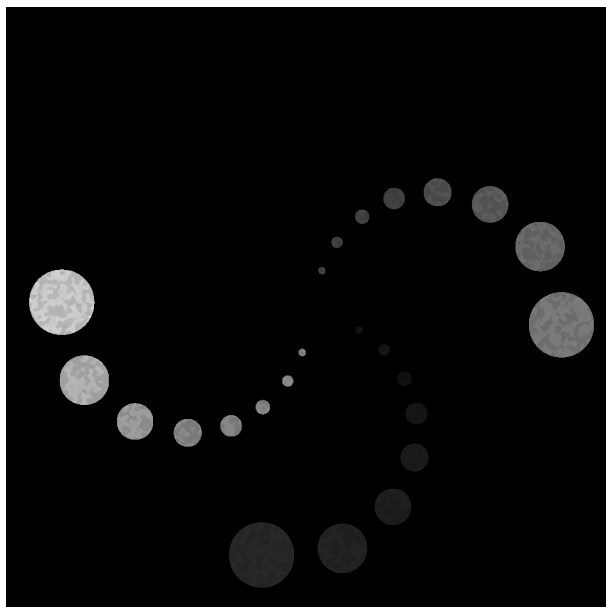
Figure 49   CsI C-delta phantom displaying two different contrast groups

The readout of the smallest discernable rod diameter gives the contrast resolution. The following table shows representative values for typical head and body 3D-RA reconstructions.

	Head Scan			Thorax/Abdomen/Peripheral/Spine Scan		
	Detector size FD20 42 cm FD12 30 cm	Detector size FD15 39 cm	Detector size FD20/15/12 22 cm	Detector size FD20 42 cm FD12 30 cm	Detector size FD15 39 cm	Detector size FD20/15/12 22 cm
Contrast group	Diameter (mm)	Diameter (mm)	Diameter (mm)	Diameter (mm)	Diameter (mm)	Diameter (mm)
>2700	1	1	1	1	1	1
1160	1	1	1	1	1	1
562	1	1	1	1	1	1
274	1	1	1	1	1	1
116	1 - 1.4	2	2	1.4	2	2
53	4	4	Not visible	5.7	5.7	Not visible
27	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible
14	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible

13.2 Clinical Procedures

SmartCT can be used for the following clinical procedures.

Indication	Treatment Technique	Procedure Examples
AVM	• Coils Embolization • Glue Embolization • Vascular Plug	• Brain AVM Embolization • Patent Ductus Arteriosus plug closure • Gastric AVM Embolization
Aneurysm	• Coils Embolization • Flow Diverter	• Brain Aneurysm Coiling • Splenic Artery Aneurysm Coil Embolization

Indication	Treatment Technique	Procedure Examples
Small vessels	Embolization • Beads • Lipiodol • Polyvinyl Alcohol (PVA) • Gelfoam	• TACE • SIRT • PAE • UFE
Stenosis	• Balloon Angioplasty • Stenting	• Carotid Artery Stenosis Stenting (CAS) • Congenital Aorta Coarctation Stenting (CoA) • Iliac Artery Stenosis Stenting
Occlusion	• Thrombolysis • Mechanical Thrombectomy • Intrahepatic stent placement	• Ischemic Stroke Thrombectomy • TIPS
Bleeding	• Coils Embolization • Glue Embolization	• Hemorrhagic stroke treatment • GI Bleeding Embolization • Endoleak Embolization
Tumor	Ablation • RF • MW • Cryo	• Renal Tumor Cryoablation • Lung Tumor RF ablation • HCC MW ablation
Fracture	Cementoplasty	• Vertebroplasty • Sacroplasty • Acetabuloplasty

For details of applications and procedure settings, refer to the Instructions for Use supplied with the X-ray system.

13.3 Protocols

Procedure Group	12-in Detector	15-in Detector	20-in Detector
3DRA (including 3D-Vertebroplasty)	●	●	●
CBCT			●
VasoCT (including CT Cranial Stent)			●

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This medical device conforms with the applicable requirements set out by the European Union, as demonstrated in the
Declaration of Conformity.

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