



SOMATOM Sensation Cardiac Application Guide

Software Version A60

SIEMENS
medical

The information presented in this application guide is for illustration only and is not intended to be relied upon by the reader for instruction as to the practice of medicine. Any health care practitioner reading this information is reminded that they must use their own learning, training and expertise in dealing with their individual patients.

This material does not substitute for that duty and is not intended by Siemens Medical Solutions Inc., to be used for any purpose in that regard. The drugs and doses mentioned herein were specified to the best of our knowledge. We assume no responsibility what is over for the correctness of this information. Variations may prove necessary for individual patients.

The treating physician bears the sole responsibility for all of the parameters selected. The pertaining operating instructions must always be strictly followed when operating the SOMATOM Sensation Cardiac. The statutory source for the technical data are the corresponding data sheets. To improve future versions of this application guide, we would highly appreciate your questions, suggestions and comments.

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We express our sincere gratitude to the many customers who contributed valuable input.

In addition I would like to stress at this point that the SOMATOM Sensation Cardiac Application Guide is based very much on the other SOMATOM Application Guides which have been written by Dr. Xiao-Yan Chen, Loke-Gie Haw and Bettina Klingemann.

Special thanks to Dr. med. Martin Heuschmid,
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Editor: Ute Feuerlein

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Concept

The scan protocols for adult are defined according to body regions – **Head, Neck, Thorax, Abdomen, Extremities**.

The pediatric scan protocols are defined under the folder **“Children”**.

The protocols for special applications are defined under **“Special”**.

The general concept is as follows:

“Fast”: uses 1.5 mm slice collimation and a higher pitch for fast acquisition for CT Angios or trauma cases.

“Routine”: uses either 0.75 mm or 1.5 mm slice collimation depending on the region of interest for routine studies.

“ThinSlice”: uses 0.75 mm slice collimation for thin slice studies.

“Combi”: uses 0.75 mm as slice collimation and reconstruct images as both thinner slice width for HiRes or CTA and thicker slice width for soft tissue studies.

“Seq”: stands for Sequence. E. g. **“HeadSeq”** means the sequence mode for the head;

“Spi” stands for **“Spiral”**. E. g. **“HeadSpi”** means the spiral mode for the head.

Scan Set Up

Scans can be simply set up by selecting a predefined examination protocol. To repeat any mode, just click the chronicle with the right mouse button for **“repeat”**. To delete it, select **“cut”**. Each chronicle is rewriteable before **“load”**.

Multiple ranges can be run either automatically with **“auto range”**, or separately with a **“pause”** in between.

Scan and Reconstruction

Slice Collimation and Slice Width

Slice collimation is the slice thickness collimated by the tube collimator, which determines the Z-coverage per rotation. In Multislice CT, this is divided by the number of active detector channels (e. g. 16 x 0.75 mm).

Slice width is the true thickness of the reconstructed image.

With the SOMATOM Sensation Cardiac, you select the slice collimation together with the slice width desired, the slice width is independent of pitch and algorithm, i. e. what you select is always what you get. Actually, you do not need to care about the algorithm any more; the software does it for you.

On the SOMATOM Sensation Cardiac some slice widths are marked as "fast" (blue background). These images will be reconstructed with highest performance (up to 6-10 images per second). All others will be reconstructed with up to 3 images per second.

The reconstruction time depends on slice collimation and the reconstructed slice width. To get the fast performance, slice width has to be at least 3 times the slice collimation.

During scanning the user normally will get "real time" reconstructed images in full image quality, if the "fast" slice has been selected.

In some cases – this depends also on Scan range, Feed/Rotation and Reconstruction increment – the Recon icon on the chronicle will be labeled with "RT". This indicates the real time display of images during scanning. The real time displayed image series has to be reconstructed afterwards.

General

The following tables show you the possibilities of image reconstruction in spiral and sequential scanning.

Slice Collimation and Slice Width for Spiral Mode

0.75 mm	0.75, 1, 1.5, 2, 3, 4, 5, 6, 7, 8, 10 mm
1.5 mm	2, 3, 4, 5, 6, 7, 8, 10 mm

Cardio Spiral Modes

0.75 mm	0.75, 1.0, 1.5, 2, 3 mm
1.5 mm	2, 3, 4, 5 mm

Slice Collimation and Slice Width for Sequence Mode

0.75 mm	0.75, 1.5, 3, 4.5, 9 mm
1.5 mm	1.5, 3, 4.5, 6, 9 mm
5 mm	5, 10 mm

ECG triggered Modes

0.75 mm	0.75, 1.5, 3 mm
1.5 mm	1.5, 3, 6 mm

Pitch

In single slice CT:

Pitch = table movement per rotation/slice collimation

E. g.: slice collimation = 5 mm,

table moves 5 mm per rotation, then pitch = 1.

With the SOMATOM Sensation Cardiac, in Siemens Multislice CT, we differentiate between:

Feed/Rotation, the table movement per rotation

Volume Pitch, the table movement per rotation/single slice collimation

E. g.: single slice collimation = 1.5 mm, table moves 24 mm per rotation, then the Volume Pitch = 16

Pitch Factor, the table movement per rotation/collimation

E. g.: slice collimation = 16 x 1.5 mm, table moves 24 mm per rotation, then the Pitch Factor = 1

With the SOMATOM Sensation Cardiac, you do not need to select pitch. Once the scan range, scan time, slice collimation, and rotation time is defined, the software will adapt the table feed per rotation accordingly. The Pitch Factor can be freely adapted from 0.5 to 1.5.

Recon Job

In the Recon card, you can define up to 3 reconstruction jobs with different parameters either before or after you acquire the data. When you click on "Recon", they will all be done automatically. In case you want to add another recon job, simply click the little icon on the chronicle with the right mouse button and select "delete recon job" to delete the one which has been completed, and then one more recon job will be available in the Recon card (Note: what you delete is just the job from the display, not the images that have been reconstructed).

You can also reconstruct images for all scan modes completed at once – do not select any chronicle before you click "Recon".

Kernels

There are 5 different types of kernels: "H" stands for Head, "B" stands for Body and "C" stands for ChildHead. The image sharpness are defined by the numbers – the higher the number, the sharper the image; the lower the number, the smoother the image.

Note: Do not use different kernels for other body parts than designed for.

Image Filter

There are 4 different filters available:

PFO: To reduce beam-hardening artifacts in head images, particularly in the base of the skull, use the Posterior Fossa Optimization (PFO) filter.

ASA: The Advanced Smoothing Algorithm (ASA) filter reduces noise in soft tissue while edges with high contrast are preserved.

LCE: The Low-contrast enhancement (LCE) filter enhances low-contrast detectability. It reduces the image noise.

HCE: The High-contrast enhancement (HCE) filter enhances high-contrast detectability. It increases the image sharpness.

Effective mAs

In sequential scanning, the dose (D_{seq}) applied to the patient is the product of the tube current-time (mAs) and the $CTDI_w$ per mAs:

$$D_{seq} = D_{CTDI_w} \times \text{mAs}$$

In spiral scanning, however, the applied dose (D_{spiral}) is influenced by the mAs (mA x Rot Time) and in addition by the Pitch Factor. For example, if a Multislice CT scanner is used, the actual dose applied to the patient in spiral scanning will be decreased when the Pitch Factor is larger than 1, and increased when the Pitch Factor is smaller than 1. Therefore, the dose in spiral scanning has to be corrected by the Pitch Factor:

$$D_{spiral} = (D_{CTDI_w} \times \text{mA} \times \text{Rot Time}) / \text{Pitch Factor}$$

To make it easier for the users, the concept of the effective mAs was introduced with the SOMATOM Multislice scanners.

The effective mAs takes into account the influence of pitch on both the image quality and dose:

$$\text{Effective mAs} = \text{mAs} / \text{Pitch Factor}$$

To calculate the dose on the SOMATOM Sensation Cardiac, you simply have to multiply the $CTDI_w$ per mAs with the effective mAs of the scan:

$$D_{spiral} = D_{CTDI_w} \times \text{effective mAs}$$

For spiral scan protocols, the indicated mAs is the effective mAs per image. The correlation between tube current mA and effective mAs of spiral scans on a Multislice CT scanner is given by the following formula:

$$\text{Effective mAs} = \text{mA} \times \text{RotTime} / \text{Pitch Factor}$$

$$\text{Pitch Factor} = \frac{\text{Feed} / \text{Rot}}{\text{nrow} \times \text{Slice collimation}}$$

$$\text{mA} = \frac{\text{effective mAs}}{\text{RotTime}} \times \text{Pitch Factor}$$

where collimated Slice refers to the collimation of one detector row, and nrow is the number of used detector rows.

Dose Information

The dose as described by $CTDI_w$ is displayed on the user interface for the selected scan parameters. The $CTDI_w$ is measured in the dedicated plastic phantoms – 16 cm diameter for head and 32 cm diameter for body (as defined in IEC 60601-2-44). This dose number gives a good estimate for the average dose applied in the scanned volume as long as the patient size is similar to the size of the respective dose phantoms.

Since the body size can be smaller or larger than 32 cm, the $CTDI$ value displayed can deviate from the dose in the scanned volume.

The $CTDI_w$ value does not provide the entire information of the radiation risk associated with CT examination. For the purpose, the concept of the “Effective Dose” was introduced by ICRP (International Commission on Radiation Protection). The effective dose is expressed as a weighted sum of the dose applied not only to the organs in the scanned range, but also to the rest of the body. It could be measured in whole body phantoms (Alderson phantom) or simulated with Monte Carlo techniques.

The calculation of the effective dose is rather complicated and has to be done by sophisticated programs. These have to take into account the scan parameters, the system design of individual scanner, such as x-ray filtration and gantry geometry, the scan range, the organs involved in the scanned range and the organs affected by scattered radiation. For each organ, the respective dose delivered during the CT scanning has to be calculated and then multiplied by its radiation risk factor. Finally the weighted organ dose numbers are added up to get the effective dose.

The concept of effective dose would allow the comparison of radiation risk associated with different CT or x-ray exams, i. e. different exams associated with the same effective dose would have the same radiation risk for the patient. It also allows comparing the applied x-ray exposure to the natural background radiation, e. g. 2 – 3 mSv per year in Germany.

For most of our scan protocols, we calculated the effective dose numbers for standard male* and female* and listed the result in the description of each scan protocol.

The calculation was done by the commercially available program "WinDose" (Wellhoefer Dosimetry) – as shown in figure 1-3. For pediatric protocols, we used the WinDose calculation and the correction factors published in "Radiation Exposure in Computed Topography"**; in which there only the conversion factors for the age of 8 weeks and 7 years old are available.

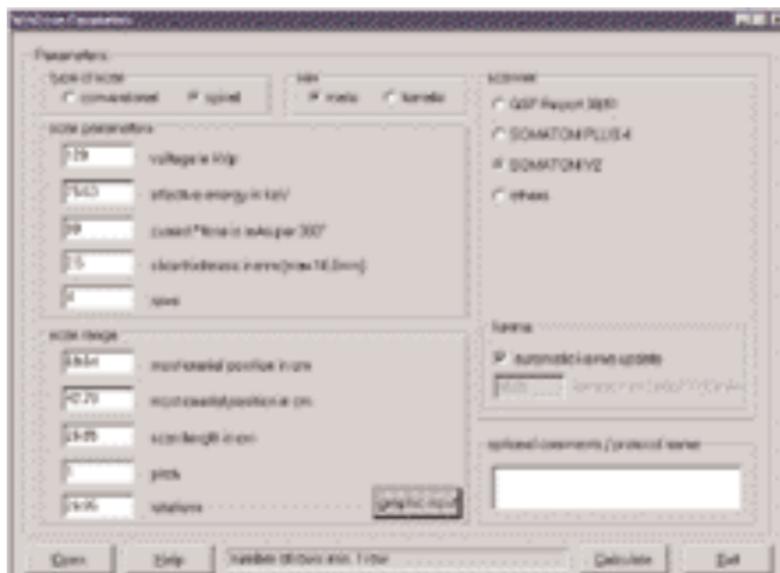


Fig. 1: User interface of the PC program WinDose. All parameters necessary for the effective dose calculation have to be specified.

- * The Calculation of Dose from External Photon Exposures Using Reference Human Phantoms and Monte Carlo Methods. M. Zankl et al. GSF report 30/91
- ** Radiation Exposure in Computed Topography, edited by Hans Dieter Nagel, published by COCIR c/o ZVEI, Stresemannallee 19, D-60596, Frankfurt, Germany.

General

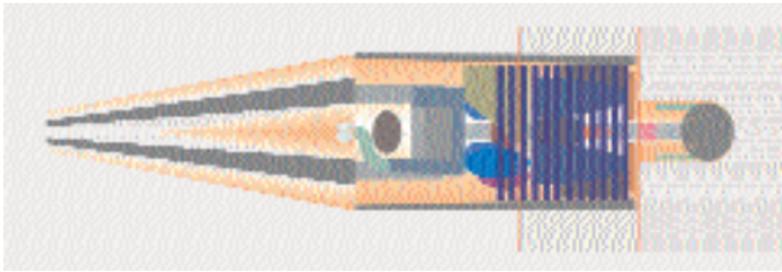


Fig. 2: A graphic interface of WinDose allows to specify the anatomical scan range.

Organ	ICRP60 (mSv)	ICRP60 (mSv)	ICRP26 (mSv)	ICRP26 (mSv)
Heart	0.00	0.72	0.00	0.00
Liver	0.00	0.00	0.00	0.00
Gonads	0.00	0.00	0.00	0.00
Bladder	0.00	0.00	0.00	0.00
Stomach	0.00	0.00	0.00	0.00
Intestine	0.00	0.00	0.00	0.00
Effective dose		0.72 mSv		0.72 mSv
Yield (mSv)		0.72		0.72

Fig.3: Results as output of WinDose with the organ dose readings and the effective dose according to ICRP26 (previous version) and ICRP60 (currently valid).

Please note:

Effective dose values were calculated with the WinDose™ Software Version 2.1, which was optimized for SOMATOM Volume Zoom scanners.

SOMATOM Sensation Cardiac has modified shaped filters which might cause slightly different effective dose numbers (difference not expected to be more than 5%). An update of WinDose™ for the SOMATOM Sensation Cardiac is currently developed.

CARE Dose

CARE Dose is a clinical application package that provides real-time tube current modulation for Spiral and Sequential Scanning.

CARE Dose reduces patient dose significantly, especially in the regions of shoulder and pelvis. It decreases tube load, which extends the capacity for volume scanning with thinner slices, larger volumes or Multi-phase studies.

It can also improve image quality by increasing mA and thus reducing image noise on the lateral views.

How does it work

It reduces the mA for low attenuation views up to 90% and keeps the nominal higher mA for high attenuation views, e. g. in the lateral projection (Fig. 1). This is done "on-the-fly", i. e. the scanner adapts the mA in real-time, according to the patient's attenuation profile (Fig. 2).

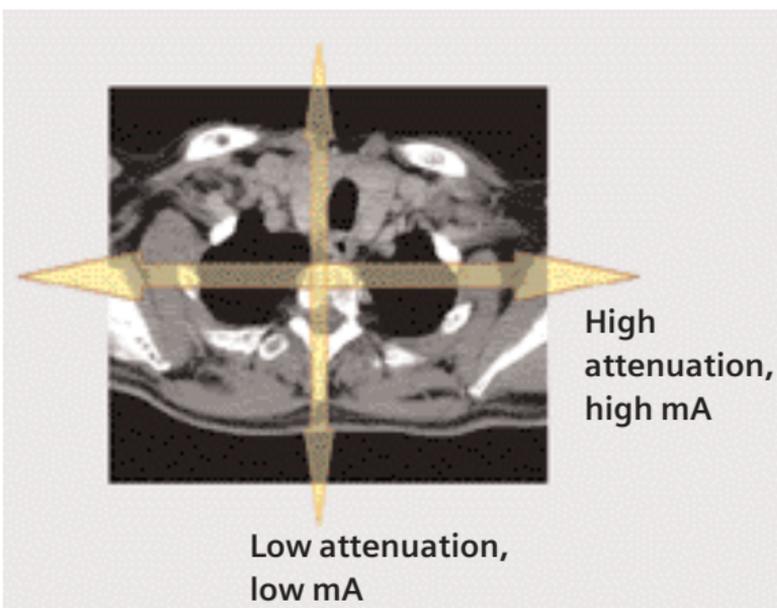


Fig. 1: Example of scanning in the region of shoulder.

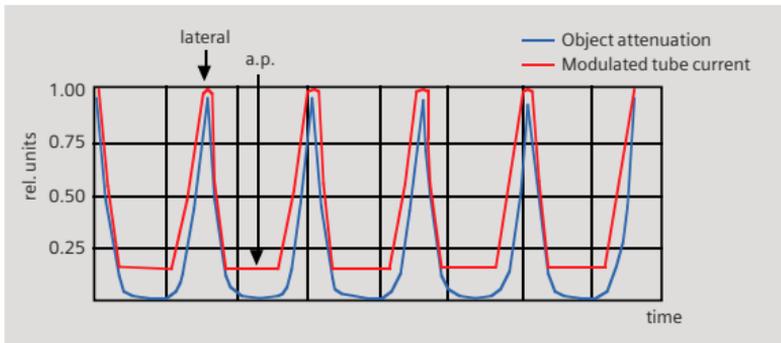
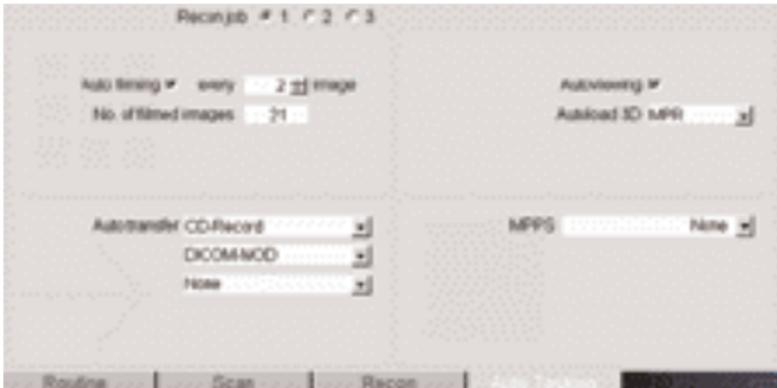


Fig. 2: Principle of CARE Dose tube current adaptation.

- CARE Dose is pre-selected by default for all standard protocols, except head and cardiac protocols. It can be switched on/off in the scan card.
- The application of CARE Dose does not require any changes in the scan parameters. The mean value of the mAs applied will be lower than what you have selected.
- The mean value of the effective mAs applied is shown in the image text.

Workflow



Auto Load in 3D and Postprocessing Presets

You can activate the “Auto load in 3D” function on the Examination Card/Auto Tasking and link it to a recon job. For example, the 2nd recon job with thinner slice width in some of the examination protocols. If the post-processing type is chosen from the pull down menu, the reconstructed images will be loaded automatically into the 3D Card on the Navigator with the corresponding postprocessing type.

On the 3D Card you have the possibility to create for MPR and MIPthin Range Parallel and Radial protocols which can be linked to a special series.

For example, if you always do some sagittal Multiplanar Reconstructions for a Spine examination, you load once a Spine examination into the 3D Card. Select the image type (MPR, MIPthin), select the orientation and open the Range Parallel function. Adapt the range settings (Image thickness, Distance between the images etc.) and hit the link button. From now on, you have a predefined postprocessing protocol, linked to the series description of a Spine examination.

Exactly the same can be done for VRT presets. In the main menu, under Type/VRT Definition, you can link VRT presets with a series description.

Some of the Scan protocols, mainly for Angio examinations, are already delivered with Auto load in 3D. If you do not like, please deselect the Auto load in 3D and save your scan protocol.

Some of the Scan protocols are delivered with links to a postprocessing protocol. If you do not like our suggestions, please delete the Range Parallel preset or overwrite them with your own settings.

Contrast Medium IV Injection*

The administration of a contrast medium depends on the indication and on the delay times to be used during the examination. The patients weight and circulatory situation also play a role. In general, no more than 3 ml per kg of body weight for adults and 2 ml per kg of body weight for children should be applied.

As a rule of thumb, the contrast medium injection should be stopped when the scan (or acquisition) is finished. Keep this in mind, you may save contrast medium in your routine study since the Multislice spiral scan can be up to 32 times faster than a 1 second, single slice spiral scan.

For CTA study (arterial phase), the principle is to keep contrast injection for the whole scan. Thus, the total amount of contrast medium needed should be calculated with the following formula:

$CM = (\text{start delay time} + \text{scan time}) \times \text{flow rate}.$

CARE Bolus or Test Bolus may be used for optimal contrast bolus timing. Please refer to the Application Guide for special protocols.

** For more information regarding the general use of drugs and doses mentioned in this guide, please refer to page 2.*

How to Create your own Scan Protocols

User-specific scan protocols can be saved with the following basic procedure:

- Register a test patient, patient position must be head-supine.
- Select a scan protocol.
- Set the table position to 0 (either at the gantry panel, or on the topogram routine card).
- Modify the scan protocol, change parameters, add new ranges etc.
- Do not load the scan protocol.
- Select Edit/Save Scan Protocol in the main menu.
- Select the organ region and the scan protocol name in the pop-up dialog. You can either use the same name to modify the existing scan protocol, or enter a new name.

Tips:

- It is recommended that you save your own scan protocol with a new name in order to avoid overwriting the default scan protocol.
- You may use preceding numbers (e. g. 1_Abdomen) for user specific scan protocols to make them appear on top of the list and to distinguish them from the Siemens defaults.
- Do not use special characters like “/”, “.” or “\” within scan protocol names.
- Don’t rename scan protocol files on Windows NT level – this will lead to inconsistencies.
- Do not mix head and body scan protocols: e. g. do not save a head mode in the abdomen directory.
- System/Run offers the tool “Restore Default Scan Protocols” which allows one to remove user specific scan protocols and to restore the Siemens default settings.
- System/Edit offers save/delete Scan Protocols.
- System/Run also offers the tool “List Scan Protocols” which generates an HTML table of all available scan protocols. This list can be printed or saved on Floppy (“File/Save As...”).

HeartView CT

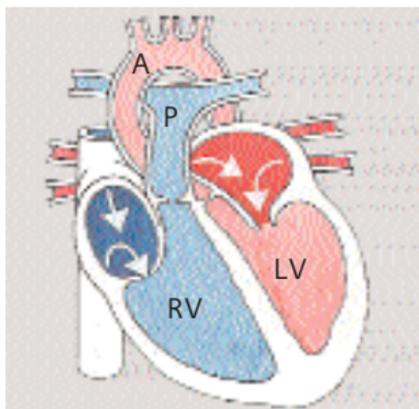
HeartView CT is a clinical application package specifically tailored to cardiovascular CT studies.

The Basics

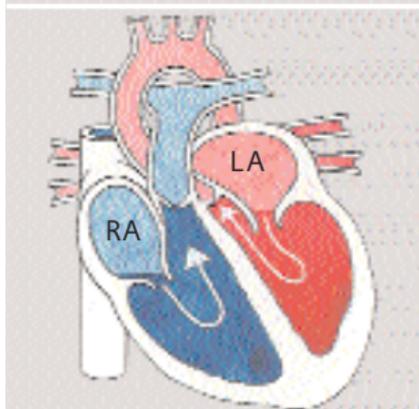
Important Anatomical Structures of the Heart

Four chambers:

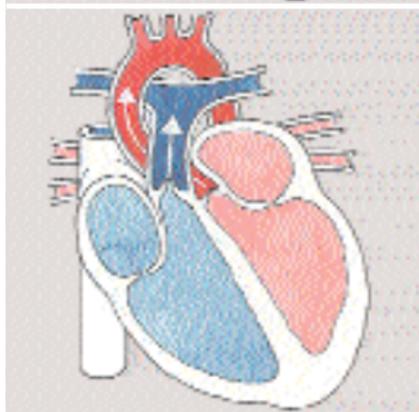
- Right atrium – receives the deoxygenated blood back from the body circulation through the superior and inferior vena cava, and pumps it into the right ventricle
- Right ventricle – receives the deoxygenated blood from the right atrium, and pumps it into the pulmonary circulation through the pulmonary arteries
- Left atrium – receives the oxygenated blood back from the pulmonary circulation through the pulmonary veins, and pumps it into the left ventricle
- Left ventricle – receives the oxygenated blood from the left atrium, and pumps it into the body circulation through the aorta.



*Fig. 1:
Blood fills both atria*



*Fig. 2:
Atria contract, blood
enters ventricles*



*Fig. 3:
Ventricles contract,
blood enters into
aorta and pulmonary
arteries*

- A: Aorta
- P: Pulmonary Artery
- RV: Right Ventricle
- LV: Left Ventricle
- RA: Right Atrium
- LA: Left Atrium

HeartView CT

Coronary arteries:

- Right coronary artery (RCA)

Right coronary artery supplies blood to the right atrium, right ventricle, a small part of the ventricular septum.

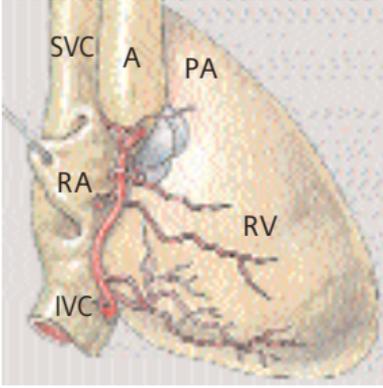


Fig. 4: Front view

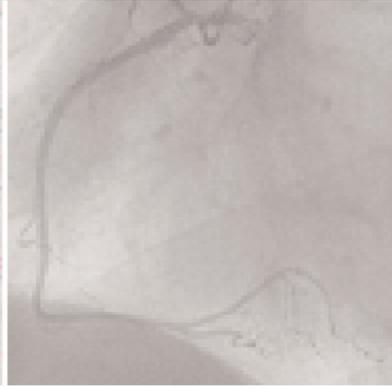


Fig. 5: Conventional Angiography

SVC: Superior Vena Cava

IVC: Inferior Vena Cava

RA: Right Atrium

RV: Right Ventricle

A: Aorta

PA: Pulmonary Artery

- Left coronary artery (LCA)

Left coronary artery supplies blood to the left atrium, left ventricle and a large part of the ventricular septum.

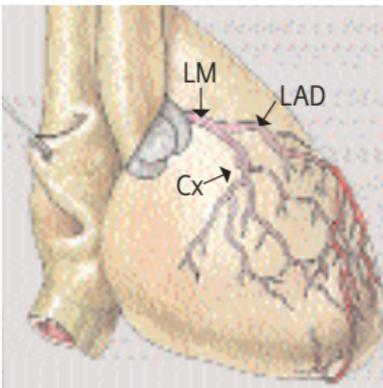


Fig. 6: Front view



Fig. 7: Conventional Angiography

LM: Left Main Artery

LAD: Left Anterior Descending Artery

Cx: Circumflex Artery

Cardiac Cycle and ECG

The heart contracts when pumping blood and rests when receiving blood. This activity and lack of activity form a cardiac cycle, which can be illustrated by an Electrocardiograph (ECG) (Fig. 8).

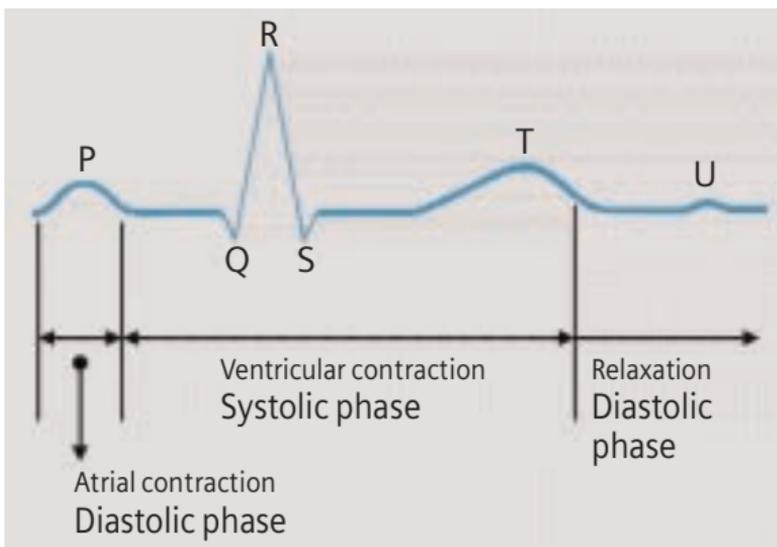


Fig. 8

To minimize motion artifacts in cardiac images, the following two requirements are mandatory for a CT system:

- Fast gantry rotation time in order to achieve fast image acquisition time
- Prospective synchronization of image acquisition or retrospective reconstruction based on the ECG recording in order to produce the image during the diastolic phase when the least motion happens.

Temporal Resolution

Temporal resolution, also called time resolution, represents the time window of the data that is used for image reconstruction. It is essential for cardiac CT imaging – the higher the temporal resolution, the fewer the motion artifacts. With the SOMATOM Sensation Cardiac, temporal resolution for cardiac imaging can be achieved at down to 105 ms.

HeartView CT

Technical Principles

Basically, there are two different technical approaches for cardiac CT acquisition:

- Prospectively ECG triggered sequential scanning.
- Retrospectively ECG gated spiral scanning.

In both cases, an ECG is recorded and used to either initiate prospective image acquisition (ECG triggering), or to perform retrospective image reconstruction (ECG gating). A given temporal relation relative to the R-waves is predefined and can be applied with the following possibilities:

Relative – delay: a given percentage of R-R interval ($_RR$) relative to the onset of the previous or the next R-wave (Fig. 9, 10).

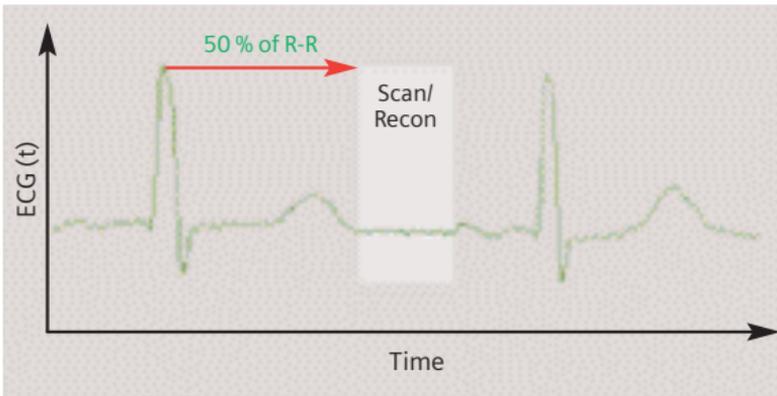


Fig. 9

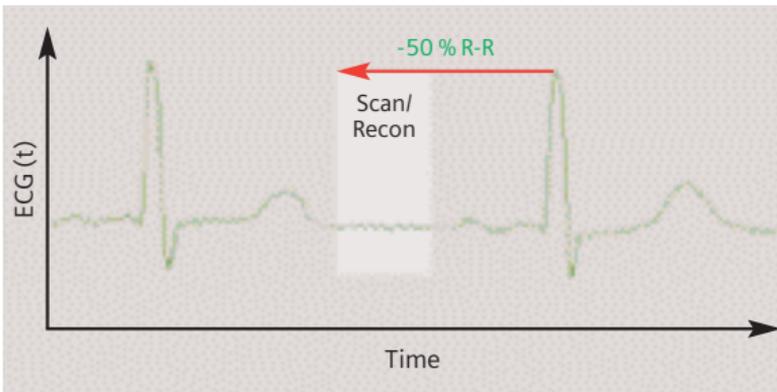


Fig. 10

Absolute – delay: a fixed time delay after the onset of the R-wave (Fig. 11).

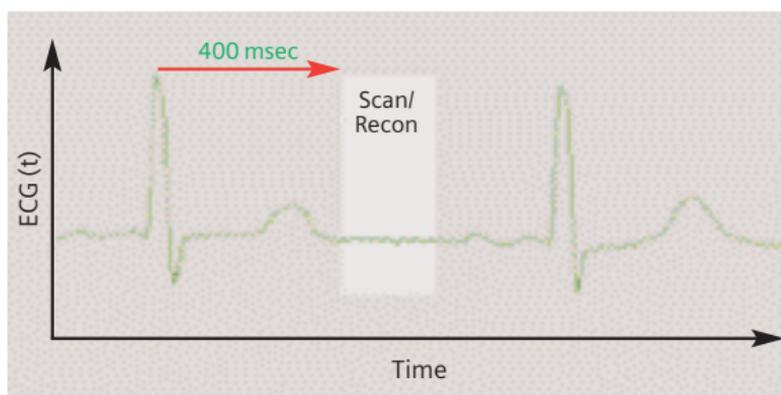


Fig. 11

Absolute – reverse: a fixed time delay prior to the onset of the next R-wave (Fig. 12).

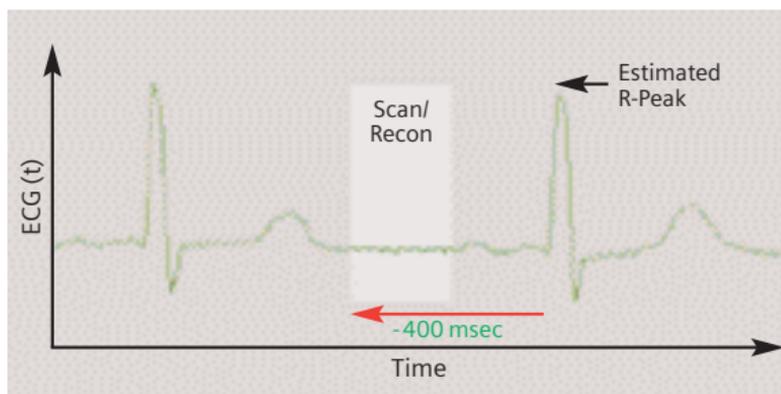
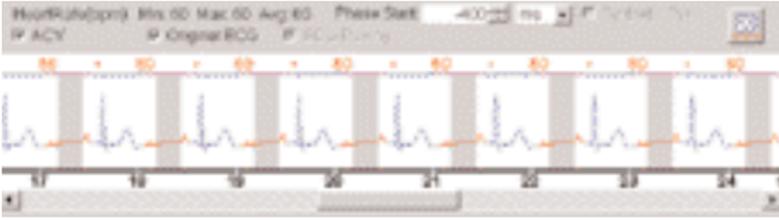


Fig. 12

Preview Series Reconstruction

Preview series can be used to define the optimal time window before the full series is reconstructed.

Click on the preview series button in the Trigger card. The slice position of the preview series is based on the currently displayed image in the tomogram segment, which has to be chosen by the user.



ECG Trace Editor

The ECG trace editor is used for adaptation of image reconstruction to irregular heart rates. This editing tool can be used after the scan is acquired. By using the right mouse menu on the Trigger card you can use several modification tools for the ECG Sync, such as Delete, Disable, Insert. To reset the ECG curve select the check box Original ECG.

ECG Pulsing

ECG Pulsing is a dedicated technique used for online dose modulation for Cardiac imaging. The tube current is ECG-controlled and reduced during systolic phases of the cardiac cycle while maintained normal during diastolic phases when best image quality is required. As shown in figure 13, essential dose reduction up to 50% can be achieved. It can be switched on/off by the user (Fig. 14).

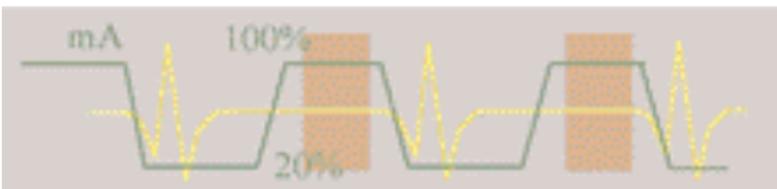


Fig. 13: Dose modulation with ECG pulsing.



Fig. 14

CardioCARE

This is a dedicated cardiac filter which can reduce image noise thus provides the possibility of dose reduction. It is applied in a pre-defined scan protocol called "CoronaryCARE."

CardioSharp

This is a dedicated reconstruction kernel used for better edge definition in coronary artery imaging. It is applied in a pre-defined cardiac scan protocol called "CoronarySharp."

Image examples are shown in figure 15.

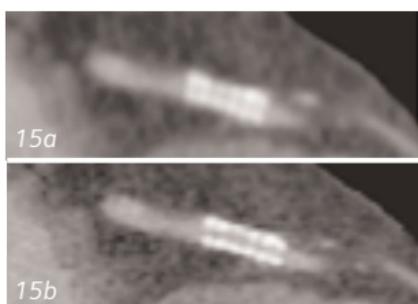


Fig. 15:
Image reconstruction
with (15b)
and without (15a)
Cardio Sharp kernel.

How to do it

Calcium Scoring

This application is used for identification and quantification of calcified lesions in the coronary arteries. It can be performed with both ECG triggering (sequential scanning) and gating (spiral scanning) techniques. The following scan protocols are predefined:

- **CaScoreSpiStd**
 - Standard spiral scanning protocol with ECG gating and a 0.42 s Rotation Time
- **CaScoreSpiStd0.5s**
 - Standard spiral scanning protocol with ECG gating and a 0.5 s Rotation Time
- **CaScoreSeqStd**
 - Sequential scanning protocol with ECG triggering

Hints in General:

- Kernel B35f is dedicated to calcium scoring studies. To ensure the best image quality and correlation to known reference data, other kernels are not recommended.
- Use the ECG triggered protocol generally except for patients with arrhythmia. Use the ECG gated protocol when accuracy and/or reproducibility are essential, e. g. follow-up studies of calcium scoring or comparison studies with conventional angiography.
- The protocol with 0.42 s Rotation Time can be applied to all examinations for HeartView CT. Temporal resolution for cardiac imaging can be achieved at down to 105 ms. The temporal resolution for the protocol with 0.5 s Rotation Time can be achieved at down to 125 ms.
- We recommend a tube voltage of 120 kV. If the tube voltage is lowered to 80 kV please use at least effective mAs 250. The use of 80 kV is not advised for large patients.

Placement of ECG Electrodes:

US Version (AHA standard)

White Electrode

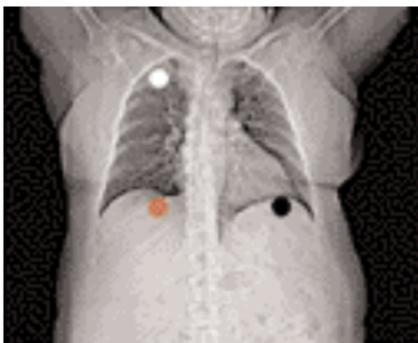
on the right mid-clavicular line, directly below the clavicle

Black Electrode:

on the left mid-clavicular line, 6 or 7 intercostal space

Red Electrode:

right mid-clavicular line, 6 or 7 intercostal space



Placement of ECG Electrodes:

Europe Version (IEC standard)

Red Electrode:

on the right mid-clavicular line, directly below the clavicle

Yellow Electrode:

on the left mid-clavicular line, 6 or 7 intercostal space

Black Electrode:

right mid-clavicular line, 6 or 7 intercostal space



CaScoreSpiStd

Indications:

This is a standard spiral scanning protocol, using an ECG gating technique for coronary calcium scoring studies, with a rotation time of 0.42 seconds.



*Topogram:
AP, 512 mm.
From the carina until
the apex of the heart.
A typical range of
15 cm covering the
entire heart can
be done in 11.6 s.*

	CaScoreSpiStd
<i>kV</i>	120
<i>Effective mAs</i>	133
<i>Slice collimation</i>	1.5 mm
<i>Slice width</i>	3 mm
<i>Feed/Rotation</i>	5.7 mm
<i>Rotation time</i>	0.42 sec.
<i>Temporal Resolution</i>	Up to 105 ms*
<i>Kernel</i>	B35f
<i>Increment</i>	1.5 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	9.6 mGy
<i>Effective Dose</i>	Male: 2.1 mSv Female: 3.1 mSv

* Depends on heart rate.

CaScoreSpiStd0.5s

Indications:

This is a spiral scanning protocol, using an ECG gating technique for coronary calcium scoring studies, with a rotation time of 0.5 seconds.



*Topogram:
AP, 512 mm.
From the carina until
the apex of the heart.
A typical range of
15 cm covering the
entire heart can
be done in 11.7 s.*

	CaScoreSpiStd0.5s
<i>kV</i>	120
<i>Effective mAs</i>	133
<i>Slice collimation</i>	1.5 mm
<i>Slice width</i>	3 mm
<i>Feed/Rotation</i>	6.8 mm
<i>Rotation time</i>	0.5 sec.
<i>Temporal Resolution</i>	Up to 125 ms*
<i>Kernel</i>	B35f
<i>Increment</i>	1.5 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	9.6 mGy
<i>Effective Dose</i>	Male: 2.1 mSv Female: 3.1 mSv

* Depends on heart rate.

CaScoreSeqStd

Indications:

This is a sequential scanning protocol using an ECG triggering technique for coronary calcium scoring studies.



*Topogram:
AP, 512 mm.
From the carina until
the apex of the heart.*

If you apply API for image acquisition, please make sure that the breathhold interval in the Patient Model Dialog is longer than the total scan time, e. g. 50 s, otherwise the image acquisition will be interrupted by the default breathhold interval. This does not apply when API is not activated.

	CaScoreSeqStd
<i>kV</i>	120
<i>Effective mAs</i>	30
<i>Slice collimation</i>	1.5 mm
<i>Slice width</i>	3 mm
<i>Feed/Rotation</i>	18 mm
<i>Rotation time</i>	0.42 sec.
<i>Temporal resolution</i>	210 ms
<i>Kernel</i>	B35f
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	2.2 mGy
<i>Effective Dose</i>	Male: 0.5 mSv Female: 0.7 mSv

Coronary CTA

This is an application for imaging of the coronary arteries with contrast medium. It can be performed with both ECG triggering and gating techniques. The following scan protocols are predefined:

- **CoronaryStd**
 - Standard spiral scanning protocol with ECG gating, using a rotation time of 0.42 seconds.
- **CoronaryStd0.5s**
 - Standard spiral scanning protocol with ECG gating, using a rotation time of 0.5 seconds.
- **CorStd_LowHeartRate**
 - Special spiral scanning protocol with ECG gating, using a 0.42 second rotation time, for patients with a heart rate below 50 bpm.
- **CoronaryCARE**
 - Spiral scanning protocol with rotation time 0.42 s and dedicated cardiac filter (Cardio CARE) which reduces image noise thus makes dose reduction possible.
- **CoronaryCARE0.5s**
 - Spiral scanning protocol with rotation time 0.5 s, and dedicated cardiac filter (Cardio CARE) which reduces image noise thus makes dose reduction possible.
- **CoronarySharp**
 - Spiral scanning protocol with rotation time 0.42 s and dedicated reconstruction kernel for better edge definition in coronary artery imaging.
- **CoronarySharp0.5s**
 - Spiral scanning protocol with rotation time 0.5 s and dedicated reconstruction kernel for better edge definition in coronary artery imaging.
- **ECGTrigCTA**
 - Sequential scanning protocol with ECG triggering, using a rotation time of 0.42 s.

General Hints:

- Generally speaking, the ECG gated protocol is recommended for premium image quality of the coronary arteries, and whenever 3D postprocessing, such as MPR, MIP, VRT or Fly Through, is required.
- Always use the ECG gated protocol for patients with arrhythmia.

CoronaryStd

Indications:

This is a standard spiral scanning protocol, using a Rotation Time of 0.42 s, with an ECG gating technique for coronary CTA studies.



*Topogram:
AP, 512 mm.
Approximately, from
the carina until the
apex of the heart.
A typical range of
12 cm covering the
entire heart can
be done in 18.7 s.*

	CoronaryStd
<i>kV</i>	120
<i>Effective mAs</i>	500
<i>Slice collimation</i>	0.75 mm
<i>Slice width</i>	1 mm
<i>Feed/Rotation</i>	2.8 mm
<i>Rotation time</i>	0.42 sec.
<i>Temporal resolution</i>	Up to 105 ms*
<i>Kernel</i>	B30f
<i>Increment</i>	0.5 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	42.0 mGy
<i>Effective dose</i>	Male: 7.0 mSv Female: 10.2 mSv

* Depends on heart rate.

CoronaryStd0.5s

Indications:

This is a standard spiral scanning protocol, using a Rotation Time of 0.5 s, with an ECG gating technique for coronary CTA studies.



*Topogram:
AP, 512 mm.
Approximately, from
the carina until the
apex of the heart.
A typical range of
12 cm covering the
entire heart can
be done in 18.4 s.*

	CoronaryStd0.5s
<i>kV</i>	120
<i>Effective mAs</i>	500
<i>Slice collimation</i>	0.75 mm
<i>Slice width</i>	1 mm
<i>Feed/Rotation</i>	3.4 mm
<i>Rotation time</i>	0.5 sec.
<i>Temporal resolution</i>	Up to 125 ms*
<i>Kernel</i>	B30f
<i>Increment</i>	0.5 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	42.0 mGy
<i>Effective dose</i>	Male: 7.0 mSv Female: 10.2 mSv

* Depends on heart rate.

CorStd_LowHeartRate

Indications:

This is a special spiral scanning protocol for coronary CTA studies. It uses ECG gating technique and a 0.42 s rotation time, and should be used for patients with heart rate below 50 bpm.



*Topogram:
AP, 512 mm.
Approximately, from
the carina until the
apex of the heart.
A typical range of
12 cm covering the
entire heart can
be done in 23.7 s.*

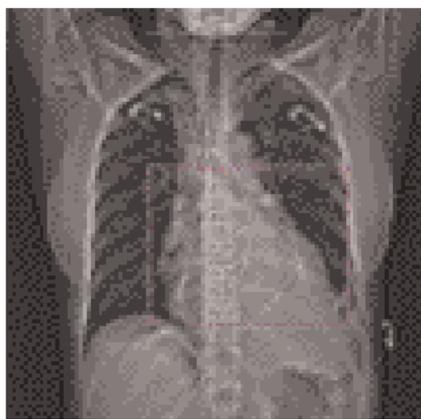
	CoronaryStdLow
kV	120
Effective mAs	500
Slice collimation	0.75 mm
Slice width	1.0 mm
Feed/Rotation	2.2 mm
Rotation time	0.42 sec.
Temporal resolution	Up to 105 ms*
Kernel	B30f
Increment	0.5 mm
Image order	cr-ca
CTDI _w	42.0 mGy
Effective dose	Male: 7.0 mSv Female: 10.2 mSv

* Depends on heart rate.

CoronaryCARE

Indications:

This is a spiral scanning protocol, using a rotation time of 0.42 s, ECG gating technique and a dedicated cardiac filter which can reduce images noise thus makes the dose reduction possible for coronary CTA studies.



*Topogram:
AP, 512 mm.
Approximately, from
the carina until the
apex of the heart.
A typical range of
12 cm covering the
entire heart can
be done in 18.7 s.*

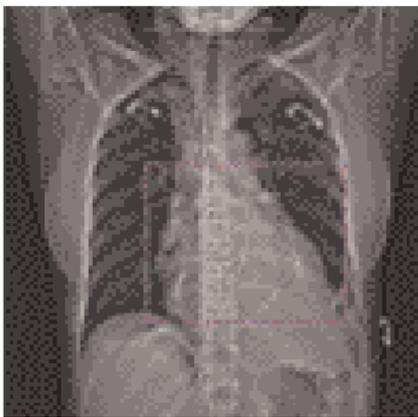
	CoronaryCARE
<i>kV</i>	120
<i>Effective mAs</i>	267
<i>Slice collimation</i>	0.75 mm
<i>Slice width</i>	1 mm
<i>Feed/Rotation</i>	2.8 mm
<i>Rotation time</i>	0.42 sec.
<i>Temporal resolution</i>	Up to 105 ms*
<i>Kernel</i>	B30f
<i>Increment</i>	0.5 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	22.4 mGy
<i>Effective dose</i>	Male: 3.8 mSv Female: 5.5 mSv

* Depends on heart rate.

CoronaryCARE0.5s

Indications:

This is a spiral scanning protocol, using a Rotation Time of 0.5 s, ECG gating technique and a dedicated cardiac filter which can reduce images noise thus makes the dose reduction possible for coronary CTA studies.



*Topogram:
AP, 512 mm.
Approximately, from
the carina until the
apex of the heart.
A typical range of
12 cm covering the
entire heart can
be done in 18.4 s.*

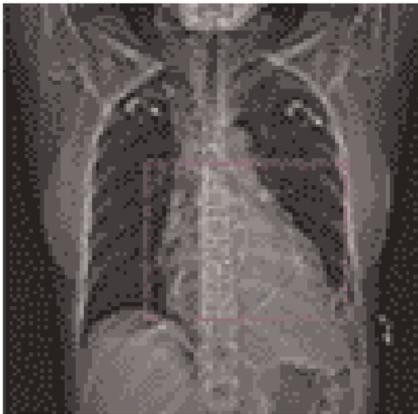
	CoronaryCARE0.5s
<i>kV</i>	120
<i>Effective mAs</i>	267
<i>Slice collimation</i>	0.75 mm
<i>Slice width</i>	1 mm
<i>Feed/Rotation</i>	3.4 mm
<i>Rotation time</i>	0.5 sec.
<i>Temporal resolution</i>	Up to 125 ms*
<i>Kernel</i>	B30f
<i>Increment</i>	0.5 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	22.4 mGy
<i>Effective dose</i>	Male: 3.8 mSv Female: 5.5 mSv

* Depends on heart rate.

CoronarySharp

Indications:

This is a spiral scanning protocol, using a Rotation Time of 0.42 s, ECG gating technique and a dedicated cardiac reconstruction kernel for better edge definition in coronary artery imaging.



*Topogram:
AP, 512 mm.
Approximately, from
the carina until the
apex of the heart.
A typical range of
12 cm covering the
entire heart can
be done in 18.7 s.*

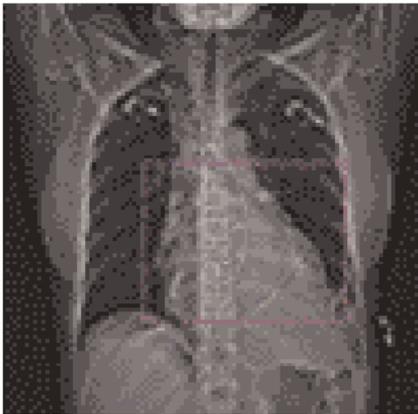
	CoronarySharp
<i>kV</i>	120
<i>Effective mAs</i>	500
<i>Slice collimation</i>	0.75 mm
<i>Slice width</i>	1 mm
<i>Feed/Rotation</i>	2.8 mm
<i>Rotation time</i>	0.42 sec.
<i>Temporal resolution</i>	Up to 105 ms*
<i>Kernel</i>	B46f
<i>Increment</i>	0.5 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	42.0 mGy
<i>Effective dose</i>	Male: 7.0 mSv Female: 10.2 mSv

* Depends on heart rate.

CoronarySharp0.5s

Indications:

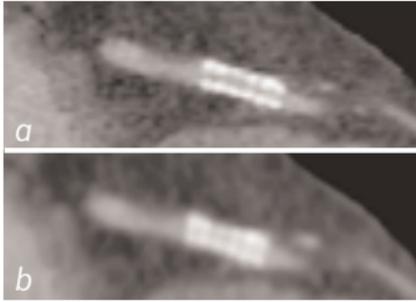
This is a spiral scanning protocol, using a Rotation Time of 0.5 s, ECG gating technique and a dedicated cardiac reconstruction kernel for better edge definition in coronary artery imaging.



*Topogram:
AP, 512 mm.
Approximately, from
the carina until the
apex of the heart.
A typical range of
12 cm covering the
entire heart can
be done in 18.4 s.*

	CoronarySharp0.5s
<i>kV</i>	120
<i>Effective mAs</i>	500
<i>Slice collimation</i>	0.75 mm
<i>Slice width</i>	1 mm
<i>Feed/Rotation</i>	3.4 mm
<i>Rotation time</i>	0.5 sec.
<i>Temporal resolution</i>	Up to 125 ms*
<i>Kernel</i>	B46f
<i>Increment</i>	0.5 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	42.0 mGy
<i>Effective dose</i>	Male: 7.0 mSv Female: 10.2 mSv

* Depends on heart rate.

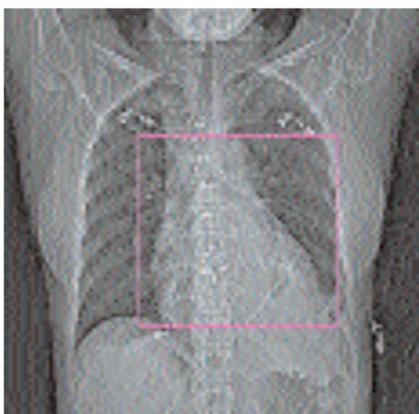


*Fig. 1:
Image reconstruction
with (a)
and without (b)
Cardio Sharp kernel.*

ECGTrigCTA

Indications:

This is a sequential scanning protocol with an ECG triggering technique for coronary CTA studies. It could also be applied for aortic CTA studies, e. g. aortic dissection.



*Topogram:
AP, 512 mm.
From the aortic arch
until the apex of the
heart.*

If you apply API for a single breathhold acquisition, please make sure that the breathhold interval in the Patient Model Dialog is longer than the total scan time, e. g. 50 s, otherwise the image acquisition will be interrupted by the default breathhold interval. This does not apply when API is not activated.

For longer ranges, e. g. the entire thoracic aorta, that can not be acquired within a single breathhold, please ensure that the breathhold interval in the Patient Model Dialog is set up correctly, according to the patient's level of cooperation.

HeartView CT

	ECGTrigCTA
<i>kV</i>	120
<i>Effective mAs</i>	120
<i>Slice collimation</i>	1.5 mm
<i>Slice width</i>	1.5 mm
<i>Feed/Scan</i>	18 mm
<i>Rotation time</i>	0.42 sec.
<i>Temporal resolution</i>	210 ms
<i>Kernel</i>	B30f
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	8.64 mGy
<i>Effective dose</i>	Male: 1.5 mSv Female: 2.2 mSv

Aortic and Pulmonary Studies

The following scan protocol is predefined:

- **PulmonaryECG**
 - Spiral scanning protocol with ECG gating

General Hints:

- The PulmonaryECG protocol is recommended for aortic or pulmonary studies, e. g. aorta dissection or pulmonary emboli.

PulmonaryECG

Indications:

This is a spiral scanning protocol with an ECG gating technique for aortic and pulmonary studies, e. g. aortic dissection or pulmonary emboli.



*Topogram:
AP, 512 mm.
From the aorta arch
until the tip of the
sternum.
A typical range of
30 cm can be covered
in 23 s.*

	PulmonaryECG
<i>kV</i>	120
<i>Effective mAs</i>	200
<i>Slice collimation</i>	1.5 mm
<i>Slice width</i>	3.0 mm
<i>Feed/Rotation</i>	5.6 mm
<i>Rotation time</i>	0.42 sec.
<i>Temporal resolution</i>	Up to 105 ms*
<i>Kernel</i>	B30f
<i>Increment</i>	2.0 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	14.4 mGy
<i>Effective dose</i>	Male: 5.7 mSv Female: 7.3 mSv

* Depends on heart rate.

Additional Important Information

By default, the “Synthetic Trigger” (ECG triggered scanning) or “Synthetic Sync” (ECG gated scanning) is activated for all predefined cardiac scan protocols (Fig. 1 and 2). And it is recommended to keep it always activated for examinations with contrast medium.

In case of ECG signal loss during the acquisition, this will ensure the continuation of the triggered scans or allows an ECG to be simulated for retrospective gating. If it is deactivated, the scanning will be aborted in case of ECG signal loss during the acquisition.

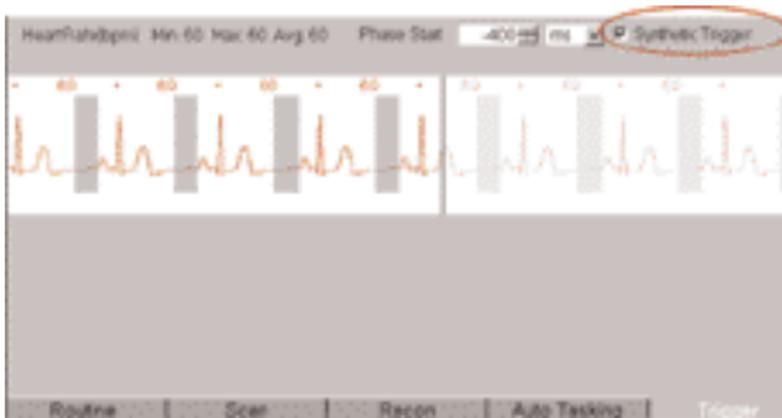


Fig. 1



Fig. 2

ACV (Adaptive Cardio Volume) (Fig. 3) is a dedicated algorithm for bi-phase image reconstruction. The image temporal resolution of 105 ms can be achieved with ACV. By default, it is switched on for all coronary CTA scan protocols, and switched off for all calcium scoring scan protocols. And it is not recommend to change this default setting.

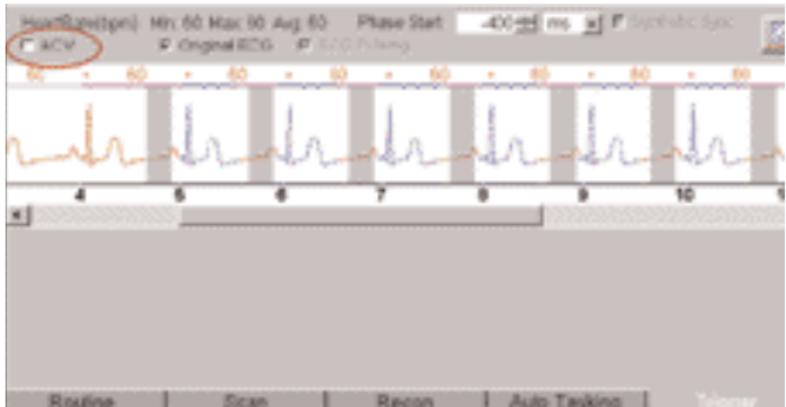


Fig. 3

HeartView CT



You can activate the “Auto load in 3D” function on the Examination Card/Auto Tasking and link it to a recon job. If the postprocessing type is chosen from the pull down menu, the reconstructed images will be loaded automatically into the 3D Card on the Navigator with the corresponding postprocessing type.

On the 3D Card you have the possibility to create for MPR, MIPthin Range Parallel and Radial protocols which can be linked to a special series.

For example, if you always do MIP Reconstructions for a Coronary CTA examination, you load once the images into the 3D Card. Select the image type (e. g. MIPthin) and the orientation, and then open the Range Parallel function. Adapt the range settings (Image thickness, Distance between the images etc.), hit the link button and save. From now on, you have a predefined post-processing protocol, linked to the series description of a coronary CTA examination.

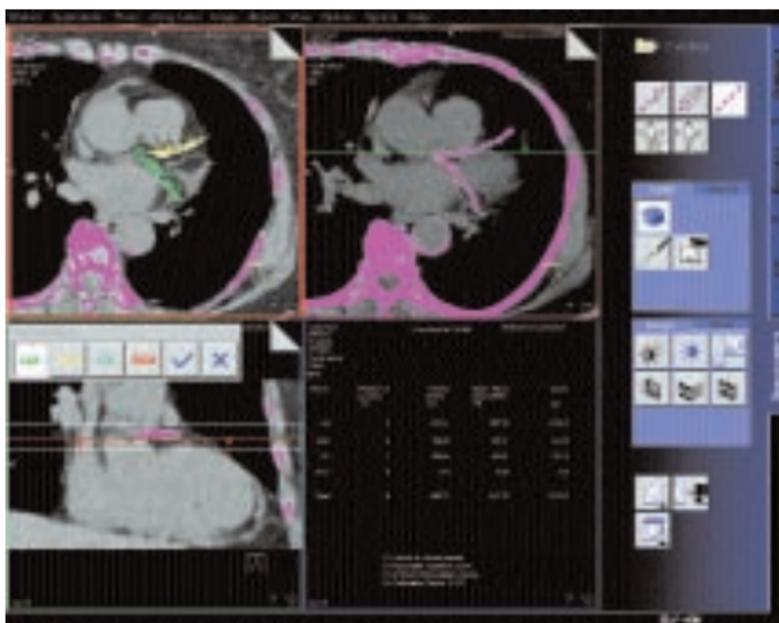
Exactly the same can be done for VRT presets. In the main menu, under Type/VRT Definition, you can link and save VRT presets with a series description.

Some of the Scan protocols are delivered with links to a postprocessing protocol. If you do not like our suggestions, please delete the Range Parallel preset or overwrite them with your own settings.

HeartView CT

Calcium Scoring evaluation is performed on a separate *syngo* task card:

1. The threshold of 130 HU is applied for score calculation by default, however, you can modify it accordingly.
2. In addition to the seeding method, you can use freehand ROI for the definition of lesions.
3. The separation and modification of lesions within a defined volume (depth in mm) can be performed not only on 2D slices, but also with 3D editing.
4. For easier identification of small lesions, you can blowup the display.
5. You can customize hospital/office information on the final report using Report Configuration.
6. You can generate HTML report including site specific information, free text and clinical images. This then can be saved on floppy disc and/or printed.
7. The results are displayed online in a separate segment including the following information:
 - Area (in mm^3)
 - Peak density (in HU)
 - Volume (in mm^3)
 - Calcium mass (mg calcium Hydroxyapatite)
 - Score (Agatston method)
8. The results can be printed on laser film, paper printer or saved into data base.



User interface of syngo Calcium Scoring

The Basics

The administration of intravenous (IV) contrast material during spiral scanning improves the detection and characterization of lesions, as well as the opacity of vessels. The contrast scan will yield good results only if the acquisition occurs during the optimal phase of enhancement in the region of interest. Therefore, it is essential to initiate the acquisition with the correct start delay. Since Multislice spiral CT can provide much faster speed and shorter acquisition time, it is even more critical to get the right timing to achieve optimal results (Fig. 1a, 1b).

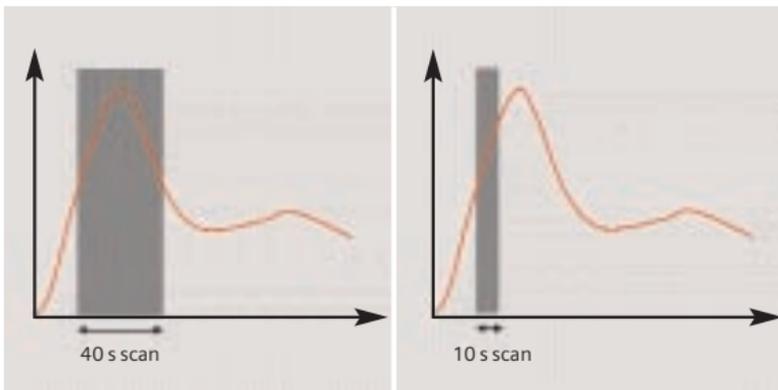


Fig. 1a: Longer scan time *Fig. 1b: Shorter scan time*

The dynamics of the contrast enhancement is determined by:

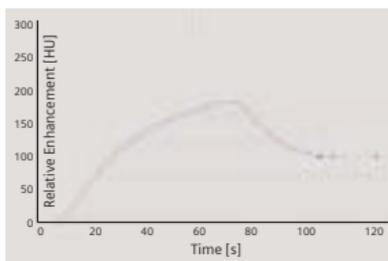
- Patient cardiac output
- Injection rate (Fig. 2a, 2b)
- Total volume of contrast medium injected (Fig. 3a, 3b)
- Concentration of the contrast medium (Fig. 3b, 4a)
- Type of injection – uni-phasic or bi-phasic (Fig. 4a, 4b)
- Patient pathology

Bolus Tracking

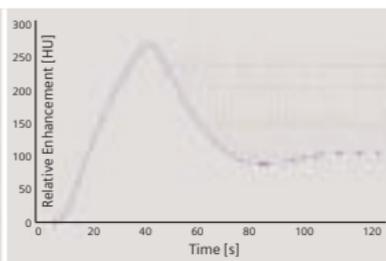
Aortic time-enhancement curves after i. v. contrast injection (computer simulation*).

All curves are based on the same patient parameters (male, 60-year-old, 75 kg).

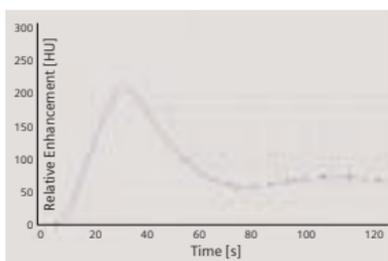
**Radiology 1998; 207:647-655*



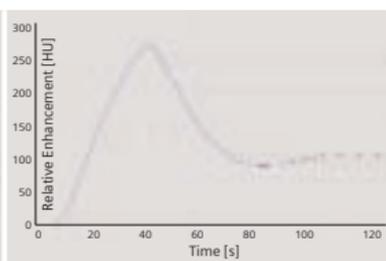
*Fig. 2a: 2 ml/s,
120 ml, 300 mg I/ml*



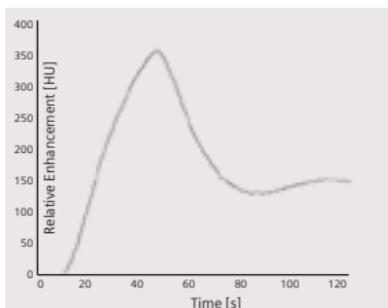
*Fig. 2b: 4 ml/s,
120 ml, 300 mg I/ml*



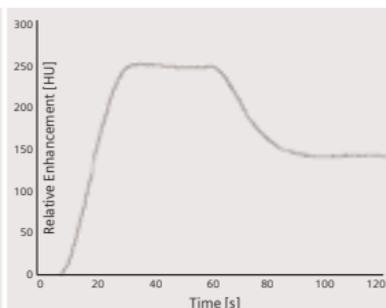
*Fig. 3a: 80 ml,
4 ml/s, 300 mg I/ml*



*Fig. 3b: 120 ml,
4 ml/s, 300 mg I/ml*



*Fig. 4a: Uni-phase
140 ml, 4 ml/s,
370 mg I/ml*



*Fig. 4b: Bi-phase
70 ml, 4 ml/s, plus 70 ml,
2 ml/s, 370 mg I/ml*

How to do it

To achieve optimal results in contrast studies, use of CARE Bolus is recommended. In case it is not available, use Test Bolus.

CARE Bolus

This is an automatic bolus tracking program, which enables triggering of the spiral scanning at the optimal phase of the contrast enhancement.

General Hints:

1. This mode can be applied in combination with any spiral scanning protocol. Simply insert "Bolus tracking" by clicking the right mouse button in the chronicle. This inserts the entire set up including pre-monitoring, i. v. bolus and monitoring scan protocol. You can also save the entire set up as your own scan protocols (please refer to page 20 "How to Create your own Scan Protocols").
2. The pre-monitoring scan is used to determine the level of monitoring scans. It can be performed at any level of interest. You can also increase the mAs setting to reduce the image noise when necessary.
3. To achieve the shortest possible spiral start delay (2 s), the position of the monitoring scans relative to the beginning of spiral scan must be optimized. A "snapping" function is provided:

Bolus Tracking

- After the Topogram is performed, the predefined spiral scanning range and the optimal monitoring position will be shown.
 - If you need to redefine the spiral scanning range, you should also reposition the monitoring scan in order to keep the shortest start delay time (2 s). (The distance between the beginning of the spiral scanning range and the monitoring scan will be the same).
 - Move the monitoring scan line **towards** the optimal position and release the mouse button, it will be snapped automatically. (Trick: if you move the monitoring scan line **away** from the optimal position the “snapping” mechanism will be inactive).
4. Place an ROI in the premonitoring scan on the target area or vessel used for triggering. (The ROI is defined with double circles – the outer circle is used for easy positioning, and the inner circle is used for the actual evaluation). You can also zoom the reference image for easier positioning of the ROI.
 5. Set the appropriate trigger threshold, and initiate the contrast injection and monitoring scans at the same time.
During the monitoring scans, there will be simultaneous display of the relative enhancement of the target ROI. When the predefined density is reached, the spiral acquisition will be triggered automatically.
 6. You can also initiate the spiral any time during the monitoring phase manually – either by pressing the START button or by clicking the START key. If you do not want to use automatic triggering, you can deselect it.

TestBolus

Indications:

This mode can be used to test the start delay of an optimal enhancement after the contrast medium injection.

	TestBolus
<i>kV</i>	120
<i>Effective mAs</i>	30
<i>Slice collimation</i>	5.0 mm
<i>Slice width</i>	10 mm
<i>Feed/Scan</i>	0 mm
<i>Rotation time</i>	0.5 sec.
<i>Kernel</i>	B40f
<i>Cycle time</i>	2 s

Bolus Tracking

Application Procedures:

1. Select the spiral mode that you want to perform, and then "Append" the TestBolus mode under **Special** protocols.
2. Insert the Test Bolus mode above the spiral mode for contrast scan by "cut/paste" (with right mouse button).
3. Perform the Topogram, and define the slice position for TestBolus.
4. Check the start delay, number of scans and cycle time before loading the mode.
5. A test bolus with 10-20 ml is then administered with the same flow rate as during the following spiral scan. Start the contrast media injection and the scan at the same time.
6. Load the images into the Dynamic Evaluation function and determine the time to the peak enhancement.

Alternatively, on the image segment, click "select series" with the right mouse button and position an ROI on the first image. This ROI will appear on all images in the test bolus series. Find the image with the peak HU value, and calculate the time "delta t" taken to reach the peak HU value (do not forget to add the preset start delay time). This time can then be used as the optimal start delay time for the spiral scan.

Additional Important Information

1. The preset start delay time for monitoring scans depends on whether the subsequent spiral scan will be acquired during the arterial phase or venous phase. The default value is 10 s. You can modify it accordingly.
2. It should be pointed out that when using "Test Bolus", there may be residual contrast in the liver and kidneys prior to scanning. This may result in an inaccurate arterial and equilibrium phase.
3. The trigger threshold is not an absolute value but a relative value compared to the non-contrast scan. E. g. if the CT value is 50 HU in the non-contrast image, and your trigger level is 100 MU, then the absolute CT value in the contrast image will be 150 HU.
4. If you change slice collimation, rotation time or kV in the spiral scanning protocol after CARE Bolus is inserted, a longer spiral start delay time will be the result, e. g. 14 s. This is due to the necessary mechanical adjustments, e. g. moving the slice collimators. Therefore, it is recommended that you modify the parameters of the spiral scanning **before** inserting the CARE Bolus.

5. If API is used in conjunction with CARE Bolus, the actual start delay time for the spiral will be as long as the length of API including the predefined start delay time. E. g. if the predefined the start delay is 2 s, and the API lasts 5 s, the spiral will start 5 s after the threshold is reached.
6. In case you have to interrupt the monitoring scanning due to injection problem, you can repeat it afterwards by inserting CARE Bolus again with a right mouse click. The same Topogram can still be used.

WholeBodyAngio

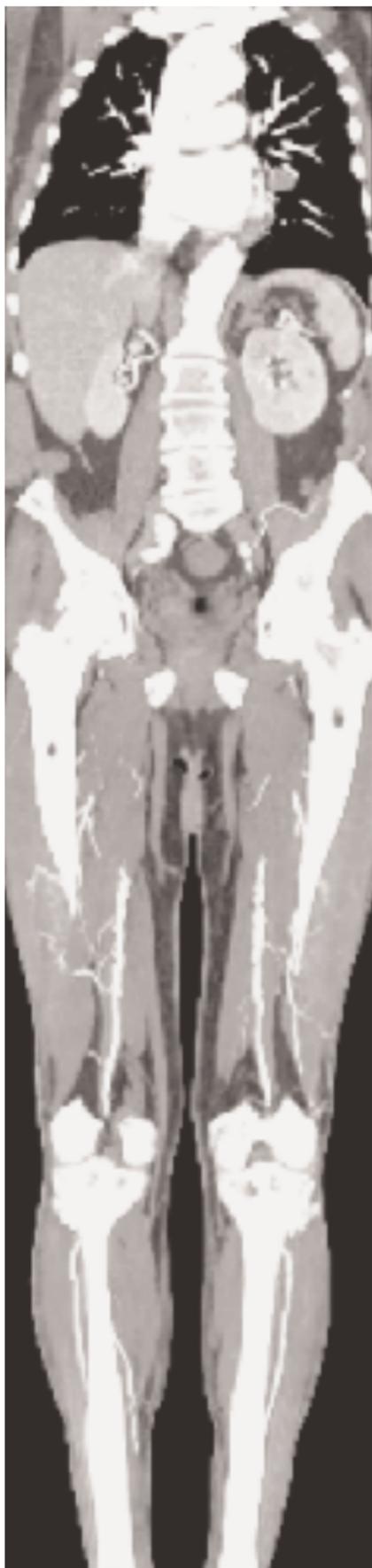
This scan protocol can be used for a whole Body Angio.
A range of 100 cm can be covered in 21.4 s.

	WholeBodyAngio 2nd Reconstr.	
<i>kV</i>	120	
<i>Effective mAs</i>	130	
<i>Slice collimation</i>	1.5 mm	
<i>Slice width</i>	6 mm	2 mm
<i>Feed/Rotation</i>	24.0 mm	
<i>Rotation time</i>	0.5 sec.	
<i>Kernel</i>	B30f	B20f
<i>Increment</i>	6 mm	1.5 mm
<i>Image order</i>	cr-ca	

The reconstruction can be loaded in the 3D Card, MPR. Select the Range function and a predefined range, linked to the series, will pop up.

Please notice, if you are not satisfied with the Range preset adapt the parameters to your needs and link them to the series.

MPRthick: WholeBodyAngio	coronal
<i>Image thickness</i>	3
<i>Distance between images</i>	3
<i>Number of images</i>	60



A dedicated low dose Spiral mode for the syngo Lung CARE evaluation.

Indications:

Lung studies with low dose setting, e. g. early visualization of pulmonary nodules.

A typical thorax study in a range of 30 cm will be covered in 8.9 s.

	LungCare
<i>kV</i>	120
<i>Effective mAs</i>	20
<i>Slice collimation</i>	0.75 mm
<i>Slice width</i>	1.0 mm
<i>Feed/Rotation</i>	18.0 mm
<i>Rotation time</i>	0.5 sec.
<i>Kernel</i>	B50f
<i>Increment</i>	0.5 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	1.7 mGy
<i>Effective dose</i>	Male: 0.6 mSv Female: 0.7 mSv

We recommend using a tube voltage of at least 120 kV.

For further information on the syngo Lung CARE Application, please refer to the Application Guide "Clinical Options".

CT Colonography

For Colonography studies.

A typically range of 40 cm can be covered in 13.9 s.

	CT Colonography	2 nd Reconstr.
<i>kV</i>	120	
<i>Effective mAs</i>	100	
<i>Slice collimation</i>	0.75 mm	
<i>Slice width</i>	5.0 mm	1.0 mm
<i>Feed/Rotation</i>	15.0 mm	
<i>Rotation time</i>	0.5 sec.	
<i>Kernel</i>	B30f	B30f
<i>Increment</i>	5.0 mm	0.7 mm
<i>Image order</i>	cr-ca	
<i>CTDI_w</i>	7.8 mGy	
<i>Effective dose</i>	Male: 4.5 mSv Female: 6.9 mSv	

CT Colonography

We recommend using a tube voltage of at least 120 kV.

A comprehensive study consists of four sections: Preparation, examination in supine & prone positioning and post processing.

- Patient preparation

In the case of CT Colonography, adequate preparation in bowel cleansing must be done prior to the CT examination.

Important for good results in a CT Colonography examination is the optimal preparation of the patient.

The patient has to start with a diet and bowel cleaning two days prior to the examination like for a conventional Colonoscopy.

- Patient examination

The bowels can be delineated with air. Or, if desired, with carbon dioxide, water or iodine/barium suspension.

Have patient inflate colon with air to maximum tolerance.

To decrease colon spasm, e. g. Buscopan™ or Glucagon™ can be given IV.

Usually a prone and supine examination are done to differentiate between polyps and fecal matter within the colon.

- Postprocessing

For further information on the *syngo* Fly Through Application, please refer to the Application Guide "Clinical Options".

Overview

This folder contains 8 organ specific pediatric protocols with 2 to 5 age or weight dependant subgroups.

For your convenience, the protocols are numbered according to the body regions, i. e. from head to abdomen.

The scan protocols for Head and Neck regions are defined according to age, and the scan protocols for the other body regions are defined according to body weight.

As a default, the effective mAs is set to the lowest category, e. g. less than 6 months in head modes, and the suggested effective mAs values for the other categories are written in additional lines in the chronicle.

For a few protocols, 80 kV is used instead of 120 kV, either to exploit the significantly higher image contrast of iodine contrast media at 80 kV or to reach a lower dose level than possible with 120 kV.

- **HeadSpi0.5s**
For routine head spiral studies
- **HeadSeq0.5s**
For routine head sequential studies
- **Head Angio**
For head CT Angio studies
- **CarotidCTA**
For carotid CT Angio studies
- **NeonateBody**
Spiral mode for neonate studies
- **ChestRoutine**
For routine chest spiral studies
- **AbdPelRoutine**
For routine abdominal studies
- **AbdCTA**
For abdominal CT Angio studies

Hints in General

1. Topograms: 256 mm lateral topograms are defined for the head modes, and 512 mm AP topograms are defined for the body modes. Please keep in mind that the children's size can be dramatically different. You should press the "Hold Measurement" button whenever the range shown on the real time growing topogram is long enough, in order to avoid unnecessary radiation.

In a consistent effort to reduce the total dose of an examination, all topograms of the pediatric protocols are defined at 80 kV with minimum current (50 mA).

2. Gantry tilt is available for sequence scanning, not for spiral scanning.

3. For all head studies, it is very important for image quality to position the patient in the center of the scan field. Use the lateral laser beam to make sure that the patient is positioned in the center.

4. Warm surroundings and dimmed lighting are helpful to make children more cooperative.

5. Sedation: Although the advent of the Multislice scanner has enabled the user to scan through an area of interest much faster than ever, sometimes, patient motion can still lead to severe motion artifacts seen on the resultant images. This becomes a factor especially with infants and younger children who are unable to hold still for the exam. Sedating this population may be a viable option for your institution. Of course, appropriate protocols need to be established at your specific institution. For instance, the drug of choice for specific ages/weights of these patients (taking into consideration the total time of the exam), the form of administration, patient preps, adequate monitoring of the patient (pre-scan, during the exam and post-scan) etc. should all be taken into consideration.

The proper personnel and equipment must also be readily available at your disposal in the event of a problem.

6. Oral and rectal contrast administration: Depending on the reason for the exam/status of the patient, oral contrast may or may not be given to these patients.

In general, oral contrast is recommended to opacify the intestinal tract, as unopacified bowel can have the appearance of abdominal fluid or mass effect. Oral, as well as rectal contrast may be required. Usually, a diluted mixture of iodine and water is used as an oral agent. Different substances can be added to this mixture to help reduce the bitter taste and make it more pleasing to the child (apple juice, fruit drink mixes are just a few of these). Barium may of course be used in some cases as well. Negative contrast agents such as water are becoming more popular for delineation of stomach or bowel wall borders, or when 3D reconstructions are needed. The user needs to be aware of all the contraindications of any of the contrast agents they are using. It is recommended to refer to the specific vendors recommendations regarding this.

7. I. V. contrast administration: In general, 1- 2 ml per kg of body weight should be applied, however, since the scanning can be completed in just a few seconds, please keep in mind that the total injection time should not be longer than the sum of start delay time and the scan time – do not inject contrast after the scanning is finished.

It is recommended to use CARE Bolus in order to achieve optimal contrast enhancement.

Both start delay time and injection rate are exam-/ patient-dependent. I.V. injection with a power injector is recommended for all scans whenever possible. Some guidelines to follow with respect to flow rate are noted in the chart below.

Children

Note: these are injector guidelines based on an antecubital injection site. These guidelines may need to be adjusted if the site is more peripheral.

Needle Size (gauge)	Flow Rate (ml/sec)
22	1.5
20	2.0 – 3.0
18	3.0 – 5.0

Central lines and ports may need to be hand injected or power injected at a very low flow rate (1 ml/sec).

PIC lines and 24 gauge (or smaller) lines are usually hand injected. All of these protocols should be decided on by your institution's appropriate personnel.

8. Applications with 80 kV: For CTA protocols, the tube voltage was set to 80 kV and the mAs values were raised by a factor of 1.5 over the reduced 120 kV values. This measure roughly reduces the dose by another factor of 2. At a lower kV, substances with a high atomic number (such as iodine) have a significantly higher CT value (= vascular contrast). Iodine CT values at 80 kV are about 50% higher than at 120 kV.

80 kV was also used for applications when the lowest achievable mAs at 120 kV was still higher than necessary for sufficient noise level (for technical reasons, generators need to operate at a certain minimum current for stable operation). For applications such as neonate or airway scanning, the low tube output at 80 kV can be used to further reduce the dose to the patient.

9. Please observe the recommended mAs settings in the chronicle.

Note, that these recommendations are valid for the default tube voltage of the specific protocol.

If the voltage is lowered from 120 kV to 80 kV substantially higher mAs values have to be used (at least by a factor of 2).

HeadSpi0.5s

Indications:

Spiral mode for routine head studies, e. g. tumors, hydrocephalus, hemorrhaging, abnormalities, etc.

	HeadSpi0.5s
kV	120
Effective mAs	*
Slice collimation	1.5 mm
Slice width	4.0 mm
Feed/Rotation	12.2 mm
Rotation time	0.5 sec.
Kernel	C30f
Increment	4.0 mm
Image order	ca-cr

* The mAs should be adjusted to the age of the child.

Body Weight	kV	mAs	CTDI _w (mGy)	Effective dose (mSv)
< 6 months	120	90	17.1	Male: 1.7* Female: 1.7*
6 months – 3 years	120	150	28.5	
3 years – 6 years	120	220	41.8	Male: 4.4** Female: 4.3**

* The conversion factor for an 8-week-old, and a scan range of 90 mm was used.

** The conversion factor for a 7-year-old, 260 mAs and a scan range of 110 mm was used.

Contrast medium IV injection

Start delay exam dependent

Flow rate dependent upon needle size/Access site

Total amount 1–2 ml per kg of body weight

Tips

- Children, who are more than 6 years old, should be scanned with an adult protocol as the skull by this time is fully grown.
- When bone structure is of interest, use kernel C60s for image reconstruction.
- **Posterior Fossa Optimization Filter**
PFO: To reduce beam-hardening artifacts in head images, particularly in the base of the skull, use the Posterior Fossa Optimization (PFO) filter.

HeadSeq0.5s

Indications:

Sequential mode for routine head studies for children, e.g. tumors, hydrocephalus, hemorrhaging, abnormalities, etc.

	HeadSeq0.5s
kV	120
Effective mAs	*
Slice collimation	1.5 mm
Slice width	4.5 mm
Feed/Scan	18.0 mm
Rotation time	0.5 sec.
Kernel	C30f
Image order	ca-cr

* The mAs should be adjusted to the age of the child.

Age	kV	mAs	CTDI _w (mGy)	Effective dose (mSv)
< 6 months	120	90	20.8	Male: 2.1* Female: 2.1*
6 months – 3 years	120	150	34.8	
3 years – 6 years	120	220	51.0	Male: 4.1** Female: 3.9**

* The conversion factor for an 8-week-old, and a scan range of 90 mm was used.

** The conversion factor for a 7-year-old, 260 mAs and a scan range of 117.5 mm was used.

Contrast medium IV injection

Start delay exam dependent

Flow rate dependent upon needle size/Access site

Total amount 1–2 ml per kg of body weight

Tips

- Children, who are more than 6 years old, should be scanned with an adult protocol as the skull by this time is fully grown.
- When bone structure is of interest, use kernel C60s for image reconstruction.
- **Posterior Fossa Optimization Filter**
PFO: To reduce beam-hardening artifacts in head images, particularly in the base of the skull, use the Posterior Fossa Optimization (PFO) filter.

HeadAngio

Indications:

Spiral mode for head CT angiography, e. g. cerebral vascular abnormalities, tumors etc.

	HeadAngio	2 nd Reconstr.
kV	80	
Effective mAs	*	
Slice collimation	0.75 mm	
Slice width	2.0 mm	1.0 mm
Feed/Rotation	6.8 mm	
Rotation time	0.5 sec.	
Kernel	H20f	H10f
Increment	2.0 mm	0.7 mm
Image order	ca-cr	

* The mAs should be adjusted to the age of the child.

Age	kV	mAs	CTDI _w (mGy)	Effective dose (mSv)
< 6 years	80	100	8.4	Male: 0.4* Female: 0.4*
6 years – 12 years	80	150	12.6	Male: 0.3** Female: 0.4**

* The conversion factor for an 8-week-old, and a scan range of 40 mm was used.

** The conversion factor for a 7-year-old and a scan range of 60 mm was used.

Children

For the 2nd reconstruction the Autoload into MIPthin Range on the 3D Card is activated. The images will be automatically loaded into 3D, MIPthin, and a coronal MIPthin Range will pop up.

Please notice, if you are not satisfied with the Range preset adapt the parameters to your needs and link them to the series.

MIPthin: HeadAngio	coronal
<i>Image thickness</i>	3
<i>Distance between images</i>	3
<i>Number of images</i>	35

Contrast medium IV injection	
<i>Start delay</i>	18 – 20 sec.
<i>Flow rate</i>	dependent upon needle size/Access site
<i>Total amount</i>	1 – 2 ml per kg of body weight

Tips

- Children, who are more than 12 years old should be scanned with an adult protocol.
- The first recon job is defined for soft tissue visualization.

CarotidCTA

Indications:

CT angiography of the carotid arteries, e.g. carotid stenosis or occlusion, vascular abnormalities of the carotids or vertebral arteries, etc.

	CarotidCTA	2 nd Reconstr.
kV	80	
Effective mAs	*	
Slice collimation	0.75 mm	
Slice width	5.0 mm	1.0 mm
Feed/Rotation	12 mm	
Rotation time	0.5 sec.	
Kernel	B30f	B20f
Increment	5.0 mm	0.7 mm
Image order	cr-ca	

* The mAs should be adjusted to the age of the child.

Age	kV	mAs	CTDI _w (mGy)	Effective dose (mSv)
< 6 years	80	100	2.6	Male: 0.6* Female: 0.7*
6 years – 12 years	80	150	3.9	Male: 0.4** Female: 0.4**

* The conversion factor for an 8-week-old, and a scan range of 80 mm was used.

** The conversion factor for a 7-year-old and a scan range of 120 mm was used.

Children

For the 2nd reconstruction the Autoload into MIPthin Range on the 3D Card is activated. The images will be automatically loaded into 3D, MIPthin, and a coronal MIPthin Range will pop up.

Please notice, if you are not satisfied with the Range preset adapt the parameters to your needs and link them to the series.

MIPthin: CarotidCTA	coronal
<i>Image thickness</i>	3
<i>Distance between images</i>	3
<i>Number of images</i>	20

Contrast medium IV injection	
<i>Start delay</i>	<i>exam dependent</i>
<i>Flow rate</i>	<i>dependent upon needle size/Access site</i>
<i>Total amount</i>	<i>1 – 2 ml per kg of body weight</i>

Tips

- Children, who are more than 12 years old should be scanned with an adult protocol.
- The first recon job is defined for soft tissue visualization.

NeonateBody

Indications:

Spiral mode for routine neonate body studies, e. g. tumors, abnormalities, malformations, abscesses, etc.

	NeonateBody
<i>kV</i>	80
<i>Effective mAs</i>	25
<i>Slice collimation</i>	1.5 mm
<i>Slice width</i>	6.0 mm
<i>Feed/Rotation</i>	24 mm
<i>Rotation time</i>	0.5 sec.
<i>Kernel</i>	B30f
<i>Increment</i>	6.0 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	0.55 mGy
<i>Effective mAs*</i>	Male: 0.5 mSv Female: 0.7 mSv

* The conversion factor for an 8-week-old, and a scan range of 150 mm was used.

Contrast medium IV injection

Start delay *exam dependent*

Flow rate *dependent upon needle size/Access site*

Total amount *1 – 2 ml per kg of body weight*

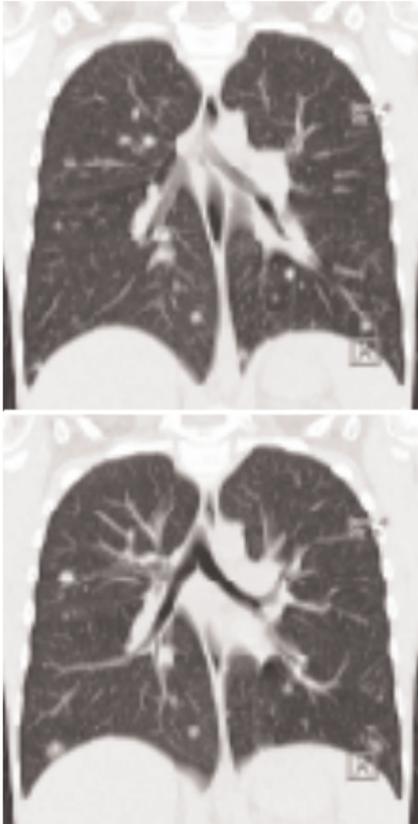
Tips

- You can modify the slice width for image reconstruction according to the clinical indications.

ChestRoutine

Indications:

Spiral mode for routine thorax studies, e. g. pneumonia, tumors, metastases, lymphoma, vascular abnormalities etc.



	ChestRoutine	2 nd Reconstr.
kV	120	
Effective mAs	*	
Slice collimation	1.5 mm	
Slice width	6.0 mm	6.0 mm
Feed/Rotation	24.0 mm	
Rotation time	0.5 sec.	
Kernel	B30f	B60f
Increment	6.0 mm	6.0 mm
Image order	cr-ca	

* The mAs should be adjusted to the body weight of the child.

Children

Body weight	kV	mAs	CTDI _w (mGy)	Effective dose (mSv)
< 15 kg	120	17	1.2	Male: 0.6* Female: 0.8*
15 – 24 kg	120	20	1.4	
25 – 34 kg	120	30	2.1	Male: 0.9** Female: 1.1**
35 – 44 kg	120	50	3.5	
45 – 54 kg	120	70	4.9	

* The conversion factor for an 8-week-old, and a scan range of 100 mm was used.

** The conversion factor for a 7-year-old and a scan range of 150 mm was used.

Contrast medium IV injection

Start delay exam dependent

Flow rate dependent upon needle size/Access site

Total amount 1 – 2 ml per kg of body weight

Tips

- Children with a body weight of more than 54 kg should be examined with an adult protocol.
- The first and second recon jobs are defined for visualization of the mediastinum and the lungs, respectively.

AbdPelRoutine

Indications:

Spiral mode for routine studies in the region of abdomen and pelvis, e. g. tumors, lymphoma, abscesses, post-traumatic changes, etc.

AbdPelRoutine 2 nd Reconstr.		
kV	120	
Effective mAs	*	
Slice collimation	1.5 mm	
Slice width	5.0 mm	5.0 mm
Feed/Rotation	24.0 mm	
Rotation time	0.5 sec.	
Kernel	B30f	B60f
Increment	5.0 mm	5.0 mm
Image order	cr-ca	

* The mAs should be adjusted to the body weight of the child.

Body weight	kV	mAs	CTDI _w (mGy)	Effective dose (mSv)
< 15 kg	120	20	1.4	Male: 0.9* Female: 1.2*
15 – 24 kg	120	35	2.5	
25 – 34 kg	120	55	3.8	Male: 2.3** Female: 3.1**
35 – 44 kg	120	85	6.0	
45 – 54 kg	120	120	8.4	

* The conversion factor for an 8-week-old, and a scan range of 100 mm was used.

** The conversion factor for a 7-year-old and a scan range of 150 mm was used.

Children

Contrast medium IV injection

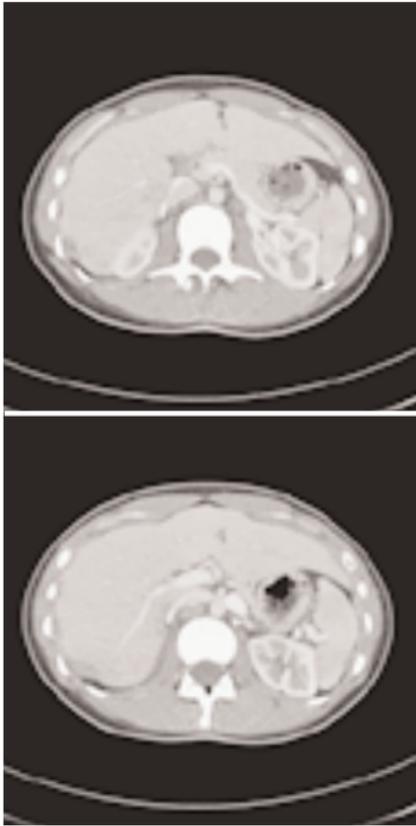
Start delay exam dependent

Flow rate dependent upon needle size/Access site

Total amount 1 – 2 ml per kg of body weight

Tips

- Children with a body weight of more than 54 kg should be examined with an adult protocol.
- There are two recon jobs predefined. The second one is for the reconstruction of the lungs in the upper range.



AbdCTA

Indications:

For abdominal CT Angio studies, e. g. vascular abnormalities, aneurysms, etc.

	AbdCTA	2 nd Reconstr.
kV	80	
Effective mAs	*	
Slice collimation	0.75 mm	
Slice width	3.0 mm	1.0 mm
Feed/Rotation	12 mm	
Rotation time	0.5 sec.	
Kernel	B30f	B20f
Increment	3.0 mm	0.7 mm
Image order	cr-ca	

* The mAs should be adjusted to the body weight of the child.

Body weight	kV	mAs	CTDI _w (mGy)	Effective dose (mSv)
< 15 kg	80	30	0.8	Male: 0.4* Female: 0.6*
15 – 24 kg	80	50	1.3	
25 – 34 kg	80	75	1.9	Male: 0.9** Female: 1.4**
35 – 44 kg	80	110	2.9	
45 – 54 kg	80	150	3.9	

* The conversion factor for an 8-week-old, and a scan range of 100 mm was used.

** The conversion factor for a 7-year-old and a scan range of 200 mm was used.

Children

For the 2nd reconstruction the Autoload into MIPthin Range on the 3D Card is activated. The images will be automatically loaded into 3D, MIPthin, and a sagittal MIPthin Range will pop up.

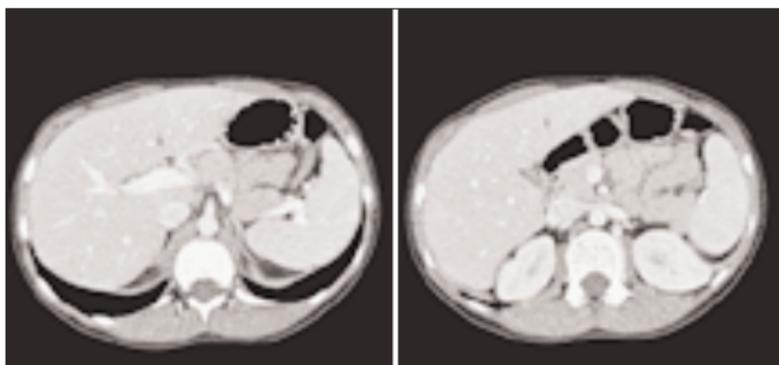
Please notice, if you are not satisfied with the Range preset adapt the parameters to your needs and link them to the series.

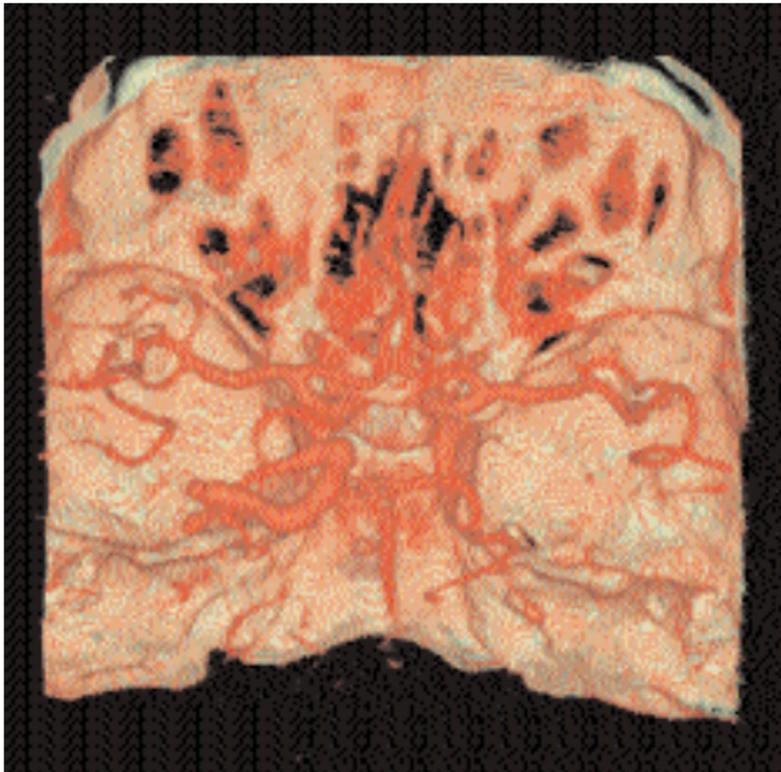
MIPthin: AbdCTA	sagittal
<i>Image thickness</i>	3
<i>Distance between images</i>	3
<i>Number of images</i>	60

Contrast medium IV injection	
<i>Start delay</i>	<i>exam dependent</i>
<i>Flow rate</i>	<i>dependent upon needle size/Access site</i>
<i>Total amount</i>	<i>1 – 2 ml per kg of body weight</i>

Tips

- Children with a body weight of more than 54 kg should be examined with an adult protocol.
- The first recon job is defined for image viewing and filming.





Overview

- **AngioHead**
For CT Angio studies using 0.75 mm slice collimation and a 1.0 mm slice thickness
- **AngioThinSlice**
For CT Angio studies using 0.75 mm slice collimation and 0.75 mm slice thickness
- **HeadSeq0.5s**
Sequence mode for base of the skull and cerebrum routine studies and a 0.5 s rotation time
- **HeadSpi0.5s**
Spiral mode for base of skull and cerebrum routine studies and a 0.5 s rotation time

Hints in General

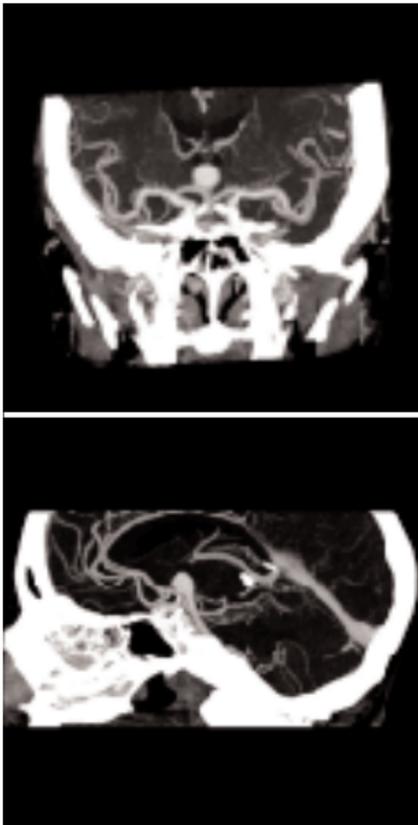
1. Topogram: Lateral, 256 mm.
2. Patient positioning:
Patient lying in supine position, arms resting against body, secure head well in the head holder, support lower legs.
3. Gantry tilt is available for sequence scanning, not for spiral scanning.
4. For all head studies, it is very important for image quality to position the patient in the center of the scan field. Use the lateral laser beam to make sure that the patient is positioned in the center.
5. For image reconstruction of bone structure, use kernel H60.
6. In general, cerebrum studies with contrast medium, except CTA and nasopharynx, can be performed by hand injection. Start the scan after the injection is completed.

AngioHead

Indications:

Spiral mode for cerebral CT Angios, e. g. cerebral vascular abnormalities, tumors and follow up studies etc.

A range of 80 mm will be covered in 3.3 s.



Head

	AngioHead	2nd Reconstr.
<i>kV</i>	120	
<i>Effective mAs</i>	100	
<i>Slice collimation</i>	0.75 mm	
<i>Slice width</i>	4.0 mm	1.0 mm
<i>Feed/Rotation</i>	15.0 mm	
<i>Rotation time</i>	0.5 sec.	
<i>Kernel</i>	H20f	H10f
<i>Increment</i>	4.0 mm	0.7 mm
<i>Image order</i>	ca-cr	
<i>CTDI_w</i>	21.1 mGy	
<i>Effective dose</i>	Male: 0.4 mSv Female: 0.5 mSv	

For the 2nd reconstruction the Autoload into MIPthin Range on the 3D Card is activated. The images will be automatically loaded into 3D, MIPthin, and a coronal MIPthin Range will pop up.

Please notice, if you are not satisfied with the Range preset adapt the parameters to your needs and link them to the series.

MIPthin: AngioHead	coronal
<i>Image thickness</i>	3
<i>Distance between images</i>	3
<i>Number of images</i>	35

Contrast medium IV injection	
<i>Start delay</i>	18 sec.
<i>Flow rate</i>	3.5 ml/s
<i>Total amount</i>	75 ml

Use of CARE Bolus with monitoring scans positioned at the level of the basilar artery or carotid artery. Set the trigger threshold at 120 HU, or use manual triggering.

AngioThinSlice

Indications:

For cerebral CT Angio studies, with one reconstruction job for a 0.75mm slice thickness.

E. g. cerebral vascular abnormalities, tumor, and follow up studies etc.

A range of 80 mm will be covered in 6.5 s.



Head

	AngioThinSlice	2nd Reconstr.
<i>kV</i>	120	
<i>Effective mAs</i>	130	
<i>Slice collimation</i>	0.75 mm	
<i>Slice width</i>	4.0 mm	0.75 mm
<i>Feed/Rotation</i>	6.8 mm	
<i>Rotation time</i>	0.5 sec.	
<i>Kernel</i>	H20f	H10f
<i>Increment</i>	4.0 mm	0.5 mm
<i>Image order</i>	ca-cr	
<i>CTDI_w</i>	27.4 mGy	
<i>Effective dose</i>	Male: 0.6 mSv Female: 0.7 mSv	

For the 2nd reconstruction the Autoload into MPRthick Range on the 3D Card is activated. The images will be automatically loaded into 3D, MPRthick, and a coronal MPRthick Range will pop up.

Please notice, if you are not satisfied with the Range preset adapt the parameters to your needs and link them to the series.

MPRthick: AngioThinSlice	coronal
<i>Image thickness</i>	3
<i>Distance between images</i>	3
<i>Number of images</i>	35

Contrast medium IV injection	
<i>Start delay</i>	18 sec.
<i>Flow rate</i>	3.5 ml/sec.
<i>Total amount</i>	75 ml

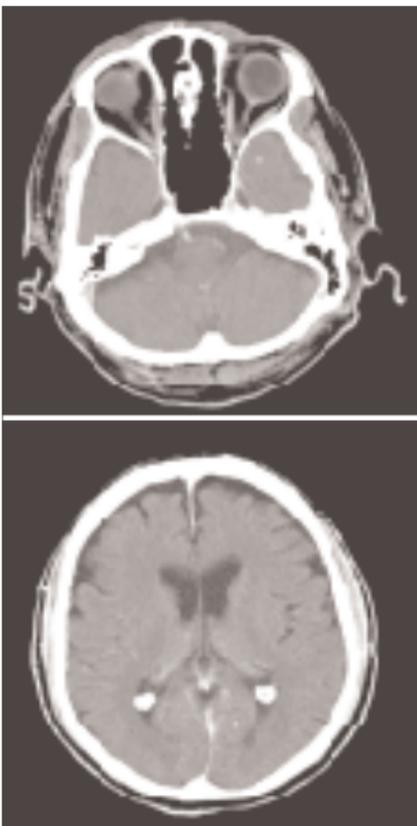
Use of CARE Bolus with monitoring scans positioned at the level of the basilar artery or carotid artery. Set the trigger threshold at 120 HU, or use manual triggering.

HeadSeq0.5s

Indications:

Sequence mode for routine head studies, e. g. stroke, brain tumors, cranial trauma, cerebral atrophy, hydrocephalus, and inflammation, etc.

Two ranges are predefined. One for the base of the skull and one for the cerebrum.



Head

	ThinSliceSeq	RoutineSeq
<i>kV</i>	120	120
<i>Effective mAs</i>	250	250
<i>Slice collimation</i>	0.75 mm	1.5 mm
<i>Slice width</i>	4.5 mm	9.0 mm
<i>Feed/Scan</i>	9.0 mm	18.0 mm
<i>Rotation time</i>	0.5 sec.	0.5 sec.
<i>Kernel</i>	H31f	H31f
<i>Image order</i>	ca-cr	ca-cr
<i>CTDI_w</i>	58.2 mGy	60.3 mGy
<i>Effective dose</i>	Male: 0.7 mSv Female: 0.8 mSv	Male: 1.6 mSv Female: 1.8 mSv

PosteriorFossaOptimization Filter

PFO: To reduce beam-hardening artifacts in head images, particularly in the base of the skull, use the Posterior Fossa Optimization (PFO) filter.

Contrast medium IV injection	
<i>Start delay</i>	60 sec.
<i>Flow rate</i>	2 ml/sec.
<i>Total amount</i>	50 – 60 ml

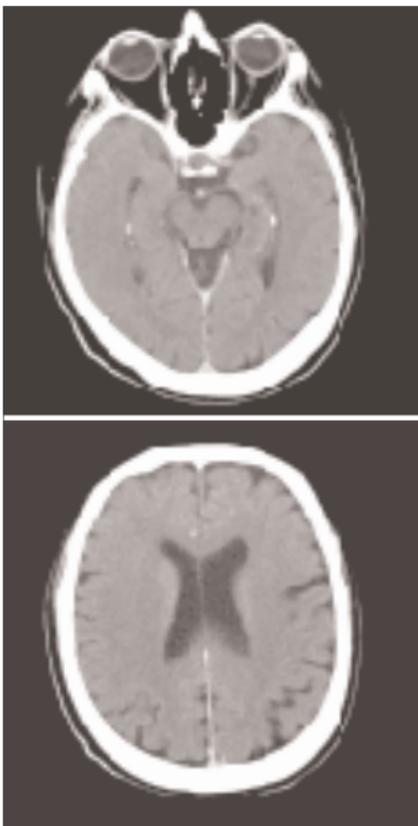
If you want to set up the scan with only one range, i. e. either 12 x 0.75 mm or 12 x 1.5 mm, you can easily delete one mode by clicking the chronicle with the right mouse button, and select *cut*.

HeadSpi0.5s

Indications:

Spiral mode for routine head studies, e. g. stroke, brain tumors, cranial trauma, cerebral atrophy, hydrocephalus, and inflammation, etc.

Two ranges are predefined for the base of the skull and cerebrum.



	ThinSliceSpi	RoutineSpi
<i>kV</i>	120	120
<i>Effective mAs</i>	320	320
<i>Slice collimation</i>	0.75 mm	1.5 mm
<i>Slice width</i>	4.0 mm	8.0 mm
<i>Feed/Rotation</i>	6.8 mm	13.7 mm
<i>Rotation time</i>	0.5 sec.	0.5 sec.
<i>Kernel</i>	H31f	H31f
<i>Increment</i>	4.0 mm	8.0 mm
<i>Image order</i>	ca-cr	ca-cr
<i>CTDI_w</i>	50.6 mGy	45.6 mGy
<i>Effective dose</i>	Male: 0.7 mSv Female: 0.8 mSv	Male: 1.1 mSv Female: 1.2 mSv

PosteriorFossaOptimization Filter

PFO: To reduce beam-hardening artifacts in head images, particularly in the base of the skull, use the Posterior Fossa Optimization (PFO) filter.

Contrast medium IV injection	
<i>Start delay</i>	60 sec.
<i>Flow rate</i>	2 ml/sec.
<i>Total amount</i>	50 – 60 ml

If you want to set up the scan with only one range, i. e. either 16 x 0.75 mm or 16 x 1.5 mm, you can easily delete one mode by clicking the chronicle with the right mouse button, and select *cut*.



Overview

- **AngioCarotid**
For CTA studies

Hints in General

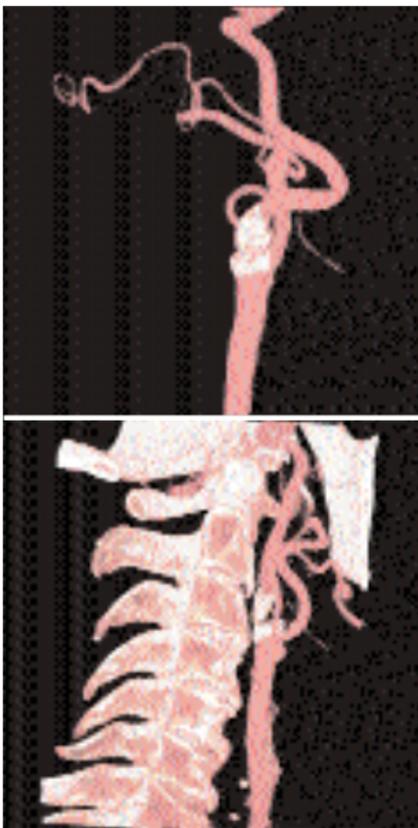
1. Topogram: Lateral, 256 mm.
2. Patient positioning:
Patient lying in supine position, hyperextend neck slightly, secure head well in head cradle.
3. Patient respiratory instruction:
do not breathe, do not swallow.
4. For image reconstruction of bone structure, use kernel B60.
5. In case of 3D study only, the mAs value can be reduced by 50%. Use kernel B10 and 50% overlapping for image reconstruction.
6. For examinations in the Neck/Shoulder region at least 120 kV is recommendable for optimized image quality. For large patients 140 kV is advisable.

AngioCarotid

Indications:

Noninvasive CT angiography of carotid stenosis or occlusions, plaques course abnormalities of the carotids and vertebral arteries, etc.

A range of 20 cm including the aortic arch will be covered in 8.9 s.



Neck

	AngioCarotid	2nd Reconstr.
<i>kV</i>	120	
<i>Effective mAs</i>	120	
<i>Slice collimation</i>	0.75 mm	
<i>Slice width</i>	5.0 mm	1.0 mm
<i>Feed/Rotation</i>	12.0 mm	
<i>Rotation time</i>	0.5 sec.	
<i>Kernel</i>	B30f	B30f
<i>Increment</i>	5.0 mm	0.7 mm
<i>Image order</i>	cr-ca	
<i>CTDI_w</i>	9.4 mGy	
<i>Effective dose</i>	Male: 1.6 mSv Female: 1.7 mSv	

For the 2nd reconstruction the Autoload into MIPthin Range on the 3D Card is activated. The images will be automatically loaded into 3D, MIPthin, and a coronal MIPthin Range will pop up.

Please notice, if you are not satisfied with the Range preset adapt the parameters to your needs and link them to the series.

MIPthin: AngioCarotid	coronal
<i>Image thickness</i>	3
<i>Distance between images</i>	3
<i>Number of images</i>	20

Contrast medium IV injection	
<i>Start delay</i>	15 sec.
<i>Flow rate</i>	4 ml/sec.
<i>Total amount</i>	100 ml

CARE Bolus may be used to optimize the bolus timing.

Set the ROI for monitoring scan in the aortic arch with triggering threshold of 120 HU, or use manual triggering.



Overview

- **LungLowDose**
Spiral mode with very low dose for special lung studies, e. g. early visualization of pulmonary nodules
- **PulmonaryEmboli**
Spiral mode for Pulmonary Emboli studies
- **ThoraxCombi**
For the combination of thin slice lung and routine thorax studies
- **ThoraxRoutine**
For routine thorax studies

Hints in General

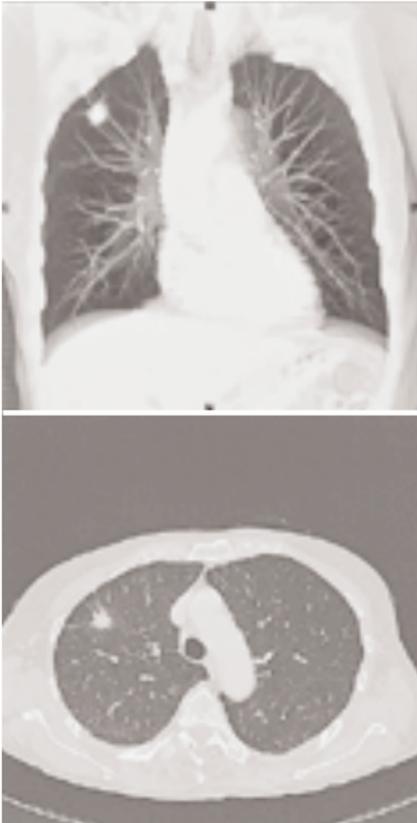
1. Topogram: AP, 512 mm.
2. Patient positioning:
Patient lying in supine position, arms positioned comfortably above the head in the head-arm rest, lower legs supported.
3. CARE Bolus may be used to optimize the bolus timing.
Set the ROI for monitoring scan in the aorta at the level of the diaphragm with triggering threshold of 120 HU, or use manual triggering.
4. For image reconstruction of mediastinum, use kernel B30.
5. For image reconstruction of the lung, use kernel B80.
6. If the voltage is lowered from 120 kV to 80 kV significant higher mAs values have to be used (at least by a factor of 2).

LungLowDose

Indications:

Lung studies with low dose setting, e. g. early visualization of pulmonary nodules.

A typical thorax study in a range of 30 cm will be covered in 8.9 s.



Thorax

	LungLowDose	2 nd Reconstr.
<i>kV</i>	120	
<i>Effective mAs</i>	20	
<i>Slice collimation</i>	0.75 mm	
<i>Slice width</i>	5.0 mm	1.0 mm
<i>Feed/Rotation</i>	18.0 mm	
<i>Rotation time</i>	0.5 sec.	
<i>Kernel</i>	B50f	B50f
<i>Increment</i>	5.0 mm	0.7 mm
<i>Image order</i>	cr-ca	
<i>CTDI_w</i>	1.6 mGy	
<i>Effective dose</i>	Male: 0.6 mSv Female: 0.7 mSv	

Contrast medium IV injection

<i>Start delay</i>	30 sec.
<i>Flow rate</i>	2.5 ml/sec.
<i>Total amount</i>	50 – 70 ml

You could repeat the same protocol simply by clicking the chronicle with the right mouse button for "repeat". E. g. when both non-contrast and contrast studies are required.

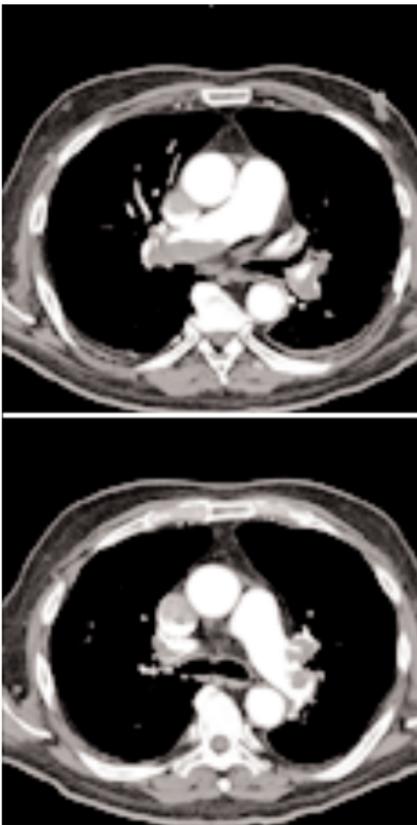
Pulmonary Emboli

Indications:

For Pulmonary Emboli studies.

There are two recon jobs predefined. The first one, with 5 mm slice thickness, the second reconstruction, with 1 mm slice thickness.

A range of 30 cm will be covered in 10.6 s.



Thorax

	Pulmonary Emboli	2nd Reconstr.
<i>kV</i>	120	
<i>Effective mAs</i>	100	
<i>Slice collimation</i>	0.75 mm	
<i>Slice width</i>	5.0 mm	1.0 mm
<i>Feed/Rotation</i>	15.0 mm	
<i>Rotation time</i>	0.5 sec.	
<i>Kernel</i>	B30f	B80f
<i>Increment</i>	5.0 mm	0.7 mm
<i>Image order</i>	cr-ca	
<i>CTDI_w</i>	7.8 mGy	
<i>Effective dose</i>	Male: 3.0 mSv Female: 3.9 mSv	

Contrast medium IV injection

<i>Start delay</i>	12 – 15 sec. *
<i>Flow rate</i>	4 ml/sec.
<i>Total amount</i>	100 – 120 ml

* CARE Bolus may be used to optimize the bolus timing.

Set the ROI for monitoring scan in the truncus pulmonalis with triggering threshold of 120 HU, or use manual triggering.

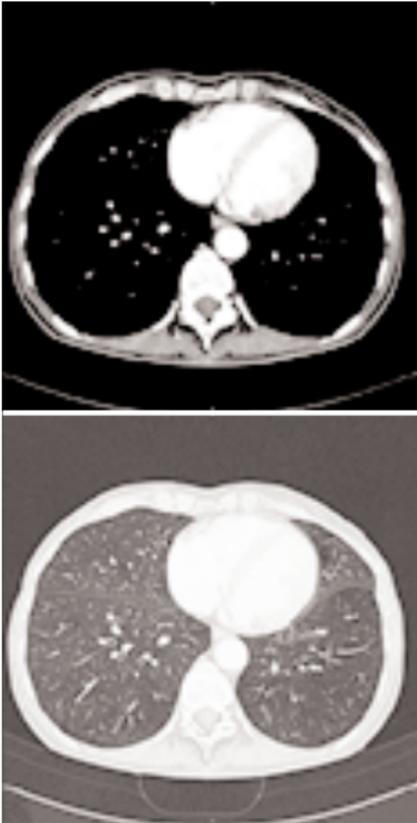
ThoraxCombi

Indications:

Combining thin slice lung and routine thorax studies with one spiral scan. E.g. thorax studies in general and interstitial changes in the lungs.

There are two recon jobs predefined. The first one, with 5 mm slice thickness, for the mediastinum, the second reconstruction, with 1 mm slice thickness, for the lung.

A range of 30 cm will be covered in 10.6 s.



Thorax

	ThoraxCombi	2nd Reconstr.
<i>kV</i>	120	
<i>Effective mAs</i>	100	
<i>Slice collimation</i>	0.75 mm	
<i>Slice width</i>	5.0 mm	1.0 mm
<i>Feed/Rotation</i>	15.0 mm	
<i>Rotation time</i>	0.5 sec.	
<i>Kernel</i>	B31f	B80f
<i>Increment</i>	5.0 mm	0.7 mm
<i>Image order</i>	cr-ca	
<i>CTDI_w</i>	7.8 mGy	
<i>Effective dose</i>	Male: 3.0 mSv Female: 3.9 mSv	

Contrast medium IV injection

<i>Start delay</i>	25 sec.
<i>Flow rate</i>	2.5 ml/sec.
<i>Total amount</i>	80 ml

If you want to reconstruct thin slices in every 2 mm or 10 mm instead of 0.7 mm as predefined, simply change the increment before image reconstruction.

ThoraxRoutine

Indications:

Routine studies for the region of thorax, e. g. screening of tumors, metastases, lymphoma, lymphonodes, vascular anomalies etc.

A range of 30 cm will be covered in 5.6 s.

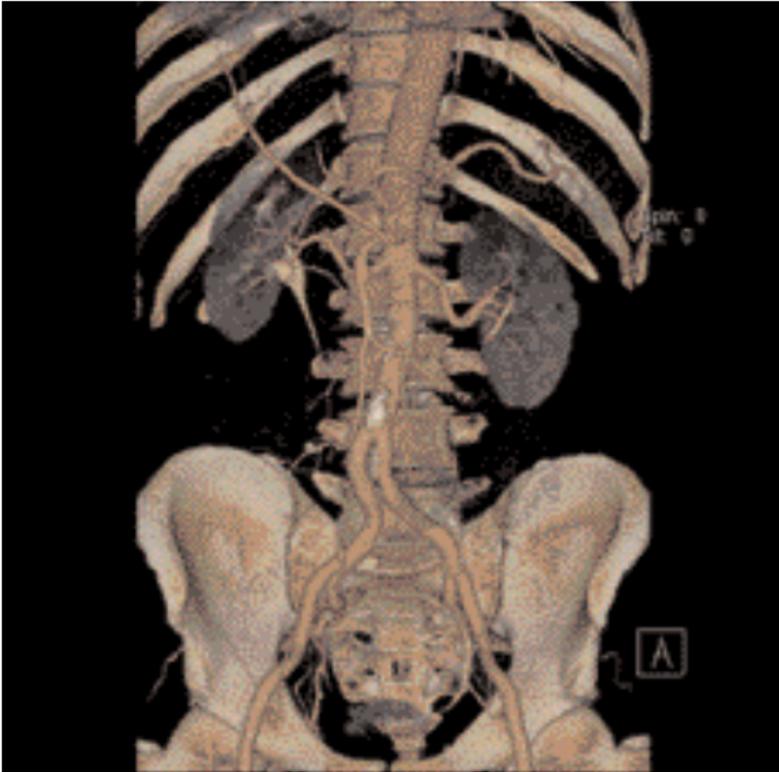


Thorax

ThoraxRoutine	
<i>kV</i>	120
<i>Effective mAs</i>	100
<i>Slice collimation</i>	1.5 mm
<i>Slice width</i>	6.0 mm
<i>Feed/Rotation</i>	30.0 mm
<i>Rotation time</i>	0.5 sec.
<i>Kernel</i>	B41f
<i>Increment</i>	6.0 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	7.0 mGy
<i>Effective dose</i>	Male: 2.8 mSv Female: 3.6 mSv

Contrast medium IV injection	
<i>Start delay</i>	25 – 30 sec.
<i>Flow rate</i>	2.5 ml/sec.
<i>Total amount</i>	80 ml

You could repeat the same protocol simply by clicking the chronicle with the right mouse button for "repeat". E. g. when both non-contrast and contrast studies are required.



Overview

- **AbdRoutine**
For routine abdominal studies
- **AngioFast**
For long-range CTA studies
- **AngioRoutine**
For CTA routine studies
- **AbdomenSeq**
Sequence mode for routine studies

Hints in General

1. Topogram: AP, 512 or 768 mm.
2. Patient positioning:
Patient lying in supine position, arms positioned comfortably above the head in the head-arm rest, lower legs supported.
3. Patient respiratory instructions: inspiration.
4. Oral administration of contrast medium:
For abdominal studies, it is necessary to delineate the bowels from other structures such as lymph nodes, abdominal masses & abscesses. Various types of bowel opacifying agents can be used:
 - Diluted barium suspension (1% – 2%) e. g. EZCAT
 - Water soluble agent (2% – 4%) e. g. Gastrografin
 - Water itself as a negative contrast agent.Timing of the oral contrast administration is important to ensure its even distribution in the bowels.

Upper abdomen:

Minimum 600 ml of contrast divided into 3 cups (approximately 200 – 250 ml)

1st cup to drink 30 minutes before exam

2nd cup to drink 15 minutes before exam

3rd cup to drink 5 minutes before exam

Abdomen-Pelvis:

Minimum 1000 ml of contrast divided into 4 cups

1st cup to drink 1 hour before exam

2nd – 4th cups every subsequent 15 minutes

Start exam 5 minutes after the 4th cup is administered.

Abdomen

Note: In general, for abdominal studies such as liver, gall bladder (query stones), pancreas, gastrointestinal studies, focal lesion of the kidneys and CTA studies, it is sufficient to use just water. Water is more effective than positive oral contrast agent in depicting the linings of the stomach & intestines in post enhancement studies. In addition, the use of water will not obscure the blood vessels thus allowing CTA processing to be performed easily afterwards.

For patients with bowel obstruction, only water or water-soluble contrast can be used. Barium suspension is contraindicated.

5. Be careful when examining pheochromocytoma patients. Administration of an IV CM injection in such cases may trigger a hypertensive crisis! For more information regarding the general use of drugs and doses including specific indications and contraindications mentioned in this guide, please refer to page 2.

6. For Abdomen examination we recommend at least 120 kV.

For obese patients

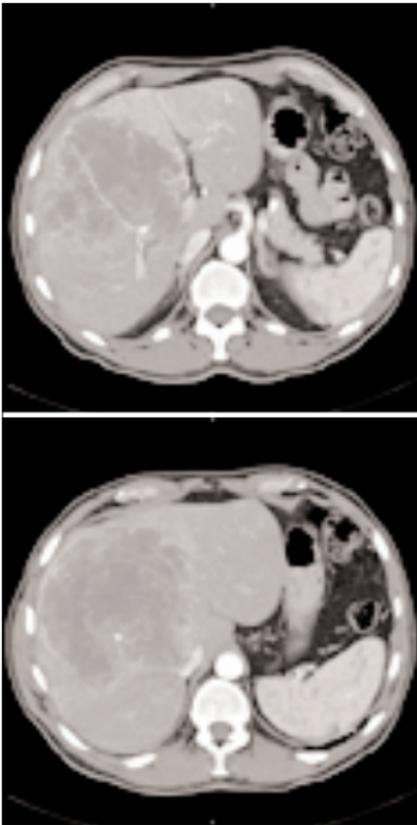
- use at least 120 kV and effective mAs 300
- for a 0.75 mm slice collimation choose 140 kV and at least effective mAs 200.

AbdRoutine

Indications:

All routines in the region of abdomen, e. g. screening, follow-up examinations etc.

A complete abdomen/pelvis scan, in a range of 40 cm will be covered in 8.9 s, and a typical liver scan in a range of 20 cm will be covered in 4.5 s.



Abdomen

AbdRoutine	
<i>kV</i>	120
<i>Effective mAs</i>	140
<i>Slice collimation</i>	1.5 mm
<i>Slice width</i>	5.0 mm
<i>Feed/Rotation</i>	24.0 mm
<i>Rotation time</i>	0.5 sec.
<i>Kernel</i>	B31f
<i>Increment</i>	5.0 mm
<i>Image order</i>	cr-ca
<i>CTDI_w</i>	10.0 mGy
<i>Effective dose</i>	Male: 5.8 mSv Female: 8.9 mSv

Contrast medium IV injection	
<i>Start delay</i>	50 – 60 sec.
<i>Flow rate</i>	4.0 ml/sec.
<i>Total amount</i>	100 ml

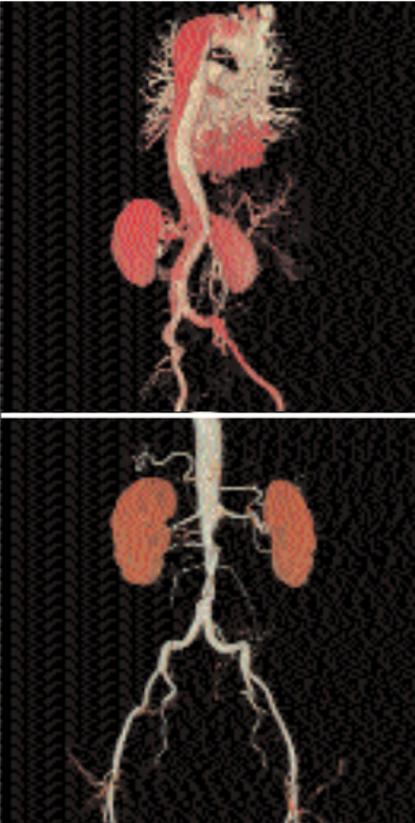
You could repeat the same protocol simply by clicking the chronicle with the right mouse button for "repeat". E. g. when both non-contrast and contrast studies are required.

AngioFast

Indications:

Long range CTA studies.

E. g.: a typical study of the whole aorta including its
brachiocephalic trunk and iliac arteries in a range of
80 cm will be covered in 19.6 s.



Abdomen

	AngioFast	2 nd Reconstr.
<i>kV</i>	120	
<i>Effective mAs</i>	130	
<i>Slice collimation</i>	1.5 mm	
<i>Slice width</i>	5.0 mm	2.0 mm
<i>Feed/Rotation</i>	21.0 mm	
<i>Rotation time</i>	0.5 sec.	
<i>Kernel</i>	B30f	B20f
<i>Increment</i>	5.0 mm	1.5 mm
<i>Image order</i>	cr-ca	
<i>CTDI_w</i>	9.1 mGy	
<i>Effective dose</i>	Male: 10.8 mSv Female: 16.4 mSv	

For the 2nd reconstruction the Autoload into the MIPthin Range on the 3D Card is activated. The images will be automatically loaded into 3D, MIPthin, and sagittal MIPthin Range will pop up.

Please notice, if you are not satisfied with the Range preset adapt the parameters to your needs and link them to the series.

MIPthin: AngioFast	sagittal
<i>Image thickness</i>	3
<i>Distance between images</i>	3
<i>Number of images</i>	60

Contrast medium IV injection	
<i>Start delay</i>	20 sec.*
<i>Flow rate</i>	3.0 ml/sec.
<i>Total amount</i>	120 ml

- * CARE Bolus may be used to optimize the bolus timing. Set the ROI for monitoring scan in the abdominal aorta at the beginning of the scan range with triggering threshold of 120 HU, or use manual triggering.

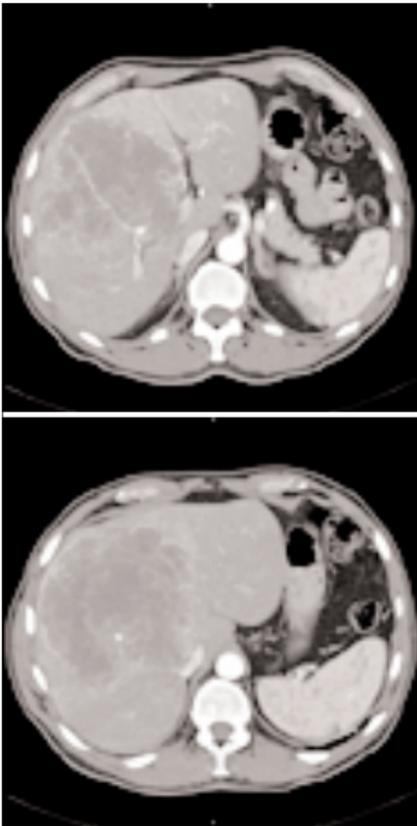
Do not administer oral contrast medium, as this impairs the editing of MIP/SSD/VRT images.

AngioRoutine

Indications:

For abdominal CTA studies.

E. g.: a typical study of renal arteries in a range of 40 cm will be covered in 13.9 s.



Abdomen

	AngioRoutine	2 nd Reconstr.
<i>kV</i>	120	
<i>Effective mAs</i>	130	
<i>Slice collimation</i>	0.75 mm	
<i>Slice width</i>	5.0 mm	1.0 mm
<i>Feed/Rotation</i>	15.0 mm	
<i>Rotation time</i>	0.5 sec.	
<i>Kernel</i>	B30f	B20f
<i>Increment</i>	5.0 mm	0.7 mm
<i>Image order</i>	cr-ca	
<i>CTDI_w</i>	10.1 mGy	
<i>Effective dose</i>	Male: 5.8 mSv Female: 7.5 mSv	

For the 2nd reconstruction the Autoload into the MIPthin Range on the 3D Card is activated. The images will be automatically loaded into 3D, MIPthin, and sagittal MIPthin Range will pop up. Please notice, if you are not satisfied with the Range preset adapt the parameters to your needs and link them to the series.

MIPthin: AngioRoutine	sagittal
<i>Image thickness</i>	3
<i>Distance between images</i>	3
<i>Number of images</i>	60

Contrast medium IV injection	
<i>Start delay</i>	20 – 25 sec. *
<i>Flow rate</i>	3.0 – 3.5 ml/sec.
<i>Total amount</i>	100 – 120 ml

* CARE Bolus may be used to optimize the bolus timing. Set the ROI for monitoring scan in the abdominal aorta at the beginning of the scan range with triggering threshold of 120 HU, or use manual triggering.

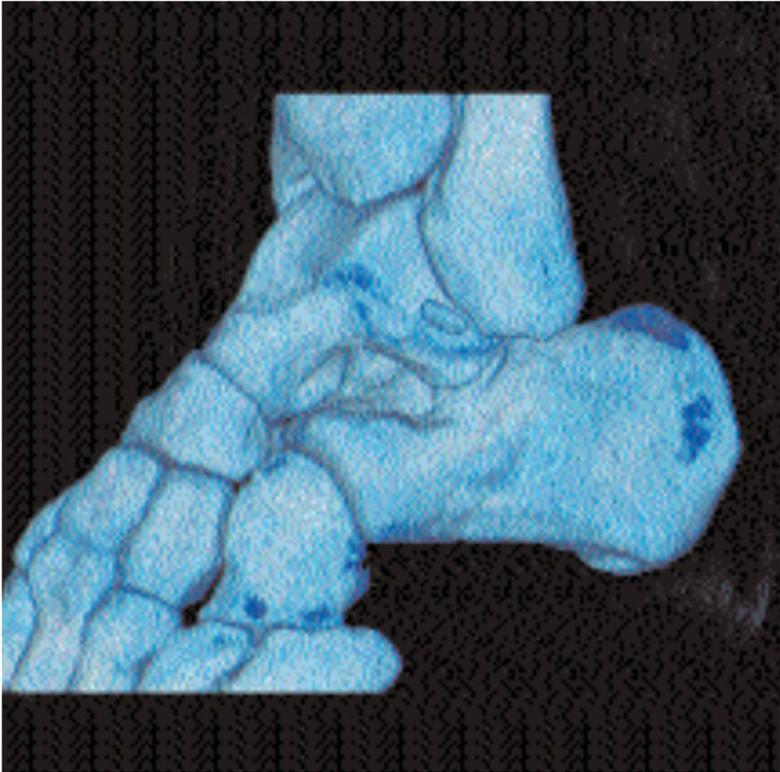
Do not administer oral contrast medium, as this impairs the editing of MIP/SSD/VRT images.

AbdomenSeq

Indications:

Sequential mode for addomen studies.

	AbdomenSeq
<i>kV</i>	120
<i>Effective mAs</i>	140
<i>Slice collimation</i>	5.0 mm
<i>Slice width</i>	5.0 mm
<i>Feed/Scan</i>	10.0 mm
<i>Rotation time</i>	0.5 sec.
<i>Kernel</i>	B31f
<i>Image order</i>	cr-ca



Overview

- **AngioRunOff**
For long range CTA studies

Hints in General

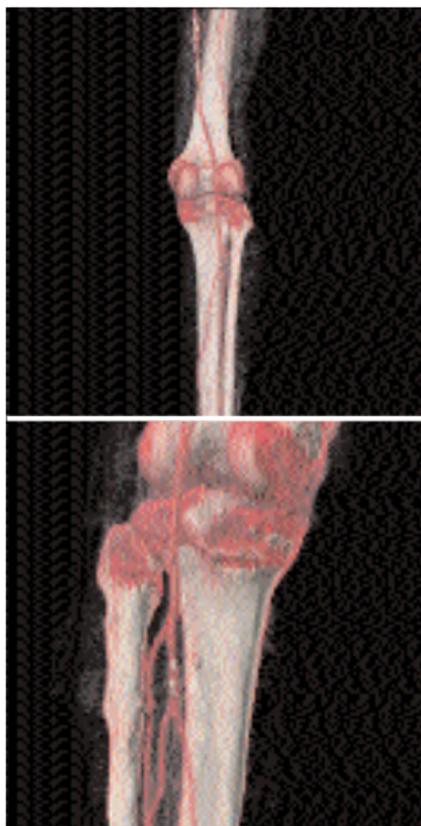
1. Topogram: AP, 1024mm for CTA.
2. If Topo length 1024 mm is not long enough, you can also choose the 1540 mm long Topogram.
3. Position the patient as feet first.
Bend the feet together if necessary.
4. If the Pelvis region is included in the scan range, we recommend at least 120 kV.

AngioRunOff

Indications:

For CTA studies

A range of 100 cm will be done in 21.4 s.



	AngioRunOff	2 nd Reconstr.
kV	120	
Effective mAs	130	
Slice collimation	1.5 mm	
Slice width	6.0 mm	2.0 mm
Feed/Rotation	24.0 mm	
Rotation time	0.5 sec.	
Kernel	B30s	B20s
Increment	6.0 mm	1.5 mm
Image order	cr-ca	cr-ca
CTDI _w	9.1 mGy	
Effective dose	Male: 4.4 mSv Female: 3.2 mSv	

Extremities

For the 2nd reconstruction the Autoload into the MIPthin Range on the 3D Card is activated. The images will be automatically loaded into 3D, MIPthin, and coronal MIPthin Range will pop up.

Please notice, if you are not satisfied with the Range preset adapt the parameters to your needs and link them to the series.

MIPthin: AngioRunOff	coronal
<i>Image thickness</i>	3
<i>Distance between images</i>	3
<i>Number of images</i>	50

Contrast medium IV injection	
<i>Start delay</i>	25 – 30 sec. *
<i>Flow rate</i>	3.0 – 3.5 ml/sec.
<i>Total amount</i>	150 ml

* CARE Bolus may be used to optimize the bolus timing. Set the ROI for monitoring scan in the abdominal aorta at the beginning of the scan range with triggering threshold of 120 HU, or use manual triggering.

If Topo length 1024 mm is not long enough, you can also choose the 1540 mm long Topogram.

Position the patient as feet first. Bend the feet together if necessary.

The data acquired can also be used for image reconstruction of soft tissue, done by the first reconstruction.

If the Pelvis region is included in the scan range, we recommend at least 120 kV.

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