SOMATOM Sensation Cardiac
Application Guide

Software Version A70

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 so ever for the accuracy 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 is the corresponding data sheets. To improve future versions of this application guide, we would highly appreciate your questions, suggestions and comments.

Please contact us:
USC-Hotline:
Tel. no. +49-1803-112244
email: ct-application.hotline@med.siemens.de

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, Universitätsklinikum Tübingen.

Editor: Ute Feuerlein

Overview

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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:
All not specially marked protocols are standard spiral modes. E. g. "Head" means the spiral mode for the head.
"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.
"Combi": uses 0.75 mm as slice collimation and by default, has two reconstruction jobs: 1 thick slice width for His Res or CTA, and 1 thicker slice width for soft tissue studies HiRes studies.
"Seq": stands for Sequence. E. g. "HeadSeq" means the sequence 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"*, which is denoted by a bracket connecting the two ranges, 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 are reconstructed with highest performance (up to 6-10 images per second). All others will be reconstructed 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 will routinely 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 after completion of spiral.

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
1.0 mm	1, 2 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
1.0 mm	1, 2 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 are defined, the software will adapt the table feed per rotation accordingly. In Volume mode, the Pitch Factor can be freely adapted from 0.5 – 1.5. For slice mode, the Pitch Factor can be freely adapted from 0.5 – 2.0 with the consequence that these scans cannot be reconstructed later with thin slices (volume mode).

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 (4th) 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). Once reconstructed, these completed recon jobs stay in the browser, until deleted from the hard drive.

You can also reconstruct images for all scans performed by Selecting any range in the chronicle, prior to clicking "Recon".

Kernels

There are 3 different types of kernels: "H" stands for Head, "B" stands for Body and "C" stands for ChildHead. The image sharpness is 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 other than what they are 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.

100kV-Protocols

The additional tube voltage 100 kV is now supported. The system offers a spectrum of 4 kV settings (80 kV, 100 kV, 120 kV and 140 kV) for individual adaptation of the patient dose in pediatric scans and for optimization of the contrast-to-noise ratio in contrast-enhanced CT angiographic studies.

In contrast enhanced studies, such as CT angiographic examinations, the contrast-to-noise ratio for fixed patient dose increases with decreasing tube voltage. As a consequence, to obtain a given contrast-to-noise ratio, patient dose can be reduced by choosing lower kV-settings. This effect is even more pronounced for smaller patient diameters. It can be demonstrated by phantom measurements using small tubes filled with diluted contrast agent embedded in plexiglass phantoms with different diameters. The iodine contrast-to-noise ratio for various kV-settings is depicted in Fig. 1 as a function of the phantom diameter. Compared to a standard scan with 120 kV, the same contrast-to-noise ratio in a 32 cm phantom, corresponding to an average adult, is obtained with 0.49 times the dose for 80 kV (1.3 times the mAs) and 0.69 times the dose (1.1 times the mAs) for 100 kV. Ideally, 80 kV should be used for lowest patient dose. In practice, however, the use of 80 kV for larger patients is limited by the available mA-reserves of the X-ray generator.

In these patients, 100 kV is a good compromise and the preferable choice for CTA examinations. In the current software version, three protocols applying 100 kV have been introduced: AngioHead100 kV, Embolism100 kV for pulmonary embolism and CoronaryCTA100 kV.

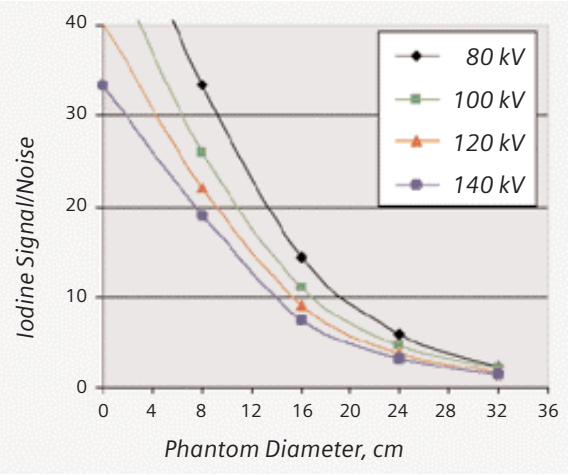


Fig. 1: Iodine contrast-to-noise ratio as a function of the phantom diameter for various kV-settings at a constant dose.

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:

$D_{seq} = D_{CTDI_w}$ x mAs

In spiral scanning, however, the applied dose (D_{spiral}) is influenced by the "classical" 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:

$D_{spiral} = (D_{CTDI_w}$ x mA x Rot Time)/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:

Effective mAs = mAs/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:

$D_{spiral} = D_{CTDI_w}$ x 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:

Effective mAs = mA x RotTime/Pitch Factor

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

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

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

Dose Information

$CTDI_W$ and $CTDI_{Vol}$

The average dose in the scan plane is best described by the $CTDI_w$ 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 $CTDI_w$ definition and measurement is based on single axial scan modes. For clinical scanning, i. e. scanning of entire volumes in patients, the average dose will also depend on the table feed in between axial scans or the feed per rotation in spiral scanning. The dose, expressed as the $CTDI_w$, must therefore be corrected by the pitch-factor of the spiral scan or an axial scan series to describe the average dose in the scanned volume.

For this purpose the IEC defined the term "$CTDI_{Vol}$" in September 2002:

$CTDI_{Vol} = CTDI_W$/pitch-factor

This dose number is displayed on the user interface for the selected scan parameters.

Please note: Up to now the dose display on the user interface was labeled "$CTDI_W$" . This displayed $CTDI_W$ was also corrected for the pitch.

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.

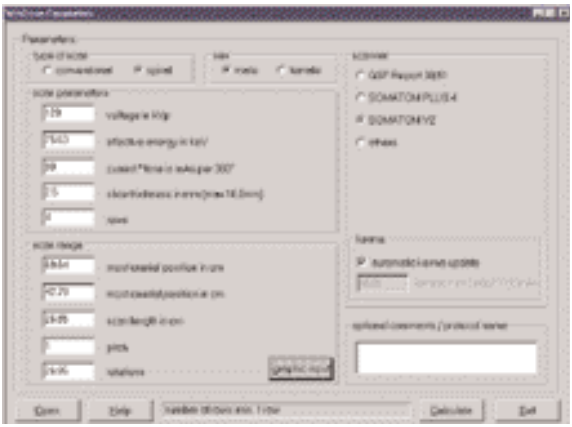


Fig. 1: User interface of the PC program WinDose. All parameters necessary for the effective dose calculation have to be specified.

* *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.*

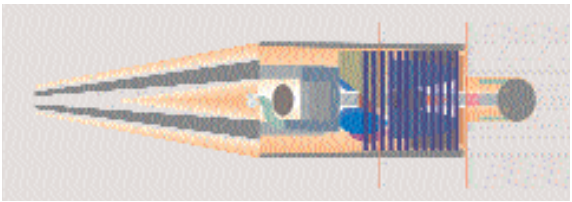


Fig. 2: A graphic interface of WinDose allows to specify the anatomical scan range.

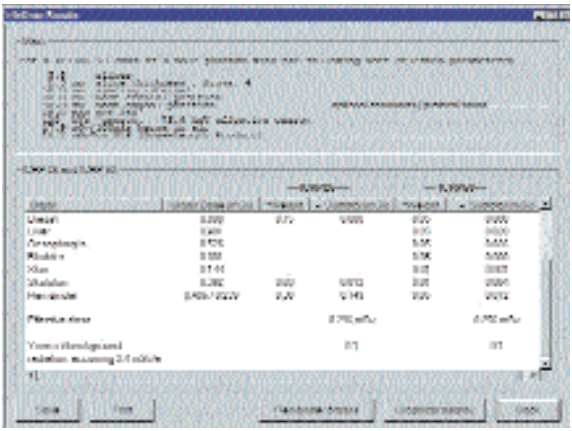


Fig.3: Results as output of WinDose with the organ dose readings and the effective dose according to ICRP26 (previous version) and ICRP60 (currently valid).

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 Multiphase studies.

It can also improve image quality by increasing mA 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).

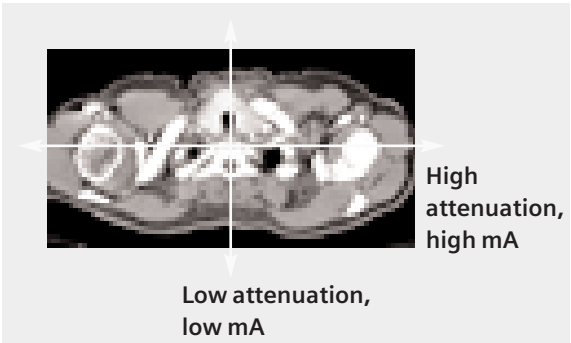


Fig. 1: Example of scanning in the region of shoulder.

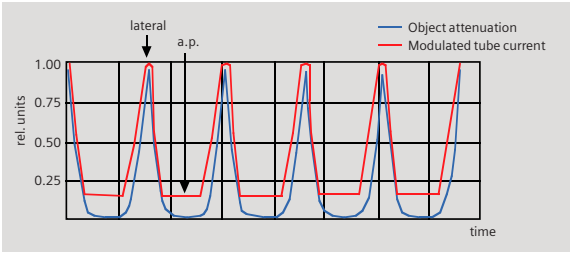


Fig. 2: Principle of CARE Dose tube current adaptation.

- CARE Dose is pre-selected by default for most 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 mAs, however, should be adapted to patient size manually for obese and pediatric patients.
- The mean value of the mAs applied will be lower than what you have selected. Although the average mA for the entire scan will be lower than selected, we allow the scanner to apply increased mA levels for the high attenuation views. This may cause different results of the tube load controller when switching on and off CARE Dose.
- 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 MPR and MIPthin Range Parallel and Radial protocols which can be linked to a special series.

For example, if you always do 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 that point 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, primarily for Angio examinations, are already preset in the protocol with Auto load in 3D. If you do not prefer to have this preset, deselect the Auto load in 3D and save your scan protocol.

Some of the Scan protocols are preset in the protocol with links to a postprocessing protocol. If you do not prefer to have this preset, 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, as you may save contrast medium on your routine studies since the Multislice spiral scan can be up to 32 times faster than a 1 second, single slice spiral scan.

For CTA studies (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 = (start delay time + scan time) x 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 First-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, which will create a new protocol name and will not alter any of the existing protocols already stored.

Tips:

– It is recommended that you save your own scan protocol with a new name in order to avoid over-writing 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 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 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.

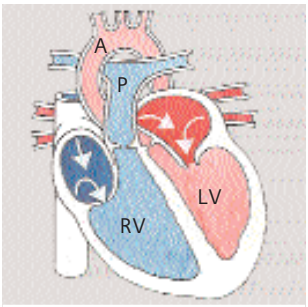


Fig. 1:
Blood fills both atria

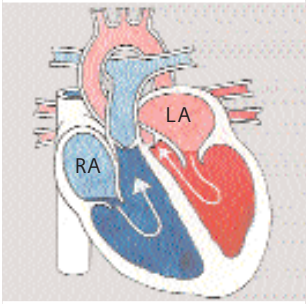


Fig. 2:
Atria contract, blood enters ventricles

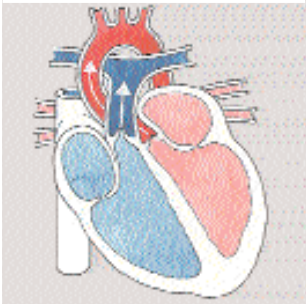


Fig. 3:
Ventricles contract, blood enters into aorta and pulmonary arteries

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

Coronary arteries:

- Right coronary artery (RCA)
  Right coronary artery supplies blood to the right atrium, right ventricle, and a small part of the ventricular septum.

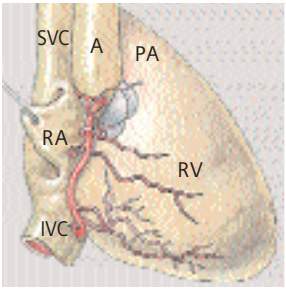


Fig. 4: Front view

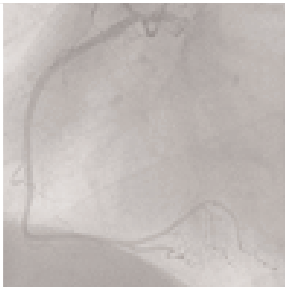


Fig. 5: Conventional Angiography

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.

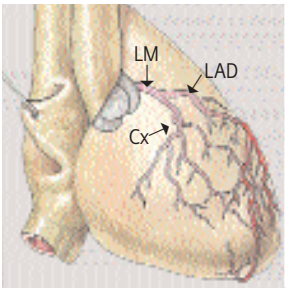


Fig. 6: Front view

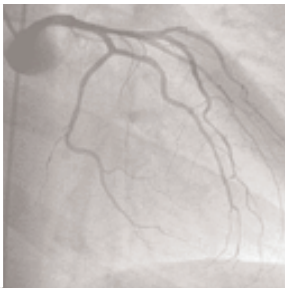


Fig. 7: Conventional Angiography

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 from a cardiac cycle, which can be illustrated by an Electrocardiograph (ECG) (Fig. 8).

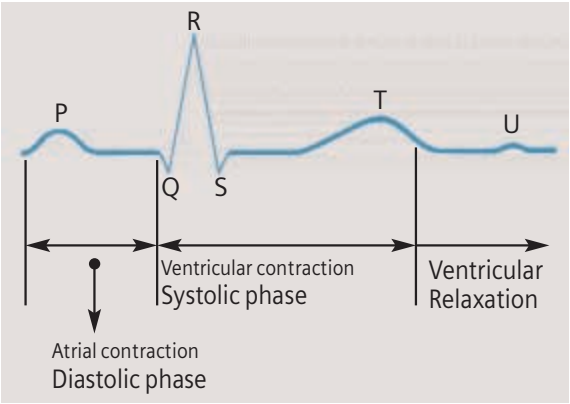


Fig. 8

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

- Fast gantry rotation to minimize the time it takes to acquire the necessary scan data to reconstruct an image.
- Prospective triggering of image acquisition in a sequential mode or retrospective gating of image reconstruction in a spiral mode based on the ECG recording in order to obtain images during the diastolic phase with least cardiac motion.

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 down to 105 ms can be achieved.

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). Only scan data acquired in a user-selectable phase of cardiac cycle is used for image reconstruction. The temporal relation of the image data interval relative to the R-waves is predefined, which can be either relative (given as a certain percentage of the RR-interval time) or absolute (given in ms) and either forward or reverse.

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).

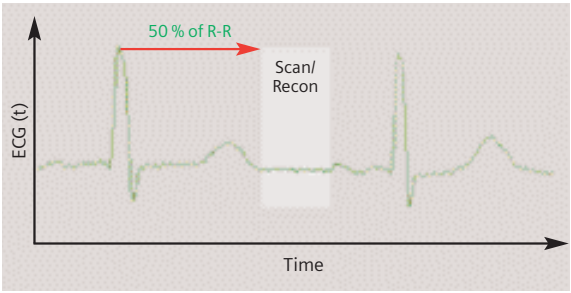


Fig. 9

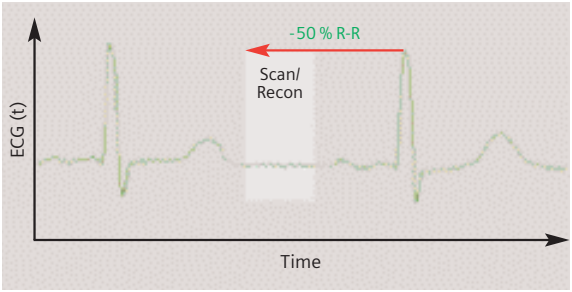


Fig. 10

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

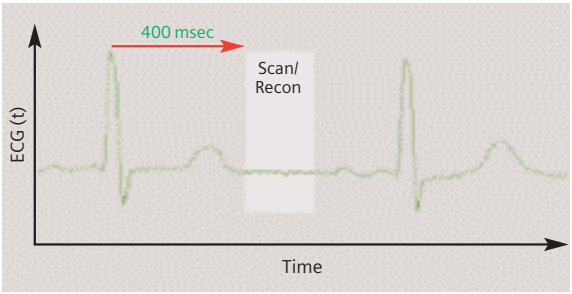


Fig. 11

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

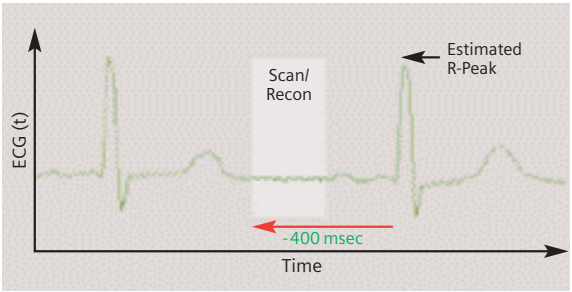


Fig. 12

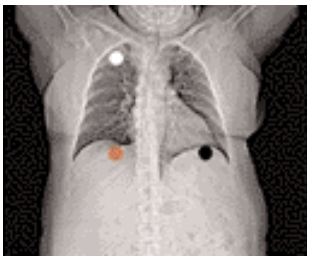
Prospective ECG-triggering Versus Retrospective ECG-gating

With prospective ECG-triggering, the heart volume is covered in a "step-and-shoot" technique. The patient's ECG-signal is used to start sequential scans with a pre-defined offset to the R-waves of the patient's ECG. With retrospective ECG-gating, the heart volume is covered continuously by a spiral scan. The patient's ECG-signal is recorded simultaneously to allow a retrospective selection of the data segments used for image reconstruction. Prospective ECG-triggering has the benefit of smaller patient dose than ECG-gated spiral scanning, since scan data is acquired in the previously selected heart phases only. It does, however, not provide continuous volume coverage with overlapping slices and mis-registration of anatomical details may occur. Furthermore, reconstruction of images in different phases of the cardiac cycle for functional evaluation is not possible. Since ECG-triggered sequential scanning depends on a reliable prediction of the patient's next RR-interval by using the mean of the preceding RR-intervals, the method should not be used for patients with arrhythmia and irregular heart rates. To maintain the benefits of ECG-gated spiral CT but reduce patient dose ECG-controlled dose-modulation is available.

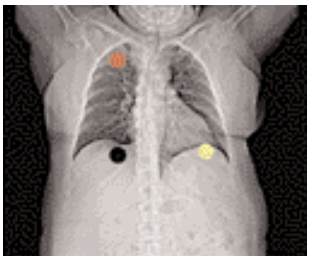
Placement of ECG-electrodes

The correct placement of the ECG electrodes is essential in order to receive a clear ECG signal with marked R-Waves. Incorrect placement of the electrodes will result in an unstable ECG signal which is sensitive to movements of the patient during the scan.

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



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

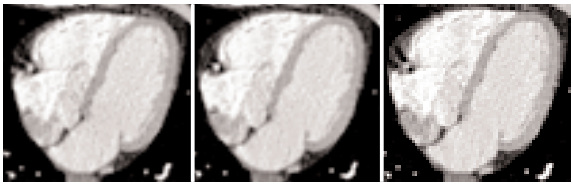


Preview Series Reconstruction

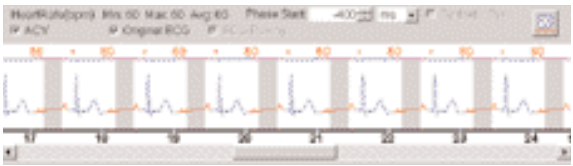
The Preview Series should be used to define the optimal time window for image reconstruction in ECG-gated spiral scanning, before the full series is reconstructed. A default value of 60% relative gating (or -400 ms absolute reverse gating) can be used as an initial setup for the optimization process which is best performed as follows:

– select an image level displaying the mid RCA.
– choose 60% (or -400 ms) reconstruction phase setting.
– reconstruct a preview series at this level of the RCA by clicking on the "Preview Series" button in the Trigger card: a series of images with different phase setting at the selected anatomical level of the RCA will be reconstructed.
– choose the image with least motion artifacts.
– reconstruct the whole dataset with the phase setting you selected. Please note that you have to enter this phase setting manually in the Trigger card.

An example for a preview series at the correct anatomical level with optimal and sub-optimal selection of the phase setting is shown below. Usually this procedure results in good image quality for the right and the left coronary artery, especially at higher and inconsistent heart rates individual optimization for left and right coronary artery may be necessary. In most cases, the RCA requires an earlier phase in the cardiac cycle to obtain the period of least motion, e. g. RCA at 40%, LAD at 60%.



Example of a preview series at the correct anatomical level (mid RCA), demonstrating the importance of optimized phase setting. Patient with an average heart rate of 63 bpm.
Left: 57%, mid: 61%, right: 65% relative delay.
The image at 61% relative delay shows the least motion artifacts. In this example, even a slight change of the phase setting from 61% to 65% deteriorates image quality.



ECG-Trace Editor

The ECG trace editor is used to modify the ECG signal. This editing tool is available after spiral scan data has been acquired. By using the right mouse menu on the Trigger card you have access to several modification tools for the ECG Sync, such as Delete, Disable, Insert. In patients with only single or few extra-systolic beats overall image quality may be improved by editing the ECG prior to reconstruction. Deleting the corresponding R-peaks prevents image reconstruction in the extra-systolic heart periods. Please keep in mind that absolute gating (in ms) must be chosen if R-peaks are deleted. Although ECG-gated spiral scanning is less sensitive to variable heart rates than ECG-triggered sequential scanning, the examination of patients with complex arrhythmia that results in unpredictable variations of the RR-intervals (e. g. complex ventricular arrhythmia or multiple extra beats) can result in limited image quality and should be performed in exceptional cases only.

ECG-Pulsing

ECG-pulsing is a dedicated technique used for online dose modulation in ECG-gated spiral scanning. During the spiral scan, the output of the X-ray tube is modulated according to the patient's ECG. It is kept at its nominal value during a user-defined phase of the cardiac cycle, in general the mid- to end-diastolic phase.

During the rest of the cardiac cycle, the tube output is reduced to 20% of its nominal value. The length of the plateau with full dose is 450 ms, which is sufficient to retrospectively shift the image reconstruction interval for patient-individual fine-tuning of the image reconstruction phase. The tube current is reduced and not switched off to allow for image reconstruction throughout the entire cardiac cycle. Even though their signal-to-noise ratio is decreased, the low-dose images are sufficient for functional evaluation. Clinical studies have demonstrated dose reduction by 30-50% depending on the patient's heart rate using ECG-pulsing. ECG-pulsing can be switched on/off by the user on the Trigger card (Fig. 14). When using ECG-pulsing, the desired reconstruction phase has to be estimated and entered into the Trigger card prior to scanning, since it determines the time interval of maximum dose. ECG-pulsing should not be used for patients with irregular heart rates and arrhythmia.

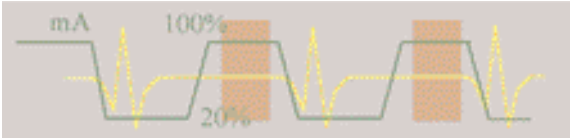


Fig. 14: Dose modulation with ECG pulsing.

ACV on/off

On the Trigger card, ACV (Adaptive Cardio Volume reconstruction) can be switched on/off by the user. With ACV off, single segment reconstruction is performed for all heart rates. Data acquired in one heart cycle are used for the reconstruction of each image, and the temporal resolution is independent of the heart rate. Temporal resolution is 210 ms for 0.42 s gantry rotation time. With ACV on, the system automatically switches between single segment and two segment reconstruction depending on the patient's heart rate. For heart rates below 71 bpm at 0.42 s gantry rotation time, single segment reconstruction is performed. For heart rates exceeding 71 bpm, two segment reconstruction is performed, using scan data acquired in two subsequent heart cycles to improve temporal resolution. With ACV on, temporal resolution is constant for heart rates below 71 bpm (210 ms for 0.42 s gantry rotation time). For heart rates above 71 bpm, temporal resolution varies between 105 ms and 210 ms depending on the patient's heart rate, reaching its optimum (105 ms) at 81 bpm. Temporal resolution as a function of the patient's heart rate is shown in Fig. 15. We recommend to switch ACV on.

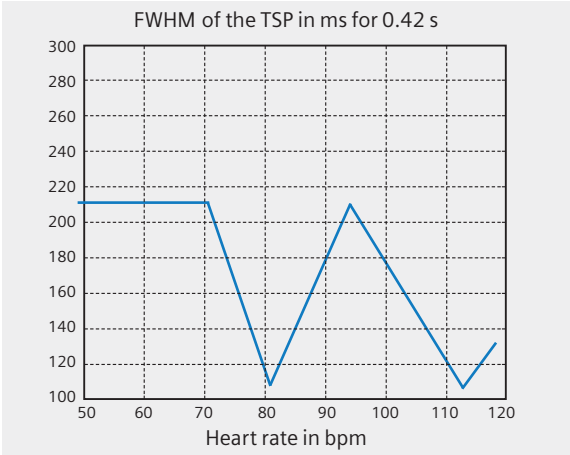
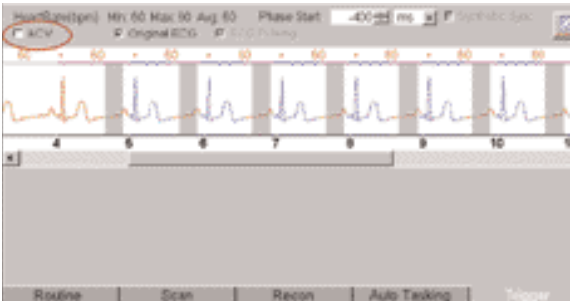


Fig. 15: Temporal resolution as a function of the patient's heart rate for 0.42 s gantry rotation time.



ASA-Filter

For the VA70 the special kernel B46f and the ASA-filter are now routinely available and can be selected in each ECG-gated spiral scan protocol.

We recommend to reconstruct 1 mm slices and use the kernel B30f for standard coronary CTA, including MPR, MIP and VRT.

The 0.75 mm reconstructed slice width should be reserved for detail viewing of stents or severely calcified coronary arteries. In these cases, the use of the kernel B46f in combination with the ASA-filter, may yield superior results.

Image examples are shown in figure 16.

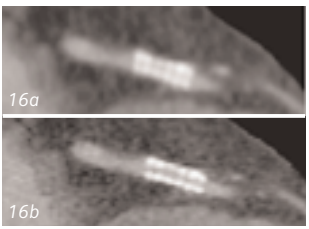


Fig. 16:
Image reconstruction without (16a) and with (16b) Kernel B46f in combination with ASA-Filter.

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 Prospective ECG triggering (sequen-tial scanning) and Retrospective gating (spiral scanning) techniques. The following scan protocols are predefined:

- **CaScoreRoutine**
  - Standard spiral protocol with ECG-gating which has been clinically used so far, relying on 12-slice acquisition, 1.5 mm collimation and 0.42 s gantry rotation time. The table feed is 5.6 mm/rotation.
- **CaScoreFastVolume**
  - Protocol with ECG-gating using 16-slice acquisition, 1.5 mm collimation and 0.42 s gantry rotation time. With the superior ability of the 16-slice acquisition, the table feed is increased to 6.8 mm/rotation. The time to cover a typical scan range of 15 cm will therefore be reduced to less than 10 s.
- **CaScoreSeq**
  - Sequential scan protocol with ECG-triggering and simultaneous acquisition of six 3 mm slices.

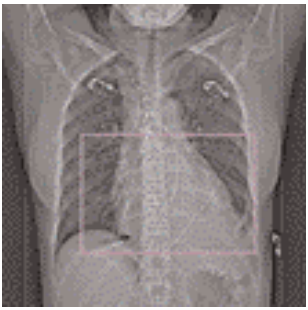
Hints in General

- Kernel B35f is dedicated to calcium scoring studies, providing most accurate determination of the HU-value of small calcified lesions. To ensure the best image quality and correlation to known reference data, other kernels are not recommended.
- Use the ECG-triggered protocol for low-dose scanning except for patients with arrhythmia. Use the ECG gated protocol when accuracy and/or reproducibility are essential, e. g. for follow-up studies of calcium scoring.
  – With 0.42 s gantry rotation time, temporal resolution varies between 105 ms and 210 ms depending on the patient's heart rate, reaching its optimum (105 ms) at 81 bpm, see Fig. 15.
  – We recommend a tube voltage of 120 kV.
  To reduce patient dose, tube voltage may be lowered to 100 kV or even 80 kV. With 80 kV, at least 250 eff. mAs should be used. 80 kV is not recommended for obese patients.
- The protocol with 0.42 s rotation time should be applied to all examinations.

CaScoreRoutine

Indications:

This is a standard spiral scanning protocol, using an ECG gating technique for coronary calcium scoring studies, with 12-slice acquisition, 1.5mm collimation and 0.42 s gantry rotation time.



Topogram: AP, 512 mm. From the carina to the apex of the heart. A typical range of 15 cm covering the entire heart can be done in 11.9 s.

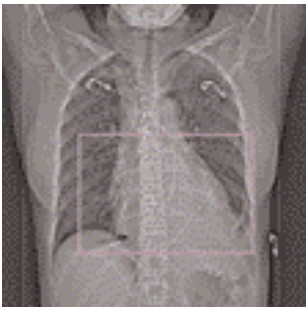
	CaSc
kV	*120*
Effective mAs	*133*
Slice collimation	*1.5 mm*
Slice width	*3 mm*
Feed/Rotation	*5.6 mm*
Rotation time	*0.42 sec.*
Temporal Resolution	*Up to105 ms**
Kernel	*B35f*
Increment	*1.5 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*9.6 mGy*
Effective Dose	*Male: 2.1 mSv*** *Female: 3.1 mSv***

** Depends on heart rate.*
*** Reduced by 30%-50% with ECG-pulsing.*

CaScoreFastVolume

Indications:

This is a standard spiral scan protocol using ECG-gating for coronary calcium scoring , with 16-slice acquisition, 1.5 mm collimation and 0.42 s gantry rotation time. With the superior ability of 16-slice acquisition, the table feed is increased to 6.8 mm/rotation, corresponding to 16.2 mm.



Topogram: AP, 512 mm. From the carina to the apex of the heart. A typical range of 15 cm covering the entire heart can be done in 9.8 s.

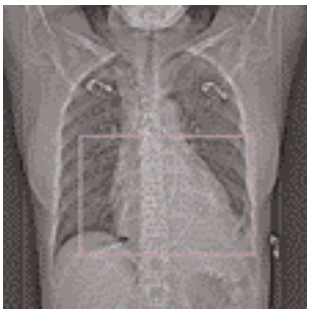
	CaSc
kV	*120*
Effective mAs	*150*
Slice collimation	*1.5 mm*
Slice width	*3 mm*
Feed/Rotation	*5.1 mm*
Rotation time	*0.42 sec.*
Temporal Resolution	*Up to105 ms**
Kernel	*B35f*
Increment	*1.5 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*10.5 mGy*
Effective Dose	*Male: 2.3 mSv*** *Female: 3.4 mSv***

** Depends on heart rate.*
*** Reduced by 30%-50% with ECG-pulsing.*

CaScoreSeq

Indications:

This is a sequential scanning protocol with ECG-triggering and simultaneous acquisition of six 3 mm slices 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 sec., otherwise the image acquisition will be interrupted by the default breathhold interval. This does not apply when API is not activated.

	CaScSeq
kV	*120*
mAs	*30*
Slice collimation	*1.5 mm*
Slice width	*3 mm*
Feed/Scan	*18 mm*
Rotation time	*0.42 sec.*
Temporal resolution	*210 ms*
Kernel	*B35f*
Image order	*cr-ca*
$CTDI_{Vol}$	*2.2 mGy*
Effective Dose	*Male: 0.5 mSv* *Female: 0.7 mSv*

* *Reduced by 30%-50% with ECG-pulsing.*

Coronary CTA

This is an application for imaging the coronary arteries with contrast medium. With the software version VA70 both, 12- and 16- slice scan protocols for ECG gated spiral scanning are supported, we recommend using only ECG gated spiral scanning. The following scan protocols are predefined:

- **CoronaryCTARoutine**
  - Standard spiral protocol with ECG-gating which has been clinically used so far, relying on 12-slice acquisition, 0.75 mm collimation and 0.42 s gantry rotation time. The table feed is 2.8 mm/rotation, corresponding to 6.7 mm/s.
- **CoronaryCTAFastVolume**
  - Protocol with ECG-gating using 16-slice acquisition, 0.75 mm collimation and 0.42 s gantry rotation time. With the superior ability of 16-slice acquisition, the table feed is increased to 3.4 mm/rotation, corresponding to 8 mm/s. The time to cover a typical scan range of 12 cm will therefore be reduced from 19 s to about 16 s.

Except from these two standard protocols three additional ECG-gated spiral protocols for coronary CTA are available.

- **CoronaryCTALowHeartRate**
  - This protocol is identical to CoronaryCTA FastVolume, except that it uses a reduced table feed of 2.6 mm/rotation. It is intended for patients with very low heart rates below 50 bpm.
- **CoronaryCTA100kV**
  - This protocol is identical to CoronaryCTAFastVolume, except that it uses 100 kV tube voltage instead of 120 kV. To ensure equal contrast-to-noise ratio for arteries filled with iodine contrast agent, the effective mAs-setting has been increased by about 10% to 600 mAs. As a consequence, patient dose with this protocol will be reduced by 30% compared to CoronaryCTAFastVolume.

- **CoronaryCTAAdaptSpeed**
  – This protocol is identical to CoronaryCTAFastVolume, except that it uses 0.5 s gantry rotation time instead of 0.42 s. The protocol is intended to provide dose reserves for obese patients with sufficiently low heart rates. It may be also worth trying for patients with a stable heart rate at 70 bpm, since with 0.5 s gantry rotation time, the optimum temporal resolution of 125 ms in reached at 69 bpm.

Hints in General

Contrast Medium:

For homogeneous contrast enhancement in the coronary arteries optimized contrast protocols are mandatory. The use of bolus tracking is helpful, with an automatic start of the spiral scan as soon as a contrast threshold of 100 HU has been reached in the ascending aorta.

Please note that correct placement of the ROI in the ascending aorta is essential. An example for an optimized contrast protocol is: Use 100 ml of contrast agent with a density of 320 mg/ml at a flow rate of 4 ml/s followed by 40 ml of saline chaser (double head injector).

For further information on the Bolus Tracking Application, please refer to the chapter “Bolus Tracking”.

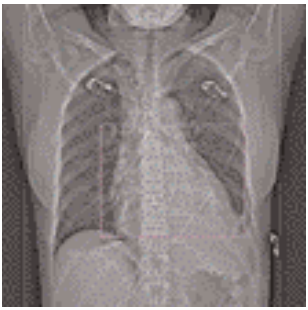
- We generally recommend using ECG-gated spiral protocols for optimized image quality of the coronary arteries and to provide high-quality 3D image data as an input for 3D postprocessing such as MPR, MIP, VRT or Fly Through. Although ECG-gated spiral scanning is less sensitive to variable heart rates than ECG-triggered sequential scanning, the examination of patients with complex arrhythmia that results in unpredictable variations of the RR-intervals (e. g. complex ventricular arrhythmia or multiple extra beats) can result in limited image quality and should be performed in exceptional cases only.
- Acquisition with 0.75 mm collimated slice width ensures best possible image quality due to the optimized intrinsic resolution of the scan data. Once high quality scan data has been acquired the reconstructed slice width has to be optimized with regard to image noise and best possible quality in MPR, MIP and VRT reconstructions. We recommend a reconstructed slice width of 1 mm at an increment of 0.5 mm, in combination with convolution kernel B30f. This choice guarantees the best trade off between maintained excellent spatial resolution, low image noise and high image quality in MPR's, MIP's and VRT's. Additional reconstructions with slice width 0.75 mm can be helpful for detailed viewing of heavily calcified coronary arteries or stents. In these cases, use of the high resolution kernel B46f in combination with the ASA image filter may further improve detail visibility.

CoronaryCTARoutine

Indications:

This is a standard spiral protocol with ECG-gating which has been clinically used so far, relying on 12-slice acquisition, 0.75 mm collimation and 0.42 s gantry rotation time.

The table feed is 2.8 mm/rotation.



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

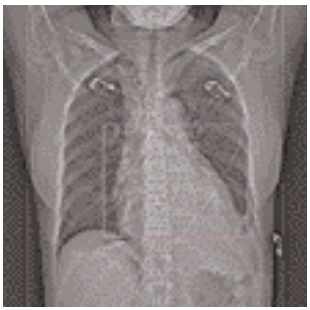
	CorCTA
kV	*120*
Effective mAs	*500*
Slice collimation	*0.75 mm*
Slice width	*1 mm*
Feed/Rotation	*2.8 mm*
Rotation time	*0.42 sec.*
Temporal resolution	*Up to 105 ms**
Kernel	*B30f*
Increment	*0.5 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*42.0 mGy*
Effective dose	*Male: 8.2 mSv*** *Female: 12.1 mSv***

** Depends on heart rate.*
*** Reduced by 30%-50% with ECG-pulsing.*

CoronaryCTAFastVolume

Indications:

ECG-gating using 16-slice acquisition, 0.75 mm collimation and 0.42 s gantry rotation time. With the superior ability 16-slice acquisition, the table feed is increased to 3.4 mm/rotation. The time to cover a typical scan range of 12 cm will therefore be reduced from 19 s to about 16 s.



Topogram: AP, 512 mm. Approximately, from the carina to the apex of the heart. A typical range of 12 cm covering the entire heart can be done in 15.4 s.

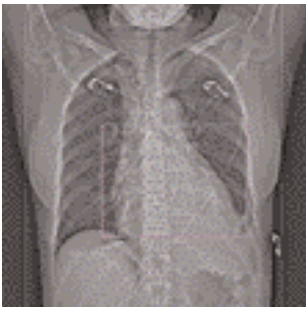
	CorCTA
kV	*120*
Effective mAs	*550*
Slice collimation	*0.75 mm*
Slice width	*1 mm*
Feed/Rotation	*2.6 mm*
Rotation time	*0.42 sec.*
Temporal resolution	*Up to 105 ms**
Kernel	*B30f*
Increment	*0.5 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*42.9 mGy*
Effective dose	*Male: 8.5 mSv*** *Female: 12.6 mSv***

** Depends on heart rate.*
*** Reduced by 30%-50% with ECG-pulsing.*

CorCTALowHeartRate

Indications:

This spiral scanning protocol is identical to CoronaryCTAFastVolume, except that it uses a reduced table feed of 2.6 mm/rotation, corresponding to 6.2 mm/s. It is intended for patients with very low heart rates below 50 bpm.



Topogram: AP, 512 mm. Approximately, from the carina to the apex of the heart. A typical range of 12 cm covering the entire heart can be done in 20.3 s.

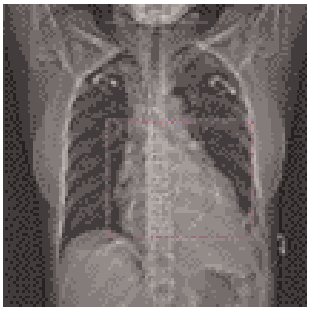
	CorCTALow
kV	*120*
Effective mAs	*700*
Slice collimation	*0.75 mm*
Slice width	*1.0 mm*
Feed/Rotation	*1.9 mm*
Rotation time	*0.42 sec.*
Temporal resolution	*Up to 105 ms**
Kernel	*B30f*
Increment	*0.5 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*54.6 mGy*
Effective dose	*Male: 10.8 mSv*** *Female: 16.2 mSv***

** Depends on heart rate.*
*** Reduced by 30%-50% with ECG-pulsing.*

CoronaryCTA100kV

Indications:

This is a spiral scanning protocol, using a rotation time of 0.42 s, and 100 kV tube voltage, with an ECG gating technique for coronary CTA studies.
As consequence of the changed parameters (100 kV, 600 mAs) the patient dose will be reduced by 30%.



Topogram: AP, 512 mm. Approximately, from the carina to the apex of the heart. A typical range of 12 cm covering the entire heart can be done in 15.4 s.

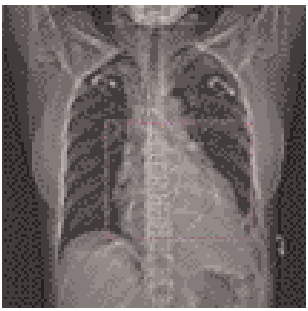
	CorCTA
kV	*100*
Effective mAs	*600*
Slice collimation	*0.75 mm*
Slice width	*1 mm*
Feed/Rotation	*2.6 mm*
Rotation time	*0.42 sec.*
Temporal resolution	*Up to 105 ms**
Kernel	*B30f*
Increment	*0.5 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*30.0 mGy*
Effective dose	*Male: 6.0 mSv*** *Female: 8.8 mSv***

** Depends on heart rate.*
*** Reduced by 30%-50% with ECG-pulsing.*

CoronaryCTAAdaptSpeed

Indications:

This is a spiral scanning protocol, using a rotation time of 0.5 s, with an ECG gating technique for coronary CTA studies. This protocol is intended to provide dose reserves for obese patients with sufficiently low heart rates. It can be also used for patients with a stable heart rate at 70 bpm.



Topogram: AP, 512 mm. Approximately, from the carina to the apex of the heart. A typical range of 12 cm covering the entire heart can be done in 15.7 s.

	CorCTA
kV	*120*
Effective mAs	*550*
Slice collimation	*0.75 mm*
Slice width	*1 mm*
Feed/Rotation	*3.0 mm*
Rotation time	*0.5 sec.*
Temporal resolution	*Up to 125 ms**
Kernel	*B30f*
Increment	*0.5 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*42.9 mGy*
Effective dose	*Male: 8.4 mSv*** *Female: 12.3 mSv***

** Depends on heart rate.*
*** Reduced by 30%-50% with ECG-pulsing.*

Aortic and Pulmonary Studies

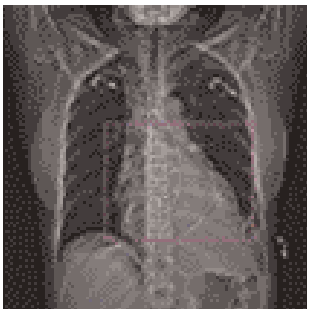
The purpose of these applications is to reduce motion artifacts in the lung, the aorta and the pulmonary arteries due to transmitted cardiac pulsation. It is intended for imaging the aorta and pulmonary arteries with contrast medium and ECG-triggered sequential scanning or ECG-gated spiral scanning, e. g. for aortic dissection or pulmonary emboli. A special protocol is available for high-resolution interstitial lung studies with ECG-triggered sequential scanning. The following scan protocols are predefined:

- **AngioECG**
  - Spiral scanning protocol with ECG-gating, using a 0.42 second rotation time.
- **AngioECGSeq**
  - Sequential scanning protocol with ECG triggering, using a rotation time of 0.42 seconds.
- **ThoraxECGHR**
  - Sequential scanning protocol with ECG triggering, using a rotation time of 0.75 seconds.

AngioECG

Indications:

This is a spiral scanning protocol using a rotation time of 0.42 s with an ECG gating technique for aortic and pulmonary studies.



Topogram: AP, 512 mm. Approximately, from the carina to the apex of the heart. A typical range of 30 cm covering the entire heart can be done in 19.2 s.

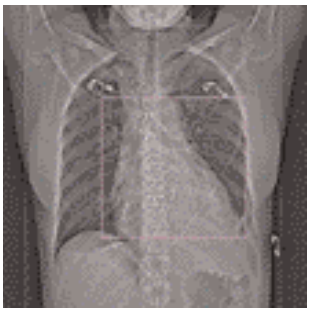
	ThorECG
kV	*120*
Effective mAs	*250*
Slice collimation	*1.5 mm*
Slice width	*3.0 mm*
Feed/Rotation	*5.1 mm*
Rotation time	*0.42 sec.*
Temporal resolution	*Up to 125 ms**
Kernel	*B30f*
Increment	*3.0 mm*
Image order	*cr-ca*
$CTDI_{vol}$	*17.5 mGy*
Effective dose	*Male: 7.0 mSv* *Female: 9.1 mSv*

* *Depends on heart rate.*

AngioECGSeq

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.



Topogram: AP, 512 mm. From the aortic arch to 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 cannot 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.

	ThorECG
kV	*120*
mAs	*120*
Slice collimation	*1.5 mm*
Slice width	*1.5 mm*
Feed/Scan	*18 mm*
Rotation time	*0.42 sec.*
Temporal resolution	*210 ms*
Kernel	*B30f*
Image order	*cr-ca*
$CTDI_w$	*8.64 mGy*
Effective dose	*Male: 1.7 mSv* *Female: 2.6 mSv*

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). It is recommended to keep always keep it 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.

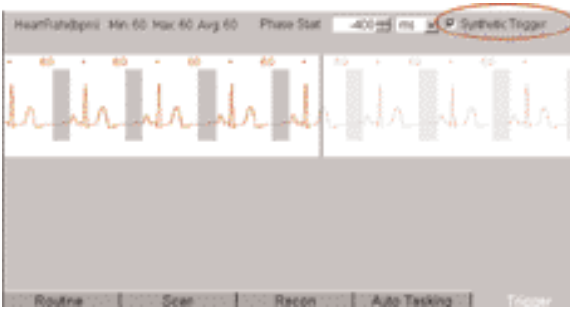


Fig. 1

Fig. 2

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 MPR, MIPthin Range Parallel and Radial protocols which can be linked to a special series.

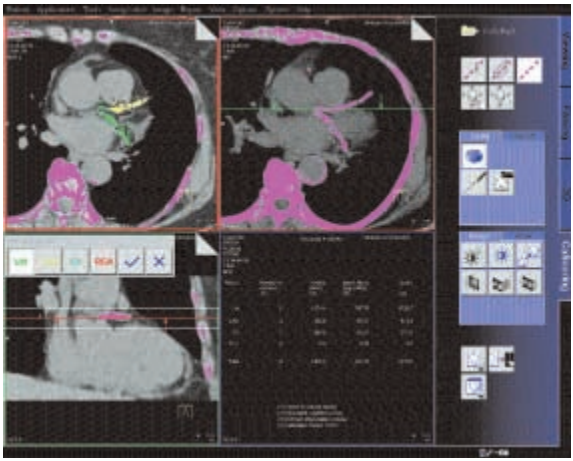
For example, if you always do MIP Reconstructions for a Coronary CTA examination, you load the images once into the 3D Card. Select the image type (e. g. MIPthin) and the orientation, and then open the Range Parallel function. Adapt the range settings (Image thickness, Distance between the images etc.), hit the link button and save. From this point on, you have a predefined postprocessing 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 preset with links to a postprocessing protocol. If you do not prefer to have this preset, please delete the Range Parallel preset or overwrite them with your own settings.

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 with a doubleclick.
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:
   – Number of lesions
   – 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 visualization 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).

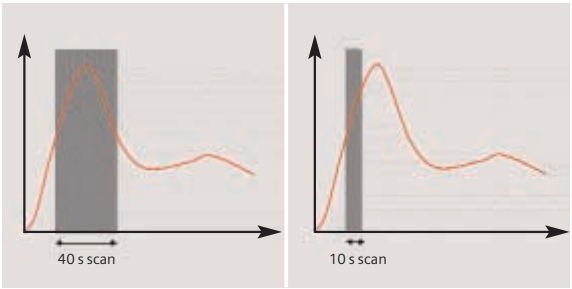


Fig. 1a: Longer scan time *Fig. 1b: Shorter scan time*

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*

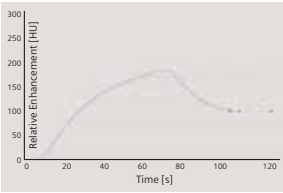


Fig. 2a: 2 ml/s, 120 ml, 300 mg I/ml

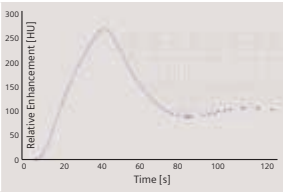


Fig. 2b: 4 ml/s, 120 ml, 300 mg I/ml

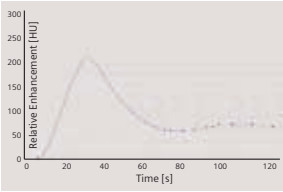


Fig. 3a: 80 ml, 4 ml/s, 300 mg I/ml

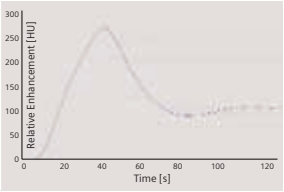


Fig. 3b:120 ml, 4 ml/s, 300 mg I/ml

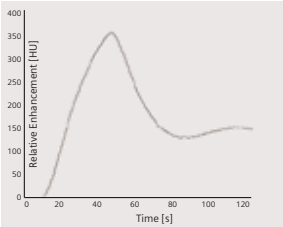


Fig. 4a: Uni-phase 140 ml, 4 ml/s, 370 mg I/ml

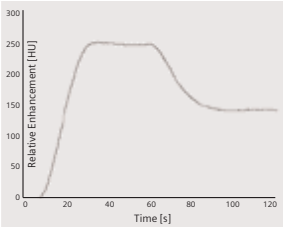


Fig. 4b: Bi-phase 70 ml, 4 ml/s, plus 70 ml, 2 ml/s, 370 mg I/ml

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. Once completed, load images into Dynamic Evaluation for the calculation of the time to peak enhancement.

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 23 "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:

- 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 with one left mouse click. (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 start 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 left mouse clicking the START radio button. If you do not want to use automatic triggering, you can set your trigger threshold number extremely high so that it will not trigger automatically, and you can start the spiral when you desire.

TestBolus

Indications:

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

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

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 subsequent 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 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 problems, you can repeat it afterwards by inserting CARE Bolus again with a right mouse click. The same Topogram can still be used.

Interventional CT

To facilitate CT interventional procedures, we created dedicated multislice and single slice sequential modes.

- Biopsy
  This is the multislice biopsy mode. E. g. 4 slices, 4.5 mm each, will be reconstructed and displayed for each scan.
- BiopsyCombine
  This is a single slice biopsy mode. 2 x 5 mm slice collimation is used to get a combined 10 mm slice.

The Basics

Any of these protocols can be appended to a spiral protocol for CT interventional procedures, such as a biopsy, abscess drainage, pain therapy, minimum invasive operations, joint studies, and arthrograms.

10 scans are predefined. You can repeat it by clicking the chronicle with the right mouse button and select “repeat”, or simply change the number of scans to 99 before you start the first scan.

You can “Append” any routine protocol after the interventional procedure for a final check and documentation, e. g. a short range of spiral scanning for the biopsy region.

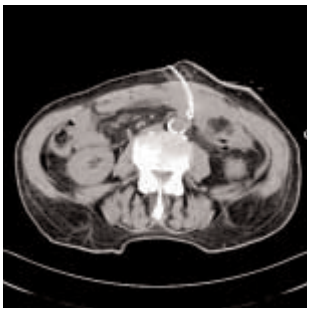
The table height can be adjusted to minimum 255 mm.

How to do it

Biopsy

Indications: This is the multislice biopsy mode. Four slices, 4.5 mm each, will be reconstructed and displayed for each scan. It can be appended to any other scan protocol, e. g. ThoraxRoutine for biopsy procedures in the thorax. Change the mAs setting accordingly before you load the mode.

	Biopsy
kV	*120*
Effective mAs	*120*
Slice collimation	*1.5 mm*
Slice width	*4.5 mm*
Feed/Scan	*0 mm*
Rotation time	*0.5 sec.*
Kernel	*B30f*



Application procedures:

1. Perform a spiral scan first to define a target slice.
2. Click “Same TP” under Table position in the routine card, and move the table.
3. Turn on the light marker to localize the Entry point, and then start the patient preparation.
4. Select “Biopsy” mode under Special protocols, and then click “Append”.

5. Click “Load” and then “Cancel move”. Press the “Start” button and 4 images will be displayed.
6. Press “Start” again, you’ll get another 4 images with the same slice position.

BiopsyCombine

Indications: This is the biopsy mode with one combined slices. It can be appended to any other scan protocol, e. g. ThoraxRoutine for biopsy procedures in the thorax.

Change the mAs setting accordingly before you load the mode.

	BiopsyCombine
kV	*120*
Effective mAs	*120*
Slice collimation	*5.0 mm*
Slice width	*10 mm*
Feed/Scan	*0 mm*
Rotation time	*0.5 sec.*
Kernel	*B30f*

Application procedures:

1. Perform a spiral scan first to define a target slice.
2. Click “Same TP” under Table position in the routine card, and move the table.
3. Turn on the light marker to localize the Entry point, and then start the patient preparation.
4. Select “BiopsyCombine” mode under Special protocols, and then click “Append”.
5. Click “Load” and then “Cancel move”. Press the “Start” button and one image will be displayed.
6. Press “Repeat” and “Start” again, you’ll get another image with the same slice position.

Additional Important Information

- In the BiopsyCombine mode, the slice position, table position, table begin and table end are all the same.
- In the Biopsy mode, the slice position, table position, table begin and table end are different.

a) The SP (slice position) in each image means the center of the image (Fig. 1).

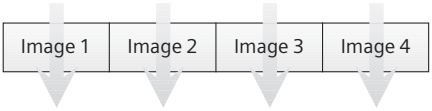


Fig. 1

b) The "Table position" means the central position of the 4 images and will also be the position of the positioning light marker (Fig. 2).

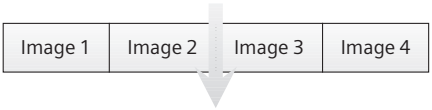


Fig. 2

c) The table "Begin" means the center of the first image, and the table "End" means the center of the last image (Fig. 3).

Fig. 3

WholeBodyAngio

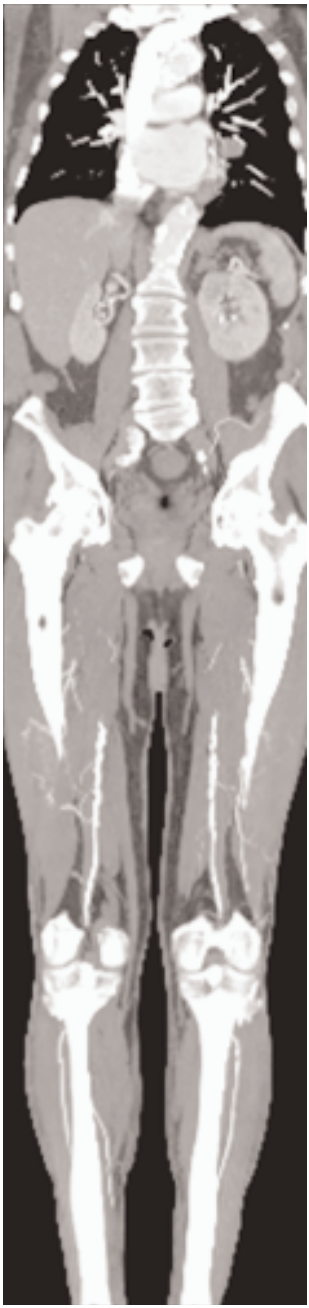
This scan protocol can be used for a whole Body Angio.

A range of 100 cm can be covered in 14.5 sec.

	WholeBody	**2nd Reconstr.**
kV	*120*	
Effective mAs	*130*	
Slice collimation	*1.5 mm*	
Slice width	*6 mm*	*2 mm*
Feed/Rotation	*27.0 mm*	
Rotation time	*0.5 sec.*	
Kernel	*B30f*	*B20f*
Increment	*6 mm*	*1.5 mm*
Image order	*cr-ca*	
$CTDI_w$	*9.1 mGy*	

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.
If you prefer to change this preset, adapt the parameters to your needs and link them to the series.

MIPthick: WholeBodyAngio	**coronal**
Image thickness	*3*
Distance between images	*3*
Number of images	*60*



LungCARE

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

Indications:

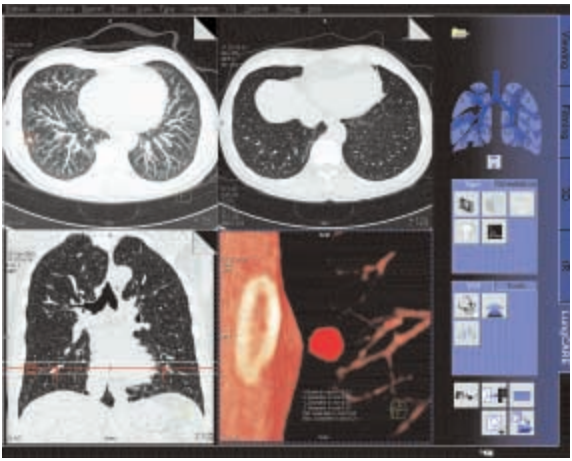
Lung studies with low dose setting, e. g. early visualization of pulmonary nodules.

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

	LungCARE
kV	*120*
Effective mAs	*20*
Slice collimation	*0.75 mm*
Slice width	*1.0 mm*
Feed/Rotation	*13.5 mm*
Rotation time	*0.5 sec.*
Kernel	*B50f*
Increment	*0.5 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*1.6 mGy*
Effective dose	*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”.

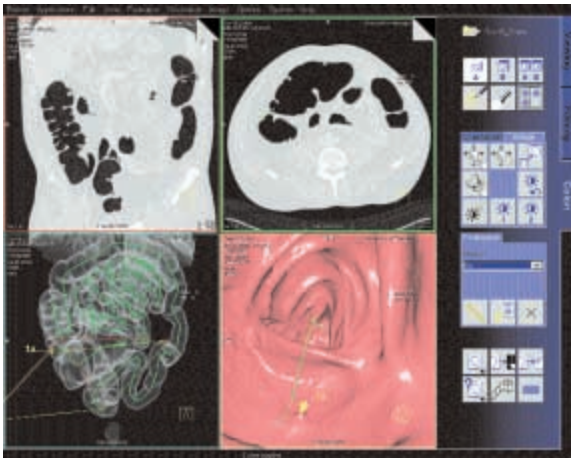


User interface of syngo LungCARE

This is a promising application, dedicated to visualize and evaluate lesions in the colon. This study is not only non-invasive, but a much more comfortable method for the patient.

A typically range of 40 cm can be covered in 11.7 sec.

	Colonography	2nd Reconstr.
kV	*120*	
Effective mAs	*100*	
Slice collimation	*0.75 mm*	
Slice width	*5.0 mm*	*1.0 mm*
Feed/Rotation	*13.5 mm*	
Rotation time	*0.5 sec.*	
Kernel	*B30f*	*B30f*
Increment	*5.0 mm*	*0.7 mm*
Image order	*cr-ca*	
$CTDI_{Vol}$	*7.8 mGy*	
Effective dose	*Male: 4.5 mSv* *Female: 7.7 mSv*	



User interface of syngo 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.

  Inflate the colon to the patients 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. The second scan can be performed with lower dose, e. g. 30 to 50 mAs.

- 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 memo lines in the chronicle. The mAs values need to be changed accordingly, to memo instructions according to size or weight.

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.

- **Head05s**
  For routine head spiral studies
- **HeadSeq05s**
  For routine head sequential studies
- **Head Angio**
  For head CT Angio spiral studies
- **CarotidCTA**
  For carotid CT Angio spiral studies
- **NeonateBody**
  Spiral mode for neonate spiral studies
- **ThoraxRoutine**
  For routine chest spiral studies
- **AbdPelRoutine**
  For routine abdominal spiral studies
- **AbdCTA**
  For abdominal CT Angio spiral 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 advantage 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 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 pleasant 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.

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).

Head kernels

The VA70 provides three new kernels for head protocols: H21, H31, H41.

The endings “s” or “f” depend on the rotation time.

They are comparable to H20, H30 or H40 with respect to sharpness but they show a different granularity with a finer image noise pattern. In general, the low contrast detectability benefits from a fine-grained noise.

The kernel H31 is set as default in all preset head protocols for soft tissue evaluation.

For adapting the image sharpness, the kernels H21 (smoother) or H41 (sharper) might be used.

Body kernels

The VA70 provides two new kernels for body region protocols: B31 and B41. The endings “s” or “f” depend on the rotation time.

They are comparable to B30 or B40 concerning sharpness but show a fine-grained noise, which generally improves low-contrast detectability In most of the preset scan protocols the new kernels are used for image reconstruction of soft tissue.

Head05s

Indications:

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

	Head
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	$CTDI_{Vol}$ (mGy)	Effective dose (mSv)
< 6 months	*120*	*90*	*17.1*	*Male: 2.3** *Female: 2.3**
6 months – 3 years	*120*	*150*	*28.5*	
3 years – 6 years	*120*	*220*	*41.8*	*Male: 3.8*** *Female: 3.7***

* *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, 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 are of interest, use kernel C60s for image reconstruction.
- **P**osterior **F**ossa **O**ptimization Filter
  PFO: To reduce beam-hardening artifacts in head images, particularly in the base of the skull, use the Posterior Fossa Optimization (PFO) filter.

HeadSeq05s

Indications:

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

	HeadSeq
kV	*120*
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	$CTDI_{Vol}$ (mGy)	Effective dose (mSv)
< 6 months	*120*	*90*	*17.3*	*Male: 1.7** *Female: 1.7**
6 months – 3 years	*120*	*150*	*28.8*	
3 years – 6 years	*120*	*220*	*42.2*	*Male: 3.4*** *Female: 3.3***

* *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, and a scan range of 121.5 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.
- **P**osterior **F**ossa **O**ptimization 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	2nd 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	$CTDI_{vol}$ (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.*

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

MIPthin: HeadAngio	**coronal**
Image thickness	*3*
Distance between images	*3*
Number of images	*35*

Contrast medium IV injection	
Start delay	*18 – 20 sec.*
Flow rate	*dependent upon needle size/Access site*
Total amount	*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	2nd 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	*ca-cr*	

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

Age	kV	mAs	$CTDI_{Vol}$ (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.*

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

MIPthin: CarotidCTA	**coronal**
Image thickness	*3*
Distance between images	*3*
Number of images	*20*

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 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
kV	*80*
Effective mAs	*25*
Slice collimation	*1.5 mm*
Slice width	*6.0 mm*
Feed/Rotation	*24 mm*
Rotation time	*0.5 sec.*
Kernel	*B30f*
Increment	*6.0 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*0.6 mGy*
*Effective mAs**	*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*

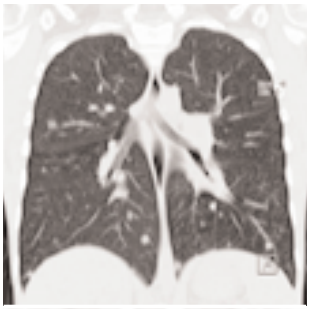
Tips

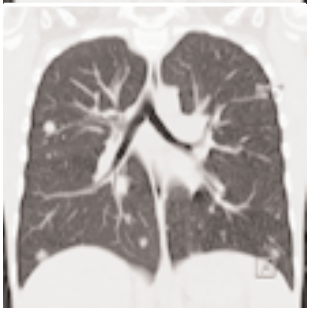
- You can modify the slice width for image reconstruction according to the clinical indications.

ThoraxRoutine

Indications:

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





	Thorax	2nd 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	*ca-cr*	

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

Body weight	kV	mAs	$CTDI_{Vol}$ (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 soft tissue 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.

	AbdPelvis	2nd 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	$CTDI_{Vol}$ (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*	*3.9*	*Male: 2.3** Female: 3.1***
35 – 44 kg	*120*	*85*	*6.0*	
45 – 54 kg	*120*	*120*	*8.4*	

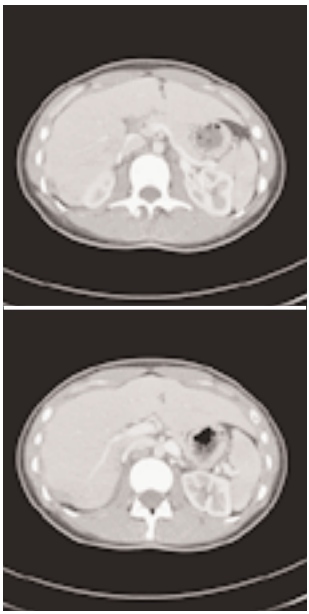
* *The conversion factor for an 8-week-old, and a scan range of 100 mm was used.*

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

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 first and second recon jobs are defined for visualization of soft tissue and the lungs, respectively.



AbdCTA

Indications:

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

	AbdCTA	2nd 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	$CTDI_{Vol}$ (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.*

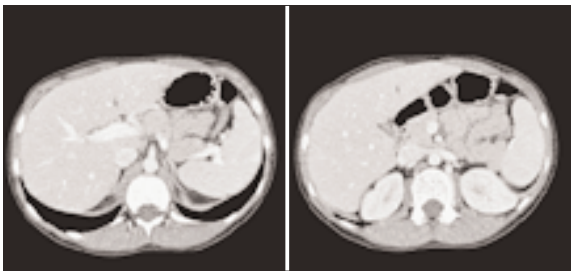
For the 2nd reconstruction the Autoload into MIPthin Range on the 3D Card is activated. The images will be automatically loaded into 3D, MIPthin, and a sagittal MIPthin Range will pop up.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

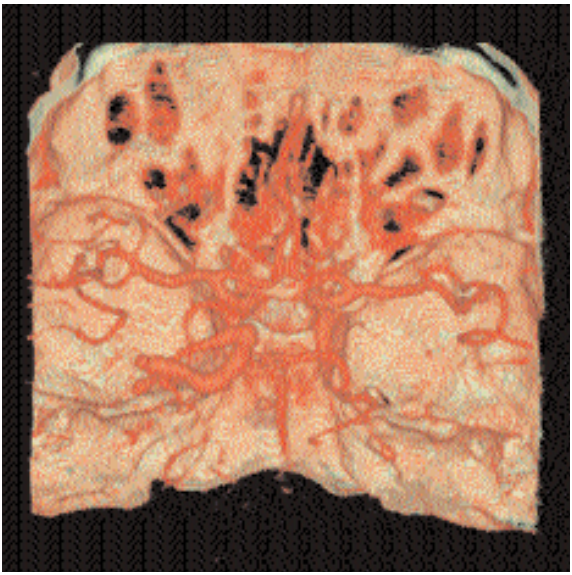
MIPthin: AbdCTA	**sagittal**
Image thickness	*3*
Distance between images	*3*
Number of images	*60*

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 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
- **AngioHead100kV**
  This protocol is identical to "AngioHead", except that it uses 100 kV tube voltage instead of 120 kV
- **HeadSeq05s**
  Sequence mode for base of the skull and cerebrum routine studies and a 0.5 s rotation time
- **Head05s**
  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.

Kernels:

The VA70 provides three new kernels for head protocols: H21, H31, H41.

The endings “s” or “f” depend on the rotation time.

They are comparable to H20, H30 or H40 with respect to sharpness but they show a different granularity with a finer image noise pattern. In general, the low contrast detectability benefits from a fine-grained noise.

The kernel H31 is set as default in all preset head protocols for soft tissue evaluation.

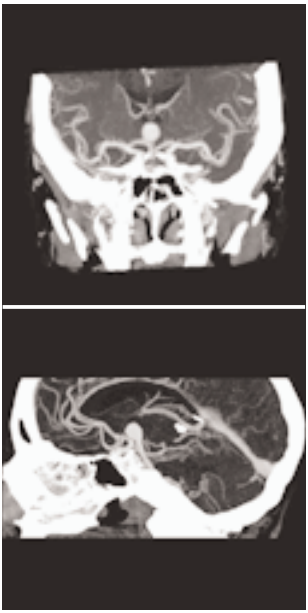
For adapting the image sharpness, the kernels H21 (smoother) or H41 (sharper) might be used.

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 sec.



	AngioHead	2nd Reconstr.
kV	*120*	
Effective mAs	*100*	
Slice collimation	*0.75 mm*	
Slice width	*4.0 mm*	*1.0 mm*
Feed/Rotation	*15.0 mm*	
Rotation time	*0.5 sec.*	
Kernel	*H20f*	*H10f*
Increment	*4.0 mm*	*0.7 mm*
Image order	*ca-cr*	
$CTDI_{Vol}$	*21.1 mGy*	
Effective dose	*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.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

MIPthin: AngioHead	coronal
Image thickness	*3*
Distance between images	*3*
Number of images	*35*

Contrast medium IV injection	
Start delay	*18 sec.*
Flow rate	*3.5 ml/s*
Total amount	*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.

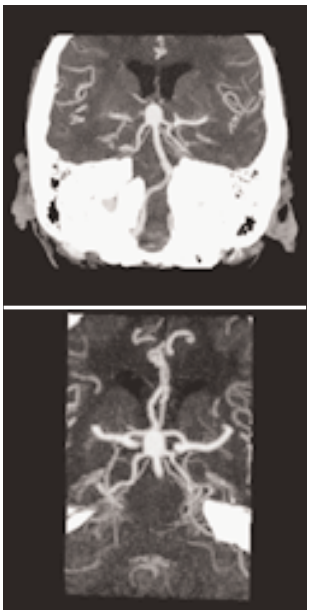
AngioHead100kV

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 3.3 sec.



	AngioHead	2nd Reconstr.
kV	*100*	
Effective mAs	*120*	
Slice collimation	*0.75 mm*	
Slice width	*4.0 mm*	*1.0 mm*
Feed/Rotation	*15.0 mm*	
Rotation time	*0.5 sec.*	
Kernel	*H20f*	*H10f*
Increment	*4.0 mm*	*0.7 mm*
Image order	*ca-cr*	
$CTDI_{Vol}$	*16.9 mGy*	
Effective dose	*Male: 0.6 mSv*	
	Female: 0.7 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.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

MIPthin: AngioThinSlice	coronal
Image thickness	*3*
Distance between images	*3*
Number of images	*35*

Contrast medium IV injection	
Start delay	*18 sec.*
Flow rate	*3.5 ml/sec.*
Total amount	*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.

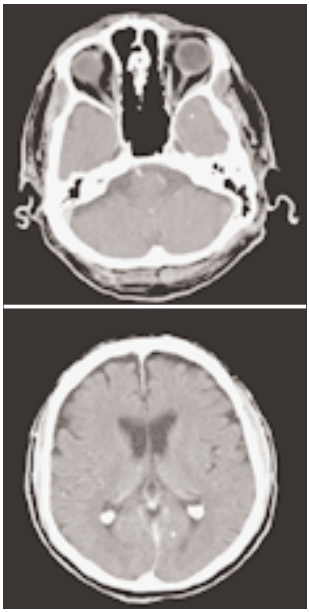
HeadSeq05s

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.

For both ranges a typical gantry tilt of -20° is predefined.



	ThinSliceSeq	RoutineSeq
kV	*120*	*120*
mAs	*250*	*250*
Slice collimation	*0.75 mm*	*1.5 mm*
Slice width	*4.5 mm*	*9.0 mm*
Feed/Scan	*9.5 mm*	*19.0 mm*
Rotation time	*0.5 sec.*	*0.5 sec.*
Kernel	*H31f*	*H31f*
Image order	*ca-cr*	*ca-cr*
$CTDI_{Vol}$	*53.0 mGy*	*45.5 mGy*
Effective dose	*Male: 1.9 mSv*	*Male: 1.6 mSv*
	Female: 2.0 mSv	*Female: 1.8 mSv*

Posterior**F**ossa**O**ptimization 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	
Start delay	*60 sec.*
Flow rate	*2 ml/sec.*
Total amount	*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*.

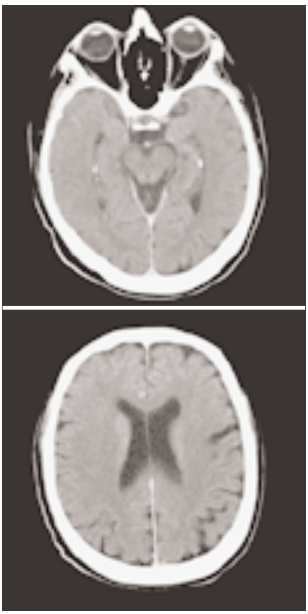
Head05s

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.

A range for the base of 40 mm will be covered in 3.5 sec., a range for the cerebrum of 80 mm will be covered in 3.5 sec.

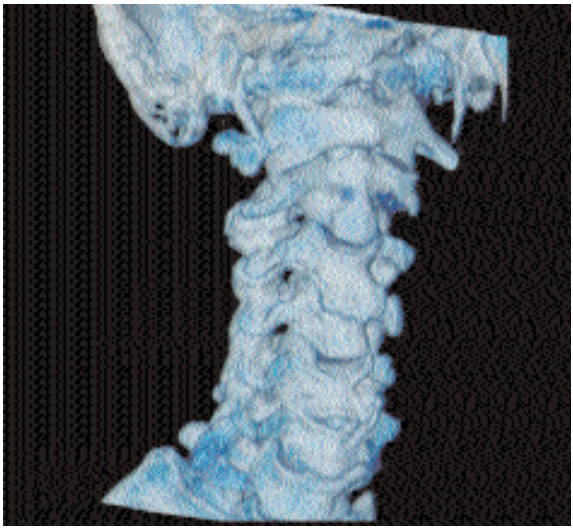


	ThinSlice	Routine
kV	*120*	*120*
Effective mAs	*320*	*320*
Slice collimation	*0.75 mm*	*1.5 mm*
Slice width	*4.0 mm*	*8.0 mm*
Feed/Rotation	*6.8 mm*	*13.7 mm*
Rotation time	*0.5 sec.*	*0.5 sec.*
Kernel	*H31f*	*H31f*
Increment	*4.0 mm*	*8.0 mm*
Image order	*ca-cr*	*ca-cr*
$CTDI_{Vol}$	*67.5 mGy*	*60.8 mGy*
Effective dose	*Male: 2.4 mSv*	*Male: 2.1 mSv*
	Female: 2.6 mSv	*Female: 2.2 mSv*

Posterior**F**ossa**O**ptimization 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	
Start delay	*60 sec.*
Flow rate	*2 ml/sec.*
Total amount	*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 spiral studies

Hints in General

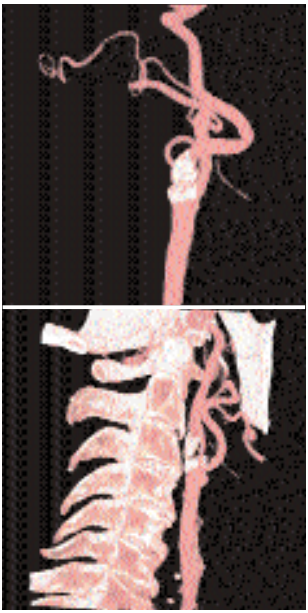
1. Topogram: AP, 512 mm.
2. Patient positioning:
   Patient lying in supine position, hyperextend neck slightly, secure head well in head holder.
3. Patient respiratory instruction:
   do not breathe, do not swallow.
4. For image reconstruction of bone structure, use kernel B60.
5. In case of 3D study only, the mAs value can be reduced by 50 %. Use kernel B10 and at least 50 % overlapping for image reconstruction.
6. For examinations in the Neck/Shoulder region at least 120 kV is recommended 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 sec.



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

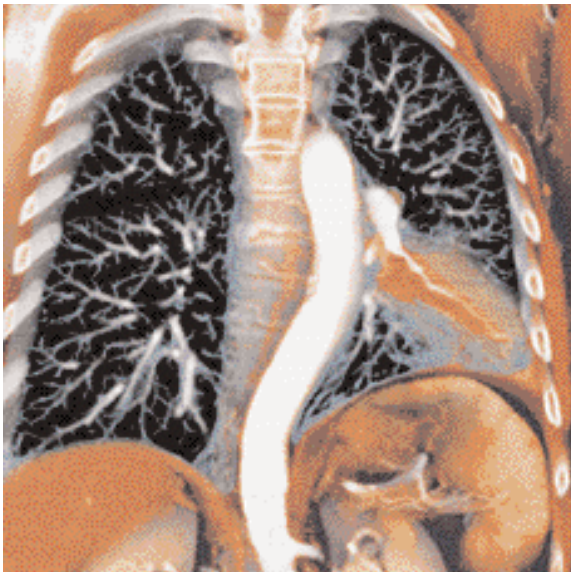
For the 2nd reconstruction the Autoload into MIPthin Range on the 3D Card is activated. The images will be automatically loaded into 3D, MIPthin, and a coronal MIPthin Range will pop up.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

MIPthin: AngioCarotid	**coronal**
Image thickness	*3*
Distance between images	*3*
Number of images	*20*

Contrast medium IV injection	
Start delay	*15 sec.*
Flow rate	*4 ml/sec.*
Total amount	*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
- **Embolism**
  Spiral mode for Pulmonary Emboli studies
- **Embolism100kV**
  Spiral mode for Pulmonary Emboli studies using 100 kV
- **ThoraxCombi**
  For the combination of thin slice lung and routine thorax spiral studies
- **ThoraxRoutine**
  For routine thorax spiral 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.

Kernels:

The VA70 provides two new kernels for body region protocols: B31 and B41. The endings “s” or “f” depend on the rotation time.

They are comparable to B30 or B40 concerning sharpness but show a fine-grained noise, which generally improves low-contrast detectability In most of the delivered scan protocols the new kernels are used for image reconstruction of soft tissue.

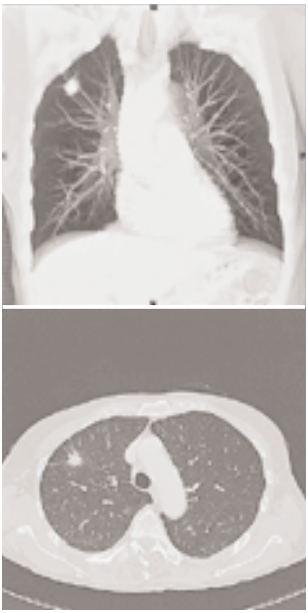
4. For image reconstruction of the lung, use kernel B80.
5. If the voltage is lowered from 120 kV to 80 kV significant higher mAs values have to be used (at least by a factor of 2).

LungLowDose

Indications:

Lung spiral 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 sec.



	LungCARE	2nd Reconstr.
kV	*120*	
Effective mAs	*20*	
Slice collimation	*0.75 mm*	
Slice width	*5.0 mm*	*1.0 mm*
Feed/Rotation	*18.0 mm*	
Rotation time	*0.5 sec.*	
Kernel	*B50f*	*B50f*
Increment	*5.0 mm*	*0.7 mm*
Image order	*cr-ca*	
$CTDI_{Vol}$	*1.6 mGy*	
Effective dose	*Male: 0.6 mSv*	
	Female: 0.7 mSv	

For the 2nd reconstruction the Autoload into the MPR Range on the 3D Card is activated. The images will be automatically loaded into 3D, MPR, and a coronal MPRthick Range will pop up.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

MPRthick: Spine	**sagittal**
Image thickness	*3*
Distance between images	*3*
Number of images	*20*

Contrast medium IV injection	
Start delay	*30 sec.*
Flow rate	*2.5 ml/sec.*
Total amount	*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.

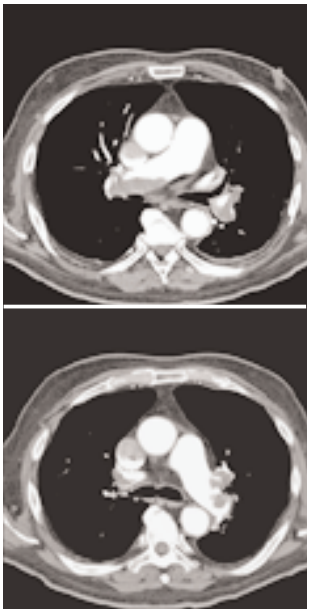
Embolism

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 and 0.7 mm increment is used for postprocessing.

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



	Embolism	2nd Reconstr.
kV	*120*	
Effective mAs	*100*	
Slice collimation	*0.75 mm*	
Slice width	*5.0 mm*	*1.0 mm*
Feed/Rotation	*15.0 mm*	
Rotation time	*0.5 sec.*	
Kernel	*B40f*	*B30f*
Increment	*5.0 mm*	*0.7 mm*
Image order	*cr-ca*	
$CTDI_{Vol}$	*7.8 mGy*	
Effective dose	*Male: 3.0 mSv*	
	Female: 3.9 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 coronal MIPthin Range will pop up.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

MIPthin: AngioRunOff	**coronal**
Image thickness	*3*
Distance between images	*3*
Number of images	*50*

Contrast medium IV injection	
Start delay	*12 – 15 sec.**
Flow rate	*4 ml/sec.*
Total amount	*100 – 120 ml*

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

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

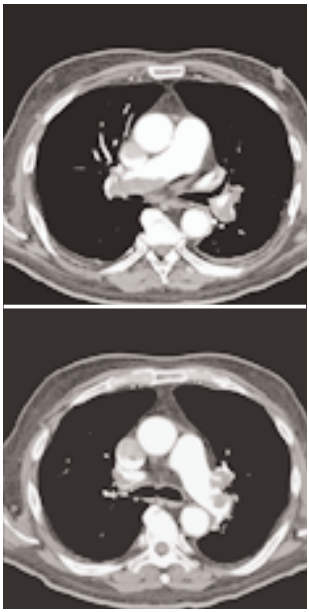
Embolism100kV

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 and 0.7 mm increment is used for postprocessing.

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



	Embolism	2nd Reconstr.
kV	*100*	
Effective mAs	*120*	
Slice collimation	*0.75 mm*	
Slice width	*5.0 mm*	*1.0 mm*
Feed/Rotation	*15.0 mm*	
Rotation time	*0.5 sec.*	
Kernel	*B40f*	*B30f*
Increment	*5.0 mm*	*0.7 mm*
Image order	*cr-ca*	
$CTDI_{Vol}$	*6.0 mGy*	
Effective dose	*Male: 2.3 mSv*	
	Female: 3.0 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 coronal MIPthin Range will pop up.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

MIPthin: AngioRunOff	**coronal**
Image thickness	*3*
Distance between images	*3*
Number of images	*50*

Contrast medium IV injection	
Start delay	*12 – 15 sec.**
Flow rate	*4 ml/sec.*
Total amount	*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.

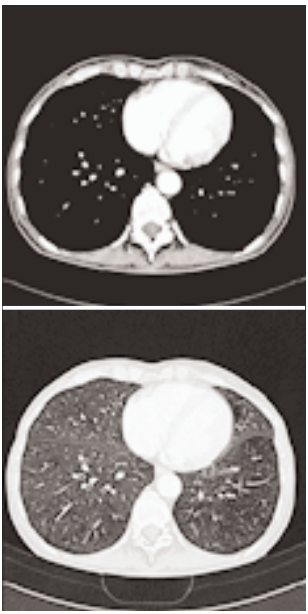
ThoraxCombi

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 sec.



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

For the 2nd reconstruction the Autoload into the MPR Range on the 3D Card is activated. The images will be automatically loaded into 3D, MPR, and a coronal MPRthick Range will pop up.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

MPRthick: ThoraxCombi	**sagittal**
Image thickness	*3*
Distance between images	*3*
Number of images	*20*

Contrast medium IV injection	
Start delay	*25 sec.*
Flow rate	*2.5 ml/sec.*
Total amount	*80 ml*

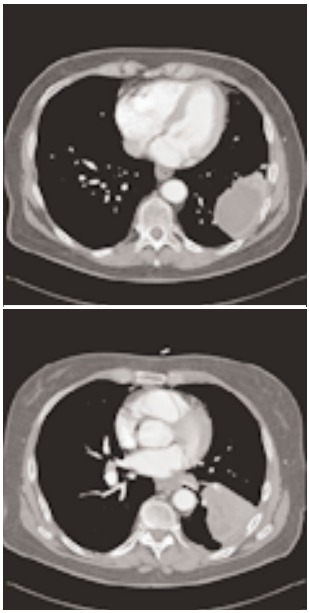
If you want to reconstruct thin slices in every 2 mm or 10 mm instead of 0.7 mm as predefined, simply change the increment before image reconstruction.

ThoraxRoutine

Indications:

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

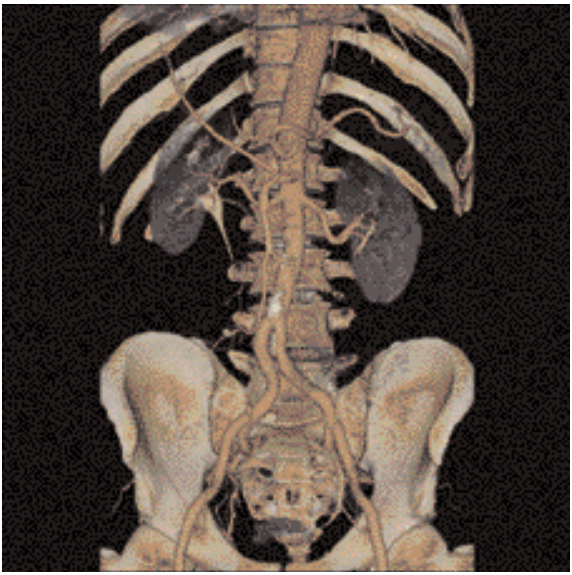
A range of 30 cm will be covered in 5.6 sec.



	ThoraxRoutine
kV	*120*
Effective mAs	*100*
Slice collimation	*1.5 mm*
Slice width	*6.0 mm*
Feed/Rotation	*30.0 mm*
Rotation time	*0.5 sec.*
Kernel	*B41f*
Increment	*6.0 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*7.0 mGy*
Effective dose	*Male: 2.8 mSv* *Female: 3.6 mSv*

Contrast medium IV injection	
Start delay	*25 – 30 sec.*
Flow rate	*2.5 ml/sec.*
Total amount	*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 spiral studies
- **AngioFast**
  For long-range CTA spiral studies
- **AngioRoutine**
  For CTA routine spiral 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: expiration.
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 bowels 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 bowel.

   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.

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.

Kernels:

The VA70 provides two new kernels for body region protocols: B31 and B41. The endings “s” or “f” depend on the rotation time.

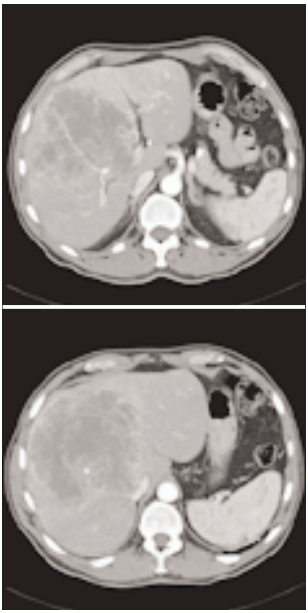
They are comparable to B30 or B40 concerning sharpness but show a fine-grained noise, which generally improves low-contrast detectability In most of the preset scan protocols the new kernels are used for image reconstruction of soft tissue.

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 sec.



	AbdRoutine
kV	*120*
Effective mAs	*160*
Slice collimation	*1.5 mm*
Slice width	*5.0 mm*
Feed/Rotation	*24.0 mm*
Rotation time	*0.5 sec.*
Kernel	*B31f*
Increment	*5.0 mm*
Image order	*cr-ca*
$CTDI_{Vol}$	*11.2 mGy*
Effective dose	*Male: 6.5 mSv* *Female: 10.0 mSv*

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

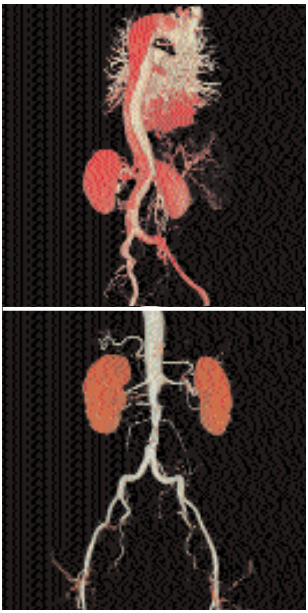
You could repeat the same protocol simply by clicking the chronicle with the right mouse button for *"repeat"*. E. g. when both non-contrast and contrast studies are required.

AngioFast

Indications:

Long range CTA studies.

E. g.: a typical study of the whole aorta including its branchiocephalic trunk and iliac arteries in a range of 80 cm will be covered in 11.7 sec.



	AngioFast	2nd Reconstr.
kV	*120*	
Effective mAs	*130*	
Slice collimation	*1.5 mm*	
Slice width	*5.0 mm*	*2.0 mm*
Feed/Rotation	*36.0 mm*	
Rotation time	*0.5 sec.*	
Kernel	*B30f*	*B20f*
Increment	*5.0 mm*	*1.5 mm*
Image order	*cr-ca*	
$CTDI_{Vol}$	*9.1 mGy*	
Effective dose	*Male: 10.5 mSv*	
	Female: 11.9 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.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

MIPthin: AngioFast	**sagittal**
Image thickness	*3*
Distance between images	*3*
Number of images	*60*

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

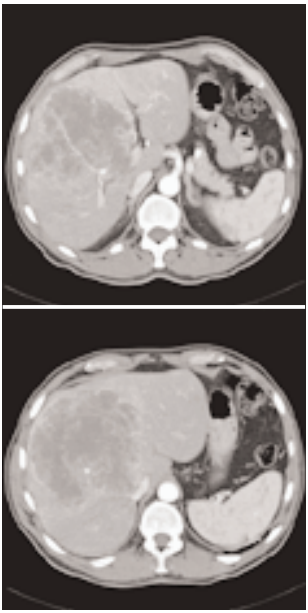
Do not administer oral contrast medium, as this impairs the editing of MIP/SSD/VRT images.

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 sec.



	AngioRoutine	2nd Reconstr.
kV	*120*	
Effective mAs	*130*	
Slice collimation	*0.75 mm*	
Slice width	*5.0 mm*	*1.0 mm*
Feed/Rotation	*15.0 mm*	
Rotation time	*0.5 sec.*	
Kernel	*B30f*	*B20f*
Increment	*5.0 mm*	*0.7 mm*
Image order	*cr-ca*	
$CTDI_{Vol}$	*10.1 mGy*	
Effective dose	*Male: 6.0 mSv*	
	Female: 9.1 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.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

MIPthin: AngioRoutine	sagittal
Image thickness	*3*
Distance between images	*3*
Number of images	*60*

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

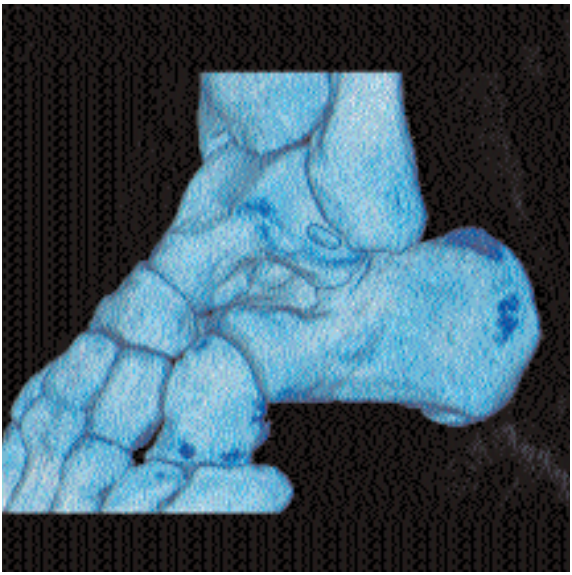
Do not administer oral contrast medium, as this impairs the editing of MIP/SSD/VRT images.

AbdomenSeq

Indications:

This protocol is created for measurement with sequential mode in the region of the abdomen.

	AbdomenSeq
kV	*120*
mAs	*140*
Slice collimation	*5.0 mm*
Slice width	*5.0 mm*
Feed/Scan	*10.0 mm*
Rotation time	*0.5 sec.*
Kernel	*B31f*
$CTDI_{Vol}$	*8.8 mGy*
Image order	*cr-ca*



Overview

- **AngioRunOff**
  For long range CTA spiral studies

Hints in General

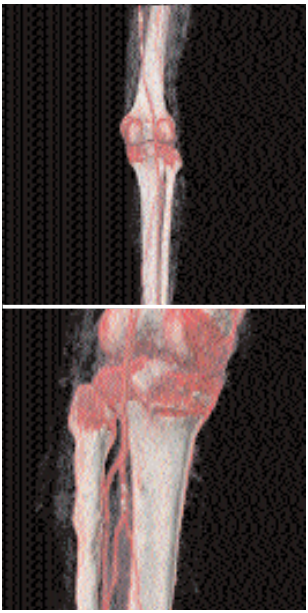
1. Topogram: AP, 1024mm for CTA.
2. If Topo length 1024 mm is not long enough, you can also choose the 1540 mm long Topogram.
3. Position the patient as feet first.
   Bend the feet together if necessary.
4. If the Pelvis region is included in the scan range, we recommend at least 120 kV.

AngioRunOff

Indications:

For CTA studies

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



	AngioRunOff	2nd 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*
$CTDI_{Vol}$	*9.1 mGy*	
Effective dose	*Male: 4.4 mSv* *Female: 3.2 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 coronal MIPthin Range will pop up.
If you are not satisfied with the Range preset, adapt the parameters to your needs and link them to the series.

MIPthin: AngioRunOff	**coronal**
Image thickness	*3*
Distance between images	*3*
Number of images	*50*

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

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

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Siemens AG
Medical Solutions
Computed Tomography
Siemensstrasse 1
D-91301 Forchheim
Germany
www.SiemensMedical.com

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