



SOMATOM Spirit Application Guide



Protocols
Principles
Helpful Hints

***syngo* 3D**
***syngo* Fly Through**
***syngo* Dental CT**
***syngo* Osteo CT**
***syngo* Volume Evaluation**
***syngo* Dynamic Evaluation**

Software Version *syngo* CT 2005C

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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 are consistent with the approval labeling for uses and/or indications of the drug. The treating physician bears the sole responsibility for the diagnosis and treatment of patients, including drugs and doses prescribed in connection with such use. The Operating Instructions must always be strictly followed when operating the CT System. The source for the technical data is the corresponding data sheets.

The pertaining operating instructions must always be strictly followed when operating the SOMATOM Spirit. The statutory source for the technical data are the corresponding data sheets.

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

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To improve future versions of this Application Guide, we would greatly appreciate your questions, suggestions and comments.

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For further information about the basic operation, please refer to the corresponding *syngo* CT Operator Manual:

***syngo* CT Operator Manual**

Volume 1:

Security Package

Basics

Preparations

Examination

CARE Bolus CT

***syngo* CT Operator Manual**

Volume 2:

syngo Patient Browser

syngo Viewing

syngo Filming

syngo 3D

***syngo* CT Operator Manual**

Volume 3:

syngo Data Set Conversion

syngo Dental CT

syngo Dynamic Evaluation

syngo Osteo CT

syngo Volume

Concept of Scan Protocols

The scan protocols for adult and children are defined according to body regions – **Head, Neck, Shoulder, Thorax, Abdomen, Pelvis, Spine, Upper Extremities, Lower Extremities, Specials, and Vascular.**

The general concept is as follows: All protocols without suffix are standard spiral modes. E.g., “Shoulder” means the spiral mode for the shoulder.

The suffixes of the protocol name are follows:

“**Routine**”: for routine studies

“**Seq**”: for sequence studies

“**Fast**”: use a higher pitch for fast acquisition

“**HR**”: use a thinner slice width (1.0 mm) for High Resolution studies and a thicker slice width for soft tissue studies

The availability of scan protocols depends on the system configuration.

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 range name in the chronicle can be easily changed 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 Modes

Sequential Scanning

This is an incremental, slice-by-slice imaging mode in which there is no table movement during data acquisition. A minimum interscan delay in between each acquisition is required to move the table to the next slice position.

Spiral Scanning

Spiral scanning is a continuous volume imaging mode. The data acquisition and table movements are performed simultaneously for the entire scan duration. There is no interscan delay and a typical range can be acquired in a single breath hold.

Each acquisition provides a complete volume data set, from which images with overlapping can be reconstructed at any arbitrary slice position. Unlike the sequence mode, spiral scanning does not require additional radiation to obtain overlapping slices.

Dynamic Serioscan

Dynamic serial scanning mode without table feed. Dynamic serio can still be used for dynamic evaluation, such as Test Bolus.

Slice Collimation and Slice Width

Slice collimation is the slice thickness resulting from the effect of the tube-side collimator and the adaptive detector array design. In Multislice CT, the Z-coverage per rotation is given by the product of the number of active detector slices and the collimation (e.g., 2 x 1.0 mm).

Slice width is the FWHM (full width at half maximum) of the reconstructed image.

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

The Recon icon on the chronicle will be labeled with "RT". After the scan, the Real Time displayed image series has to be reconstructed.

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

Scan and Reconstruction

Slice Collimation and Slice Width for Spiral Mode and HR Spiral Mode

1 mm: 1, 1.25, 2, 3, 5 mm

1.5 mm: 2, 3, 5, 6 mm

2.5 mm: 3, 5, 6, 8, 10 mm

4 mm: 5, 6, 8, 10 mm

5 mm: 6, 8, 10 mm

Slice Collimation and Slice Width for Sequence Mode and HR Sequence Mode

1.0 mm: 1, 2 mm

1.5 mm: 1.5, 3 mm

2.5 mm: 2.5, 5 mm

4.0 mm: 4, 8 mm

5.0 mm: 5, 10 mm

Increment

The increment is the distance between the reconstructed images in the Z direction. When the increment chosen is smaller than the slice thickness, the images are created with an overlap. This technique is useful to reduce partial volume effect, giving you better detail of the anatomy and high quality 2D and 3D post-processing.

Slice Thickness = 10 mm



Reconstruction Increment

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 Siemens Multislice CT, we differentiate between:

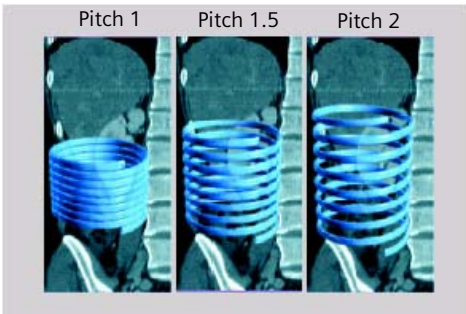
Feed/Rotation, the table movement per rotation

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

Pitch Factor, table movement per rotation/complete slice collimation.

E.g., slice collimation = 2 x 5 mm,
table moves 10 mm per rotation,
then Volume Pitch = 2, Pitch Factor = 1.

With the SOMATOM Spirit, the pitch, slice, collimation, rotation time, and scan range can be adjusted. The pitch factor can be selected from 0.5-2.



Pitch Models

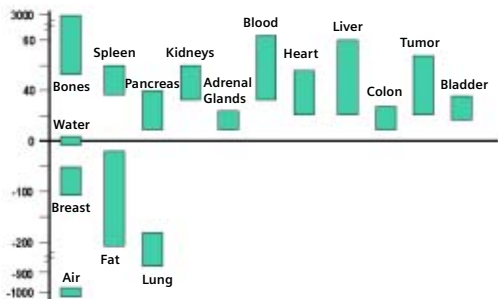
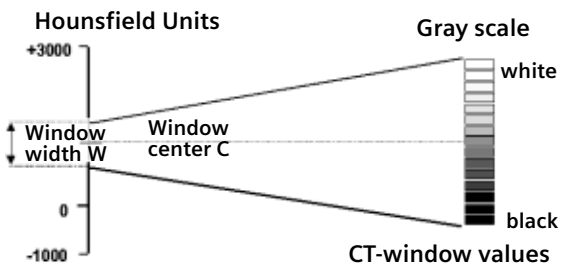
Scan and Reconstruction

Window values

The Scale of the CT Hounsfield Units is from -1024 to +3071.

The displayed window values have to correspond to the anatomical structure.

Windowing is used to optimize contrast and brightness of images.



Organ specific window values

Kernels

There are 3 different types of kernels: "H" stands for Head, "B" stands for Body, "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.

A set of 18 kernels is supplied, consisting of:

- 6 body kernels: smooth (B20s), medium smooth (B31s), medium (B41s), medium sharp (B50s), sharp (B60s), high res (B70s)
- 7 head kernels: smooth (H21s), medium smooth (H31s), medium (H41s), medium sharp (H50s), sharp (H60s), high res (H70s), ultra high res (H80s)
- 3 child head kernels: smooth (C20s), medium (C30s), sharp (C60s)
- 2 special kernels: S80s, U90s

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

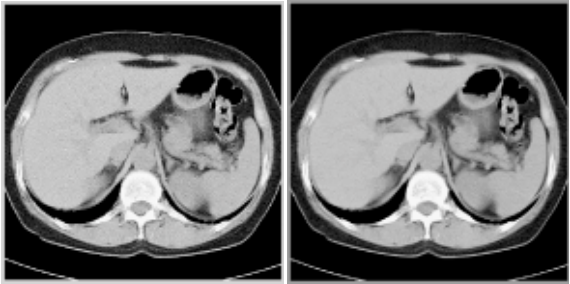
For further information regarding the kernels, please refer to the "Hints in General" of the corresponding body region.

Image Filters

There are 3 different filters available:

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

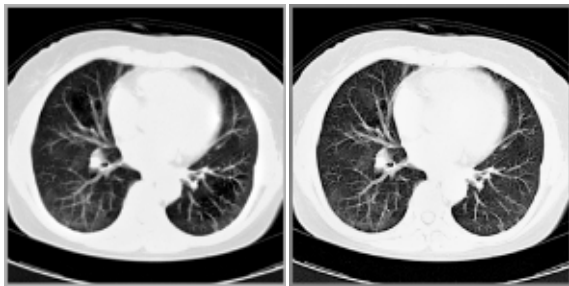
- Similar to reconstruction with a smoother kernel
- Reduces noise
- Enhances low-contrast detectability
- Adjustable in four steps
- Automatic post-processing



Scan and Reconstruction

HCE: The High-contrast enhancement (HCE) filter enhances high-contrast detectability. It increases the image sharpness, similar to reconstruction with a sharper kernel.

- Increases sharpness
- Faster than raw-data reconstruction
- Enhances high-contrast detectability
- Automatic post-processing



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

- Reduces noise without blurring of edges
- Enhances low-contrast detectability
- Individually adaptable
- Automatic post-processing

Improved Head Imaging

An automatic bone correction algorithm has been included in the standard image reconstruction. Using a new iterative technique, typical artifacts arising from the beam-hardening effect, e.g., Hounsfield bar, are minimized without any additional post-processing. This advanced algorithm allows for excellent images of the posterior fossa, but also improves head image quality in general. Bone correction is activated automatically for body region "Head".

In order to optimize image quality versus radiation dose, scans in the body region "Head" are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.



Head image without correction.



Head image with corrections.

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_w 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:

$$\text{CTDI}_{\text{vol}} = \text{CTDI}_{\text{w}} / \text{Pitch Factor}$$

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

Dose Information

The $CTDI_{vol}$ 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 allows 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.

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:

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

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:

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

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

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

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

To calculate the dose you simply have to multiply the $CTDI_w$ per mAs with the effective mAs of the scan:

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

Dose Information

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

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

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

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

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

CARE Dose

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

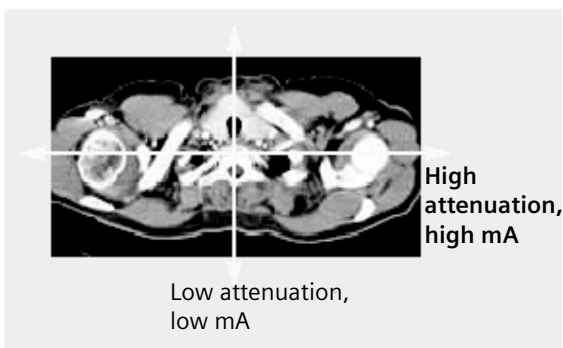
CARE Dose reduces patient dose significantly, especially in the regions of shoulder and pelvis. It decreases tube load, which extends the capacity for volume scanning with thinner slices, larger volumes or Multi-phase studies.

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

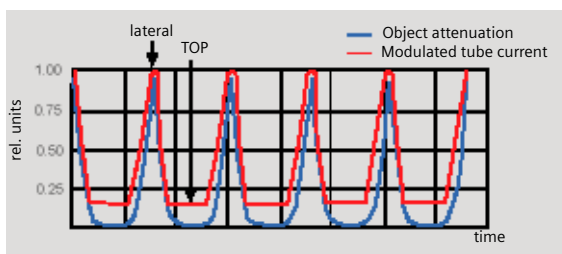
How does CARE Dose work?

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. This is done "on-the-fly", i.e. the scanner adapts the mA in real-time, according to the patient's attenuation profile.

Dose Information



Example of scanning the shoulder region.



Principle of CARE Dose tube current adaption.

- CARE Dose is pre-selected by default for most standard protocols. It can be switched on/off in the *Scan* subtask card.

Dose Information

- For the average patients examination, CARE Dose does not require any manual changes to the scan protocol. However, the mAs must be adapted 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.

Recon Jobs

In the *Recon* card, you can define up to 3 reconstruction jobs for each range with different parameters, either before or after you acquire the data. When you deselect all chronicle entries, all open recon jobs will be automatically reconstructed after you click on "Recon". In case you want to add more than 3 recon jobs, simply click the 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.

Examination Job Status

You can get an overview of all recon jobs by clicking on the recon task symbol in the status bar or selecting *Transfer – Examination Job Status* in the main menu of the Patient Browser.

The *Examination Job Status* dialog will appear where all recon jobs (completed, queued and in work) are listed. You can stop, restart and delete each job by clicking the according button. To give a selected job a higher priority click "urgent".

The column "Type" shows you which kind of reconstruction is queued.

Two types are displayed:

- Recon
all recon jobs from the *Recon* card
- Auto 3D
all 3D reconstructions which you have sent via "Auto post-processing" automatically into the *3D* card.
These jobs will be deleted from the job list as soon as the patient is closed in the *3D* card.



Auto Load in 3D and Post-processing 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.

On the *3D* card you have the ability to create Range Parallel and Radial protocols for Multi-Planar-Reconstruction (MPR) and Thin Maximum-Intensity-Projection (MIP Thin) which can be linked to a special series.

For example, if you always do sagittal MPRs for a Spine examination, once you load a Spine examination into the *3D* card, select the image type (MPR, MIP Thin), 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 post-processing protocol, linked to the series description of a Spine examination.

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.

How to Create your own Scan Protocols

There are two different ways to modify and create your scan protocols:

Edit/Save Scan Protocol

If you want to modify an existing protocol or create a new one, e.g., you want to have two "AbdomenRoutine-Protocols" with different slice width, we recommend to do this directly on the *Examination* card.

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

- Register a patient, you can choose any patient position in the "Patient Model Dialog".
- Select an existing scan protocol in the "Patient Model Dialog".
- Modify the scan protocol, change parameters, add new ranges etc., so that the new protocols fit your needs.
- Scan your patient as usual.
- Check if all parameters are as you desire.
- Select *Edit/Save Scan Protocol* in the main menu.
- Select the folder where you want the new protocol to appear and the scan protocol name in the pop-up dialog.
- You can either use the same name to overwrite 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.

Hints

- You can save your scan protocol at any time of the examination.
- It is recommended that you save your own scan protocol with a new name in order to avoid overwriting the default scan protocol.
- Do not use special characters. In addition, do not even use any blank spaces. Allowed are all numbers from 0 to 9, all characters from A to Z and a to z and explicitly the _ (underscore).
- Do not rename scan protocol files on Windows level. This will lead to inconsistencies.
- You can now save your own scan protocols in any predefined folder. The organ characteristics will belong to the scan protocol not to the region.
- In the Patient Model Dialog, the modified scan protocols are marked with a dot in front of the protocol.

Scan Protocol Manager

If you want to modify special parameters for all existing scan protocols or you want to modify the folder structure, we recommend doing this in the *“Scan Protocol Manager”*. The *“Scan Protocol Manager”* is opened and all protocols are loaded.

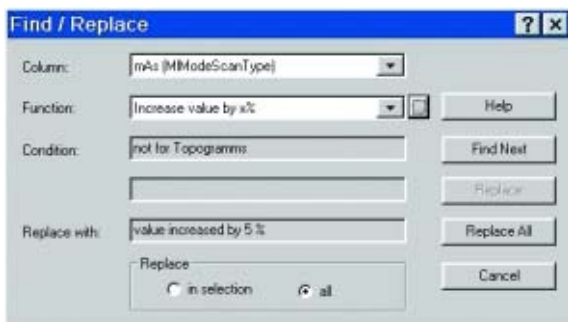
User-specific scan protocols can be saved with the following basic procedure:

Open *“Options”*, on the *“Scan Protocol Manager”* icon.

- Rename a protocol:
Select a scan protocol with the right mouse button. Select *“Rename”* and enter a new name for the protocol.

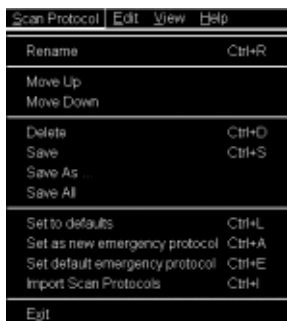
Workflow Information

- Change one (or more) parameters for all Customer protocols:
Select *"Edit – Find/Replace"*. Open the *"Column"* list box and choose the desired parameter. Select a new function of this parameter in the *"Function"* list box. Under the button next to the Function entry you can choose special selections, e.g., you can in-/decrease all mAs values by a certain percentage, e.g., 5%. Select *"Replace All"*.



Workflow Information

- Define a protocol as Emergency protocol.
Select the desired scan protocol with the right mouse button. Select entry "*Set as new emergency protocol*". The selected protocol is marked with a red cross.



A screenshot of a context menu for scan protocols. The menu is dark-themed with white text. At the top, there are four menu items: "Scan Protocol", "Edit", "View", and "Help". Below these are several actions, each with a keyboard shortcut on the right. The actions are: "Rename" (Ctrl+R), "Move Up", "Move Down", "Delete" (Ctrl+D), "Save" (Ctrl+S), "Save As...", "Save All", "Set to defaults" (Ctrl+L), "Set as new emergency protocol" (Ctrl+A), "Set default emergency protocol" (Ctrl+E), and "Import Scan Protocols" (Ctrl+I). At the bottom of the menu is the "Exit" option.

Menu Item	Shortcut
Rename	Ctrl+R
Move Up	
Move Down	
Delete	Ctrl+D
Save	Ctrl+S
Save As ...	
Save All	
Set to defaults	Ctrl+L
Set as new emergency protocol	Ctrl+A
Set default emergency protocol	Ctrl+E
Import Scan Protocols	Ctrl+I
Exit	

- Change the structure of the protocol tree. You can sort all Customers protocols as needed. Select the desired protocols, press right mouse button. You will find the entries:
 - Cut/copy
 - Pasteto change the sorting of your protocol tree. You can also do this easily by dragging and dropping the protocols under the desired position.

Hints

- With the Find/Replace function you can easily insert an API command for all protocols as needed.
- Also all Auto Tasking actions, e.g., the transfer to configured network nodes can be set within one action. Within the "Function" button you can set your transfer actions depending on the slice width.
- By sorting the scan protocols, all organ characteristics will belong to the protocol, so it does not matter which folder you choose.
- The entry "Set to defaults" in the main menu/ context sensitive menu will reset all your changes to the Siemens default values.
- Display of actions:
 - Invalid protocols or parameters are marked in yellow.
 - Changed, but not yet saved protocols and/or parameters are marked in green.
- With the entries Save/Save as/Save all, you can save your changes.
- For security purposes it is not possible to do any changes in the Siemens protocols, although you can copy or drag&drop these protocols into a Customer folder.
- Scan protocols can be deleted if they belong to the USER category. Only complete scan protocols can be deleted. It isn't possible to delete scan protocol entries or scan protocol recon jobs.
- If there are unsaved scan protocols when closing the Scan Protocol Manager you will be informed by a message.
- You can configure the displayed columns and their position with "View configure columns".

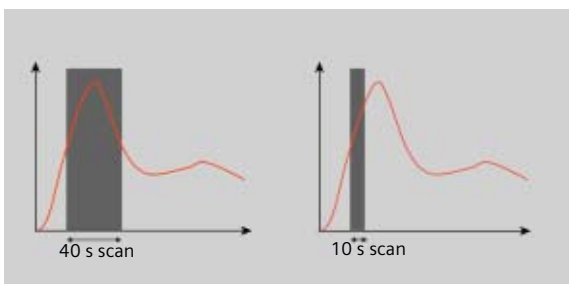
Additional Information:

1. System/Run offers the tool "Restore Default Scan Protocols" which allows you to remove user specific scan protocols and to restore the Siemens default settings.
2. The main menu entry "Edit" offers save/delete Scan Protocols.
3. System/Run or the main menu entry "View" in the Scan Protocol Manager offer the tool "List Scan Protocols" which generates an HTML table of all available scan protocols. This list can be printed or saved on Floppy (Right-click in the table, click View Source/ File/Save As...).

Contrast Medium

The Basics

The administration of intravenous (IV) contrast material during spiral scanning improves the tissue characterization 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.



Longer scan time

Shorter scan time

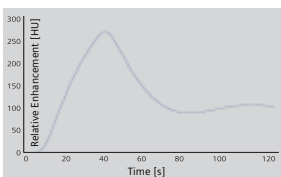
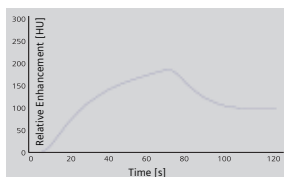
The dynamics of the contrast enhancement is determined by:

- Patient cardiac output
- Injection rate
- Total volume of contrast medium injected
- Concentration of the contrast medium
- Type of injection – uni-phasic or bi-phasic
- Patient pathology

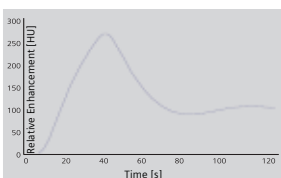
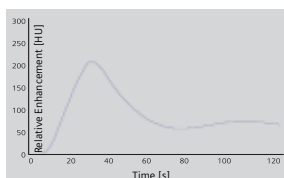
Workflow Information

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

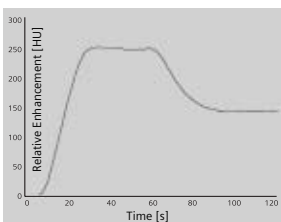
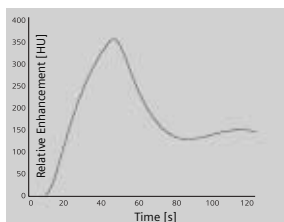
All curves are based on the same patient parameters (male, 60-year-old, 75 kg).



2 ml/s, 120 ml, 300 mg I/ml 4 ml/s, 120 ml, 300 mg I/ml



80 ml, 4 ml/s, 300 mg I/ml 120 ml, 4 ml/s, 300 mg I/ml



*Uni-phase 140 ml, 4 ml/s,
370 mg I/ml*

*Bi-phase 70 ml, 4 ml/s,
plus 70 ml,
2 ml/s, 370 mg I/ml*

*Radiology 1998; 207:647 – 655

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.

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

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

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

To achieve optimal results in contrast studies, the use of CARE Bolus is recommended. In case it is not available, use Test Bolus. Once completed, load images into Dynamic Evaluation for calculation of Time to Peak enhancement.

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

Bolus Tracking

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

General Hints

- 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 protocol.
- The pre-monitoring scan is used to determine the position of the monitoring scans. It can be performed at any position of interest. You can also increase the mAs setting to reduce the image noise when necessary.
- 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).

Workflow Information

- 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).
- Place a 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.
- 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.
- 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.

Workflow Information

Test Bolus using CARE Bolus

You can use the CARE Bolus option as a "Test Bolus".

How to do it

1. Insert a Bolus tracking via the right mouse button submenu prior to the spiral.
2. Insert "contrast" from the right mouse button context menu prior to the monitoring scans.
Hint: By inserting "contrast" you are interrupting the Auto range function, and therefore an automatic start of the spiral is not possible!
3. Start with the Topogram.
4. Position the premonitoring scan and the spiral range.
5. Perform the premonitoring scan, position and accept the ROI.
6. Start monitoring scans and a short amount of contrast (20 ml/2.5 ml/sec.).
Hint: With starting the spiral the system is switching to the *Trigger* subtask card. The trigger line is not shown at this stage.
7. Now you can read the proper delay from the *Trigger* subtask card.
8. Insert the delay in the *Routine* subtask card and load the spiral.
9. Start spiral and injector with the full amount of contrast.

Test Bolus

This is a low dose sequential protocol without table feed used to calculate the start delay of a spiral scan to ensure optimal enhancement after the contrast medium injection. The Dynamic Evaluation function may be used to generate the time density curve.

You can find the "Test Bolus" scan protocol in the chapter "Specials".

How to do it

1. Select the spiral mode that you want to perform, and then "Append" the Test Bolus 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 Test Bolus.
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.

Workflow Information

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

SOMATOM *life*

General Information

SOMATOM *life* @ Your Scanner provides actual news around your scanner, shows you helpful configuration information of your system and enables you to access the Siemens Extranet where you will find further opportunities to enhance your possibilities to use the CT system.

To benefit from the Siemens Extranet, a Siemens Remote Service connection is required. The Siemens Extranet allows you to order Trial Licenses, download the necessary Application Guide or find interesting information related to your CT system.

Note: Siemens Remote Service is an optional part of your service contract that also covers remote service capabilities for your CT system to optimize the system availability and is also prerequisite for other services.



Key Features

All users:

- General Information
- Access to Web Based E-Training or Manuals on CD ROM

In combination with a Siemens Remote Service connection:

- News-Ticker archive and FAQ (frequently asked questions) section
- Free trial software order and installation
- Download of information, manuals and scan protocols
- A contact function for an easy and fast interface to Siemens including the ability to attach up to two DICOM images

Note: In regard to legal issues, not all services may be available in every country.

Application Information

Description

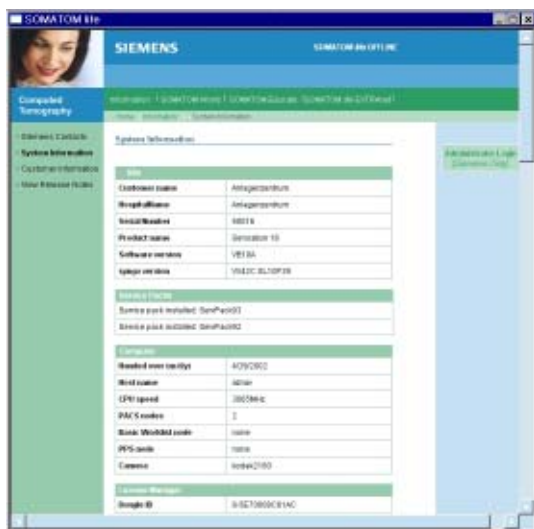
All users:

Start SOMATOM *life* @ Your Scanner by selecting SOMATOM *life* under "options" in your *syngo* menu bar and you will find a browser window that allows you to access different information about your hard- and software environment.

Under e.g., "System Information" you have information such as software version or scan second counter.

Under Customer Information you can enter your demographic data.

Note: The institution data and at least one contact person have to be entered to be able to access the Siemens Extranet. The link to the Siemens Extranet will be visible only after you have entered this data.



The screenshot displays the SOMATOM life software interface. The title bar reads "SOMATOM life". The main header features the "SIEMENS" logo and "SOMATOM life V11.00". A navigation menu on the left includes "Completed Tomography", "System Information", "Customer Information", and "Your Release Notes". The "System Information" section is active, showing a table of system details.

System Information	
Model	Antepporatum
Customer name	Antepporatum
Product name	6000
Software version	V11.00
System version	V11.00.01000

System Details	
System type	Antepporatum
System name	Antepporatum
Product name	6000
Software version	V11.00
System version	V11.00.01000

System Configuration	
System type	Antepporatum
System name	Antepporatum
Product name	6000
Software version	V11.00
System version	V11.00.01000

System Manager	
System ID	0-0000000000

Application Information

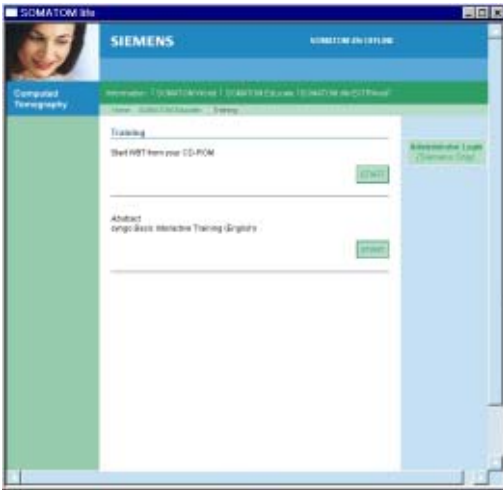
Access to Computer Based Training or Manuals on CD ROM

Start the Computer Based Training to learn more about your software and enhance your clinical knowledge.

Note: The *syngo* Basics Training is pre-installed on your system and can directly be used by selecting SOMATOM Educate. The *syngo* Advanced Application Training can be downloaded in the Siemens Extranet or is sent to you automatically on CD if you request a trial software via the Siemens Extranet.

In case a document (e.g., Application Guide) is not visible after being opened:

- Minimize or move the Browser window of the SOMATOM *life* platform.



Under the navigation path "World" you can also start your manual CD ROM.

Application Information

SRS Based Services

During the start up of your system you will receive actual information in the "Newsticker" and see the expiration date of installed trial software.

Note: Siemens will send you a Newsticker whenever there is helpful information for CT users. The trial licenses are valid for 90 days and can only be ordered once.

Access the Siemens Extranet by clicking on "Extranet". After entering your CT system serial number you will be forwarded to the workspace. You can find the serial number in the system information in the offline part of SOMATOM *life* @ Your Scanner.

Now you have the ability to view information and use the different services.



Application Information

Download of Files

Each download will be performed in the background. If you disconnect your Siemens Extranet session and start to work with the CT scanner, the download will continue until it is completed. Due to bandwidth reasons it is only possible to perform one download at a time.

Note: Depending on your connection speed, the download of larger files like e.g., the Advanced Application Training may take a long time.

Downloaded files can be found in the "Offline" folder which can be accessed under menu: Options/ File Browser/ Offline.



After the download, the WBT will install itself and can be started within the SOMATOM *life* offline part under SOMATOM Educate.

Downloaded Scan Protocols are stored in the update folder until installation. To install all downloaded protocols, choose the Scan Protocol Manager via Options/Configuration and select "Import Scan Protocols" in the menu tab "Scan Protocol". After successful import, all downloaded protocols can be found under the name that is stated in the Extranet in the "Siemens Folder".

Also, see the chapter Scan Protocol Manager for more information.

Contact incl. DICOM Images

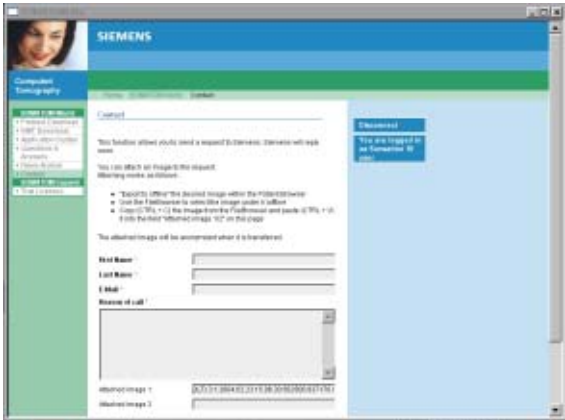
You are able to send emails to Siemens directly from your scanner. For further explanation, even DICOM images can be attached. To add an image, select the images you want to send on your *Viewing* card and export these images to H:\Offline as a DICOM image.

Also, see chapter "Export Function" for more information.

After exporting the image, open the Siemens Extranet and choose "Contact". After entering your message you can easily attach the image by selecting the images from the File Browser with the shortcut "CTRL" and "C" and paste it with the shortcut "CTRL" and "P" into the Extranet.

Application Information

Note: Every patient image will be made anonymous before sending. Because the SOMATOM *life* window is always in front, we recommend to restore/ minimize it to be able to switch between both screens, the File Browser and the SOMATOM *life* window.



Application Information

Trial Order and Installation

As a SOMATOM CT user you can request trial clinical software directly from the scanner. The requested software will be provided and installed automatically through our Siemens Remote Services connection.

After you have accessed the SOMATOM *life* Extranet, you can choose system specific trial software under SOMATOM Expand. After clicking on "Order Trial" and confirming a License Agreement for Trial-Use Software, you need to enter your contact data. You can then submit the license request.



Application Information

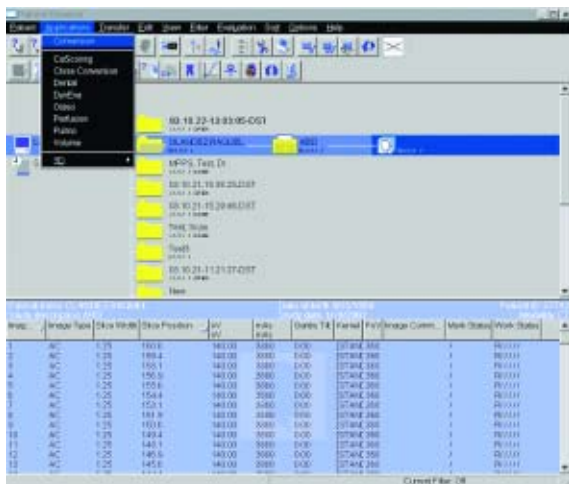
At the same time, you are informed that you can expect the trial option to be installed within 8 working days and you will then be informed about the successful installation via the SOMATOM *life* message window that appears during system start-up.



Image Converter

The CT Application Common DICOM Adapter provides conversion between different DICOM data sets as they may be provided by other CT vendors.

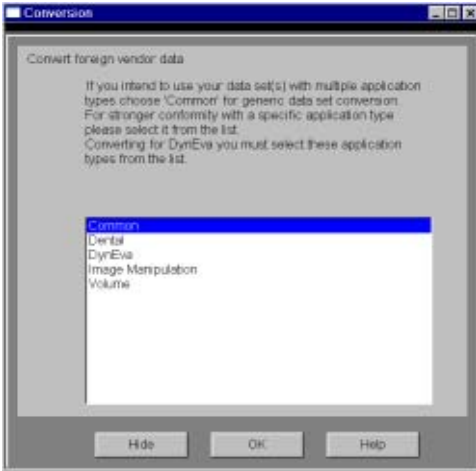
- You will find the converter in the Application menu of the Patient Browser.



In the pop-up window you can select the application for which you want to convert the images.

Application Information

After conversion you can load these data sets into the application of your choice.



File Browser

The File Browser provides the ability to access and to manage your created files:

- Copy images and files to the CD Burn folder.
- Access to all created reports and movies (AVI files).
- Access to the offline folder.
- Access to downloaded files.

Open the File Browser via the main menu entry "Options – File Browser".

The File Browser provides special folders for our Applications. Therein the created reports and movies are saved.

With an external PC connected you can access your offline data on the external PC for post-processing.

Transfer files to floppy:

- Select the desired files and send them via the right mouse button menu on a floppy disk.

Burn on CD:

- Select the desired files and drag & drop them into the folder "Burn on CD" (or send them via the right mouse button menu to the folder "Burn on CD").
- Open the "LocalJobStatus" in the Patient Browser and clear all entries.
- Select "Record to Offline" in the Transfer menu of the Patient Browser.
- CD burning starts.
- *Hint:* CD burning of offline files is only possible in a single session.

Review reports and movies:

- Select the desired files and double-click on them.
- The corresponding program, e.g., Movie Media Player will be opened and you can review what you have saved.
- Now you can send these files to floppy or burn it on CD.

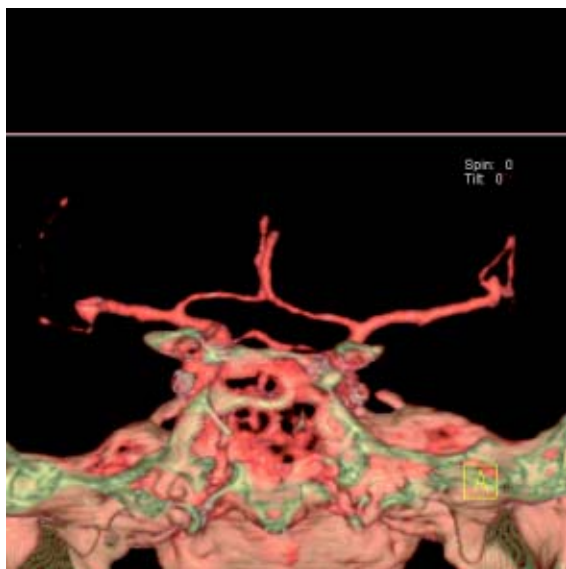
Hint

- Files with the following extensions cannot be started/ opened from the File Browser
"bat", "cmd", "com", "exe", "reg", "dot", "htm", "html", "pl", "vbs", "js", "wsf", "wsh", "xml".

Patient Protocol

Scan:	number of scan range
kV:	kilo Volt
mAs:	averaged applied mAs of the range
ref. mAs:	quality ref. mAs of the range
TI:	Rotation Time
cSL:	collimated Slice
CTDI _{vol} :	$\frac{\text{CTDIw}}{\text{Pitch Factor}}$ <p>For further information please refer to the chapter "Dose Information".</p>
DLP:	<p>Dose Length Product</p> $\frac{\text{CTDIvol} \times (\text{length} + \text{collimated slice})}{10}$

Scan	kV	mAs / ref.	CTDIvol	DLP	TI	cSL	
Jessy 04.11.15-08:48:31-STD-1.3.12.2.1107.5.1.5.111 *11/15/1970, O, 34Y							
Hospital Spirit syngo CT 2005C0 1.02							
Ward: 15-Nov-2004 08:48							
Physician: Total mAs 443							
Operator:							
Patient Position	Scan	kV	mAs / ref.	CTDIvol	DLP	TI	cSL
H-SP	1	130				3.4	1.0
Topogram							
Orbita	2	130	66	15.01	85	0.8	5.0



Overview

- *HeadRoutine*
Spiral mode for base of the skull and cerebrum routine studies
- *HeadSeq*
Sequential mode for base of the skull and cerebrum routine studies
- *InnerEarHR*
Spiral mode for inner ear studies with a high resolution kernel
- *InnerEarSeqHR*
Sequence mode for inner ear studies with a high resolution kernel
- *Sinus*
Spiral mode for sinus studies
- *SinusSeq*
Sequence mode for sinus studies
- *Orbita*
Spiral mode for orbital studies
- *Dental*
Spiral mode for dental studies

Hints in General

- Topogram: Lateral, 256 mm.
- Patient positioning:
Patient lying in supine position, arms resting against body, secure head well in the head holder, support lower legs.
- Gantry tilt is available for both, sequence and spiral scanning.
However, image artifacts may occur if spirals are acquired with a tilt angle greater than 8° .
- 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.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.

Head Kernels

- For soft tissue head studies, the standard kernel is H41s; softer images are obtained with H31s or H21s sharper images with H50s.
- High resolution head studies should be performed with H60s, H70s (e.g., for dental and sinuses) and H80s (e.g., inner ear).

HeadRoutine

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 4 cm will be covered in 23 sec., a range for the cerebrum of 8 cm will be covered in 27 sec.



	Base	Cerebrum
<i>kV</i>	130	130
<i>Effective mAs</i>	110	110
<i>Rotation time</i>	1.5 sec	1.5 sec
<i>Slice collimation</i>	1.5 mm	2.5 mm
<i>Slice width</i>	3.0 mm	8.0 mm
<i>Feed/Rotation</i>	3.0 mm	5.0 mm
<i>Pitch Factor</i>	1.0	1.0
<i>Increment</i>	3.0 mm	8.0 mm
<i>Kernel</i>	H31s	H31s
<i>CTDI_{Vol}</i>	25.05 mGy	25.05 mGy
<i>Effective dose</i>	Male: 0.37 mSv Female: 0.38 mSv	Male: 0.70 mSv Female: 0.77 mSv

Contrast medium IV injection

<i>Volume</i>	50 – 60 ml
<i>Flow rate</i>	2 ml/sec.
<i>Start delay</i>	50 – 60 sec.

Hints

- An automatic bone correction allows for improved head image quality, without any additional post-processing.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.

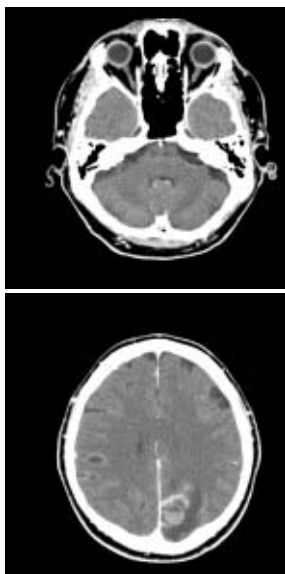
HeadSeq

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, the scan length for the entire head is 12.4 mm.

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



	BaseSeq	CerebrumSeq
<i>kV</i>	130	130
<i>Effective mAs</i>	240	240
<i>Rotation time</i>	1.5 sec	1.5 sec
<i>Slice collimation</i>	1.5 mm	4.0 mm
<i>Slice width</i>	3.0 mm	8.0 mm
<i>Feed/Scan</i>	3.0 mm	8.5 mm
<i>Kernel</i>	H31s	H31s
<i>CTDI_{Vol}</i>	54.65 mGy	51.43 mGy
<i>Effective dose</i>	Male: 0.77 mSv Female: 0.80 mSv	Male: 1.52 mSv Female: 1.68 mSv

Contrast medium IV injection

<i>Start delay</i>	60 sec.
<i>Flow rate</i>	2 ml/sec.
<i>Volume</i>	50 – 60 ml

Hints

- An automatic bone correction allows for improved head image quality, without any additional post-processing.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.

InnerEarHR

Indications:

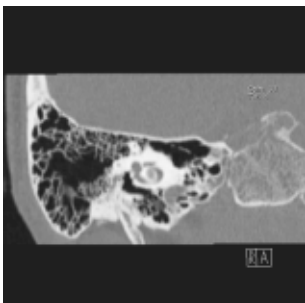
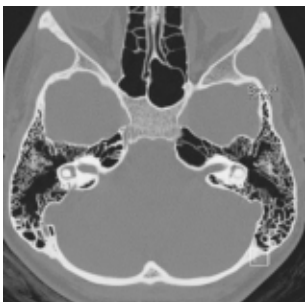
Spiral mode for inner ear High Resolution studies, e.g., inflammatory changes, tumorous processes of pyramids, cerebellopontine angle tumors, post-traumatic changes, etc.

A range of 2.5 cm will be covered in 22 sec.

	InnerEar	2nd reconstr.
<i>kV</i>	130	
<i>Effective mAs</i>	70	
<i>Rotation time</i>	1.5 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	2.0 mm	1.25 mm
<i>Feed/Rotation</i>	2.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	2.0 mm	0.8 mm
<i>Kernel</i>	H80s	H80s
<i>CTDI_{Vol}</i>	15.94 mGy	
<i>Effective dose</i>	Male: 0.17 mSv Female: 0.20 mSv	

Hints

- For image reconstruction of soft tissue, use kernel H31s.
- An automatic bone correction allows for improved head image quality, without any additional post-processing.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.



InnerEarHRSeq

Indications:

Sequential mode for inner ear studies, e.g., inflammatory changes, tumorous processes of pyramids, cerebellopontine angle tumors, post-traumatic changes, etc.

A typical gantry tilt of -20 degree is predefined. A range of 2.5 cm will be covered.



	InnerEarSeq
<i>kV</i>	130
<i>Effective mAs</i>	140
<i>Rotation time</i>	1.5 sec
<i>Slice collimation</i>	1.0 mm
<i>Slice width</i>	1.0 mm
<i>Feed/Scan</i>	2.0 mm
<i>Kernel</i>	H80s
<i>CTDI_{Vol}</i>	31.88 mGy
<i>Effective dose</i>	Male: 0.32 mSv Female: 0.38 mSv

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

Hints

- For image reconstruction of soft tissue, use kernel H31s.
- An automatic bone correction allows for improved head image quality, without any additional post-processing.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.

Sinus

Indications:

Spiral mode for paranasal sinuses studies, e.g., sinusitis, mucocele, pneumatization, polyposis, tumor, corrections etc.

A range of 7 cm will be covered in 37 sec.



	Sinus	2 nd reconstr.
kV	130	
Effective mAs	60	
Rotation time	1.0 sec	
Slice collimation	1.0 mm	
Slice width	3.0 mm	1.25 mm
Feed/Rotation	2.0 mm	
Pitch Factor	1.0	
Increment	3.0 mm	0.8 mm
Kernel	H70s	H70s
CTDI _{vol}	13.66 mGy	
Effective dose	Male: 0.21 mSv Female: 0.22 mSv	

Contrast medium IV injection

Start delay	60 sec
Flow rate	2 ml/sec
Total amount	50 – 60 ml

Hints

- An automatic bone correction and an advanced algorithm allows for improved head image quality, without any additional post-processing.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.
- For image reconstruction of soft tissue, use kernel H31s.

SinusSeq

Indications:

Sequential mode for paranasal sinuses studies, e.g., sinusitis, mucocele, pneumatization, polyposis, tumor, corrections etc.

A range of 4.2 cm will be covered.

	SinusSeq
<i>kV</i>	130
<i>Effective mAs</i>	120
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	1.5 mm
<i>Slice width</i>	3.0 mm
<i>Feed/Scan</i>	3.0 mm
<i>Kernel</i>	H70s
<i>CTDIvol</i>	27.32 mGy
<i>Effective dose</i>	Male: 0.22 mSv Female: 0.24 mSv

Contrast medium IV injection

<i>Start delay</i>	60 sec
<i>Flow rate</i>	2 ml/sec
<i>Total amount</i>	50 – 60 ml

Hints

- An automatic bone correction and an advanced algorithm allows for improved head image quality, without any additional post-processing.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location.
- For image reconstruction of soft tissue, use kernel H31s.

Orbita

Indications:

Spiral mode for orbital studies, e.g., fracture.

A range of 2 cm will be covered in 12 sec.

	Orbita	2nd reconstr.
<i>kV</i>	130	
<i>Effective mAs</i>	100	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	3.0 mm	1.25 mm
<i>Feed/Rotation</i>	2.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	3.0 mm	0.8 mm
<i>Kernel</i>	H70s	H70s
<i>CTDI_{vol}</i>	22.77 mGy	
<i>Effective dose</i>	Male: 0.10 mSv Female: 0.11 mSv	

Contrast medium IV injection

<i>Start delay</i>	60 sec
<i>Flow rate</i>	2 ml/sec
<i>Volume</i>	50 – 60 ml

Hints

- An automatic bone correction and an advanced algorithm allows for improved head image quality, without any additional post-processing.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.
- For image reconstruction of soft tissue, use kernel H31s.

Dental

This is the scan protocol for the *syngo* Dental CT application package. It is used for evaluation and reformatting of the upper and lower jaws.

It enables the display and measurement of the bone structures of the upper and lower jaw as the basis for planning in oral surgery.

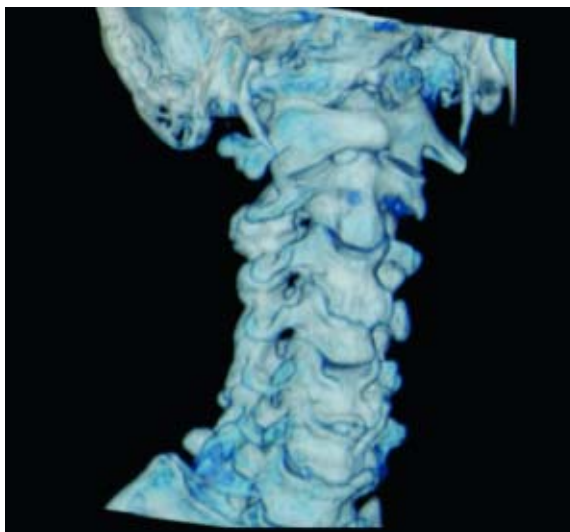
Indications:

Spiral mode for dental studies.

A range of 5 cm will be covered in 27 sec.

	Dental
<i>kV</i>	130
<i>Effective mAs</i>	45
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	1.0 mm
<i>Slice width</i>	1.25 mm
<i>Feed/Rotation</i>	2.0 mm
<i>Pitch Factor</i>	1.0
<i>Increment</i>	0.5 mm
<i>Kernel</i>	H60s
<i>CTDI_{vol}</i>	10.25 mGy
<i>Effective dose</i>	Male: 0.13 mSv Female: 0.16 mSv

Load the study into the application "*syngo* Dental CT". For further information, please refer to the chapter "*syngo* Dental CT".



Overview

- Neck
 - Spiral mode for soft tissue routine neck studies

Hints in General

- Topogram: Lateral, 256 mm
- Patient positioning
Patient lying in supine position, hyperextend neck slightly, secure head well in head holder.
- Patient respiratory instruction:
do not breathe, do not swallow.
- For contrast studies, CARE Bolus may be used to optimize the bolus timing.
- For image reconstruction of bone structures, use kernel B60.

Body Kernels

- As standard kernels for body tissue studies B31s or B41s are recommended; softer images are obtained with B20s.
- For higher sharpness, as is required e.g., in patient protocols for cervical spine, shoulder, extremities, thorax, the kernels B50s, B60s, B70s are available.
- In case of 3D study only, use kernel B20s and at least 50% overlapping for image reconstruction.

Patient positioning is very important for artifact-free images. The thoracic girdle should be positioned as far as possible in the caudal direction. This can be done using a strap with a permanent loop or Velcro fastener at its end. The ends of the strap must be attached to the patients wrists. Then the strap must be wrapped around the patients feet with his legs extended and under tension. The entire thoracic girdle is thus pulled toward the patients feet.

Neck

Indications:

For soft tissue spiral studies in the cervical region, e.g., tumors, lymphoma, abscesses etc.

A typical range of 20 cm will be covered in 42 sec.

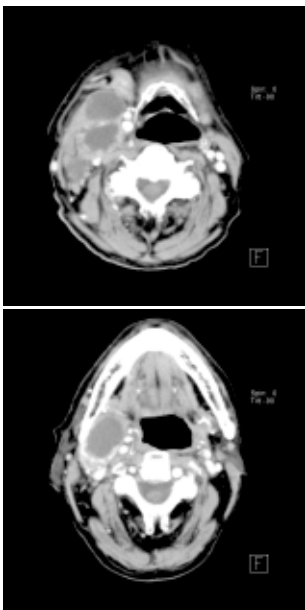
	Neck
<i>kV</i>	130
<i>Effective mAs</i>	70
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	2.5 mm
<i>Slice width</i>	5.0 mm
<i>Feed/Rotation</i>	5.0 mm
<i>Pitch Factor</i>	1.0
<i>Increment</i>	5.0 mm
<i>Kernel</i>	B50s
<i>CTDI_{Vol}</i>	7.55 mGy
<i>Effective dose</i>	Male: 1.79 mSv Female: 1.87 mSv

Contrast medium IV injection

<i>Start delay</i>	45 sec.
<i>Flow rate</i>	2.0 ml/sec.
<i>Total amount</i>	120 ml

Hints

- Due to its iodine content, the thyroid gland is hyperdense in relation to the neighboring muscles both before and after an IV CM injection. For displays of the parotid, thyroid or the floor of the mouth, the slice thickness should be < 5 mm and the length of the range should be adapted to match the anatomic region.
- Target the FoV to ensure adequate coverage of the region of interest in the upper neck & middle neck levels as well as to include the axilla in the lower neck level if required.





Overview

– *Shoulder*

Spiral mode for bone shoulder routine studies

Hints in General

- Topogram: TOP, 256 mm.
- Patient positioning:
Patient lying in supine position, the uninjured arm placed above the head, the injured arm placed flat against his body. Position side under examination in the center and support the other side with a Bocollo pillow.
- If only one side is examined, it is advisable to enter the side examined in the comment line.
- Contrast medium is required for soft tissue mass evaluation.
- To further optimize MPR image quality, we recommend that you reduce one or more of the following parameters: collimation, reconstruction increment, and slice width for image reconstruction.

Body Kernels

- As standard kernels for body tissue studies B31s or B41s are recommended; softer images are obtained with B20s.
- For higher sharpness, as is required e.g., in patient protocols for cervical spine, shoulder, extremities, thorax, lung, the kernels B50s, B60s, B70s are available.

Shoulder

Indications:

Spiral mode for bone studies and soft tissue, e.g., evaluation of joint cavities, masses, trauma, dislocations, orthopedic indications etc.

A scan range of 10 cm will be covered in 35 sec.

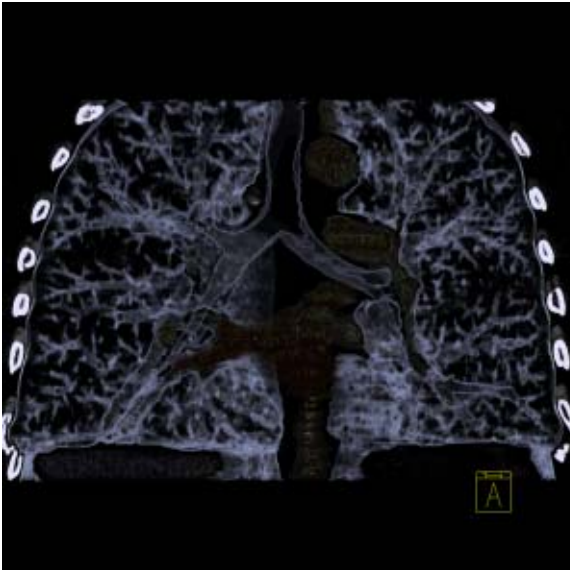


Shoulder

	Shoulder	2 nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	70	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.5 mm	
<i>Slice width</i>	3.0 mm	2.0 mm
<i>Feed/Rotation</i>	3.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	3.0 mm	1.5 mm
<i>Kernel</i>	B60s	
<i>CTDI_{Vol}</i>	7.55 mGy	
<i>Effective dose</i>	Male: 0.94 mSv Female: 1.13 mSv	

Hints

- Use raw data to review a target region if necessary.
- For image reconstruction of soft tissue, use kernel B31s and a slice width of 5.0 mm.
- Coronal and sagittal 2D planar reconstructions are important for evaluation of the joint space & bursa sacs in CT arthrograms.
- 3D renderings are helpful for complex fractures & dislocations.



Overview

- *ThoraxRoutine/ThoraxRoutine08s*
Spiral mode for routine chest studies
- *ThoraxFast*
Spiral mode for fast chest studies
- *ThoraxHRSeq*
Sequential mode for high resolution lung studies
- *LungLowDose*
Spiral mode with very low dose for early visualization of pathologies

Hints in General

- Topogram: TOP, 512 mm.
- Patient positioning: Patient lying in supine position, arms positioned comfortably above the head in the head-arm rest, lower legs supported.
- Contrast medium administration: in general, IV injections are employed in all mediastinal examinations, but not in routine high resolution studies of diffuse interstitial lung diseases. An IV contrast medium injection improves the vascular opacification and facilitates the visualization of the lesions, lymph nodes and the vessels.
- Stasis of contrast medium in the arm & superior vena cava often result in high density streak artifacts either in the region of the aortic arch or in the region of the subclavian vein. A caudo-cranial (bottom to top) scanning direction should be used to reduce this artifact – by simply acquiring the data in this region at the later phase of the spiral scan. In addition, if the patient cannot hold his/her breath for the duration of the entire scan, breathing motion will be less apparent in the apex than in the lower lobes.
- 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.

- Lung images should be documented in both soft tissue window and lung window.
- It is also possible to interleave the soft tissue & lung setting images in one film sheet. This can be set up in the configuration for filming.
- To further optimize MPR image quality, we recommend that you reduce one or more of the following parameters: collimation, reconstruction increment, and slice width for image reconstruction.

Body Kernels

- As standard kernels for body tissue studies B31s or B41s are recommended; softer images are obtained with B20s.
- For higher sharpness, as is required e.g., in patient protocols for cervical spine, shoulder, extremities, thorax, the kernels B50s, B60s, B70s are available.

ThoraxRoutine/ ThoraxRoutine08s

Indications:

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

A range of 30 cm will be covered in 23/18 sec.



Thorax

	ThorRoutine	2nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	60	
<i>Rotation time</i>	0.8/1.0 sec	
<i>Slice collimation</i>	4.0 mm	
<i>Slice width</i>	5.0 mm	5.0 mm
<i>Feed/Rotation</i>	14.4 mm	
<i>Pitch Factor</i>	1.8	
<i>Increment</i>	5.0 mm	5.0 mm
<i>Kernel</i>	B41s	B70s
<i>CTDI_{Vol}</i>	6.47 mGy	
<i>Effective dose</i>	Male: 3.28 mSv Female: 4.23 mSv	

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

Hints

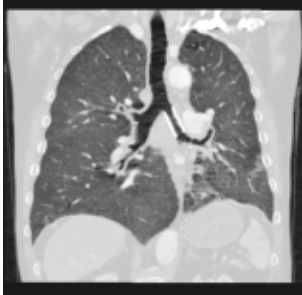
- You could repeat the same protocol by simply clicking the chronicle with the right mouse button for "repeat", e.g., when both non-contrast and contrast studies are required.
- For lung cancer evaluation, this protocol can be combined with the protocol "Neck Routine".

ThoraxFast

Indications:

Fast spiral mode for lung studies, e.g., when a patient has difficulty with breathhold.

A complete thorax scan in a range of 30 cm will be covered in 14 sec.



Thorax

	ThorFast	2nd reconstr.
<i>kV</i>	130	
<i>Effective mAs</i>	60	
<i>Rotation time</i>	0.8 sec	
<i>Slice collimation</i>	5.0 mm	
<i>Slice width</i>	8.0 mm	8.0 mm
<i>Feed/Rotation</i>	20.0 mm	
<i>Pitch Factor</i>	2.0	
<i>Increment</i>	8.0 mm	8.0 mm
<i>Kernel</i>	B41s	B70s
<i>CTDI_{vol}</i>	6.47 mGy	
<i>Effective dose</i>	Male: 3.38 mSv Female: 4.39 mSv	

Contrast medium IV injection

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

Hints

- You could repeat the same protocol by simply clicking the chronicle with the right mouse button for “repeat”, e.g., when both non-contrast and contrast studies are required.
- For lung cancer evaluation, this protocol can be combined with the protocol “Neck Routine”.

ThoraxHRSeq

Indications:

Sequence mode for HiRes lung studies, e.g., interstitial changes in the lungs.

Images are acquired with a range of 30.1 cm.



	ThorHRSeq
<i>kV</i>	130
<i>Effective mAs</i>	100
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	1.0 mm
<i>Slice width</i>	1.0 mm
<i>Feed/Scan</i>	10.0 mm
<i>Kernel</i>	U90s
<i>CTDI_{Vol}</i>	2.16 mGy
<i>Effective dose</i>	Male: 1.02 mSv Female: 1.33 mSv

Hints

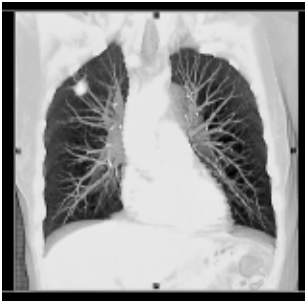
- If you want to reconstruct thin slices every 15 or 20 mm instead of 10 mm as predefined, simply change the Feed/Scan before loading the mode.
- With studies of interstitial changes in the lungs, contrast medium is not necessary.

LungLowDose

Indications:

Spiral 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 32 sec.



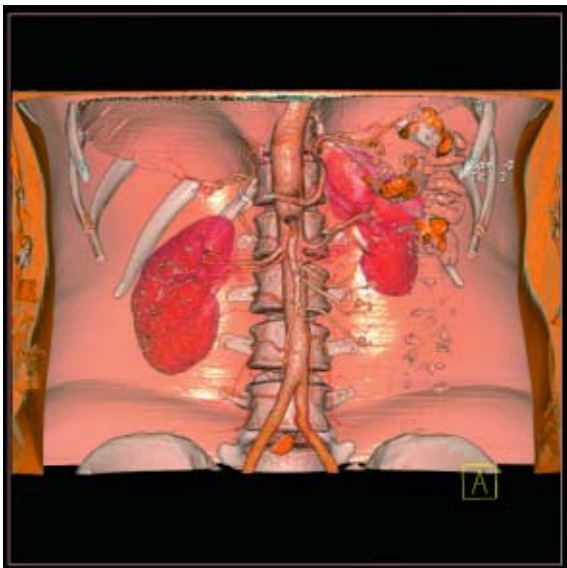
LungLowDose	
<i>kV</i>	130
<i>Effective mAs</i>	30
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	5.0 mm
<i>Slice width</i>	8.0 mm
<i>Feed/Rotation</i>	10.0 mm
<i>Pitch Factor</i>	1.0
<i>Increment</i>	8.0 mm
<i>Kernel</i>	B70s
<i>CTDI_{vol}</i>	3.23 mGy
<i>Effective dose</i>	Male: 1.69 mSv Female: 2.08 mSv

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

Hints

- You could repeat the same protocol by simply clicking the chronicle with the right mouse button for “repeat”, e.g., when both non-contrast and contrast studies are required.
- For lung cancer evaluation, this protocol can be combined with the protocol “Neck Routine”.
- Low dose lung images are usually evaluated using lung window setting. Soft tissue/bone window settings may be used to visualize the presence of calcifications in the nodules.
- It is essential to use the same protocol for follow-up studies to check for progression.

Abdomen



Overview

- *AbdomenRoutine/AbdomenRoutine08s*
Spiral mode for routine abdominal studies
- *AbdomenFast*
Spiral mode for fast abdominal studies
- *AbdMultiPhase/AbdMultiPhase08s*
Spiral mode for three-phase liver studies
- *AbdomenSeq*
Sequential mode for abdominal studies

Hints in General

- Topogram: TOP, 512.
- Patient positioning:
Patient lying in supine position, arms positioned comfortably above the head in the head-arm rest, lower legs supported.
- Patient respiratory instruction: Inspiration.
- Oral administration of contrast medium:
For abdominal studies, it is necessary to delineate the bowel from other structures such as lymph nodes, abdominal masses & abscesses. Various types of bowel opacifying agents can be used:
 - Diluted barium suspension (1% – 2%) e.g., EZCAT
 - Water soluble agent (2% – 4%) e.g., Gastrografin
 - Water alone, 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.

Abdomen

- 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.
- Be careful when examining pheochromocytoma patients. Administration of an IV CM injection in such cases may trigger a hypertensive crisis!
- To further optimize MPR image quality, we recommend that you reduce one or more of the following parameters: collimation, reconstruction increment, and slice width for image reconstruction.
- For abdominal studies deselect CARE Dose for patients > 120 kg.

Body Kernels

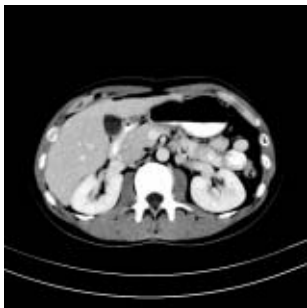
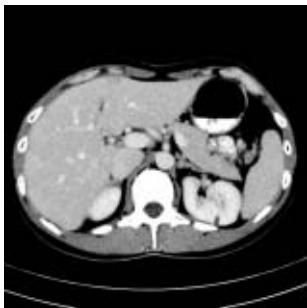
- As standard kernels for body tissue studies B31s or B41s are recommended; softer images are obtained with B20s.
- For higher sharpness, as is required e.g., in patient protocols for cervical spine, shoulder, extremities, thorax, lung, the kernels B50s, B60s, B70s are available.

AbdomenRoutine/ AbdomenRoutine08s

Indications:

Spiral mode for all routine studies in the region of abdomen, e.g., evaluation, follow-up examinations etc.

A typical abdomen scan in a range of 20 cm will be covered in 16/13 sec.



Abdomen

	AbdRoutine
<i>kV</i>	130
<i>Effective mAs</i>	60
<i>Rotation time</i>	0.8/1.0 sec
<i>Slice collimation</i>	4.0 mm
<i>Slice width</i>	5.0 mm
<i>Feed/Rotation</i>	14.4 mm
<i>Pitch Factor</i>	1.8
<i>Increment</i>	5.0 mm
<i>Kernel</i>	B41s
<i>CTDI_{vol}</i>	6.47 mGy
<i>Effective dose</i>	Male: 2.61 mSv Female: 3.32 mSv

Contrast medium IV injection	
<i>Start delay</i>	50 – 60 sec.
<i>Flow rate</i>	1.0 – 2.0 ml/sec.
<i>Total amount</i>	100 ml

Hints

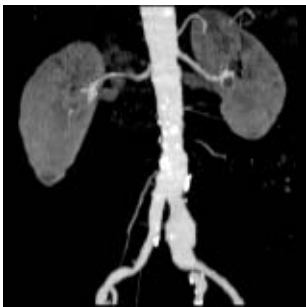
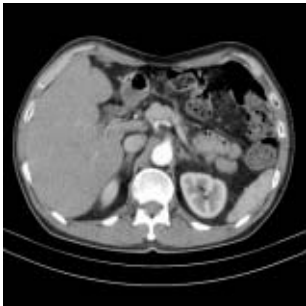
- You could repeat the same protocol by simply clicking the chronicle with the right mouse button for “repeat”, e.g., when both non-contrast and contrast studies are required.
- Delayed scans may be required for the kidneys & bladder.

AbdomenFast

Indications:

Fast spiral mode for abdominal studies, e.g., when a patient has difficulty with holding their breath.

A range of 20 cm will be covered in 9.6 sec.



Abdomen

	AbdFast
<i>kV</i>	130
<i>Effective mAs</i>	60
<i>Rotation time</i>	0.8 sec
<i>Slice collimation</i>	5.0 mm
<i>Slice width</i>	8.0 mm
<i>Feed/Rotation</i>	20.0 mm
<i>Pitch Factor</i>	2.0
<i>Increment</i>	8.0 mm
<i>Kernel</i>	B41s
<i>CTDI_{vol}</i>	6.47 mGy
<i>Effective dose</i>	Male: 2.59 mSv Female: 3.29 mSv

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

Hint

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

AbdMultiPhase/ AbdMultiPhase08s

Indications:

Spiral scan to assist the physician with differential diagnosis of liver diseases.

A typical native range of 20 cm will be covered in 15 sec.



Abdomen

	Non Contrast	Arterial Phase	Venous Phase
<i>kV</i>	130	130	130
<i>Effective mAs</i>	80	80	80
<i>Rotation time</i>	1.0 sec	0.8/1.0 sec	1.0 sec
<i>Slice collimation</i>	5.0 mm	5.0 mm	5.0 mm
<i>Slice width</i>	8.0 mm	6.0 mm	6.0 mm
<i>Feed/Rotation</i>	15.0 mm	14.0/ 15.0 mm	15.0 mm
<i>Pitch Factor</i>	1.5	1.4/1.5	1.5
<i>Increment</i>	8.0 mm	6.0 mm	6.0 mm
<i>Kernel</i>	B41s	B41s	B41s
<i>CTDI_{Vol}</i>	8.62 mGy	8.62 mGy	8.62 mGy
<i>Effective dose</i>	Male: 3.34 mSv Female: 4.19 mSv	Male: 3.34 mSv Female: 4.19 mSv	Male: 3.34 mSv Female: 4.19 mSv

Contrast medium IV injection

<i>Start delay</i>	20 – 25 sec. * (arterial phase) 50 – 75 sec. * (venous phase)
<i>Flow rate</i>	3.0 ml/sec.
<i>Total amount</i>	100 ml

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

Hints

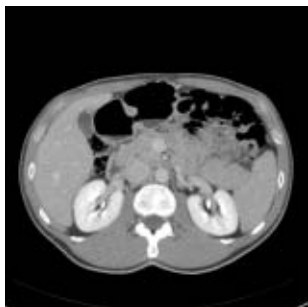
- Do not administer oral contrast medium, as this impairs the editing of MIP/SSD/VRT images. Use water instead if necessary.
- Water, rather than positive oral contrast agents should be used. Give the last cup of 200 ml just prior to positioning the patient. To ensure adequate filling of the duodenal loop, lay the patient on the right side for 5 minutes before performing the topogram.
- A pre-contrast examination is usually performed only if no CT scans were previously acquired, to exclude calculi in the common bile duct and to visualize possible lesions in the liver. Furthermore, this also ensures exact positioning for the CTA spiral.
- For pancreatic studies, the arterial phase acquisition can be acquired later with a start delay of 40–50 sec. It may be necessary to use a thinner collimation of e.g. 2.5 mm.

AbdomenSeq

Indications:

Sequential mode for all routine studies in the region of abdomen, e.g., evaluation, follow-up examinations etc.

The whole scan length covers 15.2 cm.



	AbdSeq
<i>kV</i>	130
<i>Effective mAs</i>	70
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	4.0 mm
<i>Slice width</i>	8.0 mm
<i>Feed/Scan</i>	8.0 mm
<i>Kernel</i>	B41s
<i>CTDIvol</i>	7.55 mGy
<i>Effective dose</i>	Male: 2.35 mSv Female: 2.75 mSv

Contrast medium IV injection	
<i>Start delay</i>	50 – 60 sec.
<i>Flow rate</i>	3.0 ml/sec.
<i>Total amount</i>	100 ml

Hints

- You could repeat the same protocol by simply clicking the chronicle with the right mouse button for “repeat”, e.g., when both non-contrast and contrast studies are required.
- Water, rather than positive oral contrast agents should be used. Give the last cup 200 ml just prior positioning the patient. To ensure adequate filling of the duodenal loop, lay the patient on the right side for 5 minutes before performing the topogram.
- A pre-contrast examination is usually performed only if no CT scans were previously acquired, to exclude calculi in the common bile duct and to visualize possible lesions in the liver.



Overview

- *Pelvis*
Spiral mode for routine soft tissue pelvis studies
- *Hip*
Spiral mode for routine hip studies
- *SI_Joints*
Spiral mode for sacroiliac joints studies

Hints in General

- Topogram: TOP, 512 mm for pelvis studies and 256 mm for studies of the hip and SI Joints.
- Patient positioning:
Patient lying in supine position, arms positioned comfortably above the head in the head-arm rest, lower legs supported.
- A breathing command is not necessarily required for the pelvic examination, since respiration does not negatively influence this region.
- Rectal contrast medium administration:
Rectal contrast media is usually required to delineate the rectum and sigmoid colon, if lower pelvic mass or pathology are suspected. In some cases, air may be substituted for a positive contrast agent. The use of a vaginal tampon may be helpful in adult female patients with suspected pelvis pathology.
- To further optimize MPR image quality we recommend that you reduce one or more of the following: collimation, reconstruction increment, and slice width for image reconstruction.
- For pelvis studies, deselect CARE Dose for patients > 120 kg.

Body Kernels

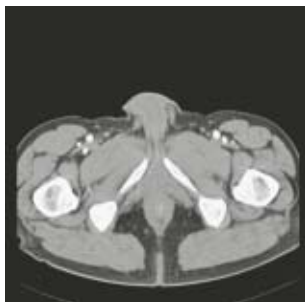
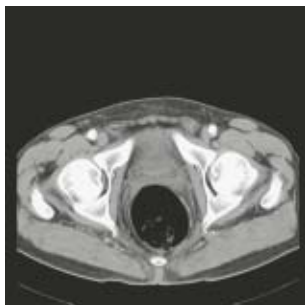
- As standard kernels for body tissue studies B31s or B41s is recommended; softer images are obtained with B20s.

Pelvis

Indications:

Spiral mode for routine pelvis studies, e.g., processes of the prostate, urinary bladder, rectum, gynecological indications etc.

A typical range of 20 cm will be covered in 12 sec.



Pelvis

Pelvis	
<i>kV</i>	130
<i>Effective mAs</i>	80
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	5.0 mm
<i>Slice width</i>	8.0 mm
<i>Feed/Rotation</i>	20.0 mm
<i>Pitch Factor</i>	2.0
<i>Increment</i>	8.0 mm
<i>Kernel</i>	B41s
<i>CTDI_{Vol}</i>	8.62 mGy
<i>Effective dose</i>	Male: 3.24 mSv Female: 5.51 mSv

Contrast medium IV injection	
<i>Start delay</i>	50 sec. *
<i>Flow rate</i>	2.0 – 3.0 ml/sec.
<i>Total amount</i>	100 – 120 ml

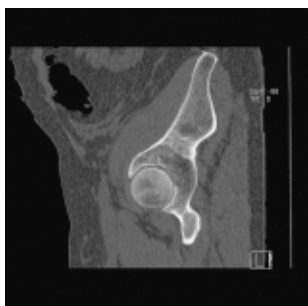
* If the examination performed requires a full urinary bladder, wait at least 3 minutes following IV administration of the contrast medium.

Hip

Indications:

Spiral mode for HiRes bone studies and soft tissue studies of the Hip, e.g., evaluation of joint cavity, masses, trauma, dysplasia, necrosis of the head of the hip, congruence evaluations, orthopedic indications etc.

A typical range of 10 cm will be covered in 35 sec.



Pelvis

	Hip	2 nd reconstr.
<i>kV</i>	130	
<i>Effective mAs</i>	70	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.5 mm	
<i>Slice width</i>	3.0 mm	2.0 mm
<i>Feed/Rotation</i>	3.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	3.0 mm	1.5 mm
<i>Kernel</i>	B70s	B70s
<i>CTDI_{Vol}</i>	7.55 mGy	
<i>Effective dose</i>	Male: 1.78 mSv Female: 1.66 mSv	

Hints

- In case of 3D study only, images should be reconstructed with at least 50% overlap in image reconstruction and kernel B20s.
- If only one side is examined, it is advisable to enter the side in the comment line on the *Routine* card.

SI_Joints

Indications:

Spiral mode for bone studies of the sacroiliac joints.

A typical range of 8 cm will be covered in 18 sec.



	SI_Joints	2 nd reconstruction
kV	130	
Effective mAs	80	
Rotation time	1.0 sec	
Slice collimation	2.5 mm	
Slice width	3.0 mm	3.0 mm
Feed/Rotation	5.0 mm	
Pitch Factor	1.0	
Increment	3.0 mm	2.0 mm
Kernel	B70s	B70s
CTDI _{vol}	8.62 mGy	
Effective dose	Male: 1.44 mSv Female: 1.93 mSv	



Overview

- *C-Spine*
Spiral mode for cervical spine studies
- *C-SpineSeq*
Sequential mode for cervical spine studies
- *Spine*
Spiral mode for routine lumbar and thoracic spine studies
- *SpineSeq*
Sequential mode for lumbar and thoracic evaluation of the discs
- *Osteo*
Sequential mode used for the application *syngo Osteo CT*

Hints in General

- Topogram: Lateral, 512 mm for thoracic and lumbar spine and 256 mm for the C-spine.
- Patient positioning for thoracic and lumbar spine studies:
Patient lying in supine position, arms positioned comfortably above the head in the head-arm rest, lower legs supported.
- Patient positioning for cervical spine studies:
Patient lying in supine position, hyperextend neck slightly, secure head well in head holder.
 - Patient respiratory instruction: do not breathe, do not swallow.

Any possible injuries to the spinal column should be determined before beginning the examination and taken into account when repositioning the patient.

Hints

- In case of 3D study only, images should be reconstructed with at least 50% overlap in image reconstruction and kernel B20s.
- In case of SSD study only, mAs value can be reduced by 50%. Use kernel B20s and 50% overlap in image reconstruction.
- For lumbar studies, place a cushion under the patient's knees. This will reduce the curve in the spine and also make the patient more comfortable.
- For image reconstruction of bone studies, use kernel B60.

- The CT scan following myelography must be performed within 4 – 6 hours of the injection, otherwise, the contrast density in the spinal canal will be too high to obtain artifact-free images. Also, if possible, it is a good idea to roll the patient once, or scan in a prone position. This will prevent the contrast from pooling posterior to the spinal cord.
- If a prone scan is performed, breathing instructions are recommended to avoid motion artifact in axial source and MPR images.
- To further optimize MPR image quality, we recommend that you reduce one or more of the following parameters: collimation, reconstruction increment, and slice width for image reconstruction.

Body Kernels

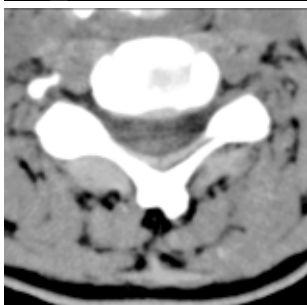
- As standard kernels for body tissue studies B31s or B41s are recommended; softer images are obtained with B20s.
- For higher sharpness, as is required e.g., in patient protocols for cervical spine, shoulder, extremities, thorax, lung, the kernels B50s, B60s, B70s are available.

C-Spine

Indications:

Spiral mode for cervical spine studies, e.g., prolapse, degenerative changes, trauma, tumors etc.

A range of 15 cm will be covered in 52 sec.



Spine

	C-Spine	2nd reconstr.
<i>kV</i>	130	
<i>Effective mAs</i>	90	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.5 mm	
<i>Slice width</i>	3.0 mm	2.0 mm
<i>Feed/Rotation</i>	3.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	3.0 mm	1.5 mm
<i>Kernel</i>	B50s	B50s
<i>CTDI_{Vol}</i>	9.70 mGy	
<i>Effective dose</i>	Male: 2.02 mSv Female: 2.07 mSv	

C-SpineSeq

Indications:

Sequential mode for cervical spine studies, e.g., prolapse, degenerative changes, trauma, tumors, etc. with a typical length for each range of 1.2 cm.

This protocol contains five ranges: C2-C3, C3-C4, C4-C5, C5-C6, C6-C7

	C2-3	C3-4	C4-5
<i>kV</i>	130	130	130
<i>Effective mAs</i>	170	170	170
<i>Rotation time</i>	1.5 sec	1.5 sec	1.5 sec
<i>Slice collimation</i>	1.0 mm	1.0 mm	1.0 mm
<i>Slice width</i>	2.0 mm	2.0 mm	2.0 mm
<i>Feed/Scan</i>	2.0 mm	2.0 mm	2.0 mm
<i>Kernel</i>	B50s	B50s	B50s
<i>CTDI_{Vol}</i>	18.33	18.33	18.33
	<i>mGy</i>	<i>mGy</i>	<i>mGy</i>
<i>Effective dose</i>	<i>Male:</i>	<i>Male:</i>	<i>Male:</i>
	0.18 mSv	0.39 mSv	0.66 mSv
	<i>Female:</i>	<i>Female:</i>	<i>Female:</i>
	0.14 mSv	0.21 mSv	0.45 mSv

Spine

	C5-6	C6-7
<i>kV</i>	130	130
<i>Effective mAs</i>	170	190
<i>Rotation time</i>	1.5 sec	1.5 sec
<i>Slice collimation</i>	1.0 mm	1.0 mm
<i>Slice width</i>	2.0 mm	2.0 mm
<i>Feed/Scan</i>	2.0 mm	2.0 mm
<i>Kernel</i>	<i>B50s</i>	<i>B50s</i>
<i>CTDI_{Vol}</i>	18.33 mGy	20.48 mGy
<i>Effective dose</i>	<i>Male:</i> 0.66 mSv <i>Female:</i> 0.73 mSv	<i>Male:</i> 0.30 mSv <i>Female:</i> 0.50 mSv

Hints

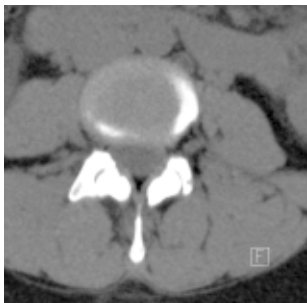
- Dental artifacts can be reduced by tilting the gantry.
- For MPRs and 3D post-processing, use spiral mode with thinner slice and reconstruct images with 50% overlap in image reconstruction. Define a long range to cover the levels of interest in one block.

Spine

Indications:

Spiral mode for thoracic and lumbar spine studies, e.g., prolapse, degenerative changes, trauma, tumors etc.

A range of 15 cm will be covered in 48 sec.



Spine

	Spine	2nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	120	
<i>Rotation time</i>	1.5 sec	
<i>Slice collimation</i>	2.5 mm	
<i>Slice width</i>	3.0 mm	3.0 mm
<i>Feed/Rotation</i>	5.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	3.0 mm	2.0 mm
<i>Kernel</i>	B31s	B60s
<i>CTDI_{Vol}</i>	12.94 mGy	
<i>Effective dose</i>	Male: 2.94 mSv Female: 6.75 mSv	

SpineSeq

Indications:

Sequence mode for spine studies, e.g., prolapse, degenerative changes, trauma, tumors etc. with a typical length for each range of 1.5 cm.

This protocol contains three ranges:
L3-4, L4-L5, L5-S1

Three different typical gantry tilts are predefined:
for L3-L4: 0°, for L4-L5: +5° and for L5-S1: +15°



Spine

	L3-4	L4-5	L5-S1
<i>kV</i>	130	130	130
<i>Effective mAs</i>	220	220	235
<i>Rotation time</i>	1.5 sec	1.5 sec	1.5 sec
<i>Slice collimation</i>	1.5 mm	1.5 mm	1.5 mm
<i>Slice width</i>	3.0 mm	3.0 mm	3.0 mm
<i>Feed/Scan</i>	3.0 mm	3.0 mm	3.0 mm
<i>Kernel</i>	<i>B31s</i>	<i>B31s</i>	<i>B31s</i>
<i>CTDI_{Vol}</i>	23.72	23.72	25.33
	<i>mGy</i>	<i>mGy</i>	<i>mGy</i>
<i>Effective dose</i>	<i>Male:</i>	<i>Male:</i>	<i>Male:</i>
	0.58 mSv	0.63 mSv	0.64 mSv
	<i>Female:</i>	<i>Female:</i>	<i>Female:</i>
	0.92 mSv	1.21 mSv	2.35 mSv

Osteo

This is the scan protocol for the syngo Osteo CT application package to assist the Physician with the quantitative assessment of vertebral bone mineral density (BMD) in the diagnosis and follow-up of osteopenia and osteoporosis.

	Osteo	Osteo	Osteo
<i>kV</i>	80	80	80
<i>Effective mAs</i>	81	81	81
<i>Rotation time</i>	1.0 sec	1.0 sec	1.0 sec
<i>Slice collimation</i>	5.0 mm	5.0 mm	5.0 mm
<i>Slice width</i>	10.0 mm	10.0 mm	10.0 mm
<i>Feed/Scan</i>	0.0 mm	0.0 mm	0.0 mm
<i>Kernel</i>	S80s	S80s	S80s
<i>CTDI_{Vol}</i>	2.23 mGy	2.23 mGy	2.23 mGy
<i>Effective dose</i>	Male: 0.03 mSv	Male: 0.03 mSv	Male: 0.03 mSv
	Female: 0.08 mSv	Female: 0.05 mSv	Female: 0.04 mSv

For obese patients, increase the mAs value to 120. Load all ranges in the application "syngo Osteo CT". For further information, please refer to the chapter "syngo Osteo CT".



Overview

- *WristHR*
Spiral mode for routine high resolution wrist studies
- *ExtrRoutineHR*
Spiral mode for routine high resolution extremity studies

Hints in General

- Topogram: TOP, 256 mm for joint studies.
- Patient positioning:
Depends on the region of examination.
In general, for bilateral studies, you should always try to position the patient symmetrical whenever the patient can comply.

For wrists and elbow scans:

Patient lying in **prone position**, hands stretched above the head and lying flat on a Bocollo pillow, ankles supported with a pad. Both wrists should be examined together when necessary.

- Retrospective reconstruction can be done:
 - a) Use B31s kernel for soft tissue evaluation.
 - b) For targeted FoV images on the affected side, it is advisable to enter the side being examined in the comment line.
- In case of 3D study only, use kernel B20s and at least 50% overlap in image reconstruction.
- To further optimize MPR image quality, we recommend that you reduce one or more of the following parameters: collimation, reconstruction increment, and slice width for image reconstruction.

Body Kernels

- As standard kernels for body tissue studies B31s or B41s is recommended; softer images are obtained with B20s.
- For higher sharpness, as is required e.g., in patient protocols for cervical spine, shoulder, extremities, thorax, lung, the kernels B50s, B60s, B70s are available.

WristHR

Indications:

Spiral mode for HiRes bone study of the wrist, e.g., trauma, orthopedic indications etc.

A range of 6 cm will be covered in 32 sec.



Upper Extremities

	WristHR	2 nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	30	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	2.0 mm	1.25 mm
<i>Feed/Rotation</i>	2.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	2.0 mm	0.8 mm
<i>Kernel</i>	U90s	U90s
<i>CTDI_{Vol}</i>	3.23 mGy	
<i>Effective dose</i>	Male: < 0.01 mSv Female: < 0.01 mSv	

Hint

- For image reconstruction of soft tissue, use kernel B31s.

ExtrRoutineHR

Indications:

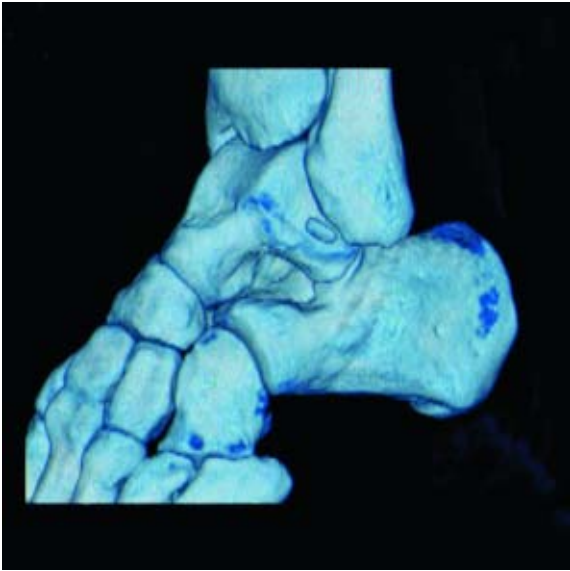
Spiral mode for HiRes bone study, e.g., trauma, orthopedic indications etc.

A range of 10 cm will be covered in 52 sec.

	ExtrHR	2nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	30	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	2.0 mm	1.25 mm
<i>Feed/Rotation</i>	2.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	2.0 mm	0.8 mm
<i>Kernel</i>	U90s	U90s
<i>CTDI_{Vol}</i>	3.23 mGy	
<i>Effective dose</i>	Male: < 0.01 mSv Female: < 0.01 mSv	

Hint

- For image reconstruction of soft tissue, use kernel B31s.



Overview

- *KneeHR*
Spiral mode for high resolution routine knee studies
- *FootHR*
Spiral mode for high resolution routine foot studies
- *ExtrRoutineHR*
Spiral mode for high resolution routine extremity studies

Hints in General

- Topogram: TOP, 256 mm for joint studies.
- Patient positioning:
Depends on the region of examination. In general, for bilateral studies, you should always try to position the patient symmetrical whenever the patient can comply.
- For knee scan:
Patient lying in supine position, feet first, promote relaxation by placing Bocollo pillows between knees and feet, bind feet together. The only exceptions are extremely light patients. The latter can remove the leg not being examined from the gantry by bending it 90° at the hip and the knee and placing the bottom of the same foot against the gantry casing.
- For ankle and feet scans:
Patient lying in supine position, feet first. Bind both ankles together if necessary to assure the TOP position of both feet.
- Retrospective reconstruction can be done:
 - a) Use B31s kernel for soft tissue evaluation.
 - b) For targeted FoV images on the affected side, it is advisable to enter the side being examined in the comment line.
- To further optimize MPR image quality, we recommend that you reduce one or more of the following parameters: collimation, reconstruction increment, and slice width for image reconstruction.

Body Kernels

- As standard kernels for body tissue studies B31s or B41s is recommended; softer images are obtained with B20s.
- For higher sharpness, as is required e.g., in patient protocols for cervical spine, shoulder, extremities, thorax, lung, the kernels B50s, B60s, B70s are available.
- In case of 3D study only, the mAs value can be reduced by 50%. Use kernel B20s and at least 50% overlap in image reconstruction.

KneeHR

Indications:

Spiral mode for high resolution studies of the knee, e.g., masses, trauma, disorders of the joint etc.

A range of 10 cm will be covered in 52 sec.



Lower Extremities

	KneeHR	2 nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	35	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	3.0 mm	1.25 mm
<i>Feed/Rotation</i>	2.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	3.0 mm	0.8 mm
<i>Kernel</i>	U90s	U90s
<i>CTDI_{Vol}</i>	3.77 mGy	
<i>Effective dose</i>	Male: 0.01 mSv Female: 0.01 mSv	

Hint

- For image reconstruction of soft tissue, use kernel B31s.

FootHR

Indications:

Spiral mode for high resolution studies of the foot, e.g., masses, trauma, disorders of the joint etc.

A range of 10 cm will be covered in 52 sec.



	FootHR	2 nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	30	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	3.0 mm	1.25 mm
<i>Feed/Rotation</i>	2.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	3.0 mm	0.8 mm
<i>Kernel</i>	U90s	U90s
<i>CTDI_{Vol}</i>	3.23 mGy	
<i>Effective dose</i>	Male: 0.01 mSv	Female: 0.01 mSv

Hint

- For image reconstruction of soft tissue, use kernel B31s.

ExtrRoutineHR

Indications:

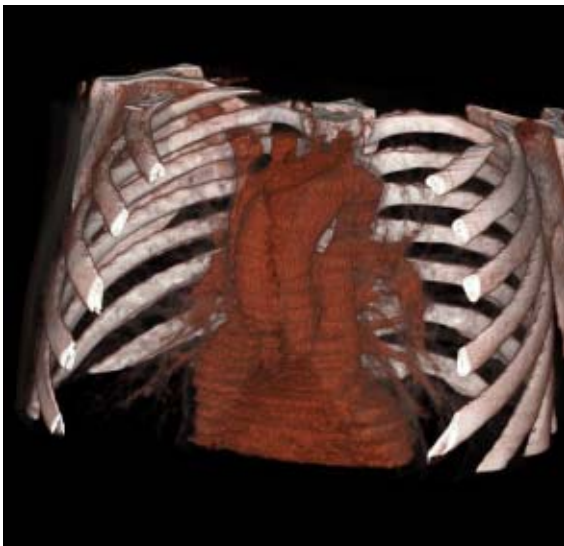
Spiral mode for HiRes bone study, e.g., trauma, orthopedic indications etc.

A range of 10 cm will be covered in 52 sec.

	ExtrHR	2nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	30	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	2.0 mm	1.25 mm
<i>Feed/Rotation</i>	2.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	2.0 mm	0.8 mm
<i>Kernel</i>	U90s	U90s
<i>CTDI_{Vol}</i>	3.23 mGy	
<i>Effective dose</i>	Male: 0.01 mSv Female: 0.01 mSv	

Hint

- For image reconstruction of soft tissue, use kernel B31s.



Overview

- *HeadAngio/HeadAngio08s*
Spiral mode for head CTAngio studies
- *CarotidAngio/CarotidAngio08s*
Spiral mode for carotid CTAngio studies
- *ThorAngio/ThorAngio08s*
Spiral mode for chest CTAngio studies
- *Embolism*
Spiral mode for pulmonary embolism studies
- *BodyAngioRoutine/BodyAngioRoutine08s*
Spiral mode for body CTAngio studies
- *BodyAngioFast*
Spiral mode for fast body CTAngio studies

Hints in General

- Topogram: TOP, 512/1024 or LAT 256
- Patient positioning:
Patient lying in supine position, arms positioned comfortably above the head in the head-arm rest, lower legs supported.
- Patient respiratory instructions: inspiration.
- Oral administration of contrast medium:
The use of water will not obscure the blood vessels, thus allowing CTA post-processing to be performed easily afterwards.
- Be careful when examining pheochromocytoma patients. Administration of an IV CM injection in such cases may trigger a hypertensive crisis!
- To further optimize MPR image quality, we recommend that you reduce one or more of the following parameters: collimation, reconstruction increment and slice width for image reconstruction.

Head Kernels

- For soft tissue head studies, the standard kernel is H41s; softer images are obtained with H31s or H21s, sharper images with H50s.

Body Kernels

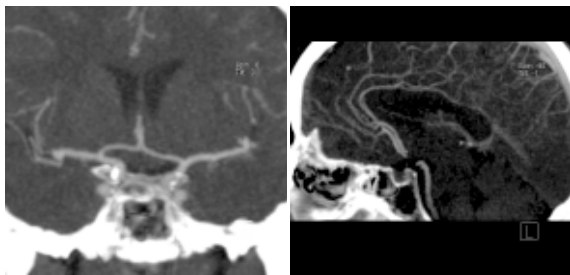
- As standard kernels for body tissue studies B31s or B41s is recommended; softer images are obtained with B20s.

HeadAngio/HeadAngio08s

Indications:

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

A range of 6 cm will be covered in 32/26 sec.



	HeadAngio	2 nd reconstruction
kV	130	
Effective mAs	50	
Rotation time	0.8/1.0 sec	
Slice collimation	1.0 mm	
Slice width	3.0 mm	1.25 mm
Feed/Rotation	2.0 mm	
Pitch Factor	1.0	
Increment	3.0 mm	0.8 mm
Kernel	H31s	H31s
CTDI _{vol}	11.39 mGy	
Effective dose	Male: 0.26 mSv	Female: 0.30 mSv

Contrast medium IV injection

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

Hints

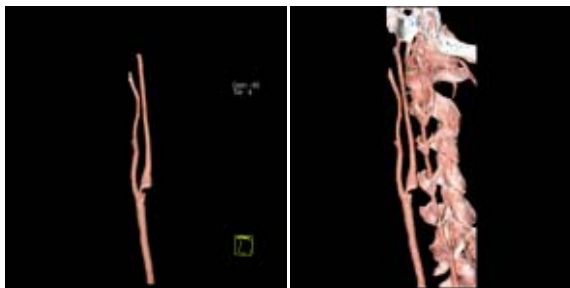
- Use of CARE Bolus with monitoring scans positioned at the level of the basilar artery or carotid artery. Set the trigger threshold at 120 HU, or use manual triggering.
- An automatic bone correction and an advanced algorithm allow for improved head image quality, without any additional post-processing.

CarotidAngio/CarotidAngio08s

Indications:

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

A range of 12 cm will be covered in 32/26 sec.



	CarotidAngio	2 nd reconstruction
kV	130	
Effective mAs	55	
Rotation time	0.8/1.0 sec	
Slice collimation	1.0 mm	
Slice width	5.0 mm	1.25 mm
Feed/Rotation	4.0 mm	
Pitch Factor	2.0	
Increment	5.0 mm	0.8 mm
Kernel	B31s	B31s
CTDI _{Vol}	5.93 mGy	
Effective dose	Male: 1.15 mSv	Female: 1.25 mSv

Contrast medium IV injection

<i>Start delay</i>	<i>15 sec.</i>
<i>Flow rate</i>	<i>4 ml/sec.</i>
<i>Total amount</i>	<i>90 ml</i>

Hints

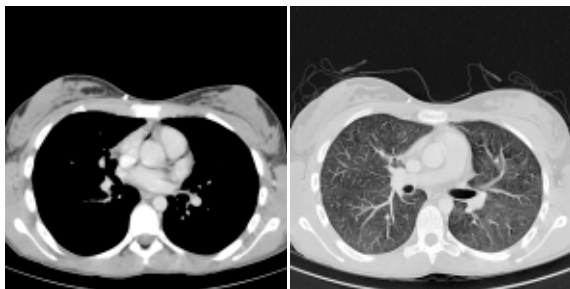
- CARE Bolus may be used to optimize the bolus timing.
- Set the ROI for monitoring scan in the aortic arch with triggering threshold of 120 HU, or use manual triggering.
- High quality 2D & 3D post-processing can be achieved using a thin slice thickness and 50% overlap in image reconstruction.
- MPR Thick and MIP Thin images can be created very quickly on the 3D card by just clicking on the appropriate icons. The thickness of these reconstructed images can be defined by clicking on the icons with the right mouse to open the entry field.

ThorAngio/ThorAngio08s

Indications:

Spiral study for location and extent of aneurysms, dissection, and ruptures of the thoracic aorta.

A range of 20 cm will be covered in 24/19 sec.



	ThorAngio	2 nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	55	
<i>Rotation time</i>	0.8/1.0 sec	
<i>Slice collimation</i>	2.5 mm	
<i>Slice width</i>	5.0 mm	3.0 mm
<i>Feed/Rotation</i>	9.0 mm	
<i>Pitch Factor</i>	1.8	
<i>Increment</i>	5.0 mm	2.0 mm
<i>Kernel</i>	B31s	B31s
<i>CTDI_{vol}</i>	5.93 mGy	
<i>Effective dose</i>	Male: 1.91 mSv Female: 2.67 mSv	

Contrast medium IV injection

<i>Start delay</i>	<i>10 – 25 sec.</i>
<i>Flow rate</i>	<i>2.5 ml/sec.</i>
<i>Total amount</i>	<i>80 ml</i>

Hints

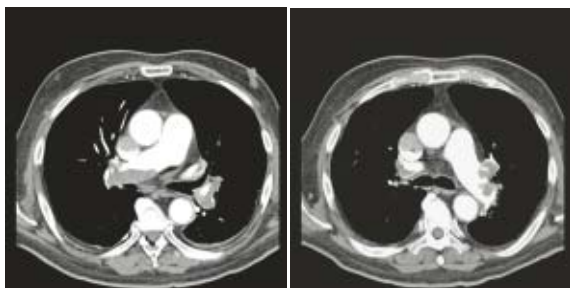
- CARE Bolus may be used to optimize the bolus timing.
- Set the ROI for monitoring scan in the aortic arch with triggering threshold of 120 HU, or use manual triggering.
- High quality 2D & 3D post-processing can be achieved using a thin slice thickness and 50% overlap in image reconstruction.
- Thick MPRs and ThinMIPs can be created very quickly on the 3D card by just clicking on the appropriate icons. The thickness of these reconstructed images can be defined by clicking on the icons with the right mouse to open the entry field.
- To display an SSD of the thoracic aorta without bone included, editing is necessary.

Embolism

Indications:

Spiral mode for Pulmonary Emboli studies.

A range of 15 cm will be covered in 24 sec.



	Embolism	2nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	55	
<i>Rotation time</i>	0.8 sec	
<i>Slice collimation</i>	1.5 mm	
<i>Slice width</i>	3.0 mm	2.0 mm
<i>Feed/Rotation</i>	5.4 mm	
<i>Pitch Factor</i>	1.8	
<i>Increment</i>	3.0 mm	1.5 mm
<i>Kernel</i>	B31s	B31s
<i>CTDI_{Vol}</i>	5.93 mGy	
<i>Effective dose</i>	Male: 1.56 mSv Female: 2.07 mSv	

Contrast medium IV injection

<i>Start delay</i>	<i>6 – 10 sec.</i>
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<i>Flow rate</i>	<i>4 ml/sec.</i>
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<i>Total amount</i>	<i>80 – 100 ml</i>
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Hints

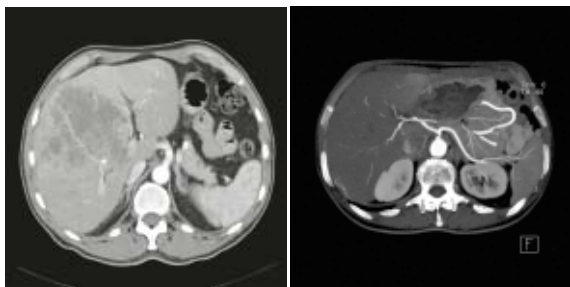
- CARE Bolus may be used to optimize the bolus timing.
- Set the ROI for monitoring scan in the pulmonary trunk with triggering threshold of 120 HU, or use manual triggering.
- You could repeat the same protocol by simply clicking the chronicle with the right mouse button for "repeat".

BodyAngioRoutine/ BodyAngioRoutine08s

Indications:

Spiral mode for abdominal CTA studies.

A range of 20 cm will be covered in 39/31 sec.



	BodyAngio	2 nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	55	
<i>Rotation time</i>	0.8/1.0 sec	
<i>Slice collimation</i>	1.5 mm	
<i>Slice width</i>	5.0 mm	3.0 mm
<i>Feed/Rotation</i>	5.4 mm	
<i>Pitch Factor</i>	1.8	
<i>Increment</i>	5.0 mm	2.0 mm
<i>Kernel</i>	B31s	B31s
<i>CTDI_{Vol}</i>	5.93 mGy	
<i>Effective dose</i>	Male: 2.17 mSv Female: 2.68 mSv	

Contrast medium IV injection

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

Hints

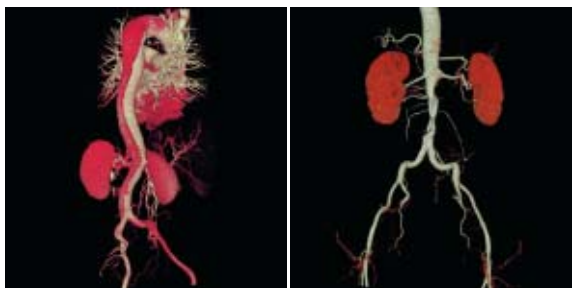
- CARE Bolus may be used to optimize the bolus timing.
- Set the ROI for monitoring scan in the abdominal aorta with triggering threshold of 120 HU, or use manual triggering.
- Do not administer oral contrast medium, as this impairs the editing of MIP/SSD/VRT images.
- Use water as oral contrast.
- The length of the CM spiral in the topogram (via the table position) can be planned exactly by means of pre-contrast images.
- Pre-contrast images are used to visualize calcification.
- Excellent post-processed images can be created using a thin slice thickness and overlapping images, i.e. the increment should be smaller than the slice thickness.

BodyAngioFast

Indications:

Spiral mode for longer coverage and larger vessels.

A range of 20 cm will be covered in 18 sec.



	BodyAngio	2nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	55	
<i>Rotation time</i>	0.8 sec	
<i>Slice collimation</i>	2.5 mm	
<i>Slice width</i>	5.0 mm	3.0 mm
<i>Feed/Rotation</i>	10.0 mm	
<i>Pitch Factor</i>	2.0	
<i>Increment</i>	5.0 mm	2.0 mm
<i>Kernel</i>	B31s	B31s
<i>CTDI_{Vol}</i>	5.93 mGy	
<i>Effective dose</i>	Male: 2.23 mSv Female: 2.77 mSv	

Contrast medium IV injection

<i>Start delay</i>	<i>20 sec.</i>
<i>Flow rate</i>	<i>3.5 ml/sec.</i>
<i>Total amount</i>	<i>120 ml</i>

Hints

- CARE Bolus may be used to optimize the bolus timing.
- Set the ROI for monitoring scan in the abdominal aorta 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.
- Use water as oral contrast.
- The length of the CM spiral in the topogram (via the table position) can be planned exactly by means of pre-contrast images.
- Precontrast images are used to visualize calcification.
- Excellent post-processed images can be created using a thin slice thickness and overlapping images, i.e. the increment should be smaller than the slice thickness.

Overview

The examination protocols designed for some of these applications are under the "Special" folder.

Trauma

In any trauma situation, time means life and the quality of life for the survivor. In order to facilitate the examinations, two protocols are provided.

- *PolyTrauma*: This is a combined mode for the examination of multiple ranges, e.g. Head, Neck, Thorax, Abdomen and Pelvis
- *HeadTrauma*: Spiral head protocol with a FoV of 500 and therefore lowered image quality

Interventional CT

- *Biopsy*: The biopsy protocol is sequential mode without table feed, using a 10 mm slice thickness.

Test Bolus

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

Trauma

In any trauma situation, time means life and the quality of life for the survivor.

This is a combined mode for the examination of multiple ranges, e.g., Head, Neck, Thorax, Abdomen and Pelvis.

The Basics

- Check that the emergency drug trolley is well stocked and that all accessories such as in-room oxygen supply, respirator and resuscitation equipment that may be required during the examination are in working order.
- Prepare the CT room before admitting the patient, e.g., load IV contrast into the injector.
- Know, observe and practice the standard hospital operating policy for handling a patient in distress e.g., Code Blue for cardiac and respiratory arrest.
- Any possible injuries to the spinal column should be determined before beginning the examination and taken into account when shifting and positioning the patient.
- Ensure that all vital lines e.g., IV tubing and oxygen tubing are not trapped under the patient or between the table and the cradle. Make allowance for the length of tubing required for the topogram scan range.
- Never leave patients unattended at any time during the procedure.
- Observe the vital signs e.g., ECG, respiration, etc. at all times during the procedure.
- Finish the examination in the shortest possible time.

PolyTrauma

Two times 2 combined recon jobs are predefined, head with neck and thorax with abdomen.

A range for the Head of 11 cm will be covered in 20 sec., a range for the Neck of 14 cm will be covered in 30 sec.

	Head	Neck
<i>kV</i>	130	130
<i>Effective mAs</i>	110	90
<i>Rotation time</i>	1.5 sec	1.0 sec
<i>Slice collimation</i>	5.0 mm	2.5 mm
<i>Slice width</i>	6.0 mm	3.0 mm
<i>Feed/Rotation</i>	10.0 mm	5.0 mm
<i>Pitch Factor</i>	1.0	1.0
<i>Increment</i>	6.0 mm	3.0 mm
<i>Kernel</i>	H31s	B50s
<i>CTDI_{vol}</i>	25.05 mGy	9.70 mGy
<i>Effective dose</i>	Male: 1.02 mSv Female: 1.08 mSv	Male: 1.69 mSv Female: 1.81 mSv

Take a new Topogram for the thorax and abdomen ranges.

Specials

A range for the Thorax of 25 cm will be covered in 15 sec., a range for the AbdPelvis of 20 cm will be covered in 12 sec.

	Thorax	AbdPelvis
<i>kV</i>	130	130
<i>Effective mAs</i>	40	60
<i>Rotation time</i>	1.0 sec	1.0 sec
<i>Slice collimation</i>	5.0 mm	5.0 mm
<i>Slice width</i>	8.0 mm	8.0 mm
<i>Feed/Rotation</i>	20.0 mm	20.0 mm
<i>Pitch Factor</i>	2.0	2.0
<i>Increment</i>	8.0 mm	8.0 mm
<i>Kernel</i>	B41s	B41s
<i>CTDI_{Vol}</i>	4.31 mGy	6.47 mGy
<i>Effective dose</i>	Male: 1.82 mSv Female: 2.45 mSv	Male: 2.59 mSv Female: 3.31 mSv

- For long range scanning, please pay attention to the mark of scannable range on the table mattress while positioning the patient.
- In some cases, it might be advisable to position the patient feet first so that there will be more space for the intensive care equipment around.

HeadTrauma

A spiral mode for emergency head studies with a max. FoV of 500 mm. A typical scan range of 40/80 cm will be covered in 23/27 sec.

	Base	Cerebrum
<i>kV</i>	130	130
<i>Effective mAs</i>	110	110
<i>Rotation time</i>	1.5 sec	1.0 sec
<i>Slice collimation</i>	1.5 mm	2.5 mm
<i>Slice width</i>	3.0 mm	8.0 mm
<i>Feed/Rotation</i>	3.0 mm	5.0 mm
<i>Pitch Factor</i>	1.0	1.0
<i>Increment</i>	3.0 mm	8.0 mm
<i>Kernel</i>	H31s	H31s
<i>CTDI_{Vol}</i>	25.05 mGy	25.05 mGy
<i>Effective dose</i>	<i>Male:</i>	<i>Male:</i>
	0.37 mSv	0.70 mSv
	<i>Female:</i>	<i>Female:</i>
	0.51 mSv	0.86 mSv

Interventional CT

To facilitate CT interventional procedures, the following protocols are provided. Any of these protocols can be appended to a spiral protocol for CT interventional procedures, such as biopsy, abscess drainage, pain therapy, minimum invasive operations, joint studies, and arthrograms. Adjust the mAs according to the body region before loading.

10 scans are predefined. You can repeat it by clicking the chronicle with the right mouse button and select "repeat", or by simply changing 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.

Biopsy

Indications:

This is the conventional sequential mode without table feed using a 10 mm slice.

	Biopsy
<i>kV</i>	130
<i>Effective mAs</i>	80
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	5.0 mm
<i>Slice width</i>	10.0 mm
<i>Feed/Scan</i>	0.0 mm
<i>Kernel</i>	B31s
<i>CTDI_{vol}</i>	8.62 mGy

Hint

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

TestBolus

Indications:

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

	TestBolus
<i>kV</i>	<i>80</i>
<i>Effective mAs</i>	<i>110</i>
<i>Rotation time</i>	<i>1.0 sec</i>
<i>Slice collimation</i>	<i>5.0 mm</i>
<i>Slice width</i>	<i>10.0 mm</i>
<i>Feed/Scan</i>	<i>0.0 mm</i>
<i>Kernel</i>	<i>B31s</i>
<i>CTDI_{Vol}</i>	<i>3.03 mGy</i>

Overview

The scan protocols for children are defined according to body regions – Head, Neck, Shoulder, Thorax, Abdomen, Pelvis, Spine, Upper Extremities, Lower Extremities, Vascular, Specials and Private.

For children six (6) years and older, use the adult protocols.

Whenever possible, 80 kV is used instead of 130 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 130 kV.

- **Head**

- *HeadRoutine_Baby*
Spiral mode for routine baby head studies
- *HeadRoutine_Child*
Spiral mode for routine children head studies
- *HeadSeq_Baby*
Sequential mode for routine baby head studies
- *HeadSeq_Child*
Sequential mode for routine children head studies
- *InnerEar*
Spiral mode for inner ear studies
- *SinusOrbi*
Spiral mode for routine sinus or orbital studies

- **Neck**

- *Neck*
Spiral mode for soft tissue routine neck studies

- **Thorax**

- *ThoraxRoutine_Baby*
Spiral mode for routine baby chest studies
- *ThoraxRoutine_Child*
Spiral mode for routine children chest studies
- *ThoraxHRSeq_Baby*
Sequential mode for high resolution baby lung studies
- *ThoraxHRSeq_Child*
Sequential mode for high resolution children lung studies

- **Abdomen**

- *Abdomen_Baby*
Spiral mode for routine baby abdominal studies
- *Abdomen_Child*
Spiral mode for routine children abdominal studies

Children

- **Spine**
 - *Spine_Baby*
Spiral mode for routine baby spine studies
 - *Spine_Child*
Spiral mode for routine children spine studies
- **Extremities**
 - *ExtrHR_Baby*
Spiral mode for routine baby high resolution extremity studies
 - *ExtrHR_Child*
Spiral mode for routine children high resolution extremity studies
- **Vascular**
 - *HeadAngio/HeadAngio08s*
Spiral mode for head CTAngio studies
 - *CarotidAngio/CarotidAngio08s*
Spiral mode for carotid CTAngio studies
 - *BodyAngio/BodyAngio08s*
Spiral mode for body CTAngio studies
- **Specials**
 - *NeonateBody*
Spiral mode for neonate studies

Hints in General

1. Topograms: 256 mm lateral topograms are defined for the head modes, and 512 mm TOP 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.
2. Gantry tilt is available for both, sequence and spiral scanning. However, image artifacts may occur if spirals are acquired with a tilt angle greater than 8° .
3. For all head studies, it is very important for image quality purposes to position the patient in the center of the scan field. Use the lateral laser beam to make sure that the patient is positioned in the center.
4. Warm surroundings and dimmed lighting are helpful to make children more cooperative.
5. Sedation: Although the advent of the Multislice CT 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 pleasing to the child (apple juice and 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. Please refer to the specific vendor's recommendations.
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.

Children

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. Whenever possible, I.V. injection with a power injector is recommended for all scans. Some guidelines to follow with respect to flow rate are noted in the chart below.

Note: these injector guidelines are 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. 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. To further optimize MPR image quality we recommend that you reduce one or more of the following parameters: collimation, reconstruction increment and slice width for image reconstruction.

Head Kernels

- For head scans of small children, the kernels C20s, C30s (e.g., for soft tissue studies) and C60s (e.g., for sinuses are provided) should be chosen instead of the "adult" head kernels H21s, H31s and H60s.
- For the standard head protocols, we recommend C20s and C30s.
- High resolution head studies should be performed with H60s, H70s (e.g., for dental and sinuses) and H80s (e.g., inner ear).

Body Kernels

- As standard kernels for body tissue studies B31s or B41s is recommended; softer images are obtained with B20s.
- For higher sharpness, as is required e.g., in patient protocols for cervical spine, shoulder, extremities, thorax, the kernels B50s, B60s, B70s are available.

The special kernels are mostly used for "physical" measurements with phantoms, e.g., for adjustment procedures (S80s), for constancy and acceptance tests (S80s, U90s), or for specification purposes (U90s).

HeadRoutine_Baby

Indications:

Routine head spiral studies, e.g., brain tumors, cranial trauma, hydrocephalus, hemorrhaging and other abnormalities etc.

A range of 8 cm will be covered in 27 sec.

	Head
<i>kV</i>	80
<i>Effective mAs</i>	122
<i>Rotation time</i>	1.5 sec
<i>Slice collimation</i>	2.5 mm
<i>Slice width</i>	3.0 mm
<i>Feed/Rotation</i>	5.0 mm
<i>Pitch Factor</i>	1.0
<i>Increment</i>	3.0 mm
<i>Kernel</i>	C30s
<i>CTDI_{vol}</i>	7.89 mGy
<i>Effective dose</i>	Male: 0.84 mSv* Female: 0.92 mSv*

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

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

Hints

- Use this protocol for children below 6 months of age.
- When bone structure is of interest, use kernel C60s for image reconstruction.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.

HeadRoutine_Child

Indications:

Routine head spiral studies, e.g., brain tumors, cranial trauma, hydrocephalus, hemorrhaging and other abnormalities etc.

A range of 8 cm will be covered in 27 sec.

	Head
<i>kV</i>	130
<i>Effective mAs</i>	60
<i>Rotation time</i>	1.5 sec
<i>Slice collimation</i>	2.5 mm
<i>Slice width</i>	3.0 mm
<i>Feed/Rotation</i>	5.0 mm
<i>Pitch Factor</i>	1.0
<i>Increment</i>	3.0 mm
<i>Kernel</i>	C30s
<i>CTDI_{vol}</i>	13.66 mGy
<i>Effective dose</i>	Male: 0.55 mSv* Female: 0.60 mSv*

* The conversion factor for a 7-year-old child, and a scan range of 80 mm was used.

Hints

- 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.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.
- Please change the mAs value according to the age of the child:
3 – 6 years 80 mAs.

HeadSeq_Baby

Indications:

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

A range of 8.25 cm is predefined.

	HeadSeq
<i>kV</i>	80
<i>Effective mAs</i>	250
<i>Rotation time</i>	1.5 sec
<i>Slice collimation</i>	2.5 mm
<i>Slice width</i>	2.5 mm
<i>Feed/Scan</i>	5.0 mm
<i>Kernel</i>	C30s
<i>CTDI_{vol}</i>	16.18 mGy
<i>Effective dose</i>	Male: 1.71 mSv* Female: 1.87 mSv*

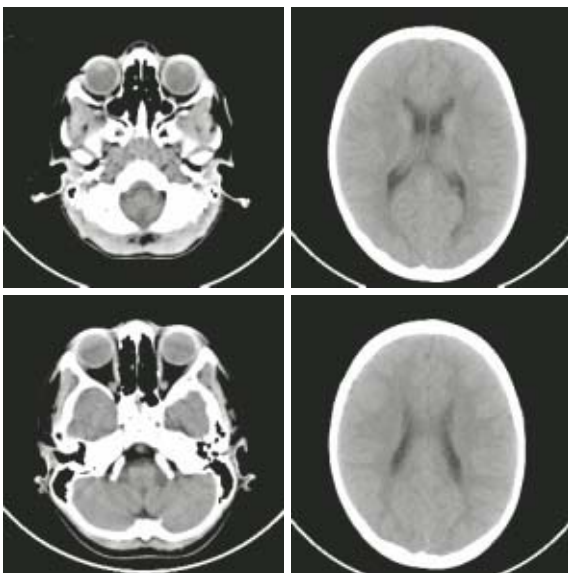
* The conversion factor for an 8-week-old child, and a scan range of 82.5 mm was used.

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

Children

Hints

- Use this protocol for children below 6 months of age.
- When bone structure is of interest, use kernel C60s for image reconstruction.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.



HeadSeq_Child

Indications:

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

A range of 8.25 cm is predefined.

	HeadSeq
<i>kV</i>	130
<i>Effective mAs</i>	120
<i>Rotation time</i>	1.5 sec
<i>Slice collimation</i>	2.5 mm
<i>Slice width</i>	2.5 mm
<i>Feed/Scan</i>	5.0 mm
<i>Kernel</i>	C30s
<i>CTDI_{vol}</i>	27.32 mGy
<i>Effective dose</i>	Male: 1.09 mSv* Female: 1.18 mSv*

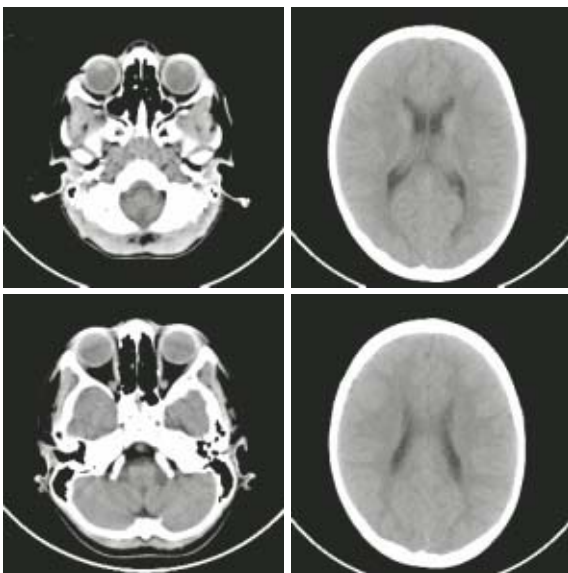
* The conversion factor for a 7-year-old child, and a scan range of 82.5 mm was used.

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

Children

Hints

- 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.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.
- Please change the mAs value according to the age of the child:
3 – 6 years 160 mAs.

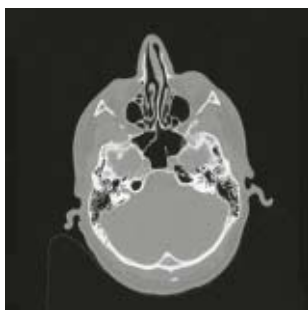


InnerEar

Indications:

High Resolution Spiral mode for inner ear studies, e.g., malformations of the inner ear, inflammatory changes, pathologies of the mastoid process, tumor processes of the pyramids, post-traumatic changes, etc.

A range of 2.5 cm will be covered in 22 sec.



	InnerEar
<i>kV</i>	80
<i>Effective mAs</i>	125
<i>Rotation time</i>	1.5 sec
<i>Slice collimation</i>	1.0 mm
<i>Slice width</i>	1.25 mm
<i>Feed/Rotation</i>	2.0 mm
<i>Pitch Factor</i>	1.0
<i>Increment</i>	1.0 mm
<i>Kernel</i>	H80s
<i>CTDI_{vol}</i>	8.09 mGy
<i>Effective dose</i>	Male: 0.04 mSv* Female: 0.04 mSv*

* The conversion factor for a 7-year-old child, and a scan range of 25 mm was used.

Hints

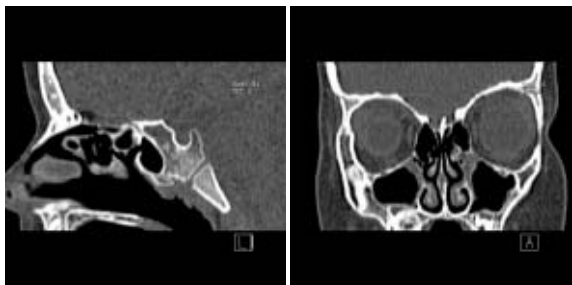
- Children, who are more than 6 years old, should be scanned with an adult protocol as the skull by this time is fully grown.
- When soft tissue is of interest, use kernel H31s for image reconstruction.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.
- Please change the mAs value according to the age of the child:
3 – 6 years 160 mAs.

SinusOrbi

Indications:

Spiral mode for routine spiral studies of the sinuses and paranasal sinuses, e.g., sinusitis, pneumatization, polyposis, malformations, tumors etc.

A range of 4 cm will be covered in 22 sec.



	SinusOrbi	2 nd reconstruction
kV	80	
Effective mAs	81	
Rotation time	1.0 sec	
Slice collimation	1.0 mm	
Slice width	3.0 mm	1.25 mm
Feed/Rotation	2.0 mm	
Pitch Factor	1.0	
Increment	3.0 mm	0.8 mm
Kernel	C60s	C60s
CTDI _{Vol}	5.24 mGy	
Effective dose	Male: 0.03 mSv* Female: 0.04 mSv*	

* The conversion factor for a 7-year-old child, and a scan range of 40 mm was used.

Contrast medium IV injection

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

Hints

- Children, who are more than 6 years old, should be scanned with an adult protocol.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.
- Please change the mAs value according to the age of the child:
3 – 6 years 100 mAs.

Neck

Indications:

Spiral mode for routine neck studies, e.g., tumors, lymphoma, abscesses, etc.

A range of 15 cm will be covered in 19 sec.

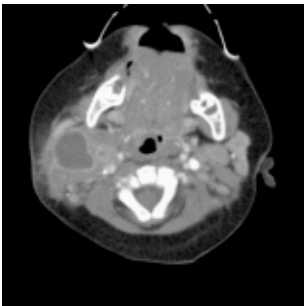
Neck	
<i>kV</i>	130
<i>Effective mAs</i>	26
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	2.5 mm
<i>Slice width</i>	5.0 mm
<i>Feed/Rotation</i>	9.0 mm
<i>Pitch Factor</i>	1.8
<i>Increment</i>	5.0 mm
<i>Kernel</i>	B50s
<i>CTDI_{Vol}</i>	2.80 mGy
<i>Effective dose</i>	Male: 2.40 mSv* Female: 2.52 mSv*

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

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

Hints

- If necessary, scan down to the aortic arch or mediastinum to include the entire lesion.
- Cooperative children can be instructed to hold their breath during the acquisition.
- Children, who are more than 6 years old should be scanned with an adult protocol.
- Please change the mAs value according to the age of the child:
3 – 6 years 39 mAs.

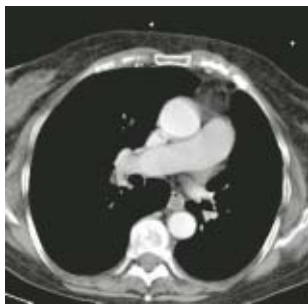


ThoraxRoutine_Baby

Indications:

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

A range of 15 cm will be covered in 17 sec.



	ThorRoutine	2 nd reconstruction
<i>kV</i>	80	
<i>Effective mAs</i>	41	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	2.5 mm	
<i>Slice width</i>	5.0 mm	5.0 mm
<i>Feed/Rotation</i>	10.0 mm	
<i>Pitch Factor</i>	2.0	
<i>Increment</i>	5.0 mm	5.0 mm
<i>Kernel</i>	B41s	B60s
<i>CTDI_{Vol}</i>	1.13 mGy	
<i>Effective dose</i>	Male: 1.55 mSv* Female: 1.85 mSv*	

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

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

Hints

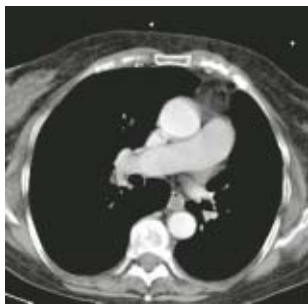
- Use this protocol for children below 35 kg.
- The first and second recon jobs are defined for visualization of the mediastinum and the lungs, respectively.
- Please change the mAs value according to the weight of the child:
25 – 34 kg 60 mAs.

ThoraxRoutine_Child

Indications:

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

A range of 15 cm will be covered in 17 sec.



Children

	ThorRoutine	2 nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	26	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	2.5 mm	
<i>Slice width</i>	5.0 mm	5.0 mm
<i>Feed/Rotation</i>	10.0 mm	
<i>Pitch Factor</i>	2.0	
<i>Increment</i>	5.0 mm	5.0 mm
<i>Kernel</i>	B41s	B60s
<i>CTDI_{Vol}</i>	2.80 mGy	
<i>Effective dose</i>	Male: 1.46 mSv* Female: 1.72 mSv*	

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

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

Hints

- Children with a body weight of more than 55 kg should be examined with an adult protocol.
- The first and second recon jobs are defined for visualization of the mediastinum and the lungs, respectively.
- Please change the mAs value according to the weight of the child:
45 – 54 kg 37 mAs.

ThoraxHRSeq_Baby

Indications:

Sequence mode for High Resolution lung studies, e.g., interstitial changes of the lung parenchyma, etc.

A range of 20.1 cm is predefined.

	ThorHRSeq
<i>kV</i>	80
<i>Effective mAs</i>	90
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	1.0 mm
<i>Slice width</i>	1.0 mm
<i>Feed/Scan</i>	10.0 mm
<i>Kernel</i>	U90s
<i>CTDI_{Vol}</i>	0.50 mGy
<i>Effective dose</i>	Male: 0.88 mSv* Female: 1.06 mSv*

* The conversion factor for an 8-week-old child, and a scan range of 201 mm was used.

Children

Hints

- Use this protocol for children below 35 kg.
- If you want to acquire the patient at full inspiration or full expiration, you should practice the breathing with the patient a few times before beginning the scan, so that reproducibility may be improved.



ThoraxHRSeq_Child

Indications:

Sequence mode for High Resolution lung studies, e.g., interstitial changes of the lung parenchyma, etc.

A range of 20.1 cm is predefined.

	ThorHRSeq
<i>kV</i>	130
<i>Effective mAs</i>	70
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	1.0 mm
<i>Slice width</i>	1.0 mm
<i>Feed/Scan</i>	10.0 mm
<i>Kernel</i>	U90s
<i>CTDI_{Vol}</i>	1.51 mGy
<i>Effective dose</i>	Male: 1.02 mSv* Female: 1.21 mSv*

* The conversion factor for a 7-year-old child, and a scan range of 201 mm was used.

Children

Hints

- Children with a body weight of more than 55 kg should be examined with an adult protocol.
- If you want to acquire the patient at full inspiration or full expiration, you should practice the breathing with the patient a few times before beginning the scan, so that reproducibility may be improved.



Abdomen_Baby

Indications:

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

A range of 30 cm will be covered in 32 sec.

	Abdomen
<i>kV</i>	80
<i>Effective mAs</i>	41
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	2.5 mm
<i>Slice width</i>	5.0 mm
<i>Feed/Rotation</i>	10.0 mm
<i>Pitch Factor</i>	2.0
<i>Increment</i>	5.0 mm
<i>Kernel</i>	B41s
<i>CTDI_{vol}</i>	1.13 mGy
<i>Effective dose</i>	Male: 3.26 mSv* Female: 5.05 mSv*

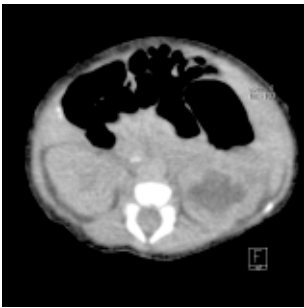
* The conversion factor for an 8-week-old child, and a scan range of 300 mm was used.

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

Children

Hints

- Use this protocol for children below 35 kg.
- Delayed scans may be required for the kidneys and bladder.
- Rectal contrast may be required for evaluation of pelvic mass.
- Please change the mAs value according to the weight of the child:
25 – 34 kg 70 mAs.



Abdomen_Child

Indications:

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

A range of 30 cm will be covered in 32 sec.

	Abdomen
<i>kV</i>	130
<i>Effective mAs</i>	41
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	2.5 mm
<i>Slice width</i>	5.0 mm
<i>Feed/Rotation</i>	10.0 mm
<i>Pitch Factor</i>	2.0
<i>Increment</i>	5.0 mm
<i>Kernel</i>	B41s
<i>CTDI_{vol}</i>	4.42 mGy
<i>Effective dose</i>	Male: 4.83 mSv* Female: 7.40 mSv*

* The conversion factor for a 7-year-old child, and a scan range of 300 mm was used.

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

Hints

- Delayed scans may be required for the kidneys and bladder.
- Rectal contrast may be required for evaluation of pelvic mass.
- Children with a body weight of more than 55 kg should be examined with an adult protocol.



Spine_Baby

Indications:

Spiral mode for spine studies, e.g., post-traumatic changes, tumors, malformations, orthopedic indications, etc.

A range of 15 cm will be covered in 32 sec.

	Spine	2nd reconstruction
<i>kV</i>	80	
<i>Effective mAs</i>	110	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	2.5 mm	
<i>Slice width</i>	3.0 mm	3.0 mm
<i>Feed/Rotation</i>	5.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	3.0 mm	2.0 mm
<i>Kernel</i>	B41s	B60s
<i>CTDI_{Vol}</i>	3.03 mGy	
<i>Effective dose</i>	Male: 1.90 mSv* Female: 4.06 mSv*	

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

Hints

- Use this protocol for children below 35 kg.
- Please change the mAs value according to the weight of the child:
25 – 34 kg 160 mAs.



Spine_Child

Indications:

Spiral mode for spine studies, e.g., post-traumatic changes, tumors, malformations, orthopedic indications, etc.

A range of 15 cm will be covered in 32 sec.

	Spine	2nd reconstruction
<i>kV</i>	130	
<i>Effective mAs</i>	70	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	2.5 mm	
<i>Slice width</i>	3.0 mm	3.0 mm
<i>Feed/Rotation</i>	5.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	3.0 mm	2.0 mm
<i>Kernel</i>	B41s	B60s
<i>CTDI_{Vol}</i>	7.55 mGy	
<i>Effective dose</i>	Male: 1.79 mSv* Female: 3.78 mSv*	

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

Hint

- Children with a body weight of more than 55 kg should be examined with an adult protocol.



ExtrHR_Baby

Indications:

Spiral mode for high resolution extremity studies, e.g., post-traumatic changes, tumors, malformations, etc.

A range of 10 cm will be covered in 27 sec.

	ExtrHR
<i>kV</i>	80
<i>Effective mAs</i>	50
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	1.0 mm
<i>Slice width</i>	1.25 mm
<i>Feed/Rotation</i>	4.0 mm
<i>Pitch Factor</i>	2.0
<i>Increment</i>	0.8 mm
<i>Kernel</i>	B70s
<i>CTDI_{Vol}</i>	1.38 mGy
<i>Effective dose</i>	Male: < 0.01 mSv* Female: < 0.01 mSv*

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

Hints

- Use this protocol for children below 35 kg.
- Please change the mAs value according to the weight of the child:
15 – 34 kg 80 mAs.

ExtrHR_Child

Indications:

Spiral mode for bone studies, e.g., tumors, post-traumatic changes, orthopedic indications, etc.

A range of 10 cm will be covered in 27 sec.

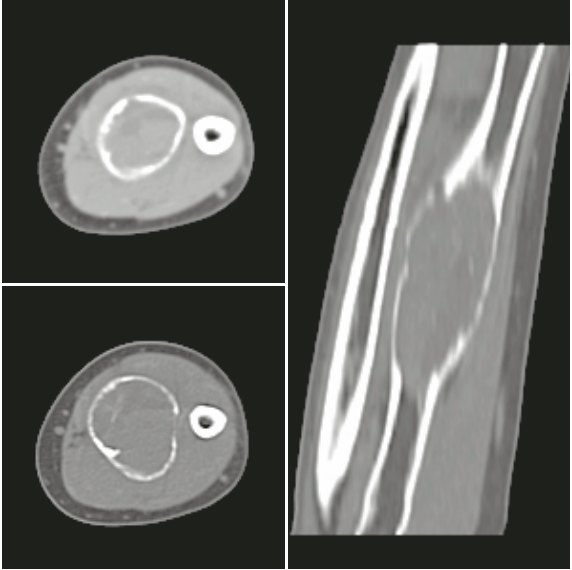
	ExtrHR
<i>kV</i>	130
<i>Effective mAs</i>	40
<i>Rotation time</i>	1.0 mm
<i>Slice collimation</i>	1.0 mm
<i>Slice width</i>	1.25 mm
<i>Feed/Rotation</i>	4.0 mm
<i>Pitch Factor</i>	2.0
<i>Increment</i>	0.8 mm
<i>Kernel</i>	B70s
<i>CTDI_{Vol}</i>	4.31 mGy
<i>Effective dose</i>	Male: < 0.01 mSv* Female: < 0.01 mSv*

* The conversion factor for a 7-year-old child, and a scan range of the knee of 100 mm was used.

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

Hint

- Children with a body weight of more than 55 kg should be examined with an adult protocol.



HeadAngio

Indications:

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

A range of 6 cm will be covered in 32 sec.

	HeadAngio	2 nd reconstruction
<i>kV</i>	80	
<i>Effective mAs</i>	81	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	2.0 mm	1.25 mm
<i>Feed/Rotation</i>	2.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	2.0 mm	0.8 mm
<i>Kernel</i>	C30s	C30s
<i>CTDI_{Vol}</i>	5.24 mGy	
<i>Effective dose</i>	Male: 0.12 mSv* Female: 0.13 mSv*	

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

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

Hints

- Children, who are more than 12 years old, should be scanned with an adult protocol as the skull by this time is fully grown.
- CARE Bolus may be used to optimize the bolus timing with a triggering threshold of 120 HU, or use manual triggering.
- An advanced algorithm allows for improved head image quality, without any additional post-processing.

HeadAngio08s

Indications:

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

A range of 6 cm will be covered in 26 sec.

	HeadAngio	2nd reconstruction
<i>kV</i>	80	
<i>Effective mAs</i>	65	
<i>Rotation time</i>	0.8 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	2.0 mm	1.25 mm
<i>Feed/Rotation</i>	2.0 mm	
<i>Pitch Factor</i>	1.0	
<i>Increment</i>	2.0 mm	0.8 mm
<i>Kernel</i>	C30s	C30s
<i>CTDI_{vol}</i>	4.21 mGy	
<i>Effective dose</i>	Male: 0.10 mSv* Female: 0.10 mSv*	

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

Hints

- Please change the mAs value according to the age of the child:
6 – 12 years 80 mAs.
- Children, who are more than 12 years old, should be scanned with an adult protocol as the skull by this time is fully grown

CarotidAngio

Indications:

Spiral mode for the carotid arteries, e.g., carotid stenosis or occlusion, vascular abnormalities of the carotids or vertebral arteries, etc.

A range of 10 cm will be covered in 27 sec.

	CarotidAngio	2nd reconstr.
<i>kV</i>	80	
<i>Effective mAs</i>	50	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	3.0 mm	1.25 mm
<i>Feed/Rotation</i>	4.0 mm	
<i>Pitch Factor</i>	2.0	
<i>Increment</i>	3.0 mm	0.8 mm
<i>Kernel</i>	B41s	B41s
<i>CTDI_{vol}</i>	1.38 mGy	
<i>Effective dose</i>	Male: 0.50 mSv* Female: 0.50 mSv*	

* The conversion factor for a 7-year-old child, and a scan range of 100 mm was used.

Contrast medium IV injection

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

Children

Hints

- Please change the mAs value according to the age of the child:
6 – 12 years 75 mAs.
- Children, who are more than 12 years old should be scanned with an adult protocol.
- CARE Bolus may be used to optimize the bolus timing with a triggering threshold of 120 HU, or use manual triggering.



CarotidAngio08s

Indications:

Spiral mode for the carotid arteries, e.g., carotid stenosis or occlusion, vascular abnormalities of the carotids or vertebral arteries, etc.

A range of 10 cm will be covered in 22 sec.

	CarotidAngio	2nd reconstr.
<i>kV</i>	80	
<i>Effective mAs</i>	50	
<i>Rotation time</i>	0.8 sec	
<i>Slice collimation</i>	1.0 mm	
<i>Slice width</i>	3.0 mm	1.25 mm
<i>Feed/Rotation</i>	4.0 mm	
<i>Pitch Factor</i>	2.0	
<i>Increment</i>	3.0 mm	0.8 mm
<i>Kernel</i>	B41s	B41s
<i>CTDI_{vol}</i>	1.38 mGy	
<i>Effective dose</i>	Male: 0.50 mSv* Female: 0.50 mSv*	

* The conversion factor for a 7-year-old child, and a scan range of 100 mm was used.

Contrast medium IV injection

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

Hints

- Please change the mAs value according to the age of the child:
6 – 12 years 75 mAs.
- Children, who are more than 12 years old should be scanned with an adult protocol.
- CARE Bolus may be used to optimize the bolus timing with a triggering threshold of 120 HU, or use manual triggering.

BodyAngio

Indications:

Spiral mode for abdominal CT Angio studies, e.g., vascular abnormalities, aneurysms, etc.

A range of 10 cm will be covered in 19 sec.

	BodyAngio	2nd reconstr.
<i>kV</i>	80	
<i>Effective mAs</i>	41	
<i>Rotation time</i>	1.0 sec	
<i>Slice collimation</i>	1.5 mm	
<i>Slice width</i>	3.0 mm	2.0 mm
<i>Feed/Rotation</i>	6.0 mm	
<i>Pitch Factor</i>	2.0	
<i>Increment</i>	3.0 mm	1.5 mm
<i>Kernel</i>	B41s	B41s
<i>CTDI_{Vol}</i>	1.13 mGy	
<i>Effective dose</i>	Male: 0.73 mSv* Female: 0.84 mSv*	

* The conversion factor for a 7-year-old child, and a scan range of 100 mm was used.

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

Hints

- Please change the mAs value according to the weight of the child:
35 – 44 kg 45 mAs
45 – 54 kg 60 mAs.
- Children with a body weight of more than 55 kg should be examined with an adult protocol.
- CARE Bolus may be used to optimize the bolus timing. Set the ROI for the monitoring scan in the abdominal aorta with triggering threshold of 120 HU, or use manual triggering.

BodyAngio08s

Indications:

Spiral mode for abdominal CT Angio studies, e.g., vascular abnormalities, aneurysms, etc.

A range of 10 cm will be covered in 15 sec.

	BodyAngio	2nd reconstr.
<i>kV</i>	80	
<i>Effective mAs</i>	35	
<i>Rotation time</i>	0.8 sec	
<i>Slice collimation</i>	1.5 mm	
<i>Slice width</i>	3.0 mm	2.0 mm
<i>Feed/Rotation</i>	6.0 mm	
<i>Pitch Factor</i>	2.0	
<i>Increment</i>	3.0 mm	1.5 mm
<i>Kernel</i>	B41s	B41s
<i>CTDI_{Vol}</i>	0.96 mGy	
<i>Effective dose</i>	Male: 0.62 mSv* Female: 0.72 mSv*	

* The conversion factor for a 7-year-old child, and a scan range of 100 mm was used.

Hints

- Please change the mAs value according to the weight of the child:
35 – 44 kg 45 mAs
45 – 54 kg 60 mAs.
- Children with a body weight of more than 55 kg should be examined with an adult protocol.

NeonateBody

Indications:

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

A range of 15 cm will be covered in 17 sec.

	NeonateBody
<i>kV</i>	80
<i>Effective mAs</i>	41
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	2.5 mm
<i>Slice width</i>	5.0 mm
<i>Feed/Rotation</i>	10.0 mm
<i>Pitch Factor</i>	2.0
<i>Increment</i>	5.0 mm
<i>Kernel</i>	B41s
<i>CTDI_{Vol}</i>	1.13
<i>Effective dose</i>	Male: 1.59 mSv* Female: 2.01 mSv*

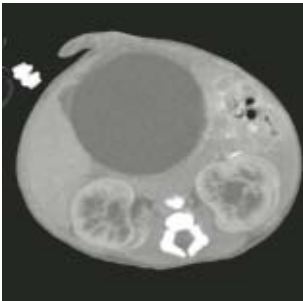
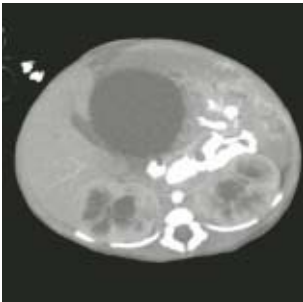
* The conversion factor for a 7-year-old child, and a scan range of 150 mm was used.

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

Children

Hints

- Use this protocol for children below 1 month of age.
- CARE Bolus may be used to optimize the bolus timing. Set the ROI for the monitoring scan in the abdominal aorta with triggering threshold of 120 HU, or use manual triggering.
- You can modify the slice width for image reconstruction according to the clinical indications.



The 3D card offers the possibility to combine two-dimensional images to form three-dimensional views.

To do this, the 3D card provides you with the following methods:

Multi Planar Reconstruction (MPR)

Interactive navigation through 3D volumes in arbitrary orientations.

- Orthogonal, oblique or double-oblique orientation.
- Easy scrolling through 3D volume data set.
- Real-time reconstruction of secondary slices.
- Additional diagnostic information, e.g., with sagittal or coronal reconstructions from axial images.
- Variable slice thickness (MPR Thick, MPR) and distance with configurable default values.
- Calculation of arbitrarily curved cuts.

Maximum Intensity Projection (MIP)

Angiographic display.

- Projection of pixels with highest intensity (vascular information) onto an arbitrarily oriented plane.
- Display of e.g., aneurysms, plaques, stenoses and other vascular anomalies.
- MIP Thin function for projection within a small slab to focus on particular vascular structure.

Shaded Surface Display (SSD)

Surface display of complex anatomies.

- 3D display of surfaces from a series of contiguous slices using a variable threshold.
- The displayed volume consist of voxels whose HU are in a range defined by two limit values, an upper and a lower threshold (= HU limits).
- Display and analyze various anatomy, e.g., from the cranium, pelvis, extremities, e.g., for the purpose of planning surgical interventions.
- The 3D objects can be tilted and rotated in real-time.

Volume Rendering Technique (VRT)

True 3D visualization of volume data.

- Projection onto an arbitrarily oriented plane.
- Density, opacity and refraction information is used to generate views that optimally meet different clinical objectives.
- Optimal display quality and differentiation of different organs through independent control of color, opacity and shading in up to 4 tissue classes.
- Predefined settings for many clinical objectives and anatomic regions are easily selected from an image gallery.
- Pre-settings can be linked to DICOM series description to automatically ensure standardized quality in clinical routine.
- Clip-planes can be used to easily scroll through the volume in VRT Thin mode.
- Easy interaction with SmartSelect control (right mouse button).

Prerequisites

At least 3 and maximum of 1600 images must have been loaded to process 3D; (with more than 1600 images the series will be split up). All images must have the same x/y coordinates and FoV.

- You should close any data sets that you no longer need in order to release memory space and maintain application performance.
- CT volume data sets are best acquired with overlapping thin slice CT technique.

Workflow

Loading the Images

After loading the images into *syngo* 3D the following layout is displayed:

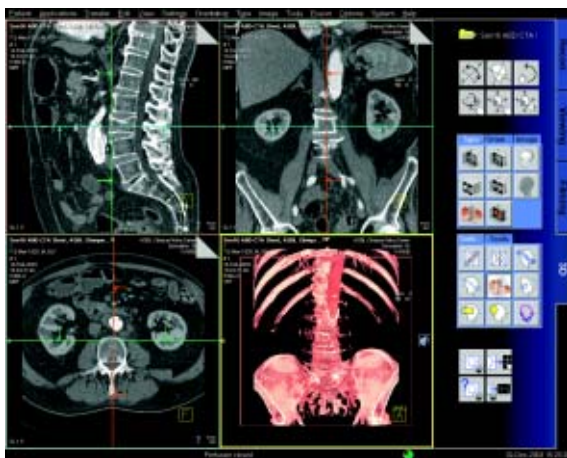


Image Representation on the 3D Card

The image area on the 3D card is divided into four segments:

- Reference segment (sagittal view)
- Reference segment (coronal view)
- Reference segment (transversal view)
- Output segment

The first three segments are reference segments, the fourth segment is an output segment. In the three reference segments the images are first shown in the views that are parallel and perpendicular to the direction of scanning.

By turning and moving the views you can define the position and orientation of the plane that is to be used as the reference image for the reconstruction of images or series.

The reference segments are used to display different views of the volume data set, while the reference display (the view) is used as a reference for a 3D-reconstruction.

The images and series generated by various tools on the basis of the reference image are displayed in the output segment.

To find the best suitable reference image for planning reconstruction of images and series, you can freely rotate and move all three views.

Defining Output Types

You can change the output type for a segment at any time, i.e., from Multi Planar Reconstruction (MPR) to Maximum Intensity Projection (MIP), to Shaded Surface Display (SSD), or to Volume Rendering Technique (VRT).

Depending on your working method, you will first generate a reference image, for example, in MPR in the desired view and then switch to MIP, SSD or VRT display.

- Click on the segment for which you want to change the output type.
- If you want to switch over all segments, you must select and switch over each one separately, one after the other.

Creating Series

This application gives you the ability to easily create new images or even image series, e.g., for fast display of interesting anatomical structures

- With any slice thickness (at least the reconstructed slice thickness)
- Variable distance/angle between the images
- Selectable number of images
- Selectable range of reconstruction
- Different output types

Parallel Ranges

With this option you generate series of cut images that are parallel to one another and perpendicular to the reference image for the output types MPR, MPR Thick, MIP Thin and VRT Thin.

For example, for MPRs or MIP Thin through a process in the lung or abdomen.

Radial Ranges

For output types MPR, MPR Thick and MIP Thin you generate a series of cut images arranged in a star shape.

For output types MIP, SSD and VRT you generate a series of projections and views of the volume each rotated around a defined angle. In this way, you simulate a step-by-step rotation.

For example, for colored VRT images, showing a process from different angles.

Expanded Ranges

With this option you generate images that are located in front of or behind the reference image. This option, too, is only available for output types MPR, MPR Thick or MIP Thin.

For example, for MPRs or MIP Thin through a process in the lung or abdomen.

Curved Ranges

If you want to view sub-areas that cannot be obtained by planar, i.e., flat images, you can draw a cut line with any curvature freehand. This cut will then be shown as an image/series in the output segment.

For example, for MPRs or MIP Thin from the aorta or the peripheral arteries.

Editing

A common problem in evaluating medical images is that areas relevant to an examination are hidden by other structures, especially bones. The necessary image information is contained in the volume data set but must be made visible with suitable editing steps.

1. **VOI mode:** With a Volume of Interest (VOI), you extract a volume of diagnostic interest by limiting the volume to be reconstructed to a partial volume.

You can extract a VOI (volume of interest) in one of the following ways:

- Position and differentiate a cuboid VOI (VOI Clipbox)
 - Draw a freehand VOI (VOI Punch Mode)
2. **Clip planes:** Clip planes can also be used for hiding parts of the data set.

Sometimes it is useful to use only a part of the volume for projection. The sub area is defined by the two parallel intersection planes ("separation plane"). The distance between these planes is the slice thickness to be defined. For example, you can avoid cutting out interfering structures; (MIP Thin, VRT Thin/Clip).

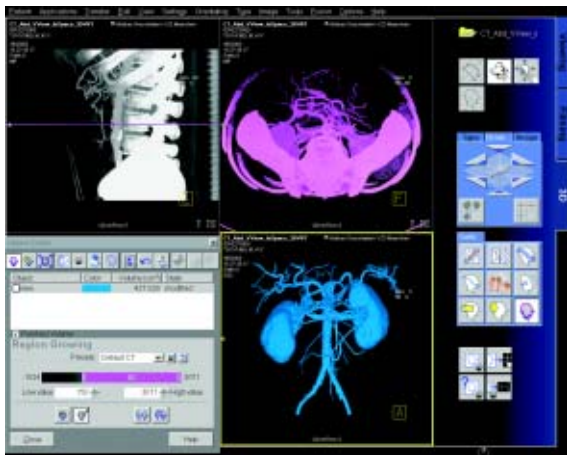
3. **3D Object Editor:** Easy elimination of obstructing information.
- Easy volume confinement with clip-box or variable editing slab.
 - Fast object creation with threshold operations or automatic volume growing.
 - Multiple editor objects can be displayed with differently colored SSD.
 - Complete object subtraction with dilatation and erosion functions.
 - Remaining volume data set after object subtraction can be displayed with all 3D representations, i.e. VRT, MPR, MIP or SSD.
 - With the 3D Object Editor you can perform the following operations:
 - Object generation with Region Growing
 - Object management in the object list
 - Object editing with Object Punching and Morphological Operations

Region Growing

Normally in the first step you will generate one or more “objects” from the volume data set originally loaded in 3D. By specifying a limited voxel value range you extract only a section of the voxels from the original data set. In this way, you generate an object in the result segment.

Instead of extracting globally from the entire volume data set, you can also proceed “slice by slice” (in 3D blocks) using the **Slab Editor**.

You can also set **Seed Points** in the original data set, thus limiting the creation of an object to defined regions which are also connected to one another in the specified voxel area.



Object Punching

Like editing volume data sets in the VOI mode, you can use the 3D Editor, too. You are provided with tools for cutting out structures from an object that you have previously generated.

Using the **Slab Editor** you can define your own cutting depth.

Morphological Operations

In some cases it will not be simple to separate the structures of an object using the cutting tools. Here we recommend eroding or shrinking the areas of the object by a specified surface thickness, until the obscuring structures are no longer contained in the object.

You can subsequently dilate or blow up the remaining object areas by a defined surface thickness. As a result, the irrelevant areas contained at the outset are now removed from the representation.

If you perform the same operations in reverse order, small cavities in the object will be filled.

Documentation of Results

The buttons *Copy to Film sheet* and *Save/Save As* are always available. You can always document intermediate results by using these buttons.

To save images you have following possibilities:

- Storing the new series automatically during reconstruction
- The *Save* button will store the image/series with no further check
- The *Save as* button will give you the ability to choose a name for the new the image/series before storing

Workflow for a CT Extremity Examination

Using MPR/MPR Thick

1. Load the series to MPR.
2. Manipulate the volume to evaluate anatomy:
 - a) Orientate the image volume for the best view of the anatomy.
 - b) Adjust the window as necessary.
 - c) Pan and zoom image as necessary.
3. Scroll through the volume quickly using the 3D cross-hair or dog-ears to gain a three-dimensional impression.
4. The minimum slice thickness of an MPR image is one voxel, but you can generate thicker slices (MPR Thick) for easier evaluation.
5. Measure, annotate and document as needed.
6. Optionally, create image series using parallel, expanded or curved ranges and output them either on a film or save them to the database.

Using SSD

1. Load the series to SSD.
Hint: Do not use a series with a high resolution kernel, e.g., kernel 10 or 20 is recommended.
2. Manipulate the volume to evaluate anatomy:
 - a) Orientate the image volume for the best view of the anatomy.
 - b) Adjust the threshold as necessary.
 - c) Pan and zoom image as necessary.
 - d) To eliminate unwanted structures, use VOI punching/3D Object Editor.
3. Measure, annotate and document as needed.
4. Optionally, create image series using radial ranges and output them either on a film or save them to the database.

Using VRT

1. Load the series to VRT.
2. Manipulate volume to evaluate anatomy:
 - a) Orientate the image volume for the best view of the anatomy.
 - b) To eliminate unwanted structures, either activate VRT Thin/Clip or use VOI punching/3D Object Editor.
 - c) Select a VRT preset from the VRT gallery.
 - d) Adjust window, opacity, color and lighting effects as necessary.
 - e) Pan and zoom image as necessary.
3. Measure, annotate and document as needed.
4. Optionally, create image series using radial ranges for VRT; parallel, expanded or curved ranges for VRT Thin/Clip and output them either on a film or save them to the database.

Workflow for a CT Angiography

Using MIP/MIP Thin

1. Load the series to MIP.
2. Manipulate the volume to evaluate anatomy:
 - a) Orientate the image volume for the best view of the anatomy.
 - b) To eliminate unwanted bone, either activate MIP Thin or use VOI punching/3D Object Editor.
 - c) Adjust the window as necessary.
 - d) Pan and zoom image as necessary.
3. Measure, annotate and document as needed.
4. Optionally, create image series using radial ranges for MIP; parallel, expanded or curved ranges for MIP Thin and output them either on a film or save them to the database.

Using VRT/VRT Thin/Clip

1. Load the series to VRT.
2. Manipulate volume to evaluate anatomy:
 - a) Orientate the image volume for the best view of the anatomy.
 - b) To eliminate unwanted bone, either activate VRT Thin/Clip or use VOI punching/3D Object Editor.
 - c) Select VRT preset from VRT gallery.
 - d) Adjust window, opacity, color and lighting effects as necessary.
 - e) Pan and zoom image as necessary.
3. Measure, annotate and document as needed.
4. Optionally, create image series using radial ranges for VRT; parallel, expanded or curved ranges for VRT Thin/Clip and output them either on a film or save them to the database.

Hints in General

Setting Views in the Volume Data Set

Three-dimensional image processing allows you to create images in any orientation and position within the data volume.

You can "move" through the volume and rotate it in any direction. Depending on the method you are using, various aids are available to you.

Rotating around one axes (oblique cut planes)

For oblique slices, you rotate a slice about one axis of the patient coordinate system starting from the standard view.

The orientation is displayed in the image as a combination of two orientation labels.

One of the two reference lines in the image is now dotted. The corresponding plane is therefore oblique in relation to the displayed image.

Rotating around two axis (double-oblique cut planes)

You obtain cut planes in two axes whenever you rotate one slice around two different patient coordinate axes one after the other.

The plane is then no longer perpendicular to either of the coordinate axes. The image orientation is displayed as a combination of three orientation labels.

- The subtask card *Orientation* will always give you the ability to return immediately back to the beginning or to any standard view.
- View perpendicular to reference image (Ortho Sync). Usually, you activate the orthogonal view to display slices along the main axis of an organ, e.g., the heart.

Changing /Creating VRT Presets

You will use the Volume Rendering Technique (VRT) to obtain more precise representation and separation of tissue types. To highlight certain aspects of the anatomical region, you can change the color, brightness, and transparency of different areas.

As display parameters for the VRT view, customary default settings are stored on your system in the VRT gallery.

If the default settings are not appropriate for your diagnostic problem, you can alter them individually. In that way you can emphasize the structures of interest in an optimum way.

- Ramp and trapezoid manipulation: Ramps and trapezoids are functions which define window and rendering settings. Trapezoids can also be used to differentiate a tissue classification range (e.g., bone versus soft tissue in a CT image).
- Change rendering settings using the table classifier trapezoids. Moving the ramp changes the window width and center. Opacity and brightness can be adjusted to optimize organ-specific settings.
- Lighting to enhance 3D. The mouse cursor is used to define the direction of incident light.
- VRT presets can be stored in the VRT gallery and linked to specific series description.

Auto Load in 3D and Post-processing Presets

You can activate the Auto load in 3D function on the *Examination card/Auto Tasking* and link it to a recon job.

On the *3D* card you have the possibility to create Ranges Parallel and Radial protocols which can be linked to a special series name.

- Select the image type
- Select the orientation
- Open the Range function and adapt the range settings (Image thickness, Distance between the images etc.)
- Hit the link button
- Save the linked preset

Blow-up Mode

With the blow-up mode you display the full screen for easier visualization by double-clicking in the segment.

syngo Fly Through

syngo Fly Through is a Virtual CT Endoscopy Software integrated into the *syngo* 3D functionality. It offers the possibility to render endoluminal views of structures such as the airways and vessels from volume data sets.

Virtual CT Endoscopy simulates diagnostic conventional endoscopic procedures e.g., bronchoscopy and colonoscopy, that are usually uncomfortable and more invasive to the patient.

Key Features

- Add-on advanced 3D functionality (Fly icon) integrated in the existing, familiar 3D card.
- One-click access to perspective endoscopic rendering at a point of interest.
- Both Shaded Surface Display (SSD) and Volume Rendering Technique (VRT) can be used.
- Volume Rendering Technique (VRT) presets can be stored in the VRT gallery and linked to specific examination protocol or series description.
- Endoscopic viewing parameters e.g., the viewing angle, depth and the viewing distance from the endoscope can be defined and linked to a data set.
- Manual or Automatic endoscopic navigation.
- Fly path planning creates and saves a flight path in the volume data set. This offers the possibility to play back an endoscopic evaluation and to create a series of endoscopic snapshots that can be saved on the database.

Prerequisites

This software works with CT, MR and conventional Angiographic data sets.

CTA data set with good vessel enhancement for virtual angioscopy.

Volume data set acquired with overlapping thin slice CT technique.

The Basics for CT Virtual Endoscopy

SSD and VRT Presets for Endoscopic Renderings

In order to create endoluminal displays with CT data sets, we need to differentiate the structures of interest from the rest of the anatomy. This can be achieved with either positive or negative contrast enhancement.

In principle, there are few objects/media which are suitable for endoscopic renderings:

- Gas, e.g., air or carbon dioxide
- Fluid, e.g., water, Iodine-based intravenous/infusion media or Barium-based oral and rectal contrast agents
- Bone
- Metal, e.g., stents

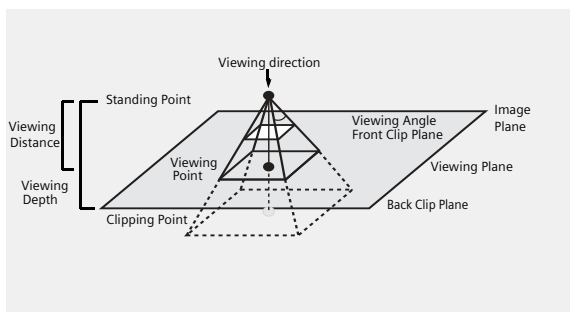
syngo Fly Through

Endoscopic Viewing Parameters/Fly Cone Settings

In general, the shape of a pyramidal cone can be used to represent visualization of an endoscopic volume. The boundaries and the viewing perspective of the endoscopic volume are defined by adjusting the shape and size of this cone.



Cone setting for flying through the airways.



Cone Graphic and Definition

syngo Fly Through

- Standing Point
 - The cone rotates around the viewing point.
- Viewing Point
 - The complete cone moves.
- Clipping Point
 - The cone rotates around the standing point.
- Viewing Angle
 - Is changed by moving one of the sides of the angle.
- Viewing Distance
 - The distance from the standing to the viewing point.
- Viewing Depth
 - Moving the Front/Back Clip Plane changes the viewing depth.
- Front Clip Plane
 - To remove foreground-obscuring tissue. The position of the front clip plane will always be between standing and viewing point.
- Back Clip Plane
 - To remove tissue at the back of the volume. The position of the back clip plane will always be behind viewing point.

Patient Preparation

Bony and cartilaginous structures such as the central airway and bronchial tree, the osteomeatal system of the Paranasal Sinuses are inherently filled with air and therefore ideal for performing Virtual CT Endoscopy. No special preparations are required.

For CT endoscopic evaluation of the vessel (virtual CT angiography), a good CTA data set with good vessel enhancement is required.

In the case of CT colonography, adequate preparation in bowel cleaning must be done prior to the CT exam. The bowel can be delineated with air, carbon dioxide, water or iodine/barium suspension.

Workflow

Load the images in 3D.

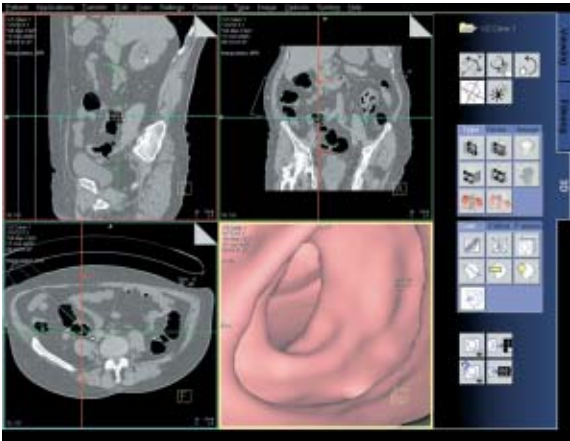
The following standard layout is displayed:

Segment 1: Sagittal view

Segment 2: Coronal view

Segment 3: Transversal view

Segment 4: Fly segment with perspective SSD as default



Scroll through the MPR images until you reach an image where you would like to start the CT endoscopic evaluation.

syngo Fly Through

Position the Reference lines at that point of interest e.g., in the trachea.

Click the Fly Through icon to activate the endoscopic display in the fourth segment.

The default endoscopic display has the same orientation (viewing direction) as the last selected image segment in which you placed the point of interest and invoked the *syngo* Fly Through option.

Change the endoscopic display by adjusting the SSD threshold or change to VRT display.

Link the new settings to data set for future evaluation. Define the Cone settings (endoscopic viewing parameters) and link the cone settings to data set for future application.

Start the endoscopic navigation by using:

- Manual method
- Auto-navigation
- Path creation

Create flight path through the data set and save the path for future playback.

Click the "Save Image" button before navigating the endoscopic projection along the path.

A series of endoscopic snapshots will be created and saved automatically on the database.

These images can be documented on hardcopy or loaded to Viewer for cine display of the endoscopic movie.

Navigation of the Endoscopic Volume

- Manual Navigation

Click with the right mouse button in the Fly segment to activate the SmartSelect menu.

The following controls are available:

- auto-navigation
- push/pull
- rotate around viewing point
- rotate view

Adjust the viewing direction and select push/pull.

Click and hold the left mouse button.

Move the mouse up or down to navigate through the endoscopic volume manually.

- Auto Navigation

Adjust the initial viewing direction.

Activate the SmartSelect menu

Select the function auto-navigation.

Click and hold with the left mouse button. Give the mouse a small upward push and then hold it steady.

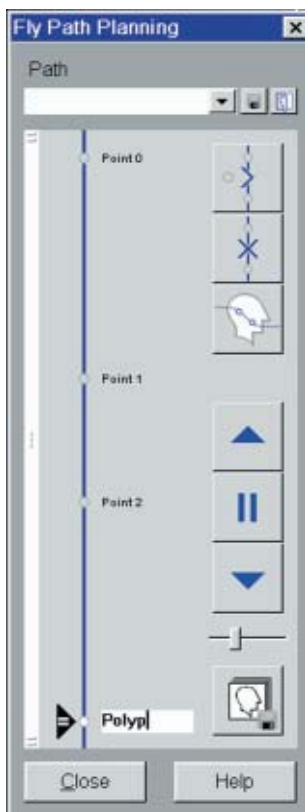
The software will automatically detect the centerline and navigate through the endoscopic volume without any user intervention.

To stop or change the direction of the navigation, release the mouse and adjust the viewing direction accordingly before proceeding further.

syngo Fly Through

Fly Path Planning

Open the Fly Path Planning.



Create a path by inserting path points in the volume during navigation.

syngo Fly Through

The relevant settings (viewing direction, viewing angle etc.) are stored along the path.

After defining and storing a path, it is possible to play back the entire navigation along the path as a movie or to jump straight to the section of the endoscopic volume predefined by the path points.

Note: Only one path can be saved with each data set. To define another flight path through the same volume, the existing path will be overwritten and deleted.

This is an application package for reformatting panoramic views and paraxial slices through the upper and lower jaw. It enables the display and measurement of the bone structures of the upper and lower jaw (especially for a 1:1 scale) as the basis for oral surgery planning.

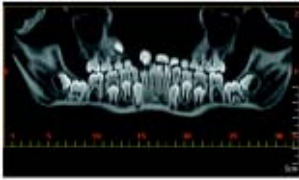
The Basics

What is the relevant anatomical information for oral surgery planning and dental implantation?

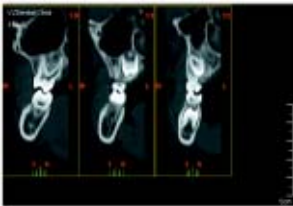
- Location of the socket for dental implant.
- Buccal and lingual thickness of the cortical component of the alveolar process.
- Position of the mandibular canal and the mental foramen.
- Extent of the nasal sinuses and position and width of the floor of the nasal cavity.

What can syngo Dental CT do?

- Reformatting of a curvilinear range of panoramic views along the jaw bone.
- Reformatting of paraxial views of selectable length and at selectable intervals perpendicular to the panoramic views.
- Presentation of results in the form of multiple image display with reference markings.
- Images are documented on film in "real-size" so that the direct measurement of the anatomic information with a ruler is possible. The layout of the film sheet is predefined such that it can accommodate the maximum number of reformatted images.



Panoramic view



Paraxial view

Scan Protocols

You will find the Dental scan protocols under body region "Head":

	Dental
<i>kV</i>	130
<i>Effective mAs</i>	45
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	1.0 mm
<i>Slice width</i>	1.25 mm
<i>Feed/Rotation</i>	2.0 mm
<i>Pitch Factor</i>	1.0
<i>Increment</i>	0.5 mm
<i>Kernel</i>	H60s
<i>CTDI_{Vol}</i>	10.25 mGy
<i>Effective dose</i>	Male: 0.13 mSv Female: 0.16 mSv

syngo Dental CT

- It is mandatory to position the patient head in the center of the scan field – use the lateral laser light marker for positioning.
- Gantry tilt is not necessary since you have the ability to tilt the reference line to generate an axial reformed image at the desired plane. However, in order to minimize the scan length for the same anatomical region, it is recommended to position the patient's head at the appropriate scan plane whenever possible:
 - For the upper and lower jaw: occlusal plane in parallel to the scan plane.
 - For either jaw: jaw bone in parallel to the scan plane.
- It is recommended to end the exam first, and then start the Dental evaluation.



User interface of syngo Dental CT

Additional Important Information

- The Dental scan protocol delivers high resolution images for *syngo* Dental CT evaluation, however, you can also reconstruct images with softer kernel, e.g., H20s, for 3D/SSD post-processing.



TOP-cranial view

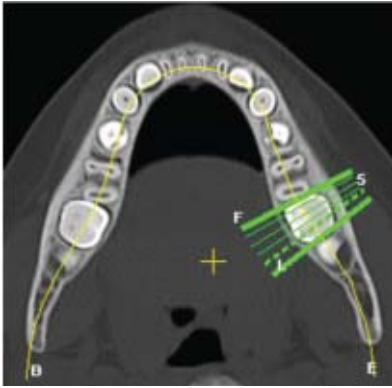


Caudal view

- Image orientation:
 - In the paraxial view, a “B” indicates buccal and a “L” lingual. The lingual marker “+” must always be positioned at the tongue. If not, simply drag & drop it back.
 - In the panoramic view, a “B” stands for “Begin” and an “E” for “End”.
- Filming: for the maximum use of the film, film directly from the *Dental* card instead of Patient Browser. For easy reprinting, the results of the most recent syngo Dental CT Film are stored in the Patient Browser in the folder “Film”.
- It is recommended to change the image windowing on the virtual film sheet.
- A semi-automatic detection tool can be used to mark and outline the mandibular canal on both paraxial and panoramic images for easy viewing and filming.
- Multiple paraxial ranges can be defined on one reference image by “cluster & copy function”.
I.e., you can group a number of paraxial lines and copy the lines to another location, e.g., over individual sockets at different locations.

syngo Dental CT

- ROI definition for statistical evaluations and deletion of graphics is possible.



Paraxial lines using "Cluster".

- In the control area, you can configure if you want to display the paraxial lines orthogonal to the reference line.



This is an application package for the quantitative assessment of vertebral bone mineral density for the diagnosis and follow-up of osteopenia and osteoporosis.

The Basics

This program enables the quantitative determination of bone mineral density (BMD) of the spine in mg/ml of calcium hydroxyapatite (CaHA) to assist the physician with diagnosis, staging, and follow-up of osteopenia and osteoporosis with CT. The patient is scanned together with the water- and bone-equivalent calibration phantom.

Siemens Reference Data:

The Siemens reference data was acquired at three European centers, including 135 male and 139 female subjects, ranging from 20 to 80 years of age.

Scanning Procedure

Scan Protocols

You will find the Osteo scan protocols under body region "Spine":

	Osteo
<i>kV</i>	80
<i>Effective mAs</i>	81
<i>Rotation time</i>	1.0 sec
<i>Slice collimation</i>	5.0 mm
<i>Slice width</i>	10.0 mm
<i>Feed/Scan</i>	0.0 mm
<i>Kernel</i>	S80s
<i>CTDI_{vol}</i>	2.23 mGy
<i>Effective dose</i>	Male: 0.03 mSv Female: 0.08 mSv

The special kernels are mostly used for “physical” measurements with phantoms, e.g., for adjustment procedures (S80s), for constancy and acceptance tests (S80s, U90s), or for specification purposes (U90s). For special patient protocols, S80s and U90s are chosen, e.g., for Osteo (S80s) and for high resolution bone studies (U90s).

Patient positioning:

- Set the table height at 125. The gantry tilt will be available from -22° to $+22^{\circ}$.
- Patients should be positioned straight on the table. Support the knees to compensate for lordosis.
- The calibration phantom should be positioned directly below the target region. Put the Gel-pad between the calibration phantom and the patient to exclude air pockets.

Scanning:

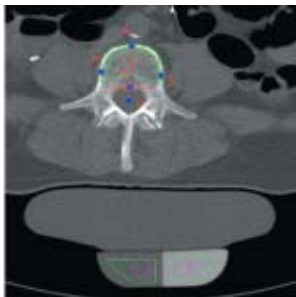
- For obese patients increase the mAs value to 120.
- Typically, one scan each is performed at L1, L2 and L3 levels. Use image comments L1, L2, L3, L4, L5, or T12 prior to scanning of the respective vertebrae, these comments will be used for syngo Osteo CT evaluation results (no blanks or other deviations are allowed, e.g., use “L4” instead of “L 4”, or “T12” instead of “TH12”).
- Before ending the examination, you can drag & drop the recon jobs from the chronicle to the topogram segment to get the Topographics, i.e. the cut lines for each vertebra on the topogram.

syngo Osteo CT

- Position the cut line of scanning through the middle of the vertebra, i.e. bi-sector between the angle of the upper and lower end plate.
- The phantom must be included in the FoV of the images for evaluation.
- It is recommended to end the exam first, and then start the *syngo Osteo CT* evaluation.
- Do not use the calibration phantom from other CT scanners, as your system is calibrated to a particular phantom.



Topographic



*Phantom inside
the FoV*

Configuration

In the Osteo configuration you can define the following parameters:

You can

- use the Siemens standard reference database or create and import your own
- change between 1 and 2 standard deviations (display of the summary graph)
- use the Siemens Reference phantom or enter values for bone and water manually
- change the age of the young controls, used for the calculation of the T-Score
- enable the export of results:

Osteo Configuration

Reference Database

- Siemens Standard
- User Path: _____

Display of Standard Deviation :

- +/- 1 SD from Mean
- +/- 2 SD from Mean

Siemens Reference Phantom in Image?

- Siemens Standard
- Manual

Bone equiv. [HU]

Water equiv. [HU]

Age of Young Controls

Male

Female

Enable Export of Results

OK Cancel Help

How can you save the results on your PC?

- Select Option/Configuration from the main menu and click icon “CT Osteo”.
- Activate the checkbox “Enable Export of Results”.
- “Exit” the configuration dialog.



- Call up the Osteo card and you will see the new icon “Export results” on the lower, right part of the screen.
- Click on this icon to copy the evaluation results to floppy disk (*note*: with every mouse click on the icon, the previous result file will be appended).
- The data file can be transferred to your PC for further evaluation, e.g., with MS Excel.

Example for one patient with three Osteo tomograms:

PATIENT; John Smith; 007; 64; Male

IMAGE; L2; 234; 2; 27-JAN-1998; 11:12:17; 61.7;
48.9; 55.3; 20.8; 20.1; 21.5; 205.8; 192.0; 198.7;
50.6; 47.5; 49.5

IMAGE; L3; 236; 3; 27-JAN-1998; 11:12:18; 60.4;
54.5; 49.3; 22.3; 21.1; 21.8; 210.5; 191.9; 180.7;
50.4; 47.5; 52.3

IMAGE; L4; 238; 4; 27-JAN-1998; 11:12:18; 59.3;
43.1; 55.0; 20.6; 29.0; 23.3; 201.8; 178.1; 192.3;
43.6; 45.9; 44.2

REFDATA; 64; Male; 20; -4.35; -3.12; 75.4; 125.3; 26.5

Data structure of the result file:

PATIENT; <Patient name>; <Patient ID>;
<Age of patient>; <Sex of patient>

IMAGE; <Vertebra name>; <Image number>;
<Scan number>; <Scan date>; <Scan time>; <TML>;
<TMR>; <TMT>; <TSL>; <TSR>; <TST>; <CML>; <CMR>;
<CMT>; <CSL>; <CSR>; <CST>

REFDATA; <Age of patient>; <Sex of patient>;
<Age of young normal>; <T-Score>; <Z-Score>;
<BMD reference data, age matched>;
<BMD reference data, young control>;
<Standard deviation reference data>

Abbreviations:

TML Trabecular Mean Left

TMR Trabecular Mean Right

TMT Trabecular Mean Total

TSL Trabecular Standard Deviation Left

TSR Trabecular Standard Deviation Right

TST Trabecular Standard Deviation Total

CML Cortical Mean Left

CMR Cortical Mean Right

CMT Cortical Mean Total

CSL Cortical Standard Deviation Left

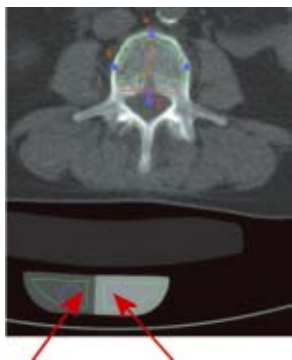
CSR Cortical Standard Deviation Right

CST Cortical Standard Deviation Total

Evaluation Workflow

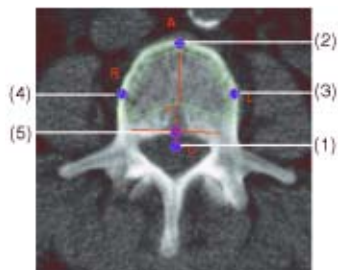
After loading the images into the syngo Osteo CT application, press "Start Evaluation".

Check the correct positioning of the ROIs in the Calibration phantom. You can change the position by moving the two circles.



*Water
equivalent*

*Bone
equivalent*



Correcting contour lines

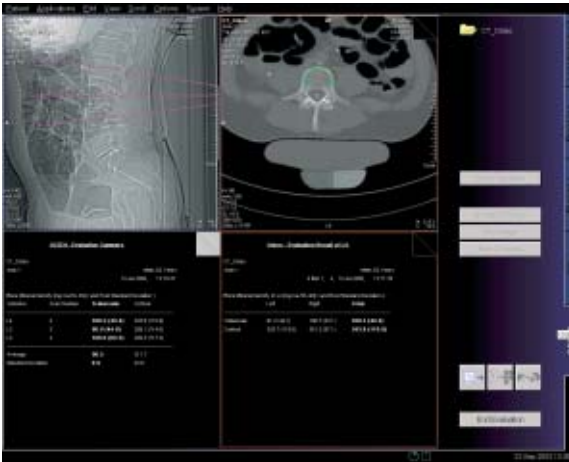
You can perform correction of the contours by moving the base points. The following order is recommended:

- 1.Center of the spinal canal (C)
- 2.Uppermost point of the cortical spinal body (A)
- 3.Intermediate point (L)
- 4.Intermediate point (R)
- 5.Uppermost point of the spinal canal (T)
 - Click on a base point with the mouse.
 - Move it keeping the left mouse key pressed.

If you are satisfied with the contours press “Accept Contours” otherwise skip the image. If the contours for all images are accepted or skipped, the results are automatically displayed. The skipped images are not taken into account.

The third segment contains two summary images: Displayed results include bone mineral density (mg CaHA/ml) and standard deviation. The results are listed in a table:

- the evaluated vertebra
(if the comment is correctly inserted, e.g., L1)
- the scan number of the image
- the trabecular bone mineral density for each vertebra and the pixel standard deviation (in brackets)
- the cortical bone mineral density for each vertebra and the pixel standard deviation (in brackets)
- additionally, the average and standard deviation over all evaluated vertebrae are listed



The other summary image displays a graph which shows the comparison of all evaluated vertebrae with the selected Reference Data.

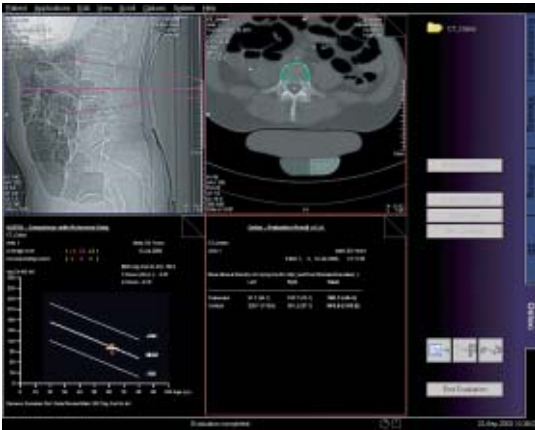
"T-score"

This is the deviation of average BMD of the patient from that of a young healthy comparison group. It represents bone loss with reference to the peak bone mass.

"Z-score"

This is the deviation of average BMD of the patient from that of a healthy person of the same age. It is an indicator of biological variability.

syngo Osteo CT

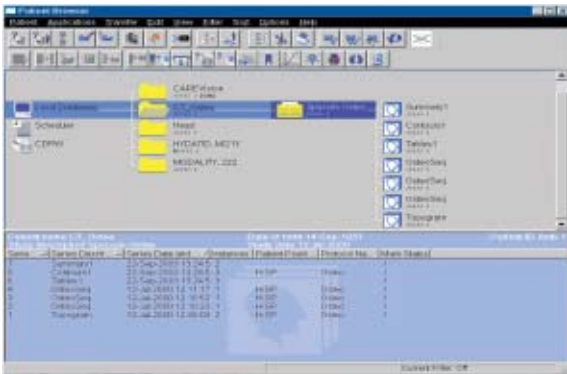


The second and the fourth segment belong together. The second segment shows the tomogram images with the contours superimposed. The fourth segment shows the calculated results of the corresponding tomogram image. Both segments are bordered by the same color. If you scroll through one of these segments the other segment is updated to same vertebra.

syngo Osteo CT

After "End Evaluation" the evaluation results are automatically saved in three series:

- Summary
contains both images of the third segment
- Contours
contains the tomogram images with the contours superimposed (second segment)
- Tables
contains the result tables for each vertebra (fourth segment)



Additional Important Information

- Fractured vertebrae are not suited for *syngo* Osteo CT evaluation since the more compact nature of these vertebrae result in bone mineral density value that is much higher than one would expect.
- When you examine a patient who is older than 80 years, the patient examination data cannot be compared with the reference data base.
- It is recommended to film directly from the Osteo card. Select images or series with Edit/Select all, and click "film" icon. You can also configure your film layout, e.g., 3 x 3 as shown in Option/Configuration/FilmingLayout.



Filming layout

Note: it is not recommended to use filming layout setting of 4 x 5 segments since the image text elements of the result image are overlapped and hard to read.

syngo Volume Evaluation

Volume is an evaluation function which allows most accurate calculation of a volume out of a stack of two-dimensional images.

This can be done by Volume-of-Interest (VOI) definition and by limiting the minimum and maximum density (HU) values for calculation. Different views of the image data provide fast navigation and easy volume definition.

Potential applications are volume measurements of a tumor or organs such as lung and kidney.

To do this, the *Volume Evaluation* card provides you with the following features:

- Evaluation on a separate *syngo* card on the user interface.
- Calculation of 5 different Volumes is possible in parallel.
- For easy navigation, the image data is displayed in 3 different views: coronal, sagittal and transversal.
- Use of *syngo* functions such as Navigation lines and dog-ears can be used for fast paging through each view.
- Transversal thick slice Multi Planar Reformat (MPR), Maximum Intensity Projection (MIP) or Minimum Intensity Projection (MinIP) segments are available for better recognition of the Volume of Interest.
- Zoom & Pan is available for each image segment which is especially helpful for Volume definition of smaller structures.

syngo Volume Evaluation

- Interactive outlining of freehand and elliptical Regions-of-Interest is available, with the possibility to define evaluation (HU) limits inside the VOI.
- Automatic interpolation between two pending ROIs is performed, i.e. the user only has to define the ROI in selected images within the stack.
- Automatic detection of a volume using threshold based 3D region growing, for quick calculation of high contrast structures such as bone, lung or contrast filled organs.
- Combination of interactive and automatic approach possible.
- Dedicated linking methods available for fusion or separation of ROIs, in order to define complex volumes.
- Display of color-coded VOIs for easy differentiation of multiple volumes.
- Configuration of result parameters.

Prerequisites

The images must fulfill the following conditions:

- Only images of one patient must be loaded for evaluation with Volume.
- The scans must have been acquired with the same table height and the same gantry tilt.
- Only image data sets with the same slice orientation must be used; (the selection should not include a topogram image).
- The loaded images must have the same zoom factor and the same reconstruction center.
- At least four images must be loaded before volume evaluation can be performed.
- The time range between the first and the last image must not exceed one hour.
- The data capacity of the volume must not exceed 1024 images with matrix dimensions of 512 x 512 pixels.

Workflow

1. Loading the Images

After loading the images into *syngo* Volume Evaluation, the following layout is displayed:



- Segment 1: Display of sagittal images. The images are sorted from left to right, according to the patient's anatomy.
- Segment 2: Display of coronal images. The images are sorted from front to back, according to the patient's anatomy.
- Segment 3: Display of transversal images. The images are sorted from head to feet, according to the patient's anatomy.
- Segment 4: Display of either the evaluation results or thick slice images (MaxIP, MinIP or MPR images) that correspond to the transversal images in segment 3.

2. Preparing Volume Calculation

Before you start the volume definition, first optimize the display of the images. To make interactive volume definition easier, you can

- delete images that you do not require for volume calculation from the original data set
- change the display of the images in the MIP/results segment using the display mode (MaxIP, MinIP or MPR) and the slice thickness
- scroll through the image stack
- window, zoom and pan images
- show/hide image text display
- set evaluation limits: Using the evaluation limits you can perform volume calculation within a defined HU value range

3. Planning a Volume

Volume Evaluation offers different tools and methods to plan a volume.

- You can use the **Automatic Volume Detection** feature, where the system automatically defines a volume around a seed point. Volume CT searches for directly connected voxels within a defined HU range and assigns them to the volume.
- You can use the **Interactive Volume Definition**, where you draw either elliptical or freehand regions of interest (ROIs) on the images. The ROI contours define the outer border of the volume.

3.1. Planning a Volume with Automatic Volume Detection

The automatic method is best used to evaluate a structure which has a different contrast (HU) than the surrounding tissue, such as the lung. You plan the volume with just a few clicks.

Automatic Volume Detection uses the 3D region growing method. You enter thresholds that are to be considered for region growing and set seed points.

Volume Evaluation searches for directly connected voxels within the threshold limits, and assigns them to the VOI.

The system then generates a volume considering all voxels that are found with region growing and which CT value lies within the Evaluation Limits.

- Check and adapt the Thresholds, if necessary.
- Set a seed point.
- To enlarge the volume, set additional seed points.
- To only include a specific range of HU values into the volume, change the Evaluation Limits. By default, the Evaluation Limits are identical to the Threshold.
- To start the evaluation, click the Start Evaluation button. The evaluation results are displayed in segment 4. The volume is colored on all images in all views.
- You can define a new volume.
You can correct the Evaluation Limits and restart the evaluation. If the result is not satisfactory, you can delete the volume.

Restricting Automatic Volume Detection

You can restrict Automatic Volume Detection to a defined smaller volume.

- Draw an ROI around the image area of interest on at least the first and the last image that you want to be included in the volume. The ROIs define the bounding box for the automatic approach.
- Check the Thresholds and set the seed point inside the object to be detected.
- Region growing only includes voxels that fulfill the following conditions:
 - Their HU value lies within the thresholds.
 - They are connected to the seed point.
 - They lie inside the bounding box.

3.2 Planning a Volume with the Interactive Volume Definition

For structures that are not so well defined, it is recommended to use the Interactive Volume Definition method. You can precisely adapt the ROIs to complex body structures.

You can draw either elliptical or freehand ROIs on the transversal images or on the thick slice images (for fast navigation).

syngo Volume Evaluation

The contours of the ROIs define the outer border of the evaluated volume. You do not need to define the ROIs on every slice. The system automatically interpolates ROIs on the images which lie between the images with defined ROIs.

- Check the images and search for the desired object structure.
- You can start on any image in segments 3 or 4. We recommend displaying an image that shows the center of the desired structure.
- Draw an ROI around the area that is to be considered to be part of the object structure.
- Do the same on another image, for example, the first or last image that shows the structure. The system automatically inserts ROIs on the intermediate images. These ROIs are drawn with a dotted line to indicate that they are assumed for the evaluation of the volume, but that they are not confirmed by you. The contour of a user-defined ROI is a solid line. All ROIs have the same color and number.
- Scroll through the images and modify, if necessary, the interpolated ROIs to the true structure of the desired volume. You can edit an interpolated ROI or replace it with a new ROI.
- To extend the volume, insert an ROI before/after the first/last image on which an ROI is already defined.

syngo Volume Evaluation

- To include only a specific range of HU values into the volume, change the Evaluation Limits.
By default, the Evaluation Limits take all HU values of the last evaluation.
- To start the evaluation, click the Start Evaluation button. The evaluation results are displayed in segment 4. The volume is colored on all images in all views.
- You can define a new volume.
You can correct the Evaluation Limits and restart the evaluation. If the result is not satisfactory, you can delete the volume.

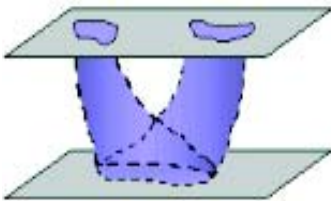
Overlap and Mark&Link Method

You can define complex volumes using the automatic (overlap) and manual (mark&link) method.

- Overlapping method

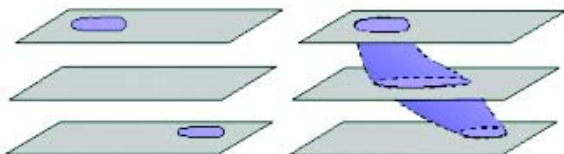
Drawn ROIs that overlap each other vertically for at least a few pixels are automatically combined to one volume. Interpolated ROIs (dotted line) are shown in the intermediate images.

Two or more small ROIs that are drawn within one image and a big ROI in a different image that overlaps both small ROIs are automatically combined into one volume. This works in both directions: top-down and bottom-up.



syngo Volume Evaluation

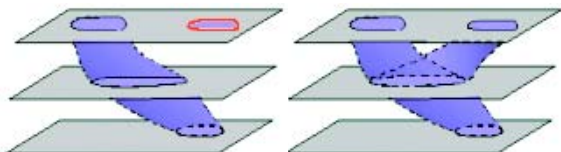
With the Overlap method, you can also create a volume from two ROIs that do not overlap in the first step. It is then necessary to draw an ROI in an image which lies between the two other ROIs, so that the new ROI overlaps with the two previous ROIs. This way, you can easily define a VOI around tortuous body structures.



- Mark & link method

If two ROIs do not have a common projection point, you can link them manually for interpolation.

You can link non-overlapping ROIs to one volume. First you mark one ROI, and then you link a second ROI to it. The system connects the ROIs and inserts interpolated ROIs on the intermediate images.



4. Evaluation Results

When you click the Start Evaluation button, the system calculates the planned volume within the evaluation limits.

The evaluation results are displayed in segment 4. Only the statistic parameters that are set in the configuration dialog box are calculated. Volume pixels and evaluation results are the same color.

The evaluation results and the thick slice images are both displayed in segment 4. To switch the display, click the MIP/Result icon.

The evaluation results include general patient information, date and time of the evaluation and for each volume the configured statistic parameters.

- **Volume [cm³/mm³]** Size of the volume.
- **Height [cm/mm]** Maximum height of the volume in cm – corresponding to the patient's anatomical feet-to-head orientation.
- **Width [cm/mm]** Maximum width of the volume in cm – corresponding to the patient's anatomical left-to-right orientation.
- **Depth [cm/mm]** Maximum depth of the volume in cm – corresponding to the patient's anatomical anterior to posterior orientation.
- **Mean [HU]** Mean CT value of the volume in HU.
- **SD** Standard deviation from the Mean value [HU].
- **L Threshold [HU]** Lower threshold considered for automatic volume detection.
- **U Threshold [HU]** Upper threshold considered for automatic volume detection.
- **L Eval Limit [HU]** Lower evaluation limit considered for volume calculation.
- **U Eval Limit [HU]** Upper evaluation limit considered for volume calculation.

5. Documentation of Results

If all volumes are evaluated, you can save and film the results.

Save – stores to your local database:

- The transversal images with the color-coded VOI
- The reformatted images (sagittal, coronal, MPR/MIP)
- The displayed result sheet

Two new series are created.

- The “VolumeResult” series, which consists of the 4 images and the result sheet that are currently displayed.
- The “VolumeAxial” series, which is a copy of the loaded transversal images and also includes the color-coded ROIs.

General Hints

• Loading Images

After all images are loaded, your system checks whether the sorted images have an equally spaced ascending or descending timestamp. If that is not the case, a warning box is displayed but loading is continued.

If the distance between slices and the slice thickness of the loaded images are not identical, a warning box is also displayed.

- **ROI and Volume Definition**

- If you insert/modify an ROI, the system automatically plans the ROIs on the preceding/following images (interpolated ROIs) up to that image with the previous/next user-defined ROI.
- User-defined ROIs have a solid contour line, whereas interpolated ROIs have a dotted contour line.
- When you modify an interpolated ROI (dotted line), it becomes an user-confirmed ROI and is displayed with a solid line.
- The system never modifies the shape of a user-defined ROI. In case that you insert or modify an ROI, the shape of previous/following interpolated ROIs may change.
- If a new ROI touches or overlaps another user-defined ROI (solid line), the ROIs are merged during volume calculation.
- If a new ROI touches or overlaps an interpolated ROI (dotted line), the new ROI replaces the system defined ROI.

- **Restrictions for Linking and Unlinking**

There are some restrictions for linking and unlinking:

- Linking can be done on user-defined ROIs as well as on interpolated ROIs. If you link an interpolated ROI (dotted line), it becomes a user-confirmed ROI (solid line).
- You cannot unlink interpolated ROIs. The unlinking only works with user-confirmed ROIs.
- If you modify the volume (for example, move a ROI) before linking an ROI to the already selected ROI, the marking is reset.

- **Evaluation**

- Bounding voxels, where no voxel lies within the entered range of HU values, stops region growing. Check the depth of the volume in the coronal and sagittal view. To complete region growing inside the entire volume, set multiple seed points if necessary.
- You can edit the thresholds even after the volume has been evaluated.
- You can modify or delete the last evaluated volume.

Configuration



In the Volume Configuration dialog box, you define which evaluation results are given by Volume Evaluation.

- Unit of Volume
 - mm³** Volume is given in mm³.
 - cm³** Volume is given in cm³.

syngo Volume Evaluation

– Statistical Parameters

Volume Volume is calculated in the defined unit: mm³ or cm³.

Max. height [cm] Maximum height of the reconstructed volume.

Max. width [cm] Maximum width of the reconstructed volume.

Max. depth [cm] Maximum depth of the reconstructed volume.

Mean value [HU] Mean CT value of the volume in HU.

Standard deviation [HU] Pixel standard deviation.

Thresholds [HU] Range of CT values that have been considered for automatic volume detection in HU.

Evaluation limits [HU] Range of CT values that have been considered for volume calculation in HU.

– Coronal/Sagittal slice thickness

In the Coronal/Sagittal slice thickness area you can preset the slice thickness for sagittal and coronal images.

Select same as *input images* if you want to have the slice thickness of the input images applied.

Dynamic evaluation is a function which allows you to analyze the absolute or relative enhancement of Hounsfield values within a Region of Interest.

The enhancement value is computed from a stack of CT images which are obtained at different points in time after contrast agent injection. For dynamic evaluation, usually images from the same cross-section of the body are taken, such as a Multi-scan through an unclear process in the liver.

The time to the maximum enhancement (Time-to-Peak) and the way a certain tissue or structure absorbs the contrast medium can be very helpful in differential diagnosis of a given process.

To do this, the *Dynamic Evaluation* card provides you with the following methods:

- Evaluation on a separate *syngo* card on the user interface.
- Selection dialog for slice positions to be evaluated in Multi-slice studies.
- Volume data sets can be evaluated also, e.g., for measurement of contrast enhancement in a vessel during spiral acquisition and further optimization of contrast injection procedure for follow-up studies.
- Dynamic evaluation of 5 different regions (circular and irregular) and a pixel lens are possible in parallel.
- ROI definition and pixel lens are automatically copied to all pending images of the stack and show an immediate display of the time-density curves, i.e. a calculation can be done with only one interaction.

- Use of *syngo* functions like dog-ears or cine mode for fast paging through the image stack.
- Easy selection, modification and deletion handling for the ROIs.
- Constant display of the time-density curves with a scalable sampling line, and of the tabular results which display for each separate ROI
 - the mean Hounsfield value
 - the time to the peak enhancement (in seconds)
 - the density value (HU) of a given time position, chosen by shifting the sampling line to that point.
- Separate image stack segment for further output images such as
 - Average image
 - Maximum Intensity Projection image
 - Peak Enhancement image
 - Time-to-Peak image.
- Configuration dialog to enable customized results.

Prerequisites

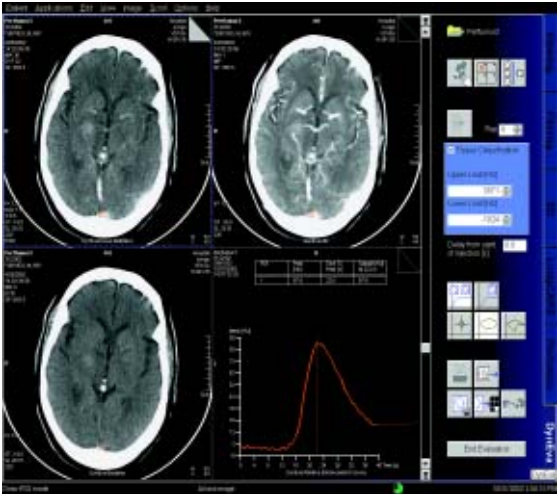
In dynamic evaluation, images that were scanned as part of an examination with contrast agent at a constant table position are evaluated.

- The selection consists only of CT tomogram images.
- The images belong to the same study.
- The images were acquired within 1 hour.
- Images of at least 4 different time positions must be loaded to Dynamic Evaluation.
- The relevant DICOM attributes are the same on all images.

Workflow

1. Loading the Images

After loading the images into *syngo* Dynamic Evaluation, the following layout is displayed:



- Tomo segment
The loaded input images are displayed in the upper left-hand segment. The images are sorted by the acquired time.
- Parameter image segment
Parameter images are displayed in the upper right-hand segment
 - MIP image
 - Average image
 - Peak Enhancement image/Time to Peak image

- **Baseline image segment**
The baseline image is displayed in the lower left hand segment (base for enhancement calculation). By default, the first image of the loaded images is used as the baseline image.
- **Result segment**
It is black after loading.

2. Inspecting the Input Images

Before you begin the evaluation, optimize the display of loaded images in the tomo segment in such way that the regions to be evaluated are clearly visible:

- Scroll through the image stack
- Window, zoom and pan images
- Remove the images that are not suitable for dynamic evaluation (e.g., when the patient has moved during scanning).

3. Generation of Parameter Images

As soon as you load the original image material, your system performs an evaluation of the entire image area. The results (parameter images) are displayed in the parameter image segment.

Each time you make a change to the original data set (by removing images, and/or defining a new baseline image) your system recalculates the parameter images based on the existing images.

- **The average image** is an averaged addition of all pixels at each pixel location across the images of the tomo segment.
- **MIP image:** Parameter image where each pixel is the maximum value of all images at that pixel location. The image data is checked pixel by pixel. The pixels with the maximum intensity are displayed in an image.
- **Time to Peak image:** Parameter image where each pixel indicates the period of time (in tenths of a second) from the time when the first image was acquired (Delay = 0) or the time when the contrast was injected (Delay > 0) to the time when the highest CT value is reached at that pixel location. The longer the time period until the peak CT value is reached, the brighter the pixels.

With a Time to Peak image, for example, you can easily detect structures in which the contrast did not spread as fast as in comparable structures.

Hint: The time to peak (in seconds) at the cursor position in the Time to Peak image is the CT value displayed in the lower right corner divided by 10.

- **Peak Enhancement image:** Parameter image where each pixel indicates the enhancement at that pixel location.

CT value of a pixel = maximum value found at that pixel location (pixel value of the MIP image) – CT value of the baseline image at that pixel location.

With a Peak Enhancement image, for example, you can easily detect structures that were not completely filled with contrast.

Hint: You can activate or deactivate the calculation of the Time to Peak image and the Peak Enhancement image in the configuration.

4. Creating a Baseline Image

A baseline image is used as a basis for all enhancement calculations.

The enhancement is calculated relatively to the baseline image. Therefore, the baseline image must show the state before enhancement starts.

By default, the first image of the loaded images is used as the baseline image.

Before the enhancement starts, you can also define the last image as the baseline image. If you do so, the mean gray values of the selected image and all the images that have been acquired before the selected image are displayed in the baseline image. The result is a smoother image that can be used to define the ROIs.

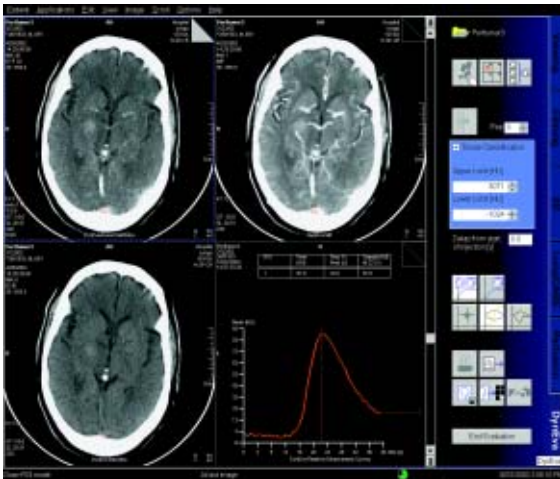
If you want to use a different baseline image, proceed as follows:

- Scroll to the required image in the tomo segment.
- Click on the button *Generate baseline image* with the mouse.

5. Evaluation of Region of Interests

You select the image regions to be evaluated by marking them with ROIs or applying the pixel lens (a circular ROI with a fixed but configurable diameter). An absolute/relative CT-value calculation is performed for these selected image.

- You can draw either elliptical or freehand ROIs.
- You can modify an ROI in any image, precisely adapting it to the shape you feel is relevant.
- The number of ROIs that can be defined is limited to five – you can only draw one pixel lens.
- The ROIs that you have drawn are transferred to the other views.
- To aid examination, they are numbered in sequence and color-coded.



Display of the Pixel Lens curve

6. Enhancement Curve

As soon as you have defined an ROI, an enhancement curve (time-density curve) is calculated and displayed in the fourth segment. To facilitate identification, this curve has the same color and numbering as the associated ROI. The maximum CT-value of the ROI first drawn is indicated by a dashed sampling line.

In the table, for each ROI, the following parameters are given:

- Peak [HU]: Highest CT value detected in the ROI.
- Time to Peak [s]: Period of time in seconds from the time when the first image was acquired (Delay = 0) or the time when the contrast was injected (Delay > 0) to the time when the highest CT value is reached in an ROI.
- Sample [HU]: CT value at the point of time (in sec) where the vertical line is positioned on the enhancement curve.

Absolute/Relative Enhancement curve

The enhancement curves are displayed as absolute or relative curves.

- The Absolute Enhancement curve displays the original CT-value derived at every point in time during the examination.
- The Relative Enhancement curve displays the variation of CT-values with reference to the CT-values in the baseline image at every point in time.

7. Documentation of Results

During the evaluation you have drawn individual ROIs and have generated enhancement curves and result tables. You can save and print out this information or store it on a floppy for further processing.

To document the evaluation, two new series are stored to your local database.

- The *"DynEva Curves"* series consists of 3 images and the result sheet that is currently displayed:
 - One original or (fused) Multi-slice image currently displayed.
 - The image displayed in segment 2, for example, the MIP image.
 - The baseline image.
 - The displayed result sheet.
- The *"DynEva Parameter"* series consists of the parameter images in segment 2:
 - The Time to Peak image (if configured).
 - The Peak Enhancement image (if configured).
 - The Average image.
 - The MIP image.

General Hints

- **Slice Position with Multi-Row Scanners**

When you use a multi-row scanner, several slice positions are scanned per acquisition. When you load the images, the window Slice Selection is displayed, in which you can define the slice position to be analyzed. You can evaluate either the scanned examination data or an averaged slice position.

- **Help to Interpret the Enhancement**

Parameter images that help to interpret the enhancement are displayed in segment 2, for example, the MIP image and the Peak Enhancement image.

- **Defining the Tissue Range**

With Tissue Classification you can exclude all tissue regions outside the CT-value range entered. This allows you to emphasize the organ to be examined and remove disturbing factors.

HU limitation does not affect evaluation of the ROIs and only appears at the Time to Peak and the Peak Enhancement image.

The excluded tissue densities are masked by a color in the baseline image. The excluded areas are displayed in black in the Time to Peak and Peak Enhancement images.

- **Filtering**

To reduce noise in the Time to Peak and Peak Enhancement image you can apply a smoothing filter.

Filtering does not affect the evaluation of ROIs.

- **Moving the Sampling Line**

If you want to evaluate the enhancement values for a different point in time, move the sampling line in the horizontal direction.

You can display the tomographic image for the time marked by the sampling line as the top image in the tomo segment. To do that, double-click on the sampling line.

- **Delay of Injection**

You usually start the CT scans with contrast medium after a delay following contrast medium injection. You can have this off-set taken into account in calculation of the Time to Peak image and enhancement curves. The results then refer to the time of contrast medium administration (zero on the time scale).

⇒ Enter the delay from the start of injection of the contrast to the start of the scan and confirm with the Enter key.

- **Relative Enhancement Curve**

Time Axis (X)

The point of time for an image is computed relative to the point of time at which the first input image was acquired:

Point of Time = Acquisition Time – Acquisition Time of the First Image + Delay

- **Enhancement Axis (Y)**

The mean CT value of each ROI is plotted on the enhancement axis of the enhancement curve.

The value is relative to the CT values of the baseline image. The mean CT value of an ROI inside the baseline image is assumed to be "0".

- **Absolute Enhancement Curve**

Enhancement Axis (Y)

The point of time for an image is computed relative to the point of time at which the first input image was acquired:

Point of Time = Acquisition Time – Acquisition Time of the First Image + Delay

Enhancement Axis (Y)

The absolute mean CT value of each ROI is plotted on the enhancement axis of the enhancement curve.

syngo Dynamic Evaluation

- **Configuring Dynamic Evaluation**

You can make the following settings in DynEva Configuration:



- *Calculate Time to Peak Image*
A Time to Peak Image is generated and displayed in the upper right-hand segment. You can use the image for ROI definition.
- *Calculate Peak Enhancement Image*
A Peak Enhancement Image is generated and displayed in the upper right-hand segment. You can use the image for ROI definition.
- *Enable export of results*
Enables the export feature: Results can be stored on floppy disk.
- *Enable printing of results*
Enables the print feature: Results can be printed.
- *Diameter of Pixel Lens*
Diameter of the circular ROI (pixel lens) in pixels.

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