Breast Routine 1.5T

Purpose

This document provides information for scanning a routine breast examination on a Philips 1.5T MRI system.

The planning images in this guide show as examples, the actual planning required should be discussed with the radiologist.

Safety

General safety rules apply to breast scanning. Refer to the general safety rules in the *Instructions for Use* and *MR the Safe Way* eReading.

For scanning the breast pay extra attention to:

- Patient ventilation: check that the patient ventilation is working and the patient is not blocking the airflow.

Refer to the *Instructions for Use* for information on how to prevent patients from touching the bore.

Setting up

Coils and accessories

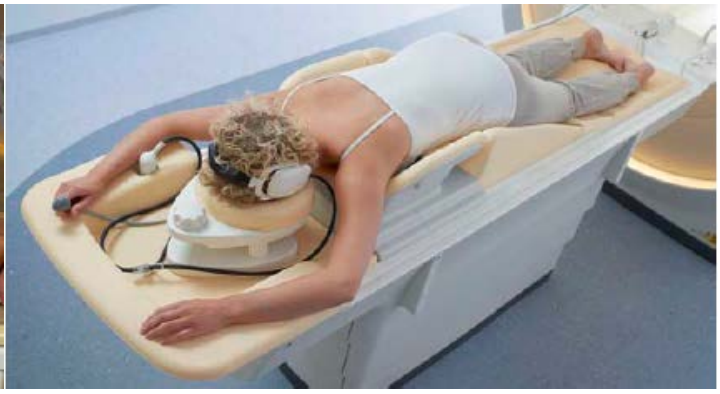
This examination makes use of the following coils and accessories:

- Dedicated breast coil or two Flex L coils with the dedicated breast mattress
- Dedicated head rest
- Dedicated pads
- Earplugs or headphone
- Extra padding for patient comfort

Positioning

For breast imaging the patient is positioned head first and prone or feet first and prone depending on the system and coil used.

SENSE Breast coil 7



dS Breast 16ch coil

Guidelines for positioning the patient

Consider the following when positioning the patient:

- Instruct the patient to remove all metal.
- Scan bare breasts or use clothing without compression of the breast tissue.
- Instruct the patient to place their arms above their head and let them rest on the table.

Note For Ingenia CX: Stretch out the patient's arms as much as possible as this will prevent the patient from lifting their upper back.

- Position the patient prone with head facing directly down. The patient shall not turn the head on the head support because in doing so one side of their body will be slightly lifted.
- Make sure the patient is as comfortable as possible to avoid repositioning between scans. Place a cushion under lower leg to relieve stress on the back.

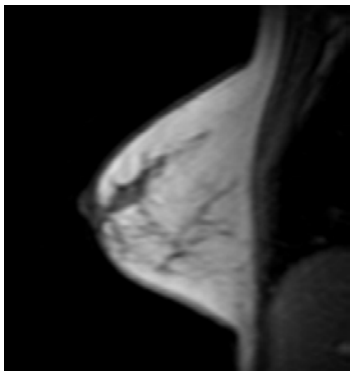
Note For extra patient comfort or if the patient indicates pressure at the sternum or lower ribs anteriorly, you can position two 15^{o} angle wedges into place as shown below.

- Ensure that the breasts are hanging freely in the coil. The breasts and the axillary areas must be free of folds.

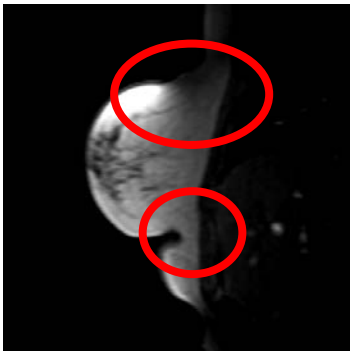
  If a patient has pendulous breasts, use lateral support to minimize vibration. For this you can use wedges, folded pillowcases or the lateral compression plates if available with a minimum of compression. Another option is to place a sheet in the coil and pull it gently to support the breasts.

- Make sure the infra mammary fold is flattened and not in the coil.
- Review the survey for folds of the mammary tissue and reposition if necessary.

  In the **Poor positioning** image below, the superior part of the breast is touching the coil, the infra mammary fold is in the coil. The patient needs to be repositioned.



Good positioning (1.5T Achieva)



Poor positioning (1.5T Achieva)

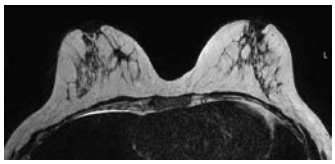
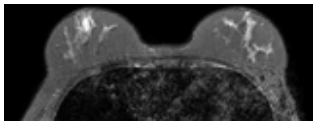
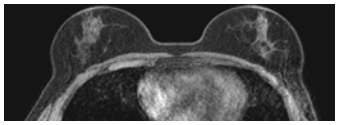
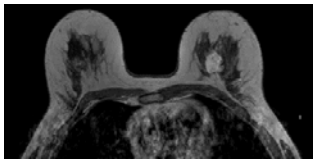
Planning

Note

Protocols are designated by physicians. Philips does not determine which sequences should be acquired for a particular anatomy or examination.

Commonly used sequences

The routine preset procedure database may contain the following sequences commonly used in breast examinations.

Sequence (Images 1.5T Ingenia)	Purpose
T2W_TSE 	See bright fluid contrast.
T2W_SPAIR 	See bright fluid contrast. Series is fat suppressed.
Dyn e-THRIVE 	Dynamic series is used to see the wash-in and wash-out of a contrast agent. e-THRIVE is fat-suppressed. The e-THRIVE is very well suited for the calculation of MIP and MPR images (if acquired isotropic).
Dyn_T1W_FFE 	Dynamic series is used to see the wash-in and wash-out of a contrast agent. T1W-FFE is not fat-suppressed. Subtraction is used as post-processing. The T1W-FFE is very well suited for the calculation of MIP and MPR images (if acquired isotropic).

FOV

1.5T Achieva

Make sure the breast tissue is included in the FOV in AP-RL and FH direction. The FOV in AP direction can be changed according to physician preferences.

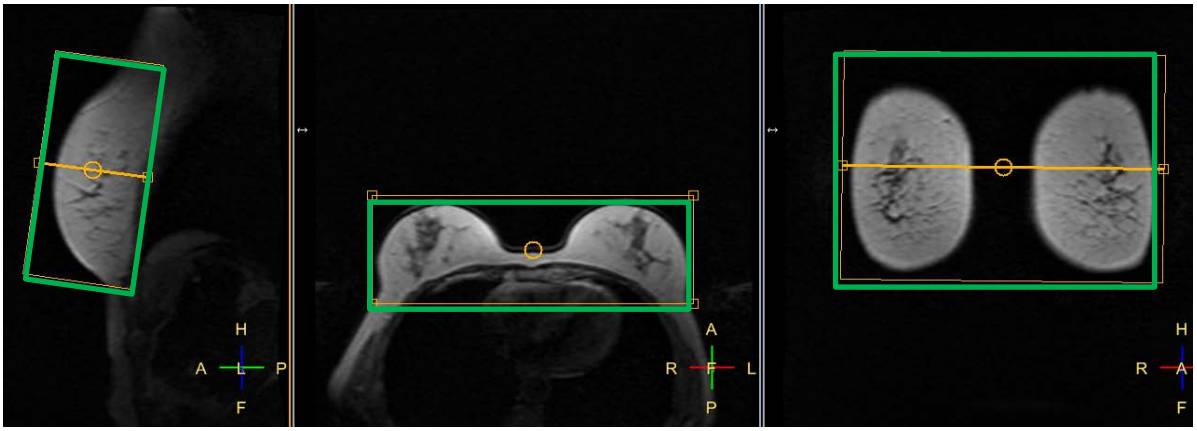
Shim Volume

Shimming is done during the preparation mode to optimize the magnetic field homogeneity.

In breast scanning volume shim is used to optimize the B0 in the area of interest. In this way we can exclude tissues causing susceptibility like the heart and lungs.

When positioning the shim volume:

- RL direction includes the complete breast tissue.
- FH direction includes the complete breast tissue and excludes area under the breast.
- AP direction includes the breast tissue and excludes most of the heart and lungs, includes part of the chest wall.

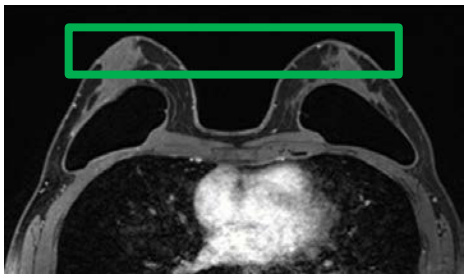


1.5T Achieva

Positioning shim volume when scanning implants

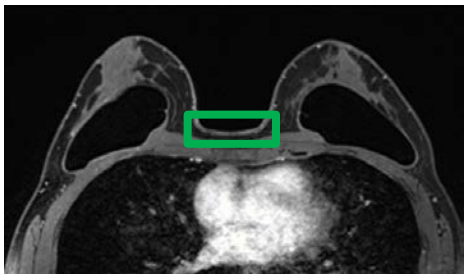
In general you can use the shim positioning showed above. However if the fat suppression is not complete there are alternative shim positioning options.

If the implants are positioned behind the chest wall muscles, or if there is a considerably amount of breast tissue in front of the implants, the positioning of the volume shim shown in the following figure is advised.



1.5T Ingenia

If the implants are positioned in the breast itself and there is hardly any breast tissue in front of the implants the shim volume can be positioned on the sternum only (small volume) or behind the implants.



1.5T Ingenia

Relevant Scan Techniques

In addition to the routine ExamCards and protocols, consider the following.

SPAIR power

For breast imaging in the T2W_SPAIR series, **SPAIR power** is set to **2**. A stronger SPAIR pulse will be applied which results in improved fat suppression. However, there can be a slight increase in SAR.

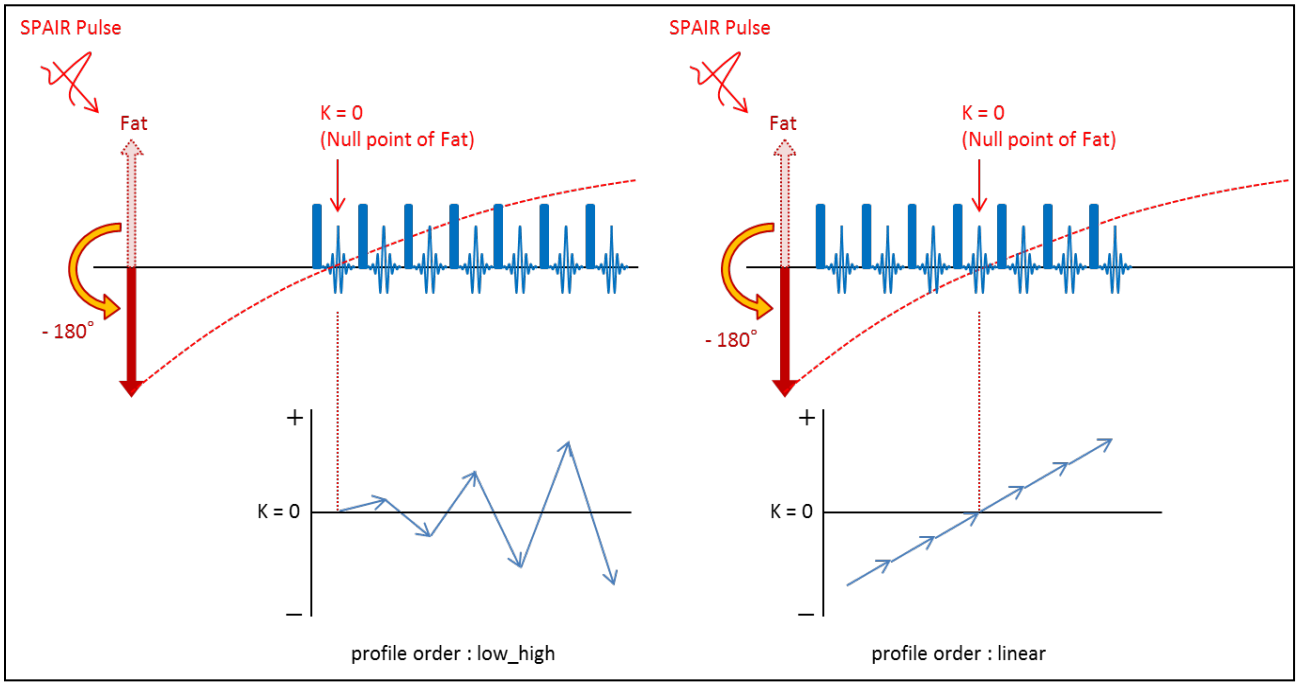
Relevant Scan Techniques…

e-THRIVE

T1 **H**igh **R**esolution **I**sotropic **V**olumetric **E**xamination (e-THRIVE) is a 3D T1W TFE sequence with fat suppression utilizing SPAIR.

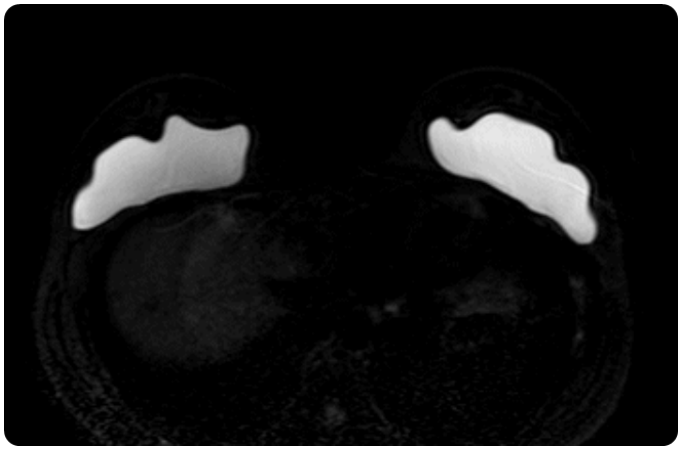
e-THRIVE:

- Parameters are optimized for:
  - Signal-to-noise and contrast-to-noise ratios
  - Sharpness
  - Robustness
- Can be used for dynamic uptake studies.
- Is very well suited for the calculation of MIP and MPR images.
- Uses linear or low high profile order, which leads to improved homogeneity, SNR, and sharpness. Profiles around K=0 are sampled at the moment the fat signal is zero.



- Uses Halfscan Z (Halfscan in slice direction). This enables the acquisition of an asymmetric TFE-shot, which results in improved fat suppression and better contrast timing because the acquisition takes place in the arterial phase.

Silicon-only series

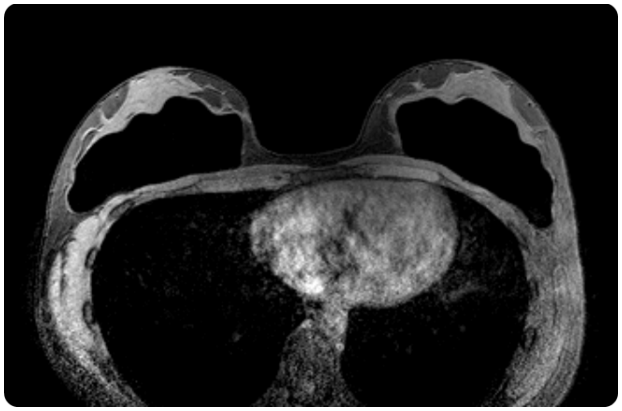


1.5T Achieva

This series is designed for imaging silicone implants. Water and fat signals are suppressed, leaving silicone as the major signal contributor in the image.

- A Dual IR technique is used to suppress the fat and water signals.
- The first inversion pulse is applied with an inversion delay to suppress fat (STIR technique) whereas the second pulse suppresses fluid.
- When planning this sequence, the **Reference tissue** parameter is set to **Breast**.

Silicon Suppression series



1.5T Achieva

This series is designed to suppress the signal of the silicone implants.

- AutoSPAIR is used to suppress the signal of the silicone implants.
- When planning this sequence, the **Reference tissue** parameter is set to **Silicone**.

Key parameters

Interactive F0 parameter

Purpose

Water and fat have specific resonance frequencies that lay 3.35 ppm apart. Fat has the lower frequency.

The difference between the frequency of water and fat is always 214 Hz on 1.5 Tesla and 428 Hz on 3.0 Tesla. However, due to local field inhomogeneities, the precession frequencies of fat and water may slightly change. Local field inhomogeneities can occur at the transition between air, bone, and soft tissue (areas of susceptibility).

Interactive F0 allows you to monitor and manually adjust the frequency of the transmitting pulses so that it matches the frequency of water. Since the difference between the frequency of water and fat is still the same (3.35 ppm), the fat suppression pulse now matches the frequency of fat, and results in an improved fat suppression.

Parameter options

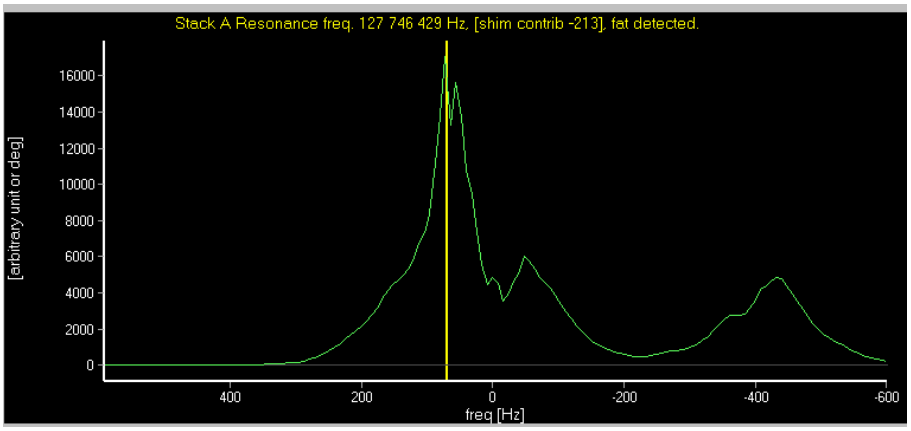
The F0 determination is performed during the preparation phase of a scan.

On the **Postproc** tab, the **Interactive F0** parameter can be set to set to:

- **auto**: F0 values of previous scans are reused. The window to adjust the Center Frequency (F0) will display only when no prior values are available or the values cannot be reused. This may, for example, occur when the slice offsets have been changed.
- **select**: after each preparation phase the window to adjust the Center Frequency (F0) opens. Previous values are not reused.

How does it work?

Following the preparation phase of a scan, the **Monitoring Display Operator Console** window opens.



The Center Frequency (F0) is the yellow line. The green line shows the water peak (at 0) and the fat peak.

When the Center Frequency matches the water peak click Accept.

What if the Center Frequency does not match the water peak?

If the Center Frequency does not match the water peak you may either drag the vertical bar to its required position or right-click on the required position.

The new value automatically propagates to subsequent scans if the **Interactive F0** parameter is set to **auto** and the slice offset does not change.

Interactive F0 in breast scanning

Usually the water peak is higher than the fat peak but in the breasts of older patients the fat peak can be higher. However, because of its higher precession frequency the water peak is always on the left of the fat peak.

The F0 determination executed by the system is always performed to match the outer-most left peak (water), not on the highest peak. Thus, the Center Frequency does not match the frequencies of fat or silicone in cases where they have a higher peak than water.

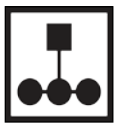
Image Quality

Fat suppression

In breast imaging fat suppression techniques can cause image quality issues, due to air tissue interfaces, moving air in the lungs, which causes susceptibilities.

Some methods to improve fat suppression include:

- Position the patient correctly on the coil.
- Position the patient so that there are no folds in the breast tissue.
- Use **Interactive F0** and position the Central Frequency (F0) on the water peak.
- Position the shim volume correctly. Try to reposition the shim volume if necessary so that it does not include the heart and lung tissue.



Scanning

Administration of contrast in combination with the dynamic scan

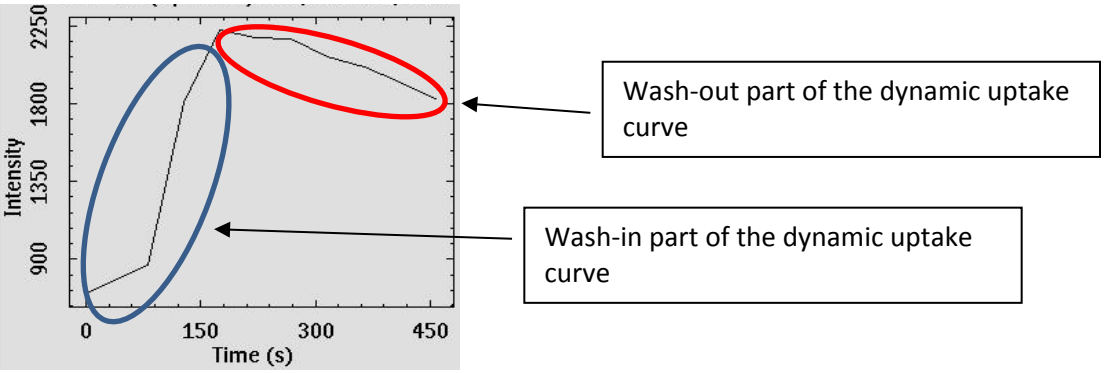
Note

Actual injection parameters need to be defined by the radiologist.

Dynamic series consist of 1 series repeated several times. The first dynamic sequence is scanned without administration of contrast. It can be reviewed for artifacts and planning. The sequence can also be used for subtraction.

The second dynamic sequence starts with a manual start so the operator can make sure the injector and scan are started at the right moment. The remaining dynamic sequences have an auto start.

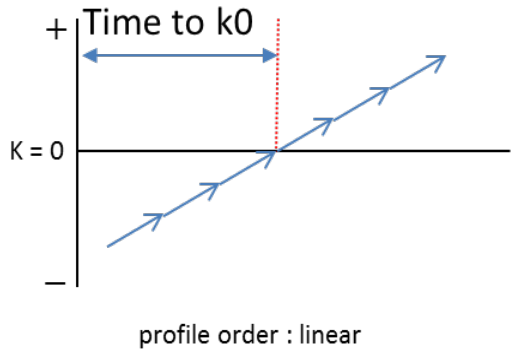
It is important to scan a few more dynamic sequences after the administration of the contrast. This is needed for the Basic T1 perfusion post processing and also to see the wash-in and wash-out for the contrast in a lesion.



On the info page in dynamic series you see displayed **Time to k0** and **dynamic scan time**.

Time to k0 describes the time it takes until the profiles at k=0 are acquired. The low order profiles sampled at k0 contribute most to the contrast and signal in the image. For optimal results the Time to k0 and the contrast peak have to match.

In general the contrast peak is about 90 sec. after the start of the injection in breast examinations.



profile order : linear

Dynamic scan time is the time it takes per dynamic scan. Common values are about 45-75 seconds.

Depending on **Time to k0** and **Dynamic scan time** in the series there are three possible scenarios:

- Injector and scan are started simultaneously
- Scan delay is used
- Injector delay is used

Note Scan delay and injector delay are settings on some injectors

The following table describes each scenario:

Injector and scan are started simultaneously	Injector and scan are started simultaneously	Contrast peak after 90 seconds matches **Time to k0** in the third dynamic	Values of the Time to k0 and Dyn. Scan time define if you can use this option
Scan delay	Injector is started and after a defined scan delay you start the series	Contrast peak after 90 seconds matches **Time to k0** in the second dynamic	Scan delay = contrast peak after injection (90s) minus **Time to k0**
Injector delay	Scan and injector are started at the same moment, however the injector starts injecting after the inserted inject delay	Contrast peak after 90 seconds matches **Time to k0** in the third dynamic	Inject delay = contrast peak after injection (90 sec) minus **Dyn. Scan time** minus **Time to k0**

For example, from the info page the Time to k0 is 45 seconds. To match the contrast peak in the **third** dynamic you can start the injector and scan simultaneously after the first dynamic is finished.

If you want to match the contrast peak in the **second** dynamic, the scan delay will be 90-45 = 45 seconds. You define the scan delay on the injector. After the first dynamic you start injecting. After 45 seconds you start the second dynamic series.

SED

Monitor the SED to maintain recommended levels refer to the *Volume One*, *Instructions for Use* for more information.

Pop up messages

During the scan, pop-up messages may display on the console. You should refer to the IfU for a description of each message.

Maintain contact with the patient

Verbally communicate with the patient during the exam.

Visually monitor the patient during the exam; this is particularly important for anesthetized and compromised patients.

Post processing

The Philips system provides many options to post process the examination:

- MPR or MIP of the series is done via the **VolumeView** tool.
- Post processing of the diffusion weighted series is done via the **Diffusion** tool.
- Subtraction of the dynamic contrast-enhanced series is done via the **Image Algebra** tool.
- Post processing of the dynamic contrast enhanced series is done via the **T1 perfusion tool.**

Please refer to the documentation for additional information.

Additional information

For additional information, refer to the following:

- *Instructions for Use* for the extended information about coils
- *Patient Ventilation System and SED* practice sheet
- *Postprocessing: VolumeView MPR Quick Step*
- *Postprocessing: VolumeView MIP Quick Step*
- *Postprocessing: Diffusion Quick Step*
- *Postprocessing: ImageAlgebra Quick Step*
- *Postprocessing: Basic T1 Perfusion Quick Step*