

# syngo GRACE

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## Introduction

Breast cancer is the second leading cause of cancer death in women. In 2007 approximately 40,460 women and 450 men will die from breast cancer per the American Cancer Society. With the improvements in MR technology, *syngo* GRACE is a valuable diagnostic tool for breast cancer with an easy workflow process.

## syngo GRACE

GRACE (GeneRALized breast speCTroscopy Exam) makes it possible to examine breast lesions on a molecular level, using the <sup>1</sup>H MR spectroscopy (MRS) single voxel spectroscopy (SVS) technology. Choline acts as biomarker in breast spectroscopy. The choline metabolite in healthy breast tissue is usually negligible. A visible higher choline signal in the spectrum can be correlated with malignant biopsy results. However, choline levels may be visible in the lactating breast.

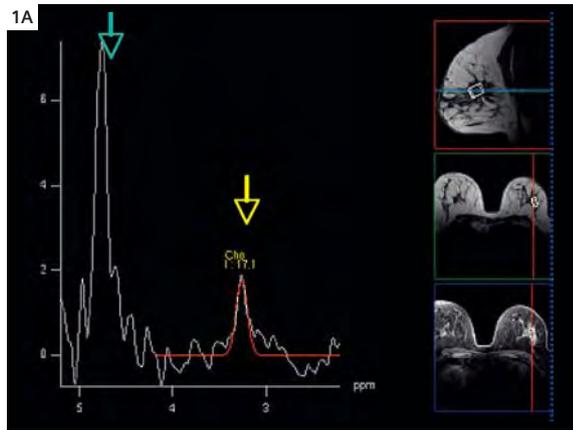
## Clinical values

By using *syngo* GRACE, the radiologist can use a noninvasive method of differentiating between benign and malignant lesions. This can eliminate the need for the biopsy of a tumor.

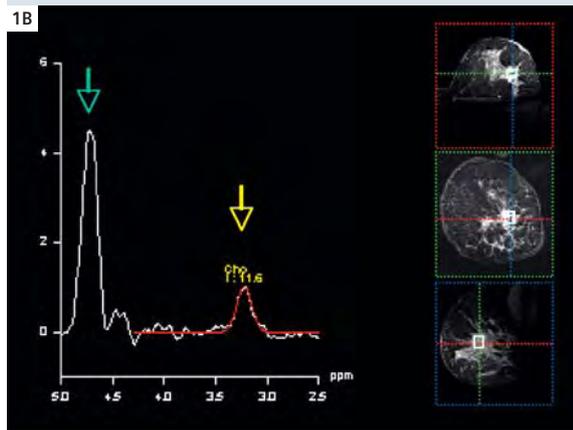
Monitoring therapeutic efficacy is essential in the management of cancer patients. The tCho concentration of the spectrum can serve as an indicator for predicting clinical response to chemotherapy.

GRACE can help improve identification of possible vital residues after chemotherapy and preoperative intervention.

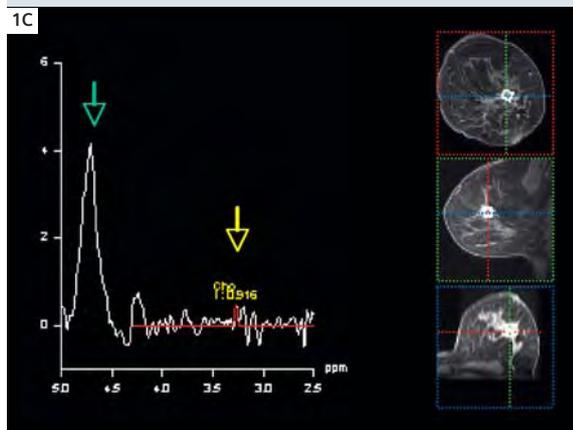
The following examples show tumor spectrum of breast cancer before, and during chemotherapy. Biopsy correlates with high choline signal in the spectrum.



**1A** Spectrum shows a high choline peak prior to chemotherapy.



**1B** Choline signal appears reduced after second cycle of chemotherapy.



**1C** Almost no choline signal is seen after the last (sixth) cycle of chemotherapy.

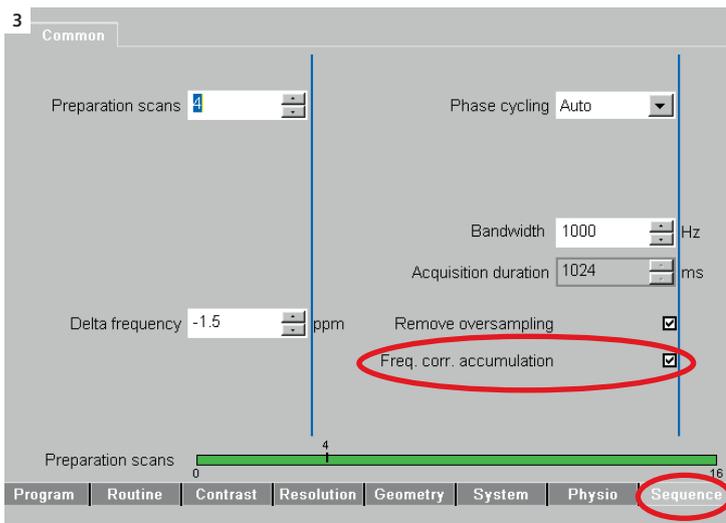
Images courtesy of Prof. T. J. Vogl, University of Frankfurt/Main, Germany.

## Quantification with external reference

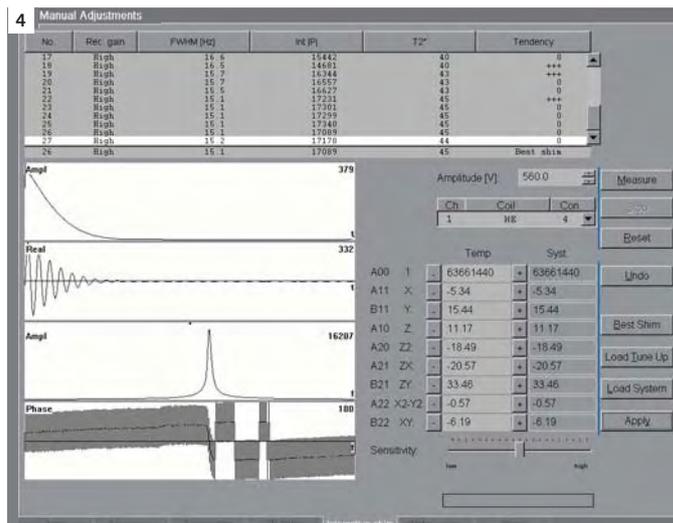
The Siemens Breast Matrix coil has a reference solution present in the coil housing for the normalization of the choline signal relative to saline. The choline signal is automatically normalized with an additional measurement of the reference sample signal.

## Quantification with internal reference

An additional possibility for normalizing the choline signal consists of an internal reference measurement. For this purpose, you can perform a fast, non-water suppressed measurement in the tumor with an identical voxel position and size. However, the internal reference method is not considered clinically sound for controlling the course of therapies.



**3** Another new feature of the sequence is the Inline frequency correction which can minimize respiratory artifacts.



**4** The shimming in breast MR spectroscopy.

## Breast MRS setup

Position the patient in the prone position in the breast coil, with careful fixation of the breast. It is helpful to use the subtraction images for voxel positioning. Voxel size should be adapted to the tumor size. If the voxel size is too large and if there is poor positioning of the voxel; then fat signal is superimposed on the choline signal.

## Sequences

GRACE uses the `svs_se` sequence with spectral lipid suppression and weak water suppression. By using the spectral lipid suppression, this reduces the effect of lipid on the choline signal. The weak water suppression leaves a residual water peak; this allows you to include the water line in various post-processing functions.

## Shim

Semi-automatic shimming is the method of choice for *syngo* GRACE pre-scan adjustments (Fig. 4). With your protocol open, select the options-adjustments, from the display window pop up, select the show tab. In the bottom right corner of the window select invalidate all then adjust all. Wait until the adjustments are complete (the system will communicate with you in the bottom left corner of the window). To confirm how well the shim adjusted, select the interactive shim tab, then measure (this begins an endless

measurement), check FWHM and T2\* in the top box, the FWHM must be equal to or less than 25 Hz, the smaller the number the better the shim. If the FWHM is greater than 25 Hz FWHM, adjust the linear terms X, Y, and Z separately using the +/- keys until the above criteria for FWHM is achieved. Select stop, best shim and apply. Close the adjustments window and apply the sequence.

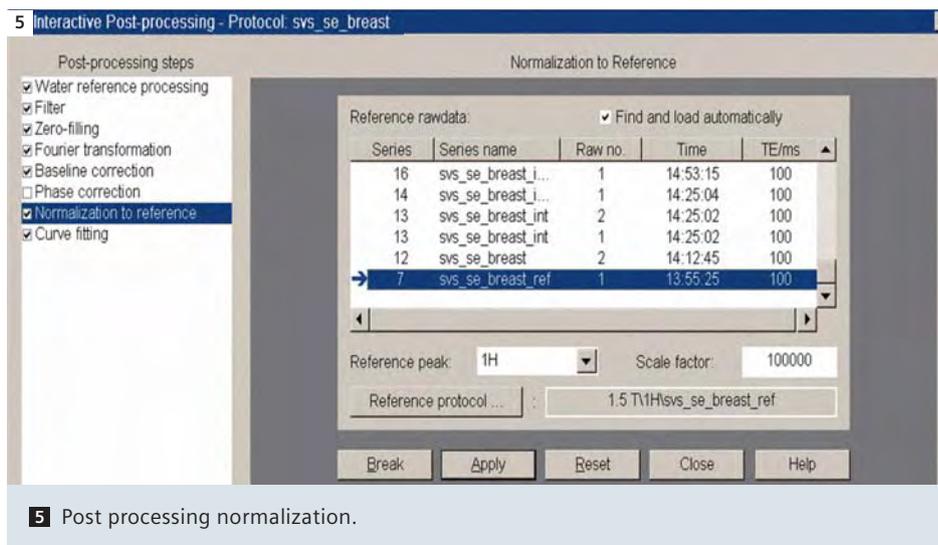
## Post processing normalization

A known reference quantity is required when normalizing the tCholine signal as part of breast spectroscopy (Fig. 5). The breast signal is normalized using an additionally measured reference data set. The reference data is acquired by doing

a fast SVS measurement without water suppression. If you are using the Siemens Breast Matrix coil in the housing there is an external probe filled with sodium chloride combined with a nitrate preservative. The normalization algorithmic step is applied in the frequency domain.

## Conclusion

*syngo* GRACE is a valuable diagnostic tool to classify lesions and to help predict the response to therapy. The application is optimized for the Siemens Breast Matrix coil that is equipped with a reference probe utilized during imaging. GRACE has an easy workflow process with semi-automatic shimming and normalization post processing.



**5** Post processing normalization.