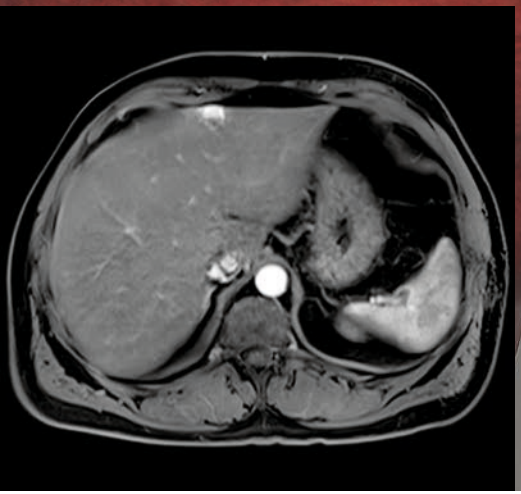
SIEMENS

siemens.com/body-mri

Growth with Body MRI.

New certainty in Liver MRI.

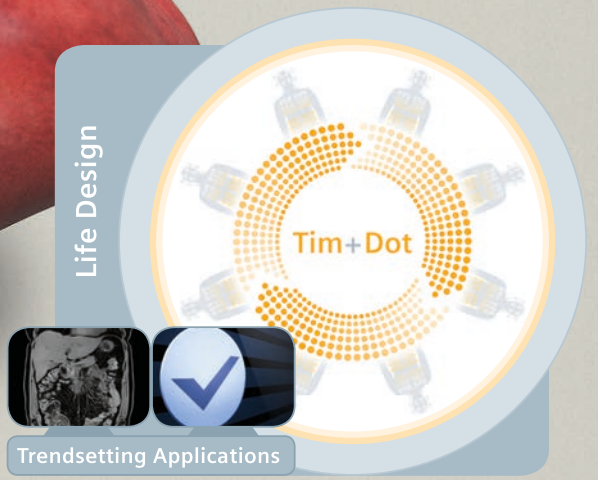
New Certainty in Liver MRI. With MAGNETOM.



Leading in patient care.
You are dedicated to providing the best care for every patient. As the world continues to grow and life expectancy rises, you encounter a more diverse range of challenging diagnostic questions. In your pursuit of delivering the highest quality care, you utilize advanced MRI technology designed with the patient in mind, enabling a broader access to quality healthcare.

You are an MRI leader.
Whether you are just beginning to work with MRI or you are at the forefront of research, with Siemens MAGNETOM MRI systems, you can be sure to lead. In your clinical field, your research, your business environment – to achieve our joint mission of advancing human health.

University Hospital Grosshadern,
Munich, Germany



Leading MRI. Together.
An intensifying demographic shift, the rise of chronic diseases, patients turning into consumers, the pace of innovation, and a broader access to medical imaging across the globe lead to a constantly growing number of examinations, including MRI.

At the same time, this development raises central questions for healthcare providers and industry alike:

- How to manage volume growth with limited resources?
- How to control costs without compromising quality of care?
- How to expand services in either established or growing markets?
- How to continuously strive for clinical excellence in the interest of patients despite economic restraints?

Siemens MR provides answers to these questions by offering a unique combination of MRI technology, software, and clinical applications, supporting you in turning these challenges into opportunities.

With the "DNA" of Siemens MR – Tim, Dot, Trendsetting Applications, and Life Design – we support you to:

- Deliver exceptional image quality and speed in MRI. With Tim.
- Go for consistent results, efficiently. With Dot.
- Expand your MRI services. With Trendsetting Applications.
- Combine higher patient friendliness and sustainability. With Life Design.

Growth with Body MRI.

Many important staging and treatment decisions today are taken on the basis of body MRI. The detection, localization, characterization, and monitoring of cancer lesions, for example, are crucial for the planning of further steps. The decision for the optimal therapy path for patients is in many cases also relying on the results of body MRI.

Body MRI is the largest opportunity to grow MRI procedure volume. Therefore, many centers have set their growth targets to be achieved in the field of body MRI.

Body imaging is already performed on 90% of all MRI scanners[1], – however, only once per day on average. This represents a huge potential for growth.

In terms of accuracy and image quality, MRI has long since surpassed other imaging modalities for soft tissue exams. Additional functional information such as diffusion provide more extensive knowledge about the disease – and all that without any potentially harmful radiation. However, functional MRI has so far been lacking in the fields of speed and robustness to assure reliable contrast timing and sharp images.

No matter if we are talking about breathing or blood and contrast agent running through the body, motion needs to be controlled and handled with care while scanning.

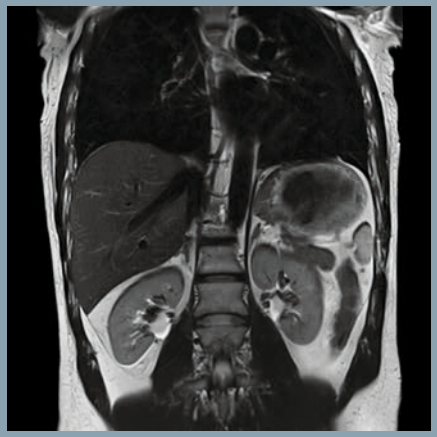
Therefore, we are introducing **FREEZEit** – our embrace motion technology. **FREEZEit** opens a huge potential to expand MRI services in this field.

As the most relevant and most challenging organ when it comes to motion, we will first tackle the liver – enabling fast and robust imaging.

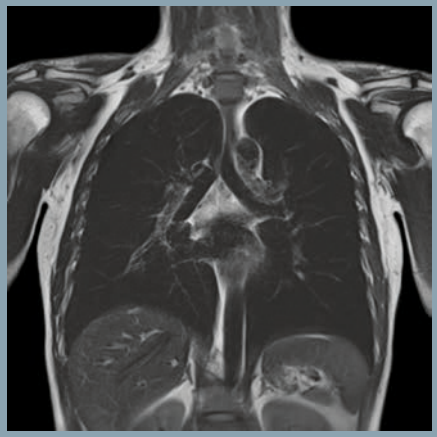
[1] Extrapolation from U.S. data according to imv MR Report, August 2012.

Examples of Body MR images

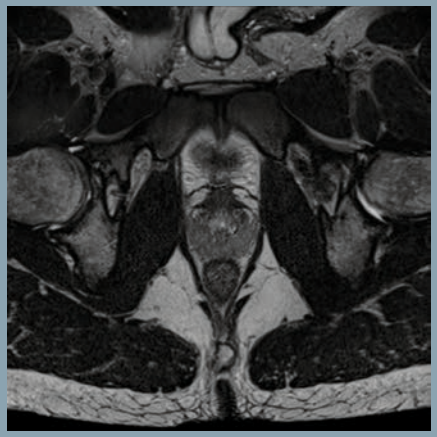
Abdominal imaging



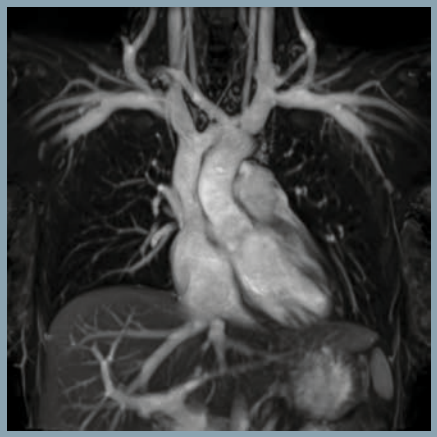
Thoracic imaging



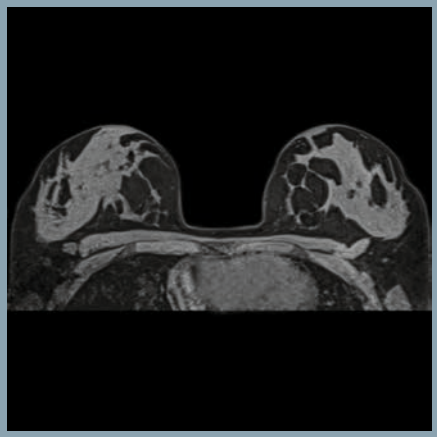
Prostate imaging



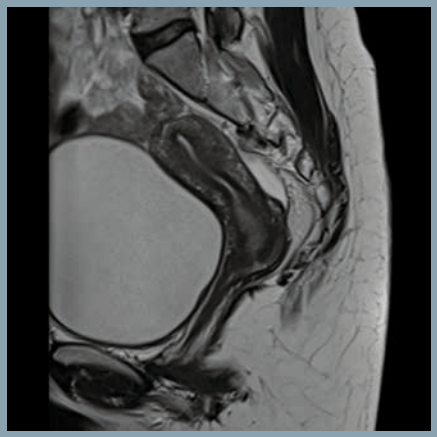
Lung imaging



Breast imaging



Pelvic imaging



New Certainty in Liver MRI.

The liver is the body's largest internal organ and one of its most complex. Over 100 forms of liver disease have been identified, affecting everyone from newborns to the elderly. What's more, we are facing a shift in demographics and changing lifestyles. It therefore gets increasingly important to ask the right questions. Gaining reliable information early on can make all the difference.

There are two main issues that can prevent accurate liver imaging or delay diagnosis:

Motion is one challenge that needs to be addressed when looking for reliable imaging results. The usage of contrast agent requires accurate contrast timing. This is often failing, so that the optimal arterial information of many lesions is missed. In addition, patients who cannot hold their breath can currently not be scanned due to the artifacts occuring because of breathing motion.

Secondly, we look at certain **liver diseases being on the rise** that are potentially requiring biopsy, such as steatosis and hemochromatosis.

Technology

With FREEZEit – embrace motion – we take body imaging to the next level by offering two new sequences tackling motion issues throughout the MR scan.

FREEZEit

FREEZE it

Can I get a precise early arterial phase, every time?

Certainly. With TWIST-VIBE.

TWIST-VIBE combines for the first time high temporal and excellent spatial resolution with full coverage for precision in dynamic liver MRI. It is reliable imaging from the very first shot, making time-consuming and, costly repeat exams a thing of the past.

Is there a way to scan patients who cannot hold their breath?

Certainly. With StarVIBE.

StarVIBE delivers robust, free-breathing, and contrast-enhanced exams for patients unable to hold their breath. The application intelligently resists motion artifacts, resulting in faster and more accurate exam results for a range of new patient populations.

Can I evaluate liver fat and iron in a non-invasive way?

Certainly. With LiverLab.

Abnormal liver iron and fat values are key indicators for a variety of serious illnesses. Evaluating them early could be a decisive step to better monitor early stages of diffuse liver diseases such as steatosis and hemochromatosis. LiverLab enables non-invasive identification of patients with fatty liver and iron overload already at an early disease stage.

FREEZEit

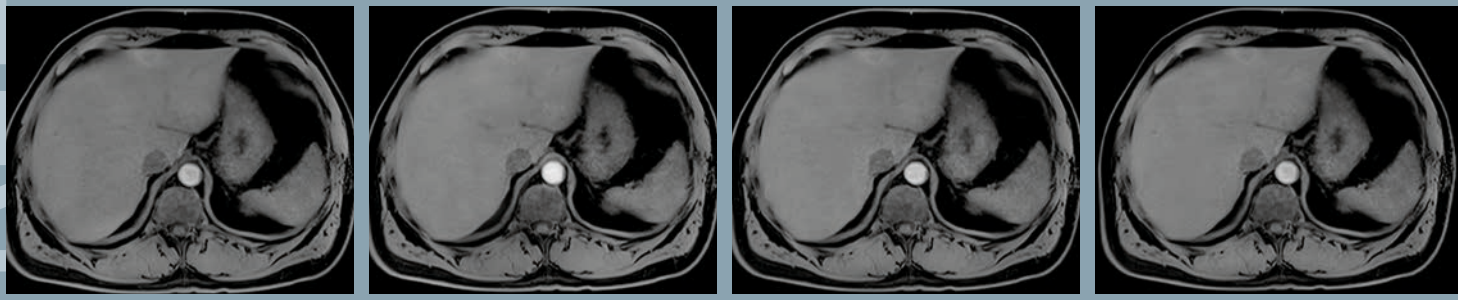
TWIST-VIBE

Always the right contrast in dynamic liver imaging. With TWIST-VIBE.

Dynamic liver imaging remains a contrast-enhanced technique. A range of agents have been developed to increase detection rates and provide more accurate information than unenhanced methods. However, using contrast agent makes it necessary to catch the right point of the arterial phase. If this point in time is missed, crucial arterial information within the liver remains unseen.

The high temporal and spatial resolution of TWIST-VIBE with its full 4D coverage unlocks the possibility of multi-arterial imaging with 100% precise contrast-timing. TWIST provides useful view-sharing techniques, while VIBE extends TWIST's functionality by incorporating CAIPIRINHA and Dixon. The combination of the unique TWIST-VIBE and the advanced parallel imaging technique CAIPIRINHA delivers high spatial resolution and fast T1-weighted imaging for dynamic multi-measurements.

With a full 4D data set acquired in one breath-hold, TWIST-VIBE makes liver imaging fast and robust. What's more? The high-quality images may be ideal for helping to plan the optimal therapy path for the patient, such as surgical interventions without the need for a further exam. It's highly reliable – which leads to more satisfied referrers.



University Hospital Grosshadern, Munich, Germany

CAIPIRINHA-Dixon-TWIST (CDT)-Volume-Interpolated Breath-Hold Examination (VIBE)

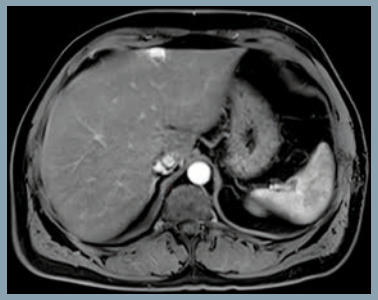
A New Technique for Fast Time-Resolved Dynamic 3-Dimensional Imaging of the Abdomen With High Spatial Resolution

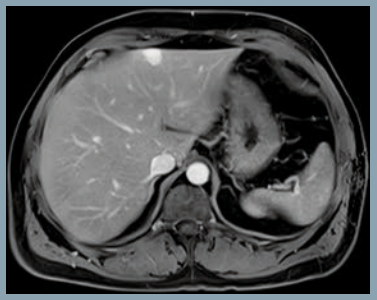
Investigative Radiology, Volume 48, Number 8, August 2013

ORIGINAL ARTICLE

CAIPIRINHA-Dixon-TWIST (CDT)–Volume-Interpolated Breath-Hold Examination (VIBE)

A New Technique for Fast Time-Resolved Dynamic 3-Dimensional Imaging of the Abdomen With High Spatial Resolution





"TWIST-VIBE revolutionizes the diagnostic possibilities for oncologic imaging. It allows for robust, high temporal and spatial resolution scans, improving lesion detection and characterization.

Thus, the detection of otherwise almost invisible liver metastases as well as small HCC foci becomes feasible. This immediately impacts further treatment decisions for our patients."[2]

Ulrike I. Attenberger, MD
University Medical Center Mannheim
Mannheim, Germany

FREEZEit

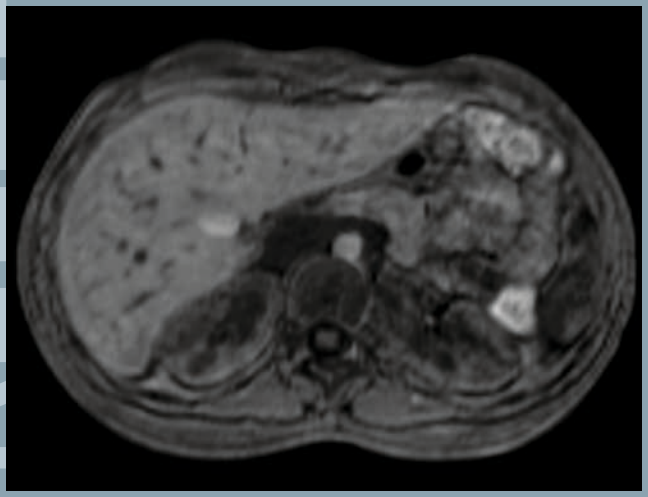
StarVIBE

Free-breathing, contrast-enhanced body imaging. With StarVIBE.

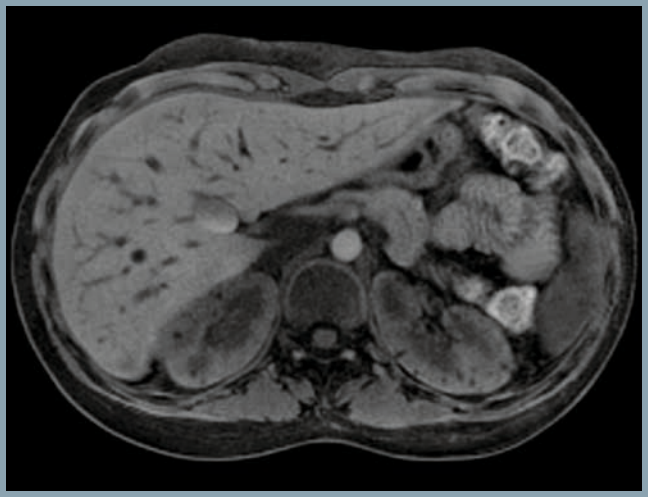
One of the most challenging groups for liver exams is the growing patient population unable to hold their breath. Dynamic imaging usually requires breathhold T1 sequences, but many elderly patients, children, or patients with co-morbidities such as spasms, M. Parkinson, or a stroke history cannot hold their breath for the required time, or at all.

StarVIBE delivers a robust free-breathing exam, making contrast-enhanced liver MR imaging accessible to a much wider spectrum of patients. The new sequence uses radial trajectories that are especially insensitive to motion, providing exceptional image quality in T1 imaging.

Reliable results in a free-breathing exam lead to higher patient cooperation rates and less need for sedation. Ready-to-use motion insensitive protocols also mean that StarVIBE takes less time to prepare and use. This leads to better scheduling – and, ultimately, more patients.



Conventional



StarVIBE

Improving the Robustness of Clinical T1-Weighted MRI Using Radial VIBE

Kai Tobias Block, et al

MAGNETOM Flash Volume 55, Number 3/2013
siemens.com/magnetom-flash

Improving the Robustness of Clinical T1-Weighted MRI Using Radial VIBE

Kai Tobias Block[1]; Hersh Chandarana[1]; Girish Fatterpekar[1]; Mari Hagiwara[1]; Sarah Milla[1]; Thomas Mulholland[1]; Mary Bruno[1]; Christian Geppert[2]; Daniel K. Sodickson[1]

[1]Department of Radiology, NYU Langone Medical Center, New York, NY, USA
[2]Siemens Medical Solutions, New York, NY, USA

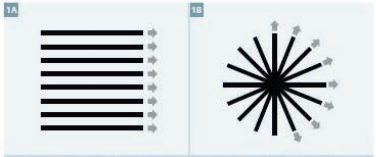
Introduction

Despite the tremendous developments that MR imaging has made over the last decades, one of the major limitations of conventional MRI is its pronounced sensitivity to motion, which requires strict immobility of the patient during the data acquisition. In clinical practice, however, suppression of motion is often not possible. As a consequence, MR images frequently show motion artifacts that appear as shifted object copies, which are well-known as 'ghosting' artifacts and which, depending on the artifact strength, can potentially obscure important diagnostic information. Ghosting artifacts pose a particular problem for abdominopelvic exams that need to be performed during suspended respiration. Because many patients struggle to adequately hold breath during the scan, the number of exams with suboptimal image quality is relatively high. This has impaired the acceptance of MRI as an imaging modality of choice in many abdominopelvic indications. Other widely utilized MRI applications such as head and neck imaging are also often affected by motion-induced ghosting artifacts, e.g., if patients are anxious, or if they cannot suppress swallowing or coughing during the exam.

Radial *k*-space acquisition scheme

The high sensitivity to motion results from the data-sampling strategy used in conventional MR imaging to spatially resolve the object. Conventional sequences acquire the data space (*k*-space) using a sampling scheme along parallel lines (Fig. 1A), which is usually referred to as 'Cartesian' sampling. The acquired parallel lines differ by a fixed difference in the signal phase, which is why the scheme is also called 'phase encoding' principle. However, if the object moves during the exam, phase offsets are created that disturb the phase-encoding scheme. In a simplified view, it can be thought of as jittering of the sampled lines, which causes gaps in the *k*-space coverage and results in aliasing artifacts along the phase-encoding direction from improper data sampling. Hence, the Cartesian geometry is inherently prone to motion-induced phase distortions. Even if navigation or triggering techniques are used to minimize phase inconsistencies within the acquired data, a certain amount of residual ghosting artifacts is almost always present.

The situation can be improved when changing the *k*-space acquisition to a different sampling geometry. One promising alternative is the 'radial' sampling scheme, which acquires the data along rotated spokes (Fig. 1B). Due to the overlap of the spokes in the center, gaps in the *k*-space coverage cannot occur if individual spokes are 'jittered' and, therefore, appearance of ghosting artifacts is not possible with this scheme. Furthermore, the overlap has a motion-averaging effect. Data inconsistencies can instead lead to 'streak' artifacts. However, in most cases the streaks have only a mild effect on the image quality, and they can easily be identified as artifacts due to their characteristic visual appearance (e.g., Fig. 3B). Because the artifacts appear mainly as 'texture' added to the underlying object, the likelihood that lesions get obscured is significantly lower than for the more dominant Cartesian ghosting artifacts.



1 (1A) Conventional 'Cartesian' MRI sampling scheme along parallel lines, and (1B) radial sampling scheme along rotated spokes that overlap in the center of *k*-space.

"Radial VIBE (StarVIBE) sequence is ideal for MR imaging of pediatric patients. It significantly improves overall image quality and is motion robust, allowing for optimal imaging in free-breathing sedated pediatric[3] patients."[2]

Sarah S. Milla, MD
Pediatric Radiologist
Atlanta, GA

LiverLab

Quantitative liver evaluation. With LiverLab.

Steatosis (fatty liver disease) and hemochromatosis (iron overload) are becoming more prevalent in industrialized countries. Whether these diseases are genetic or the result of lifestyle choices, there is a growing demand for fat and/or iron evaluation in the hope that early indicators can help halt or monitor liver disease. The traditional biopsy has long been the method of choice, but it is invasive.

Siemens' LiverLab is groundbreaking as its clinical inline workflow enables a completely non-invasive evaluation of liver fat and/or iron with only four clicks. The clinical package comprises a fat and iron screening part (First look Dixon), plus two methods for further evaluation, HISTO (voxel based) and Multi-echo Dixon VIBE (image based). Results are provided in a clinical report. The workflow can easily be included in the regular clinical liver protocol.

LiverLab might eliminate sampling errors and delivers fast, reproducible results. It has the potential to reduce the need for biopsy, reducing your patients' risk of infection, as well as saving both time and money.

Abdominal Imaging **Clinical**

Liver Imaging Today

Tobias Heye, M.D.[1]; Mustafa R. Bashir, M.D.[2]

[1]Department of Radiology, University Hospital Basel, Switzerland
[2]Department of Radiology, Duke University Medical Center, NC, USA

Introduction

Liver disease is a global burden with a growing incidence and prevalence. The World Health Organization recently estimated that there are 800,000 cirrhosis-related deaths per year world-wide [1]. Chronic liver disease has a great impact on public health care costs with therapeutic options ranging from antiviral treatment for viral hepatitis to orthotopic liver transplant for end stage cirrhosis. A variety of pathogens, which can be toxic, viral, metabolic or autoimmune in nature, can induce fibrosis which may progress to cirrhosis if the disease is not detected and treated. An estimated 150 million people world-wide are chronically infected with hepatitis C virus, approximately 350,000 people die due to hepatitis C related liver disease [2]. Liver fibrosis may be reversible at an early stage, which indicates the importance of screening and detection of liver disease. Many forms of liver fibrosis and cirrhosis especially secondary to viral hepatitis increase the risk for the development of liver cancer, namely hepatocellular carcinoma.
Non-alcoholic steatohepatatis is emerging as a major pathway into chronic liver disease and is closely related to other metabolic disease entities such as diabetes and morbid obesity. The incidence and prevalence of these diseases has risen steadily over recent years.
In a clinical context, liver disease is often reflected by a combination of several contributing factors, fibrosis, hepatic steatosis and iron overload, each with different forms of manifestations.
Although these diseases are considered 'diffuse', actual hepatic parenchymal involvement by any of these can be irregular and patchy, leaving other parenchymal areas unaffected.
Clinical management of patients with diffuse liver disease requires tools to accurately detect and classify the various forms of liver disease. Even with decades of experience in imaging, liver biopsy and the histological workup of the specimens have traditionally been the reference standard in the characterization of liver disease [3]. However, biopsy is prone to sampling errors if less affected parenchyma is sampled and may not reflect the true disease severity and distribution in a particular organ due to the variance in the heterogeneous pattern of histological changes on a macroscopic scale [4, 5]. Biopsy, associated with the risks of an invasive procedure, is employed for disease detection and staging, but periodically repeated biopsy is not a practical

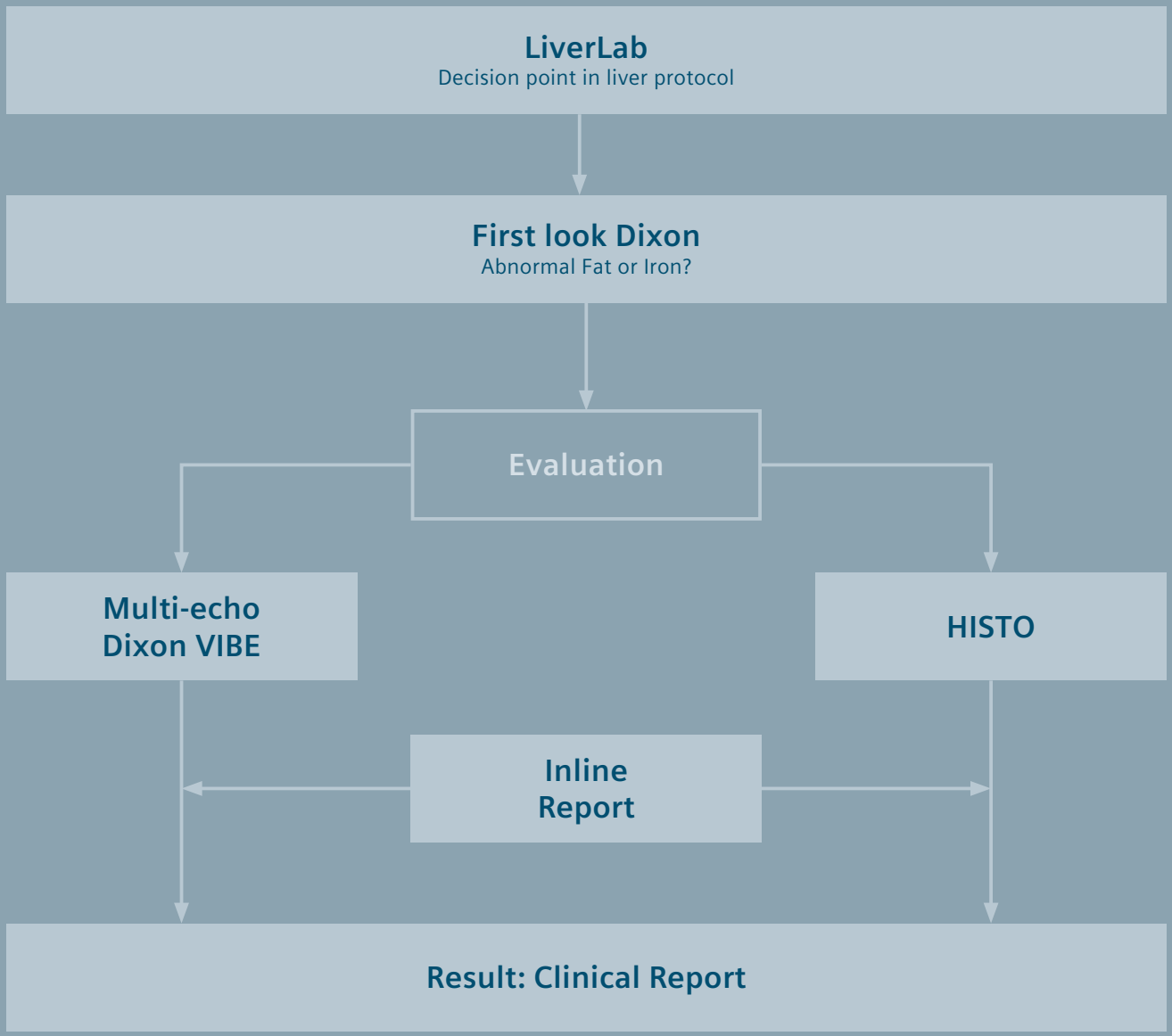
1 Results of the Screening Dixon technique which produces color coded maps to visualize the distribution of detected abnormal metabolites in two different clinical examples. **(1A)** A patient with diffuse hepatic steatosis as indicated by the yellow hue. **(1B)** A patient with diffuse iron overload as marked by blue overlay to the affected liver.

MAGNETOM Flash · 2/2013 · www.siemens.com/magnetom-world · 111

Liver Imaging Today

Tobias Heye, MD; Mustafa R. Bashir, MD
MAGNETOM Flash Volume 52, Number 2/2013
siemens.com/magnetom-flash

With LiverLab, we offer one complete workflow for your clinical routine:

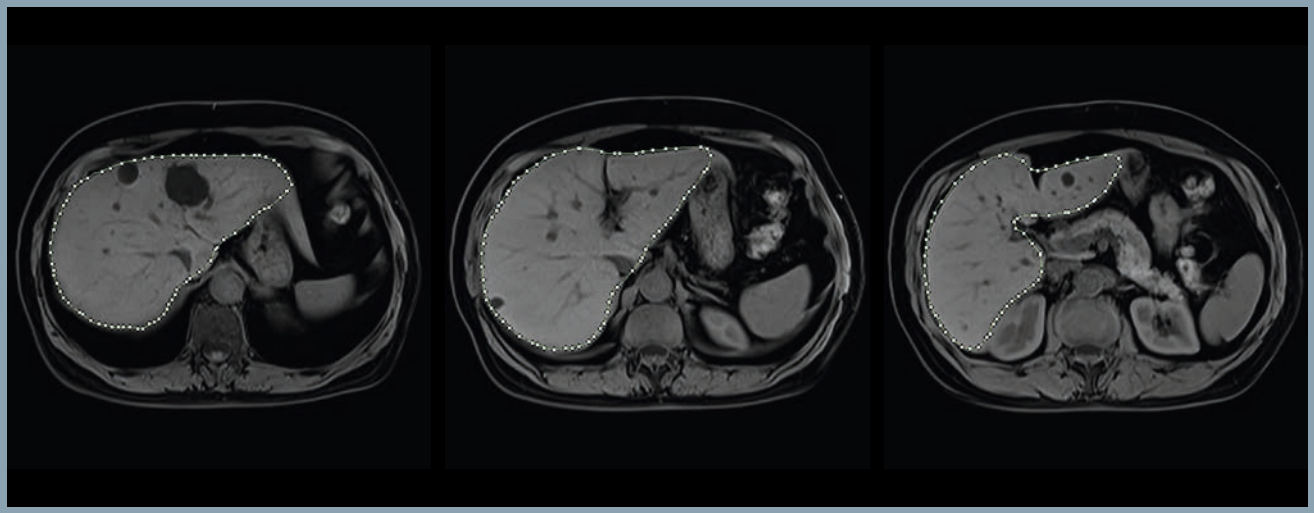


First look Dixon

As a pre-step to the actual evaluation, First look Dixon allows the user to understand whether the liver shows an abnormal fat or iron value. This information is an early indicator of liver fatty infiltration and/or liver iron overload. In addition, this solution includes a gradient echo opposed-/in-phase protocol, more recently in the form of a VIBE protocol, which allows Dixon water/fat separation. The technique is therefore called “First look Dixon”.

First look Dixon facilitates an extensive inline calculation in the background. In addition to the Dixon water/fat separation, it delivers an inline dual ratio and scatter plot as well as an inline liver segmentation.

After the First look Dixon technique has been performed, the user can decide to either go for the Multi-echo Dixon VIBE and/or the HISTO technique.



Liver segmentation

Multi-echo Dixon VIBE

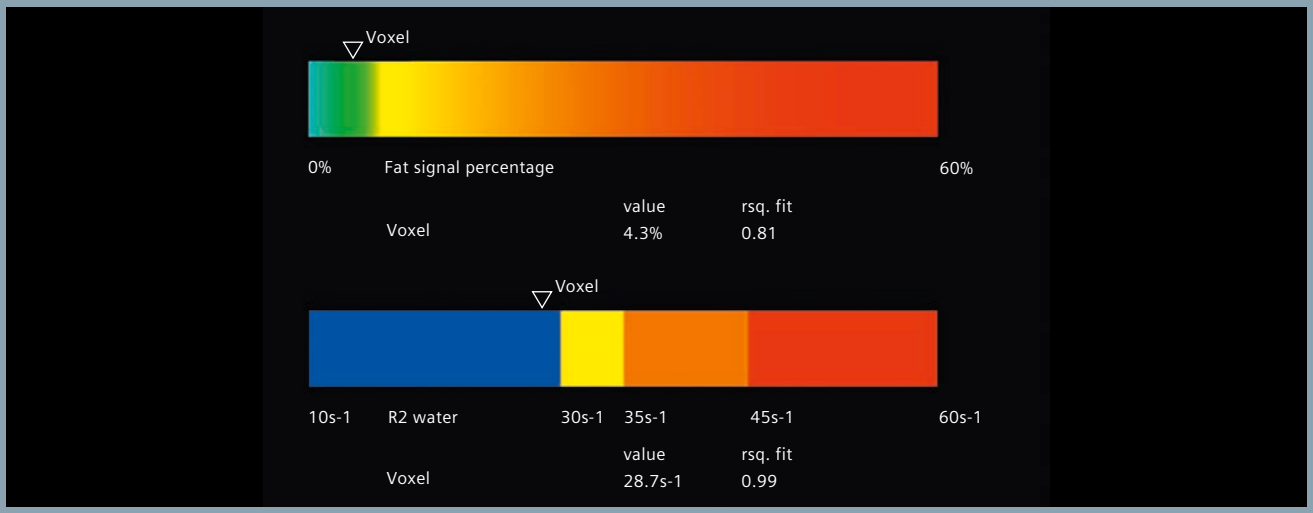
One possibility to evaluate fat and/or iron overload is the Multi-echo Dixon VIBE sequence that may rate the entire liver. Liver imaging evaluation techniques are typically based on multi-echo gradient echo sequences.

It has been recognized that there are mutual confounding effects of fat and iron on the evaluation of either quantity, which need to be corrected. As part of the inline calculation, Multi-echo Dixon VIBE offers inline signal modeling, inline parametric maps as quality checks, and an inline report showing color-coded values.

HISTO

A second possibility to evaluate fat and/or iron overload including reliable standard adjustments is an accurate evaluation spectroscopy technique called “HISTO.” It represents a fast, easy-to-use, single breath-hold method based on multi-echo, T2 corrected single voxel spectroscopy.

As an inline calculation in the background, HISTO offers inline evaluation and an inline report.

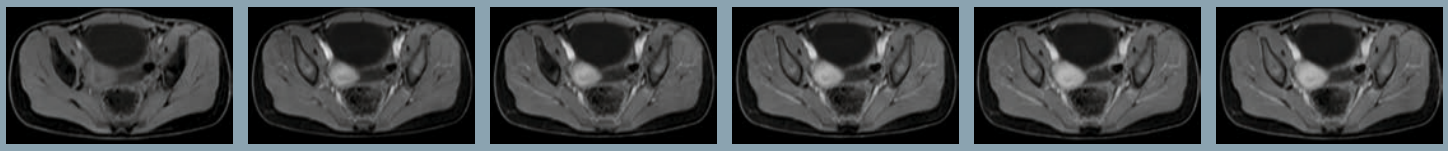


Clinical Report (done with HISTO technique)

FREEZEit – featuring TWIST-VIBE and StarVIBE – solves today's toughest challenge in liver imaging: motion. It allows whole new insights – but not just for the liver. It can also be applied to other body regions, such as the pelvis, lung, kidney, bowel, and abdomen.[4]

TWIST-VIBE used in the female pelvis[4]

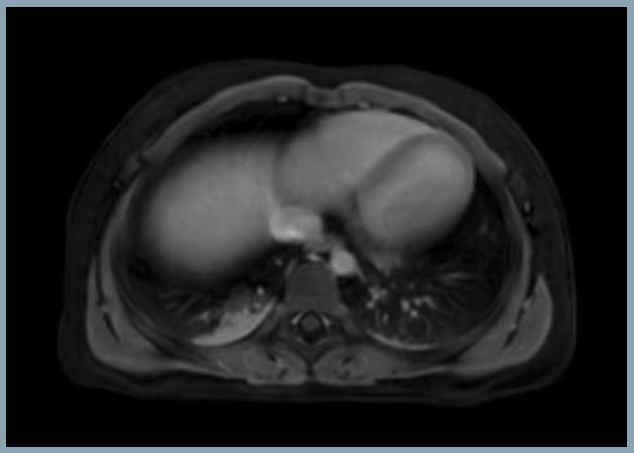
14-year-old female patient with a large paraovarian cyst and massive edema of the right ovary



Institut für Radiodiagnostik, Homburg, Germany

StarVIBE used in the lung[4]

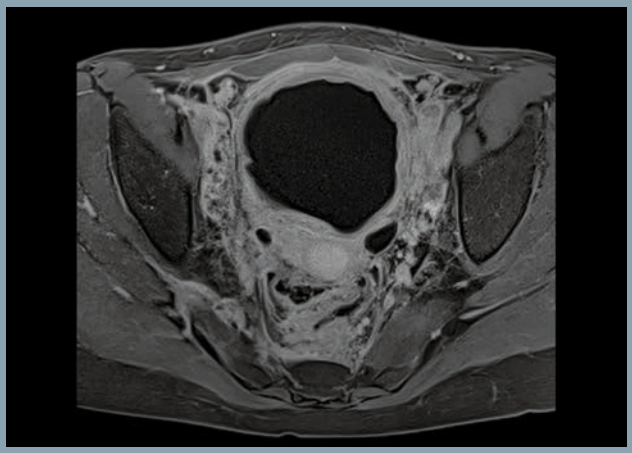
Lipoblastoma of the thoracic wall and right lung apex, 6-year-old female patient



Institut für Radiodiagnostik, Homburg, Germany

StarVIBE used in the abdomen[4]

Lipoblastoma, 6-year-old female patient



Children's MRI Centre, RCH, Victoria, Australia

In addition to our new technology, we have already well-established solutions that enable you to grow with Body MRI:

CAIPIRINHA

CAIPIRINHA is our unique iPAT2 data acquisition technique that reduces breath-hold times and still delivers high resolution 3D data. It can be used with the 3D T1 VIBE or 3D Dixon technique – which provides four contrasts (in phase, opposed phase, fat, and water) in a single short breath-hold, e.g. liver imaging in 10 seconds.

Diffusion Weighted Imaging (DWI)

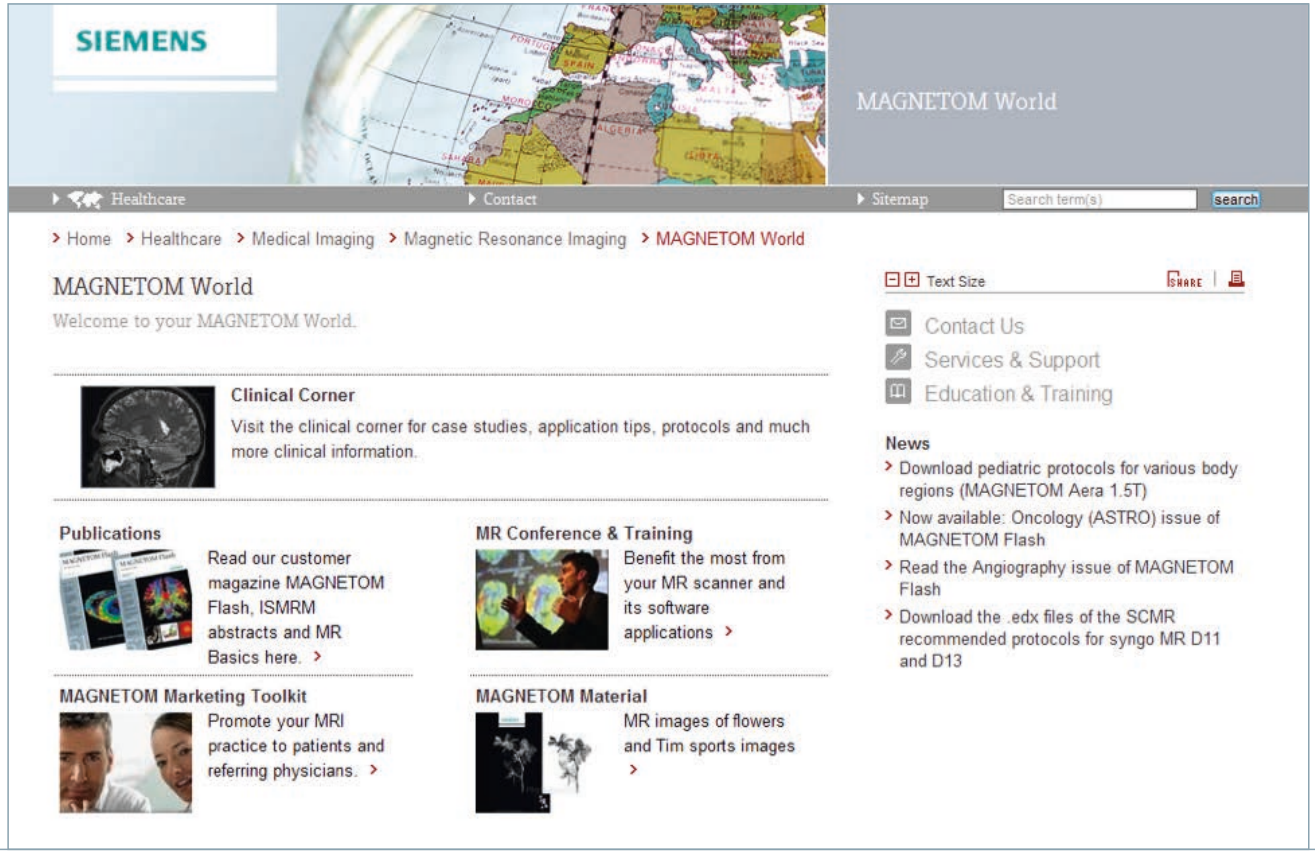
REVEAL is an echo planar imaging (EPI) based diffusion weighted imaging technique for the body. This sequence can be combined with the 2D PACE navigator technique to decrease motion artifacts. It can be useful in differential diagnosis of benign versus malignant lesions in all anatomical regions such as liver, pancreas, lymph nodes, and the pelvis. It furthermore can serve as an excellent staging tool when it comes to whole-body tumor assessment.

Abdomen Dot Engine

Abdomen Dot Engine takes the complexity out of MRI by guiding you step-by-step through the most complex procedures. Its predefined exam strategies deliver a degree of automation that takes efficiency to a whole new level – even for comprehensive exams such as the liver. Furthermore, FREEZEit is part of the Dot library and can easily be used in your individual workflow. LiverLab comes as a decision step in the Abdomen Dot Engine.

Don’t miss the wealth of clinical information.

Visit us at
siemens.com/
magnetom-world



New Certainty in Liver MRI.

With MAGNETOM.

Overcoming challenging motion in liver imaging.
With FREEZEit – our embrace motion technology featuring TWIST-VIBE & StarVIBE.

Monitoring liver diseases on the rise.
With LiverLab.

Growth with Body MRI.

On account of certain regional limitations of sales rights and service availability, we cannot guarantee that all products included in this brochure are available through the Siemens sales organization worldwide. Availability and packaging may vary by country and are subject to change without prior notice. Some/All of the features and products described herein may not be available in the United States.

All devices listed herein may not be licensed according to Canadian Medical Devices Regulations. The information in this document contains general technical descriptions of specifications and options as well as standard and optional features which do not always have to be present in individual cases.

Siemens reserves the right to modify the design, packaging, specifications, and options described herein without prior notice. Please contact your local Siemens sales representative for the most current information.

Note: Any technical data contained in this document may vary within defined tolerances. Original images always lose a certain amount of detail when reproduced.

Please find fitting accessories:
siemens.com/medical-accessories

[1] Extrapolation from U.S. data according to imv MR Report, August 2012.

[2] The statements by Siemens' customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" setting and many variables exist, there can be no guarantee that other customers will achieve the same results.

[3] MR scanning has not been established as safe for imaging fetuses and infants less than two years of age. The responsible physician must evaluate the benefits of the MR examination compared to those of other imaging procedures.

[4] The use of FREEZEit in other body regions outside of the liver is currently 510(k) pending.

Siemens Healthcare Headquarters
Siemens Healthcare GmbH
Henkestr. 127
91052 Erlangen
Germany
Phone: +49 9131 84-0
siemens.com/healthcare

Order No. A91MR-1100-74C-7600G | Printed in Germany | CG MR 1799 01151.5 | © Siemens Healthcare GmbH, 2016

siemens.com/healthcare