White paper

CT-guided intervention with the SOMATOM go. platform Case Series

Clinical value of CT-guided interventions
User experiences with the new Guide&GO interventional suite

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Take-home message

Interventions guided by computed tomography (CT) are key to providing the full range of clinical services, including the ones in private practices that serve medium-sized hospitals. Innovations in workflows and CT technologies, such as spectral shaping with Tin Filter and tablet-based workflows, are also affecting how modern CT scanners are used in interventional scenarios. This enables clinicians and radiologists to improve their clinical offerings.

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Introduction

About the hospital:

Dreifaltigkeits-Hospital Lippstadt is located in western Germany in the state of North Rhine-Westphalia. It serves as a local acute-care hospital for the town of Lippstadt (approximately 66,000 inhabitants) and the surrounding rural area. With 15 specialist departments and 350 beds, it offers everything required for typical 24/7 standard care, including a dedicated center for trauma surgery. It also provides a comprehensive and progressive range of medical services for clinical fields such as radiation therapy, dialysis, and geriatric medicine. The hospital additionally serves as a teaching hospital for the University of Muenster.

Set-up of small and mid-sized hospitals:

Small and mid-sized hospitals in Germany commonly organize their radiology departments as a cooperative unit; at Dreifaltigkeits-Hospital Lippstadt, the department is managed by a private practice called Radiologie am Dreifaltigkeits-Hospital. In addition to providing hospital and outpatient services, the department serves smaller hospitals in the greater Lippstadt area and must cover all clinical emergencies to support the hospital's 24/7 service.

Challenges and questions when replacing a CT scanner:

Until 2018, the radiologists' main workhorse was a six-slice CT system (SOMATOM Emotion 6-slice). Yet the small radiology unit had a high workload and needed to extend its clinical offerings, especially with regard to lower-dose imaging (in terms of both radiation and contrast media). The chief radiologist, Henning Bovenschulte, MD, therefore decided to replace the SOMATOM Emotion with a new SOMATOM go.Up. This system features a unique tablet-based mobile workflow for intuitive scanner operation and supports users with innovative software for planning and conducting examinations. For users, switching from a SOMATOM Emotion to a SOMATOM go.Up meant that they had to get to grips with a completely new software philosophy.

Dr. Bovenschulte has to perform a wide range of CT-guided interventions. Although the technological advances of the SOMATOM go.Up have clearly introduced new diagnostic capabilities when compared to the previous scanner, CT-guided interventions obviously place specific demands on the CT system. This therefore raised the question of whether the new scanner would (especially as a result of the tablet-based workflow) interfere with the user's experience, or if it would provide advantages for interventions. Introducing a new scanner into intervention would also pose challenges for protocol management and total applied radiation dosage, which is often a combination of scanner technology and efficiency of radiation usage, interaction with the scanner's user interface, and the user's clinical knowledge.

Contents

Concept of Guide&GO tablet-based workflow for intervention guidance

The same tablet which is used for patient positioning, scan control, and image review is also used for the Guide&GO intervention workflow. The tablet can be covered with a sterile sheet and placed on a flexible and individually positioned "gooseneck." The tablet's interactions with the scanner's interface allow the user or interventionalist to work with the scanner more intuitively than it is possible with most conventional user interfaces.

SOMATOM go.Up supports sequenced scans for guidance. After scanning, the images are displayed in a logic order. Selecting the plane, manipulating images and planning next scan is easily done thanks to the touch-based user interface (image). Radiation exposure must be triggered, however, by using a remote control or an X-ray footswitch that must also comply with radiation-protection regulations. Pre- and post-interventional scans can be handled easily with the tablet-based workflow.

Guide&GO – tablet-based workflow for CT-guided interventions

Clinical cases

The following cases demonstrate a selection of typical indications and common clinical scenarios for CT-guided interventions using the SOMATOM go.Up system.

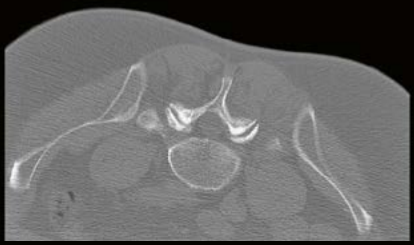
1. Pain management

An increasing number of patients are referred to the radiology department for supportive pain-management interventions. All interventions are conducted in close collaboration with the relevant pain specialists. One of the most common interventions is periradicular infiltration, which reduces nerve swelling and provides pain relief to support further treatment. Periradicular infiltration therapy (PRT) is an effective minimally invasive procedure. It is mainly used for degenerative conditions of the spine, which are also often associated with vertebral disc herniations and visa-versa.

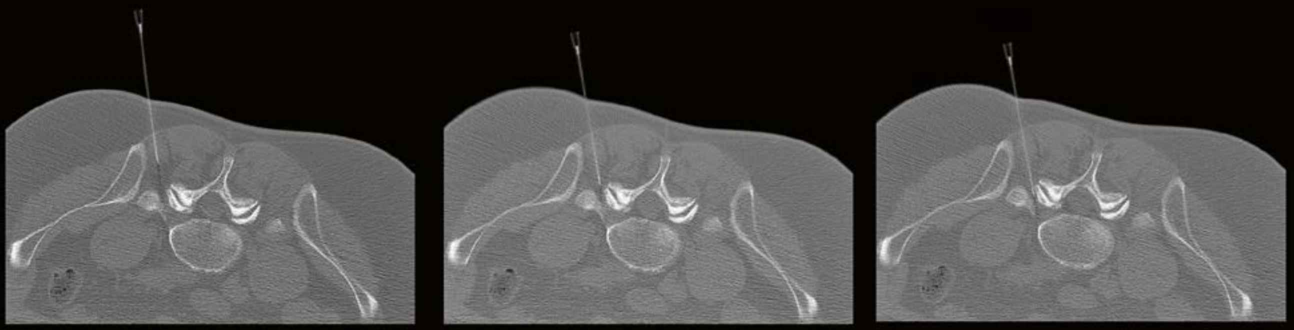
Case

In this case, the patient was suffering from severe pain and movement limitations caused by degenerative damage and pain radiating from the region of the L5/S1 nerve root. Conventional therapy had been unsuccessful, so PRT was performed to reduce the pain and swelling of the right sacroiliac nerve root. To perform the infiltration, the patient was placed in a prone position and asked to breathe shallowly.

For precise needle-path planning, a low-dose i-Sequence scan was performed. The needle path was planned using the tools provided by the tablet-based Guide&GO solution. Prior to skin disinfection and local anesthesia, a needle was placed close to the nerve root requiring treatment. Attaining the target position was aided by administering a small amount of contrast medium and performing an i-Sequence scan. The total intervention time was approximately five minutes, and the applied radiation was 40mGy cm DLP. The patient left radiology without complications and showed clear improvement in his clinical symptoms on follow-up.



1.0 Planning CT scan acquired in i-Sequence mode with 130 kVp, a $CDTI_{vol}$ of 23.8 mGy, and a scan length of 15 mm, to enable correct positioning of the patient and coverage of the target area.



a) b) c)

1.1 (a–c) 5 mm axial scan acquired with the same parameters as in 1.0, demonstrating needle progression and location of the needle tip prior to medication.

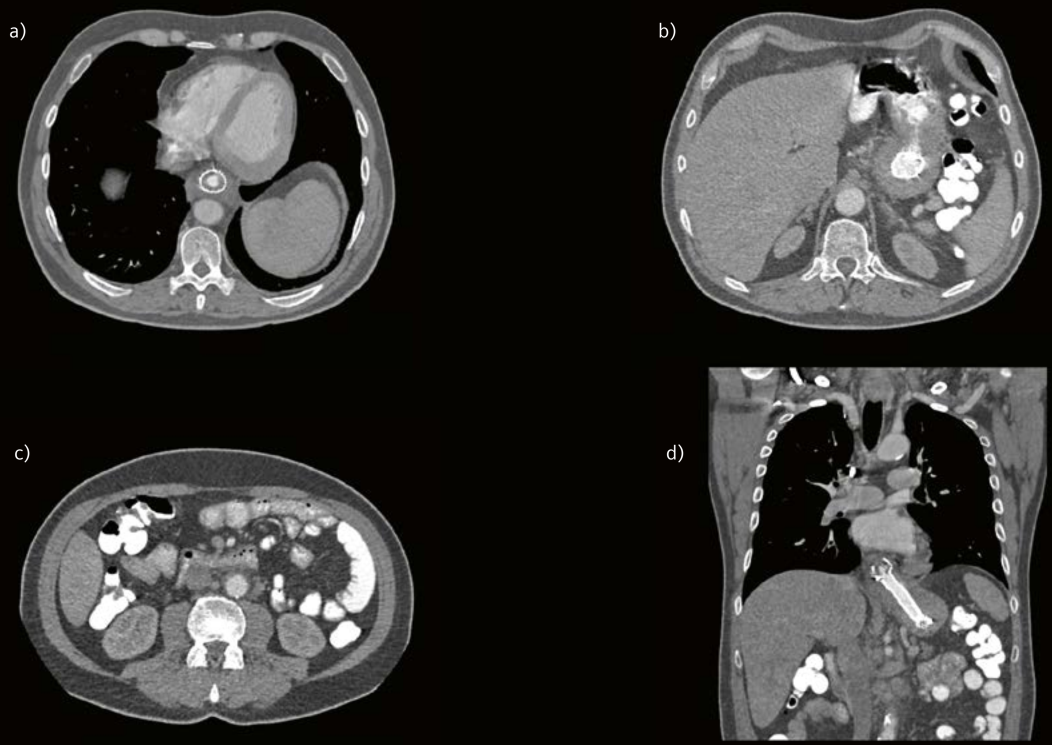
1.2 Final image to document correct placement of steroids (same i-Sequence parameters as in 1.0); contrast medium was added to the medication to visualize the applied corticosteroid.

2. Biopsies

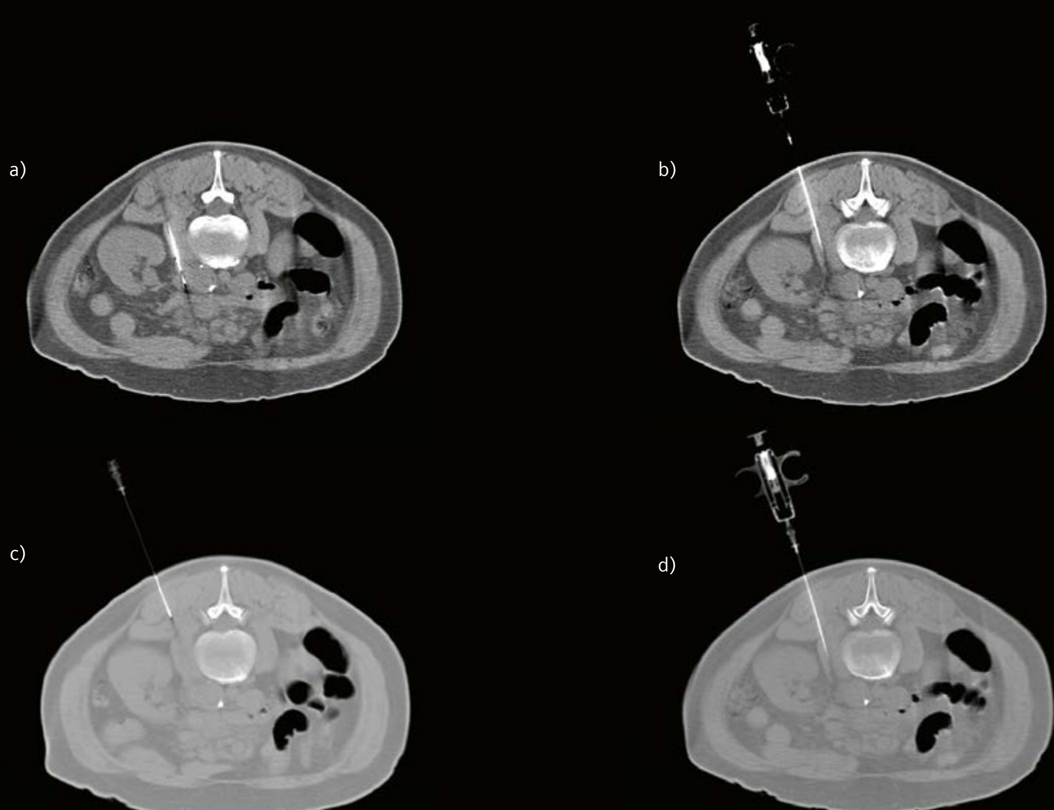
As a main application of CT-guided interventions, CT-guided biopsies are performed whenever the location of the suspicious findings cannot be accessed by ultrasound or other means. Examples include lung lesions via bronchoscopy, and pancreatic lesions via ERCP.

Case

A patient with extensive stenosis of the gastroesophageal passage underwent stenting and a further whole-body evaluation. As well as showing the known pathology clearly, the scan (see image 2.1) also displayed multiple lymph node glomerates at the peritoneal lymph node stages. Unfortunately, the location and size of the nodes meant that safe access for a representative biopsy was not possible by ultrasound. Therefore, CT-guided sampling was decided on in close collaboration with the referring ward. With a rotation time of 0.8 seconds, the SOMATOM go.Up allows clinicians to perform multiple scans in a short time and thereby visualize even challenging cases like this, in which the biopsy needle had to be placed directly alongside the aorta. The biopsy was successfully performed, and pathology verified the diagnosis of extensive stage 4 gastric cancer.



2.1 Diagnostic single-phase CT scan acquired with 130 kVp, a $CTDI_{vol}$ of 8.37 mGY, and a scan length of 490 mm. Axial (a–c) and coronal MPR (d) at a slice thickness of 2 mm demonstrating thickening of the stomach wall and the stent of the gastroesophageal passage multiple suspicious lymph nodes are also visible.



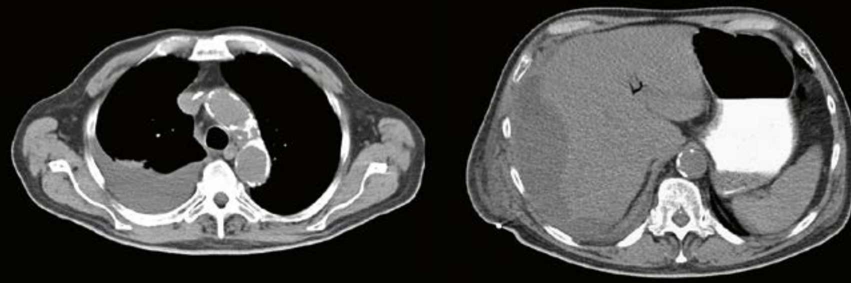
2.2 Axial (a–d) 5 mm slices acquired in sequential mode with 130 kVp, a $CTDI_{vol}$ of 46.5 mGy, and a scan length of 9 x 15 mm, demonstrating the needle progression and location of the tip before acquiring biopsy tissue. The upper and lower row are in different windowing for improved visualization of soft tissue and bony structures.

3. Management of complications, and supportive interventions

Complex surgical procedures, severe traumata, and final-stage patients are just a few common scenarios in which CT-guided interventions are required either to manage a complication or at least support therapy. One of the most frequently performed procedures is drainage placement using the Seldinger technique. This is a crucial intervention for appropriate patient management, and must be performed in very close collaboration with the treating department.

Case

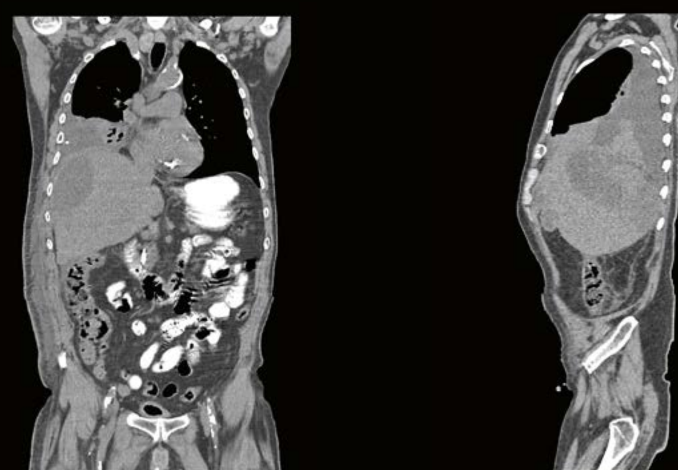
In this case, a patient was hospitalized with severe symptoms of infection. The diagnostic workup revealed a large pleural fluid collection and subcapsular fluid in the liver (see image 3.1). This resulted in a diagnosis of pleuropneumonia with subdiaphragmatic secondary abscess and subcapsular liver abscess. Working closely with the surgical department, the decision was made to support systemic antibiotic therapy via minimally invasive drains. Initially, ultrasound guidance was used to relieve the subdiaphragmatic abscess and was performed by the relevant ward. The location and extent of the subcapsular abscess led to a decision in favor of CT image-guided intervention. In this particular case, the best access to the intervention path was achieved by left-side positioning of the patient. CT Guide&GO supports interventionalists with flexible positioning including z-axis compensation when lowering the table to grant optimal access to the patient. This also enables a better workflow and consequently less in-room time overall. As demonstrated in the images in 3.2, a flexible drainage tube was successfully placed via a hollow needle. After tube placement, the CT scan showed that the drainage fully covered the abscess and relieved the purulent fluid. After the intervention, the patient recovered quickly and was soon discharged.



a) b)

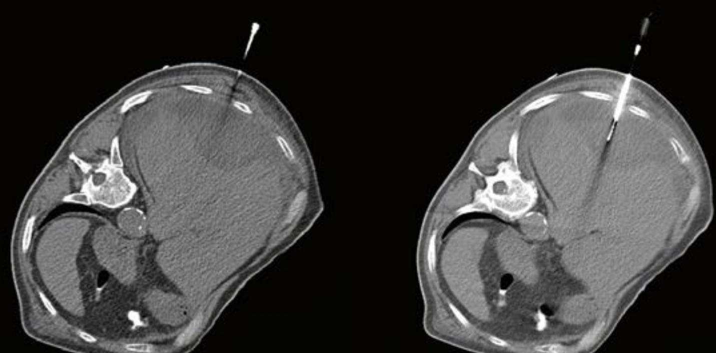
3.1 Pre-diagnostic spiral scan with oral CM application acquired with 130 kVp, a $CTDI_{vol}$ of 6.95 mGy, and a scan length of 664 mm.

Axial (a–b) 5 mm MPRs of native CT revealing extensive subpleural/subcapsular fluid collections.



a) b)

3.2 Coronal (a) and sagittal (b) 5 mm MPR of planning CT; due to the extent of the initial findings, a whole-body CT was performed.



a) b)

3.3 Axial (a–b) 5 mm slices acquired in i-Sequence mode with 130 kVp, a $CTDI_{vol}$ of 25.82 mGy, and a scan length of 5 x 15 mm.
(a) Location of the hollow needle before placing the guidewire
(b) Advancement of the guidewire inserted via the hollow needle

3.4 A 5 mm axial spiral acquisition acquired with 130 kVp, a $CTDI_{vol}$ of 6.98 mGy, and a scan length of 262 mm to control placement of the flexible drainage tube deployed in the Seldinger technique.

4. Palliative therapies

CT-guided lumbar sympathicolysis

Sympathicolysis for extensive peripheral vessel disease is an important supportive (though not curative) therapy for managing affected patients. In particular, this procedure has proven its clinical value in cases where the primary treatment either cannot be performed or does not produce the desired outcome.

Case

In this case of an elderly man with extended stenosis of the right popliteal artery (see image 4.1) and multiple risks resulting in poor general health, sympathicolysis can clearly improve quality of life.

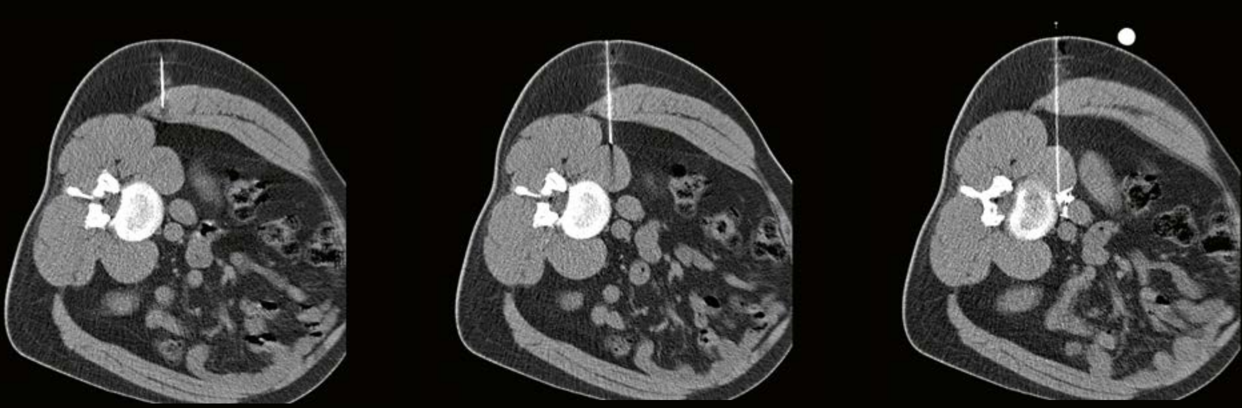
As mentioned in scenario 3, the SOMATOM go. platform enables flexible patient positioning, which is especially important for patients with poor general health conditions. The flexible table adjustment and potential use of the full bore size are necessary for a convenient and successful intervention. In addition, the flexible table concept supports an easy workflow for positioning the patient according to his/her needs and those of the procedure.

After conducting the planning CT (see image 4.2), the flexible movement concept in Guide&GO enabled easy access to the patient, especially when placing the needle and performing the sympathicolysis (see image 4.3; to visualize the applied alcohol, contrast medium was added to the medication). Shortly after the intervention, the patient's vascularization quickly improved, and follow-up visits to the referring department confirmed the success of the treatment and improved quality of life.

4.1 Peripheral MR angiography, performed with a 1.5-Tesla MAGNETOM Aera, indicating the extended occlusion of the right popliteal artery.

a) b) c)

4.2 (a–c) Axial, oblique coronal, and oblique sagittal 5 mm MPR for intervention planning, acquired with a spiral scan at 130 kVp, a $CTDI_{vol}$ of 10.2 mGy, and a scan length of 178 mm.



a) b) c)

4.3 Axial 5 mm slices acquired in i-Sequence mode with 130 kVp, a $CTDI_{vol}$ of 41.3 mGy, and a scan length of 7 x 15 mm, to monitor the incremental needle advancement and drug administration.

SOMATOM go. platform featuring Guide&GO

Guide&GO the first tablet-based solution on the market for CT-guided interventions. Built on the new mobile workflow, it is both familiar and easy to use. You can control the entire intervention with the tablet and the remote control, which are also used for routine CT operations. There is no need for dedicated ceiling-mounted displays or joysticks. Together with a cover, the tablet can be used even in sterile environments. The tablet-based easy to use interventional solution shown here represents a unique and cost-effective way to transform your daily delivery of care.

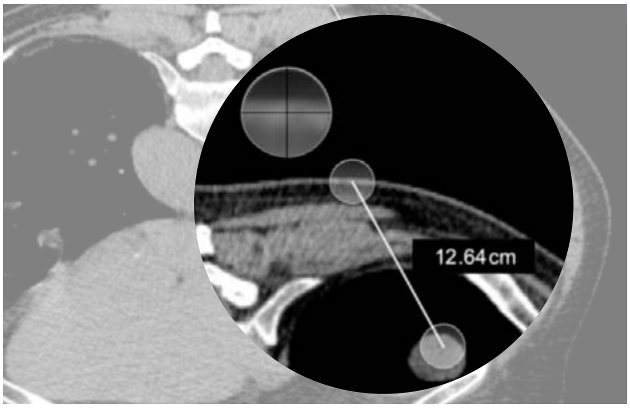
Simple and familiar tablet operation

Experience the simplicity of the only tablet-based CT-guided intervention solution:

Benefit from easy and fast image-based definition of the target position, together with the flexible patient table move concept. Leverage the straightforward workflow “ran” by the remote control for patient table movements and X-ray. For an optimized and fast workflow during needle placement while approaching the target, Guide&GO provides an Autorepeat scan functionality enabling the fast repetition of several i-Sequence scans.

Benefit from an intuitive CT workflow solution that is both familiar and accurate:

Needle guidance is supported by the highly intuitive image manipulation functions we know from our smartphones, like zoom or pan. A dedicated toolkit for performing accurate measurements and planning a secure needle path is easily accessible via the tablet and supported by a convenient “smartphone-like” zoom-glass functionality.



Safe and accurate at low dose

Protect your patients and staff by introducing high-end, low-dose technologies and improved ergonomics:

In terms of safety, Tin Filter technology reduces dose to protect the patient and the interventionist while the tablet interface displays a dose thermometer so you can monitor levels in real time. The flexible tablet holder can be adjusted to your individual needs for a safe and comfortable working environment.

Safeguard your clinical outcome with accuracy and precision:

For precision in your work, intuitive touchscreen functions at your fingertips help you to quickly find the right position for the needle and measure relevant distances with the support of a magnifying glass functionality. Fast toggling between predefined image windowing or between the i-Sequence and the spiral planning scan makes it easy to cross-check the anatomy. Laser crosshairs offer additional accuracy and confidence.

Artifact reduction at the tip of the needle with iMAR:

Artifacts due to metal implants or to the tool used in the interventional procedure (e.g., RF ablation) often hamper image quality. In these cases, accurate targeting can be impossible. iMAR*, which is smoothly integrated into the tablet workflow, reduces these artifacts – and improves confidence even in areas adjacent to metal implants.

**Requires iMAR or High Performance Package*

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