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MRI articles

# Expanding **whole body MRI** use in oncology patients

**FieldStrength** MRI magazine **User experiences** - December 2016 www.philips.com/fieldstrength

## Improved coronal DWIBS whole body protocol shortens exam time and increases referrals at Kawasaki Saiwai Hospital

Recognizing the clinical utility of whole body MR imaging, radiologists at Kawasaki Saiwai Hospital (Kasawaki, Japan) began offering whole body diffusion weighted imaging (DWI) in 2009 for oncology patients. In 2012, the hospital installed a Philips scanner, the Ingenia 1.5T. The dStream digital architecture and highly linear gradients of Ingenia allowed them to switch to coronal – rather than axial – whole body DWI, and were key to developing a fast, high quality protocol that has led to increased referrals and decreased dependence on nuclear medicine imaging.

***"The value of DWIBS in oncology cases is due to the high contrast it creates between lesions and surrounding tissue"***

**Hiroshi Nobusawa, MD, PhD**
Radiologist at Kawasaki Saiwai Hospital, Japan

**Takanori Naka**
MR technologist at Kawasaki Saiwai Hospital, Japan

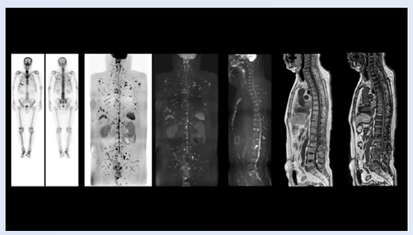
## High contrast between lesions and background is beneficial in oncology patients

Radiologist Hiroshi Nobusawa, MD, PhD, explains that the coronal DWIBS protocol for whole body DWI is excellent for visualizing lesions in oncology patients. “About 90% of the DWIBS exams are done in this type of patients. The remainder of DWIBS exams are performed to gain information in cases of fevers of unknown origin,” he says.

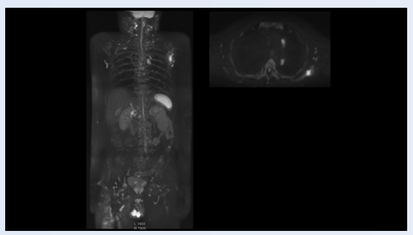
“The DWIBS sequence’s value in oncology cases is due to the high contrast it creates between lesions and surrounding tissue. Whole body DWI is requested by physicians who need to clarify TNM staging or determine therapeutic strategies, oncologists in need of diagnosis or follow-up scans, surgeons who need to see the presence of distant lesions that are sometimes difficult to detect by CT before surgery, and urologists for the evaluation of bone lesions, and the effect of chemotherapy and radiotherapy.”

Kawasaki Saiwai Hospital

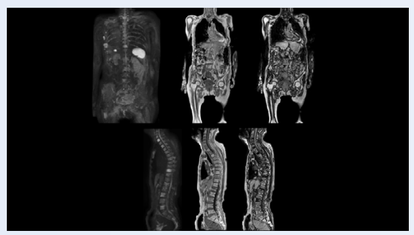
## Clinical cases



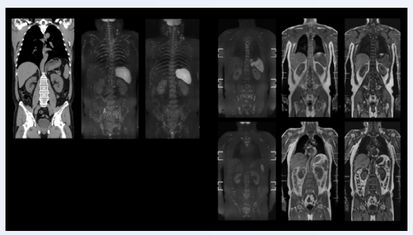
Whole body MRI of bone lesions in spine



DWIBS helps discover lesions



DWIBS of metastasized breast cancer



MRI of patient with unknown fever

***“The Ingenia 1.5T allowed us to improve our whole body DWI scan and make the exam time more tolerable for patients”***

## Shorter exam time needed for improving patient acceptance

“Before we had Ingenia, clinical adoption was hindered because the exam length of the whole body DWI protocol on our old system was difficult for many patients to tolerate,” says Takanori Naka, MR technologist.

“In our initial whole body DWI, we scanned from the top of the head to the toe in axial orientation. Because that took a lot of time, it constrained the examination to performing only coronal TSE and the axial whole body DWI scans. So, we had to compromise on clinical information to keep the exam to a reasonable length.”

“Fortunately, the Ingenia 1.5T system allowed us to improve our whole body DWI scan and make the exam time more tolerable for patients,” says Mr. Naka.

## More clinical information in much shorter exam time

“Once Ingenia was available, our first goal was to shorten the exam time of our scan,” says Mr. Naka. The next goal was to create a protocol that provided more clinical information.

“When we limited the scan coverage to the area from neck to femur, we could fit more clinical information in approximately the same scan time. So, we added coronal mDIXON, sagittal T1-weighted, and sagittal STIR sequences to our examination, instead of performing only axial DWIBS and coronal single-shot TSE scans.”

The single shot T2-weighted TSE images are used for morphology and compared to DWIBS images to identify T2 shine-through. Sagittal STIR images are used in patients with inflammation or bone metastasis.

***“We added three sequences to our examination, instead of performing only axial DWIBS and coronal TSE”***

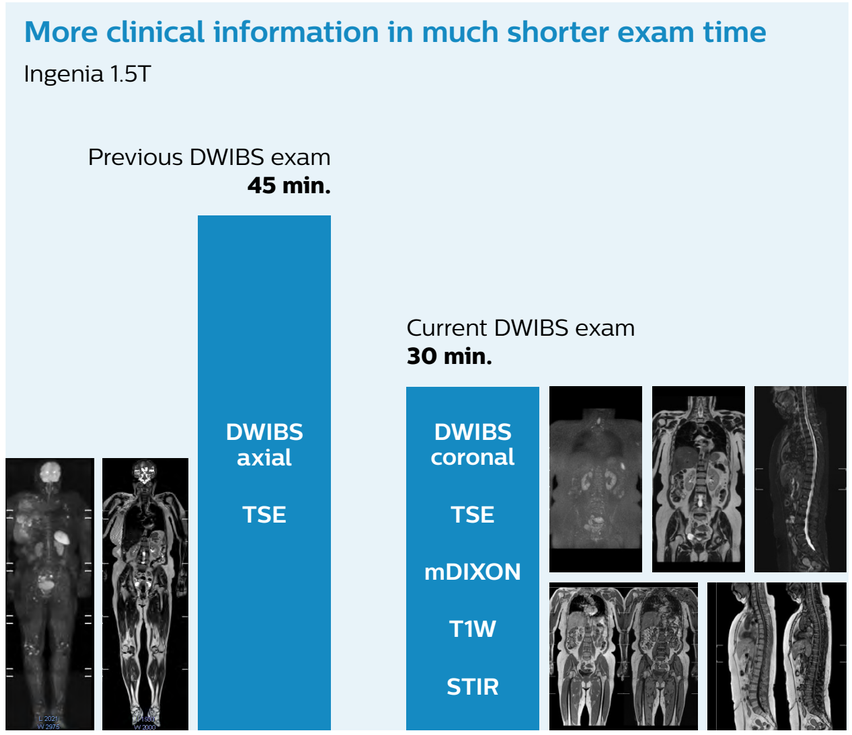
***“When we use coronal DWIBS, we can perform a full whole body examination, including other required sequences, within 30 minutes”***

## Coronal DWIBS is faster and improves image quality

“Switching to coronal DWIBS – rather than axial – further shortens scan time,” says Mr. Naka. “Important is that a dS SENSE factor of 5 shortens exam time while high image quality can be maintained, thanks to Ingenia’s dStream architecture.” He adds that the coronal orientation also avoids artifacts that are specific to combining axial images.

“When we use a coronal DWIBS acquisition, we can perform a full whole body examination, including other required sequences, within 30 minutes,” he says.

“This is considerably faster than the previously used exam with axial whole body DWI, which took more than 45 minutes,” he notes. “A shorter exam is more patient-friendly and allows us to also use it on patients in poor health who would have difficulty tolerating a long exam. Limiting the exam time is also helpful for scheduling, because it fits in a normal single exam timeslot.”




***“mDIXON FFE allows us to quickly get information we need to assess the presence of fat  and to diagnose bone lesions”***

## mDIXON FFE enriches the whole body exam without scan time penalty

Kawasaki Sawai Hospital’s whole body protocol also includes an mDIXON FFE sequence. Because mDIXON provides images for four contrast types – water only, fat only, in-phase and out-of-phase – from a single acquisition, it is useful in many ways.

“mDIXON FFE allows us to quickly get information we need to assess the presence of fat. That gives us more information when we need to diagnose bone lesions, and when we are asked to judge fat-containing lesions such as hepatocellular or renal carcinoma,” Dr. Nobusawa says.

“The mDIXON fat images can help us to differentiate fatty bone marrow from bone lesions. This is especially useful in elderly people, who tend to have fattier bone marrow. The water images provide a high signal-to-noise ratio in the intestinal canal, which is valuable for visualizing lesions in the colon,” he says.

“In-phase and out-phase sagittal T1-weighted FFE images help us to visualize and further characterize bone lesions such as metastasis and bone-marrow hyperplasia that have high signal on DWI. These images are also used throughout radiotherapy, to monitor changes in the fatty bone marrow.”

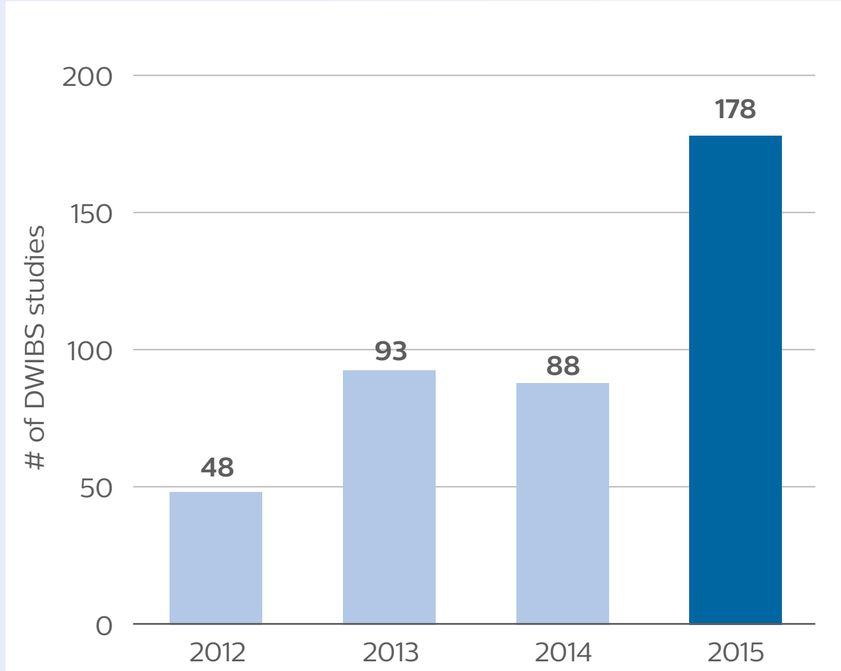
***“As oncologists and surgeons have learned more about DWIBS, referrals for the exams have increased”***

## Active education of referring physicians helped increase referrals

After implementing the improved whole body protocol, the radiology team initially did not see a large increase in referrals, although Dr. Nobusawa saw clinical cases where the DWIBS images provided him valuable information for diagnosis. This is why Dr. Nobusawa and Mr. Naka started to actively educate referring physicians about the value of whole body DWIBS. They organized several presentations for physicians in the hospital, where they explained how DWIBS can be of value in oncology patients. The information it provides can be useful for physicians when staging cancer, as well as when determining or adjusting treatment strategy.

As oncologists and surgeons have learned more about DWIBS, referrals for the exams have increased. In 2015, the 326-bed hospital’s radiology department doubled their number of whole body DWIBS exams compared to 2014.

Mr. Naka remembers some cases where DWIBS provided remarkable information.  “In one example, DWIBS visualized bone lesions that could not be seen on PET or SPECT. In another case we had found a bone lesion when a normal L-spine scan for narrowing of the disk space was done. One extra DWIBS scan (2 stations, 8 minutes) demonstrated a lesion that later was confirmed to be the primary region of cancer.”




***“The number of referrals is increasing, including referrals from other hospitals that cannot provide DWIBS”***

## Ingenia 1.5T and physician education accelerate acceptance

Dr. Nobusawa notes that acceptance of whole body DWI accelerated after the hospital installed the Ingenia 1.5T which allowed them to optimize the protocol to their needs. “The Philips system helped us promote the technique, because the DWIBS image quality was so high with Ingenia. It provides high quality in the coronal images, and a short acquisition time plus high SNR thanks to the dStream technology,” he says.

In certain cases, radiologists now choose DWIBS to make diagnoses that used to depend on nuclear medicine studies. “We don’t have SPECT or PET in our hospital, so for instance for visualizing metastasis and monitoring the effect of treatments such as chemotherapy or radiotherapy, we used to refer patients outside the hospital. Now, these patients are sent to MRI for our whole body protocol with DWIBS,” Mr. Naka says. “Our radiologists are confident when using our current exam with DWIBS and appreciate that it provides more information than nuclear medicine. The number of referrals is increasing, including referrals from other hospitals that cannot provide DWIBS. And because the scan time is short, we immediately choose DWIBS when oncology patients are referred.”

Finally Dr. Nobusawa concludes, “As soon as you understand the usefulness of DWIBS exams with the Ingenia system, surely you would like to use it. We hope that DWIBS once will be adopted as a gold standard in the care for oncology patients.”

| | **DWIBS Cor** | **SS T2W TSE Cor** | **mDIXON cor** water, fat | **TIW FFE sag** in phase, opposed phase | **STIR sag** |
|---|---|---|---|---|---|
| **FOV (FH x RL) mm** | 320 x 480 | 320 x 480 | 320 x 480 | 350 x 350 | 350 x 350 |
| **Matrix (F x P)** | 88 x 132 | 240 x 354 | 168 x 272 | 300 x 229 | 292 x 226 |
| **Slice thickness mm** | 4.5 | 4.5 | 4.5 | 5.0 | 5.0 |
| **TR ms** | 6789 | 1000 | 5.9 | 150 | 3668 |
| **TE ms** | 68 | 90 | 1.8, 4.0 | 2.3, 4.6 | 50 |
| **TI ms** | 180 | — | — | — | 180 |
| **dS SENSE factor** | 5.0 | 4.0 | 2.0 (P), 1.3 (S) | 1.3 | 1.3 |
| **NSA** | 5.0 | 1.0 | 1.0 | 2.0 | 1.0 |
| **b value** | 0, 900 | | | | |
| **Scan time** | 4:06 min. | 0:50 min. | 0:14 min. | 1:46 min. | 1:50 min. |
| | 3 Stations | | 4 Stations | 3 Stations | |
| **Scan coverage** | Neck - pelvic floor | Neck - pelvic floor | Neck - femur | Total spine | Total spine |
| **Region of interest** | Neck, lung, abdominal organs, bone | Neck, lung, abdominal organs | Neck, lung, abdominal organs, bone | Bone | Bone |
| **The patient is positioned supine. The dS Head base coil, dS Posterior and dS Anterior coils are used.** | | | | | |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# Clinical cases

View clinical case: Whole body MRI of bone lesions in spine

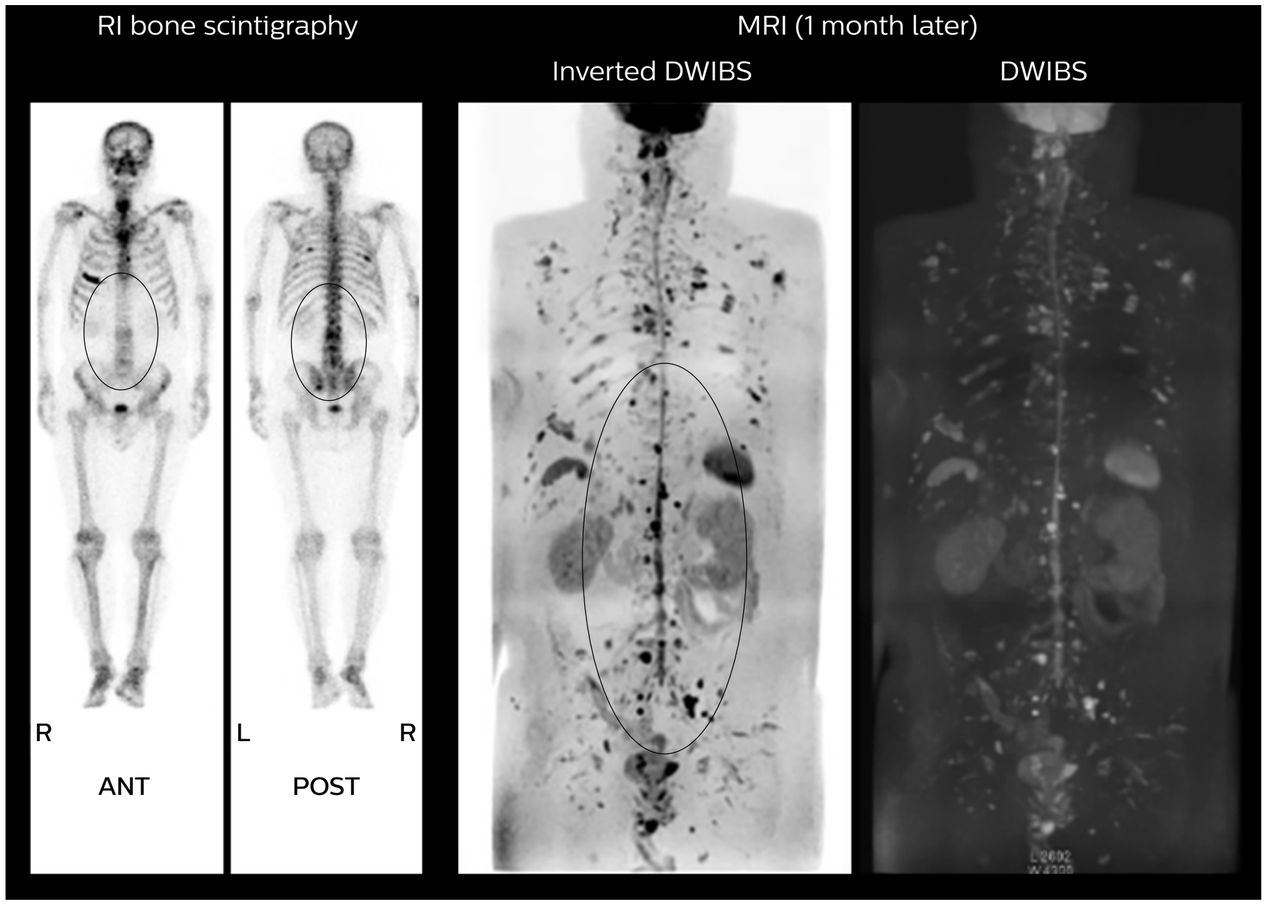
## Whole body MRI of bone lesions in spine

This oncology patient received diagnosis extent of disease (EOD) grade 2 after bone scintigraphy. The lesions in the spine (red ellipse) were thought to be age-related bone marrow effects. When the patient was sent to MRI one month later, he was scanned with the whole body oncology protocol. Many bright bone lesions were seen (yellow ellipse) on the DWIBS images.

The Dual FFE in-phase and opposed-phase images can help the physician to further characterize the lesions. Fatty bone marrow would be expected to appear bright on both in-phase and opposed phase images. Hematopoietic bone marrow would be expected to appear mid-gray on in-phase and dark on opposed phase images. The lesions in this patient are mid-gray on both in-phase and opposed-phase images.

The therapy plan for this patient was changed from radiotherapy to pain relief in line with EOD grade 4.

View ExamCard: Ingenia 1.5T Whole body with DWIBS for oncology follow-up




| | in phase | opposed phase |
|---|---|---|
| Fatty bone marrow | ● | ● |
| Hematopoietic bone marrow | ● | ● |
| Bone metastasis | ● | ● |

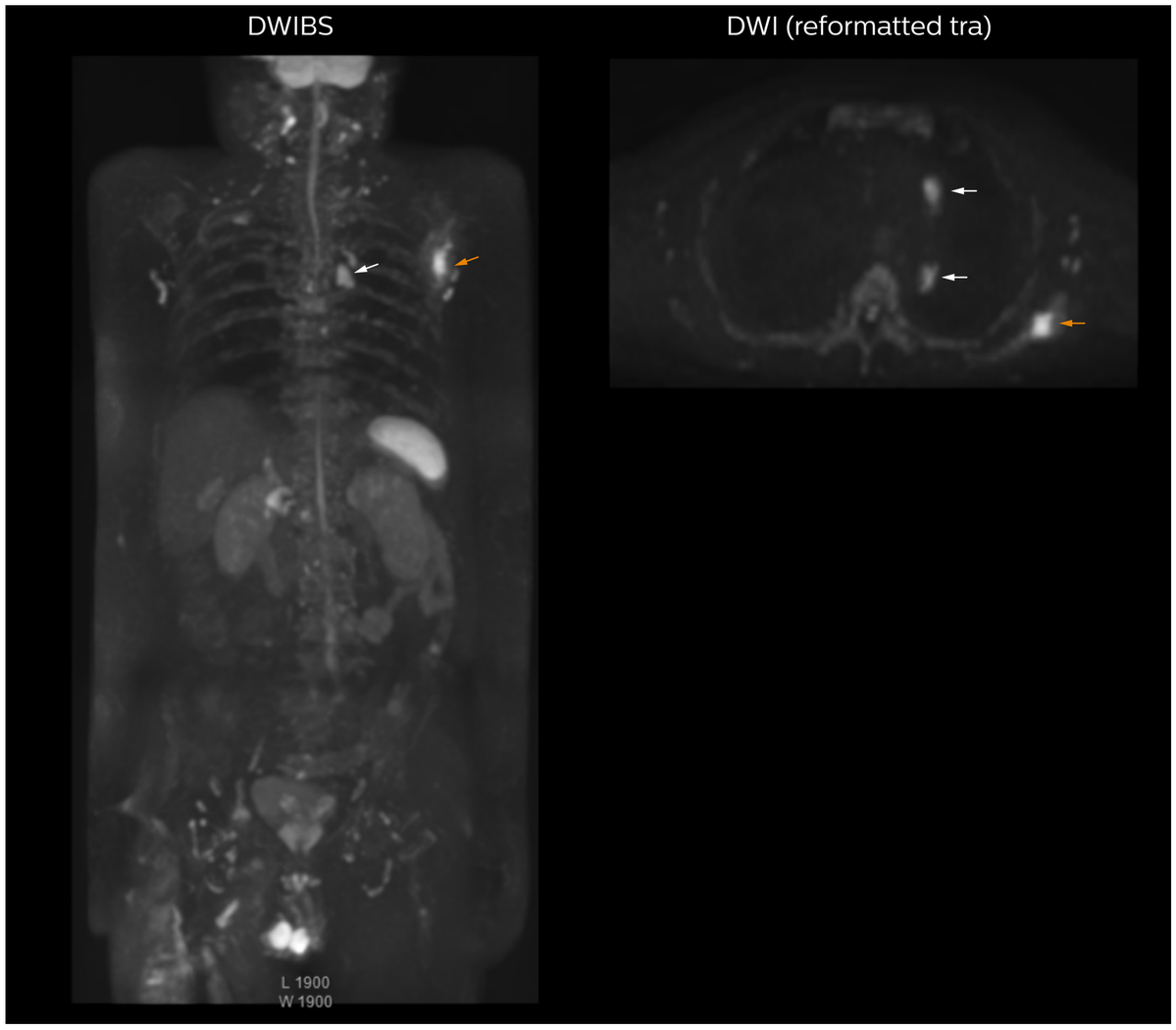
View clinical case: DWIBS helps discover lesions

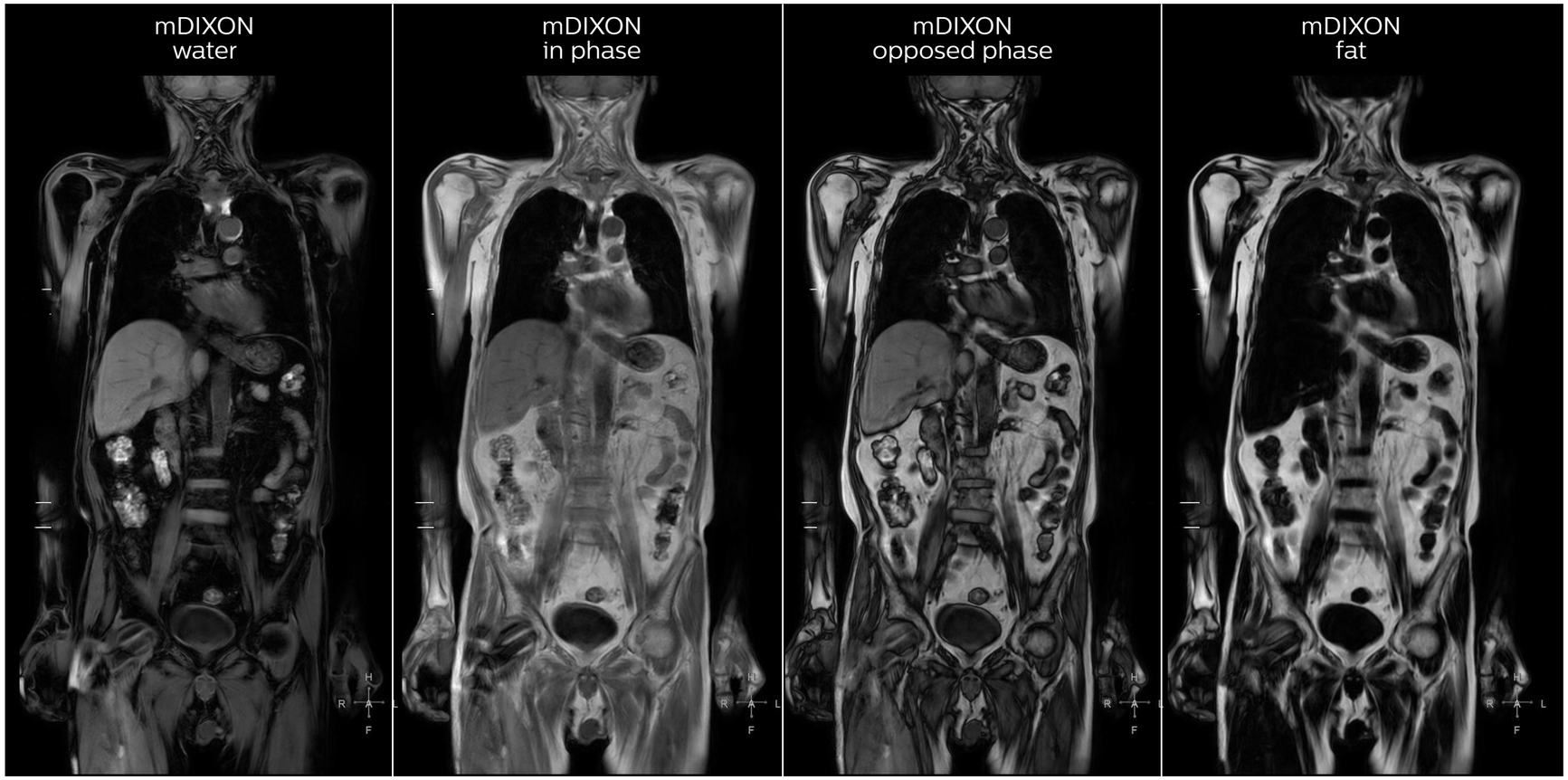
## DWIBS helps discover lesions

For this 74-year-old male patient diagnosis seemed difficult based on the patient's complaint, but pathological fracture was suspected. It was decided to send the patient to MRI for a whole body DWIBS exam. Abnormalities were discovered on the DWIBS images and reformats (arrows).

The final diagnosis turned out to be left superior lobe cancer, mediastinal lymph node metastasis and osseous metastasis.

View ExamCard: Ingenia 1.5T Whole body with DWIBS for oncology follow-up



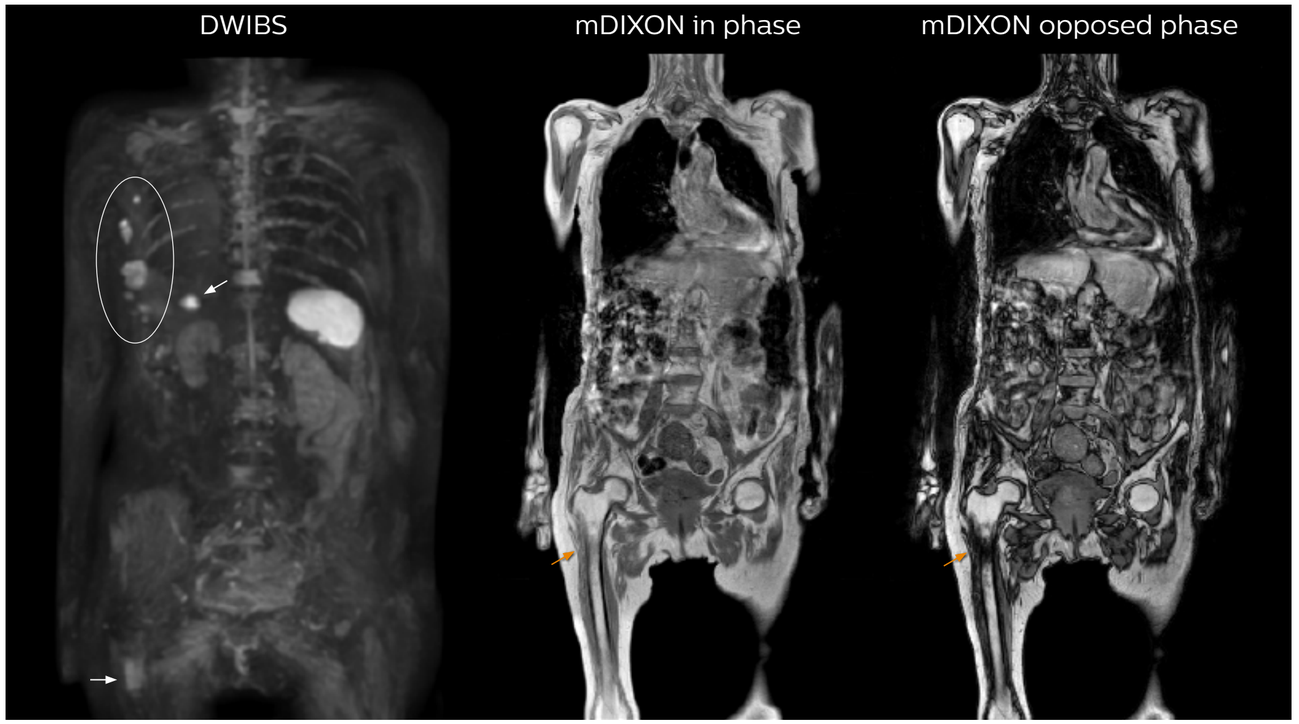

mDIXON
water
mDIXON
in phase
mDIXON
opposed phase
mDIXON
fat

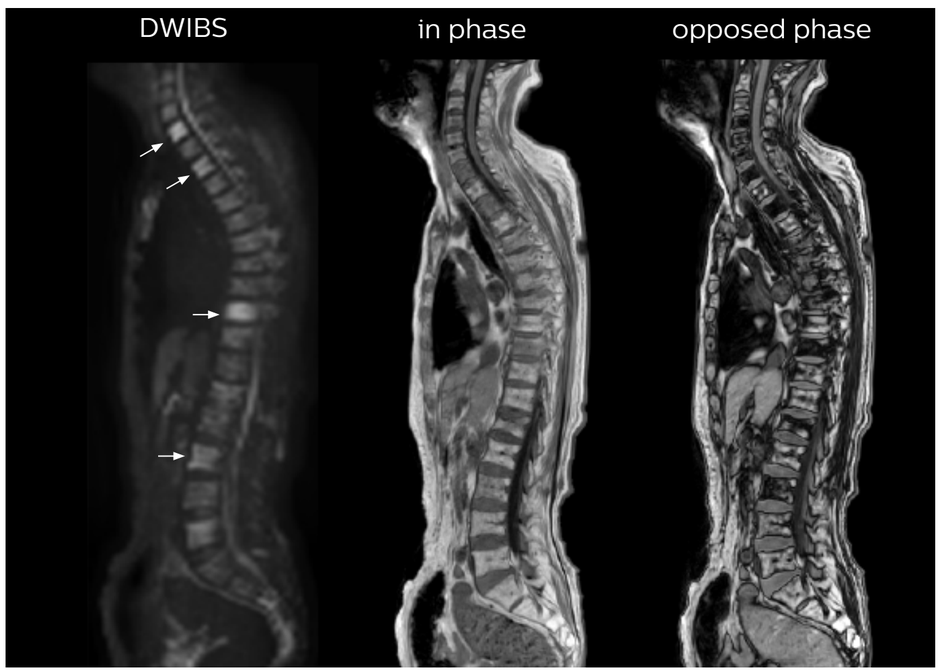
View clinical case: DWIBS of metastasized breast cancer

## DWIBS of metastasized breast cancer

A patient with metastasized breast cancer underwent MRI. Many abnormalities are easily seen on the DWIBS image and also visible on the other images. Abnormalities in bone are believed to be due to hypercellular bone marrow.

View ExamCard: Ingenia 1.5T Whole body with DWIBS for oncology follow-up



View clinical case: MRI of patient with unknown fever

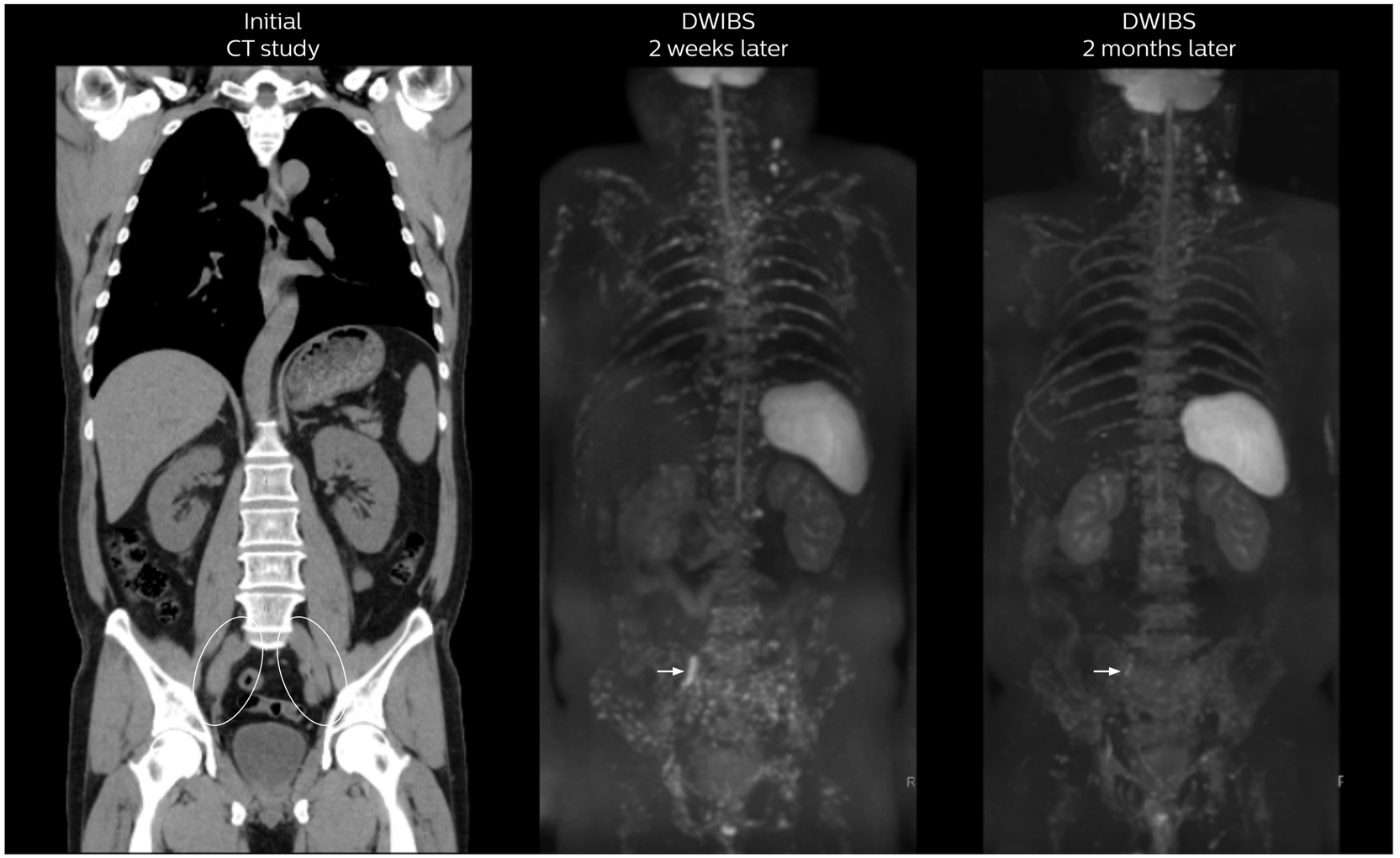
## MRI of patient with fever

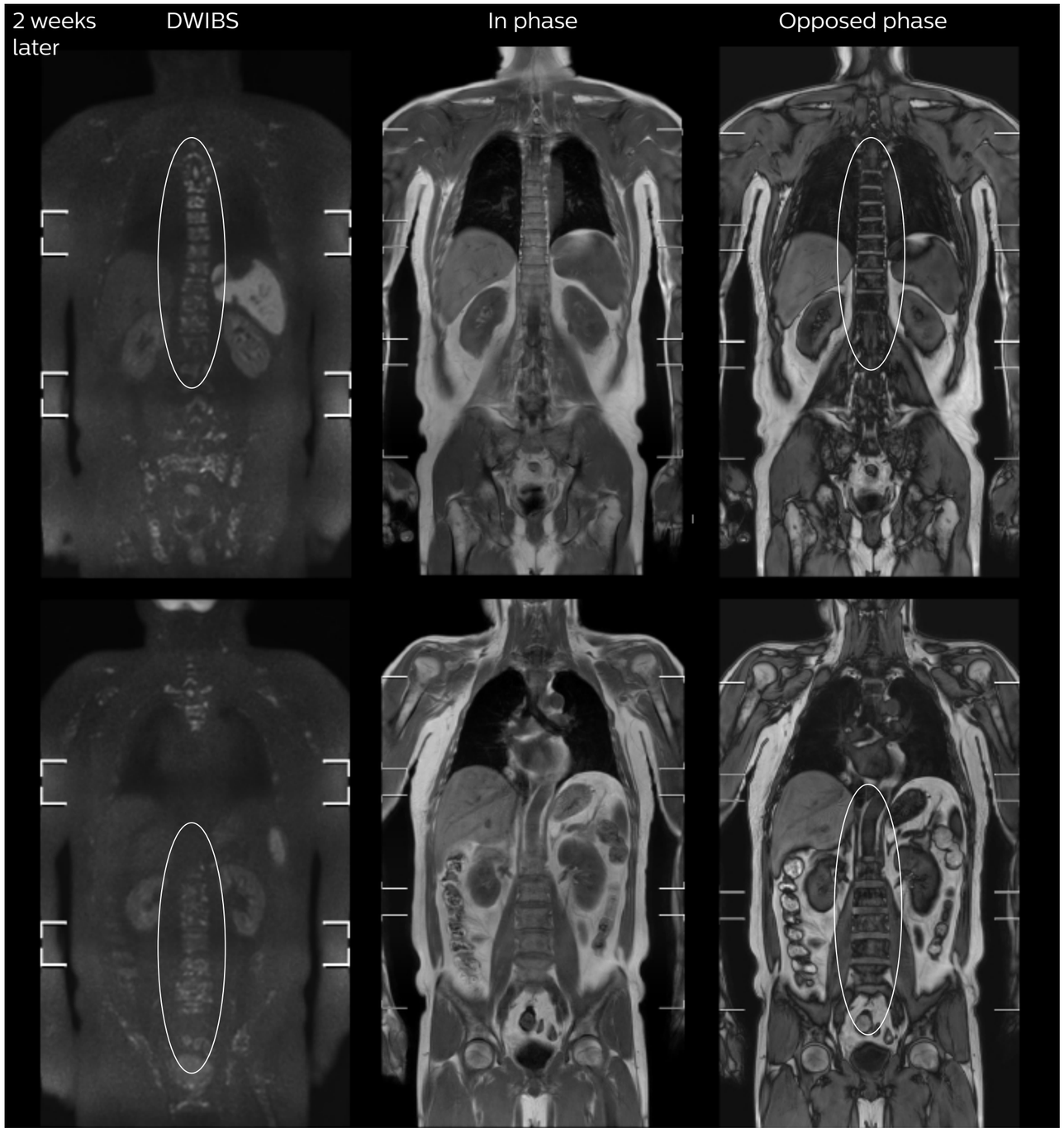
A 62-year-old male patient with fever of unknown origin and a normal appearance on CT was referred to MRI.

Abnormalities are seen on whole body DWIBS images (ellipse), which could be compatible with bone marrow hyperplasia or metastases. Lesions show diffuse low signal on the opposed-phase images, which is consistent with bone marrow hyperplasia.

Diagnosis is right iliopsoas muscle cellulitis and diffuse bone-marrow hyperplasia.

View ExamCard: Ingenia 1.5T Whole body with DWIBS for patients with fever of unknown origin






| | in phase | opposed phase |
|---|---|---|
| Fatty bone marrow | ● | ● |
| Hematopoietic bone marrow | ● | ● |
| Bone metastasis | ● | ● |

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