A Guide to Whole-Body Scanning on the 0.55T MAGNETOM Free.Max

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1. Introduction

Whole-body magnetic resonance imaging (MRI) is increasingly being used across a broad range of clinical and health-related applications. While it remains an established tool for oncology staging, therapy response assessment, and the evaluation of hematologic malignancies such as multiple myeloma, whole-body MRI is also gaining traction for non-oncologic use cases, including body composition analysis, comprehensive health checkups, and early disease detection in proactive health assessment.

Traditionally, whole-body MRI has been associated with higher-field systems. However, recent advances, including the introduction of the 0.55T MAGNETOM Free.Max and deep learning-based image reconstruction techniques such as Deep Resolve, are expanding the capabilities of mid-field MRI. These innovations enable robust image quality and clinically relevant diagnostic information while offering advantages that are particularly attractive for broader population-based imaging, longitudinal health monitoring, and body composition assessments.

This article outlines how we developed protocols optimized for whole-body imaging on MAGNETOM Free.Max, and describes the workflow that enables efficient and consistent exam execution.



1 Preparing patient positioning and coil setup.

2. Realities of whole-body scanning on MAGNETOM Free.Max

A 0.55T scanner differs from higher-field systems in terms of, among other things, lower signal-to-noise ratio which typically needs to be balanced by longer acquisition times. With *syngo* MR XB10, Siemens Healthineers has brought its Deep Resolve technology to several 3D sequences (including the VIBE sequence as a workhorse for T1w imaging in whole-body), enabeling higher image quality at 0.55T, particularly in stations requiring high resolution with breath-holding.

Note also that MAGNETOM Free.Max was designed with different priorities than conventional higher-field scanners emphasizing robustness, accessibility, and efficiency in routine MR and therefore has unique hardware capabilities and system properties which are not primarily tailored for whole-body MRI. This influences the way whole-body MRI can be acquired at 0.55T. Consider the following:

- MAGNETOM Free.Max has two coil slots, only two coils can be connected at the same time.
- The Contour L Coil is the largest coil available with the system, measuring 63 × 42 cm^2.
- The maximum scan range is roughly 140 cm, which defines the body length that can be scanned. Depending on the case, this can be extended by several centimeters (see below).

We have found effective ways of working with these parameters to perform whole-body MRI. This type of imaging often means "eyes to thighs," since this is the region that is generally considered for whole-body scans. Using the protocol detailed below, in combination with the Head/Neck Coil and the Contour L Coil in "portrait mode," MAGNETOM Free.Max can support such scans easily. Depending on the patient's body length, it might even be possible to reach the tibia, as described in our example below.

3. Patient positioning and equipment setup

Patient positioning and equipment setup is crucial to ensure a smooth and successful whole-body examination. It is important to make patients as comfortable as possible so they can tolerate the full scan without interruption. Foam pads, pillows, and knee supports should be used where needed to enhance comfort. Having patients change into hospital gowns or suitable clothing can also reduce the risk of discovering non-implanted metallic objects once the scan has started. The MAGNETOM Free. Platform's Head/Neck Coil is tilted to 9 degrees for patient comfort. The Contour L Coil should be positioned so that it covers as much of the patient as possible: Ideally, the top part will cover all of the chest, abdomen, and at least part of the pelvis. We suggest using it in "portrait mode" (Fig. 1).

The "Whole Body Automatic Isocentering" functionality should be selected to start the scan. Check with the patient about their well-being one last time before starting the scan.

3.1 Minimum equipment requirements

- One MAGNETOM Free. Platform Head/Neck Coil
- One Contour L Coil
- One MAGNETOM Free. Platform Spine Coil (built into the scanner bore)

All requirements are included in the standard system configuration, except for the Contour L Coil, which is available as a purchasable option.

3.2 Positioning images

We use a two-step process and protocol for whole-body imaging on MAGNETOM Free.Max. Start by positioning the patient's head in the Head/Neck Coil and place the Contour L Coil on the chest and abdomen (Fig. 2).

For the second part of the protocol and scan, the coil needs to be moved down, over the patient's thighs. You can do this either without moving the table at all, or by moving it about halfway out of the scanner (Fig. 3).



2 Coils positioned on the patient.



3 Moving the Contour L Coil to cover the thighs.

4. Description of the protocol

Sequence/ stations	TA (min: sec)	TR (ms)	TE (ms)	FOV (mm)	Phase FOV (%)	Slices	Slice thick-ness (mm)	Gap (%)	Matrix (interpo-lation)	Phase encoding direction (over-sampling)	iPAT / DRB / DRS / DRG	b-values s/mm²	Aver-ages
Head localizer	00:20	11	6.47	450	100	5	8	150	448 × 314	A >> P (30%)	IDG	n/a	1
Thorax localizer	00:20	11	6.47	450	100	5	8	150	448 × 314	A >> P (30%)	IDG	n/a	1
Abdomen localizer	00:20	11	6.47	450	100	5	8	150	448 × 314	A >> P (30%)	IDG	n/a	1
Pelvis and femur localizer	00:20	11	6.47	450	100	5	8	150	448 × 314	A >> P (30%)	IDG	n/a	1
T1 VIBE Dixon tra (×5)	1:10 total	9.74	2.63/ 6.47	430	85.7	80	3	20	448 × 308	A >> P (30%)	DRB & DRS	n/a	1
DWI b50, b800 tra (×6)	17:24 total	5400	78	430	87.5	30	6	20	256 × 224	A >> P (0%)	DRB & DRS	50, 800	7–22
T2 HASTE tra head	00:24	542	89	430	88.2	45	6	20	512 × 410	A >> P (0%)	DRB & DRS	n/a	1
T2 HASTE tra (×4)	1:16 total	542	89	430	88.2	35	6	20	512 × 410	A >> P (0%)	DRB & DRS	n/a	1
T2 TSE STIR sag (C-spine)	1:47	3580	53	200	140.6	13	4	10	384 × 269	H >> F (140%)	DRB & DRS	n/a	2
T2 TSE STIR sag (T-spine)	1:47	3580	53	200	140.6	13	4	10	384 × 269	H >> F (140%)	DRB & DRS	n/a	2
T2 TSE STIR sag (L-spine)	2:03	4130	53	200	140.6	15	4	10	384 × 269	H >> F (140%)	DRB & DRS	n/a	2
T1 TSE sag (C-spine)	1:51	396	14	200	139.1	13	4	10	512 × 358	H >> F (140%)	DRB & DRS	n/a	2
T1 TSE sag (T-spine)	1:52	396	14	200	141.4	13	4	10	512 × 358	H >> F (140%)	DRB & DRS	n/a	2
T1 TSE sag (L-spine)	2:06	452	14	200	139.1	15	4	10	512 × 358	H >> F (140%)	DRB & DRS	n/a	2
T1 VIBE BH lungs	00:19	4.25	1.36	400	80.4	108	2.5	20	448 × 403	A >> P (50%)	DRB & DRS	n/a	1
Break to move coil	Depending on your level of comfort, you can either move the patient halfway out or simply drag the coil down while they are inside the bore.												
T1 VIBE Dixon tra (×1)	00:15	9.71	2.63/ 6.47	430	85.7	80	3	20	448 × 308	A >> P (30%)	DRB & DRS	n/a	1
DWI b50, b800 tra (×1)	02:54	5400	78	430	87.5	30	6	20	256 × 224	A >> P (0%)	DRB & DRS	50, 800	7–22
T2 TSE HASTE tra (×1)	00:19	542	89	430	88.2	35	6	20	512 × 410	A >> P (0%)	DRB & DRS	n/a	1

Table 1: Whole-body protocol for the 0.55T MAGNETOM Free.Max.

As mentioned earlier, the protocol is split into two sections:

- The first part takes place with the Contour L Coil over the chest and abdomen. In our case, it covered about 120 cm of our female volunteer, who was 165 cm tall. We got very good signal all the way down to the femoral head. If this coverage is enough to answer the clinical question (specifically for a 165 cm body length or shorter), you might not need to perform Part 2 of the protocol.
- In the second part, you have the option to move the coil down (either while the patient is in the scanner or by moving the table about halfway out; moving it fully out would cause you to lose the reference point). The protocol then covers an additional 12 cm. In our case, this reached down to the middle of our volunteer's tibia. We definitely recommend this step for taller patients or when extra coverage is needed.

We also ran this protocol with a volunteer who was 185 cm tall. With patients of that height, the scan would allow you to approximately reach the knees.

The total scan time is approximately 34 minutes for Part 1 and approximately 8 minutes for Part 2.

Our choices for this protocol follow the guidelines of the European Institute of Oncology (IEO) in Italy [1] and from requests by customers during visits to our headquarters or at congresses. We did not include any focus areas (such as the brain, thorax, abdomen, or pelvis) because they are usually optional, as is the TSE STIR of the entire spine.

This protocol can also be used on MAGNETOM Free.Star, the 0.55T MRI system with a 60 cm bore.

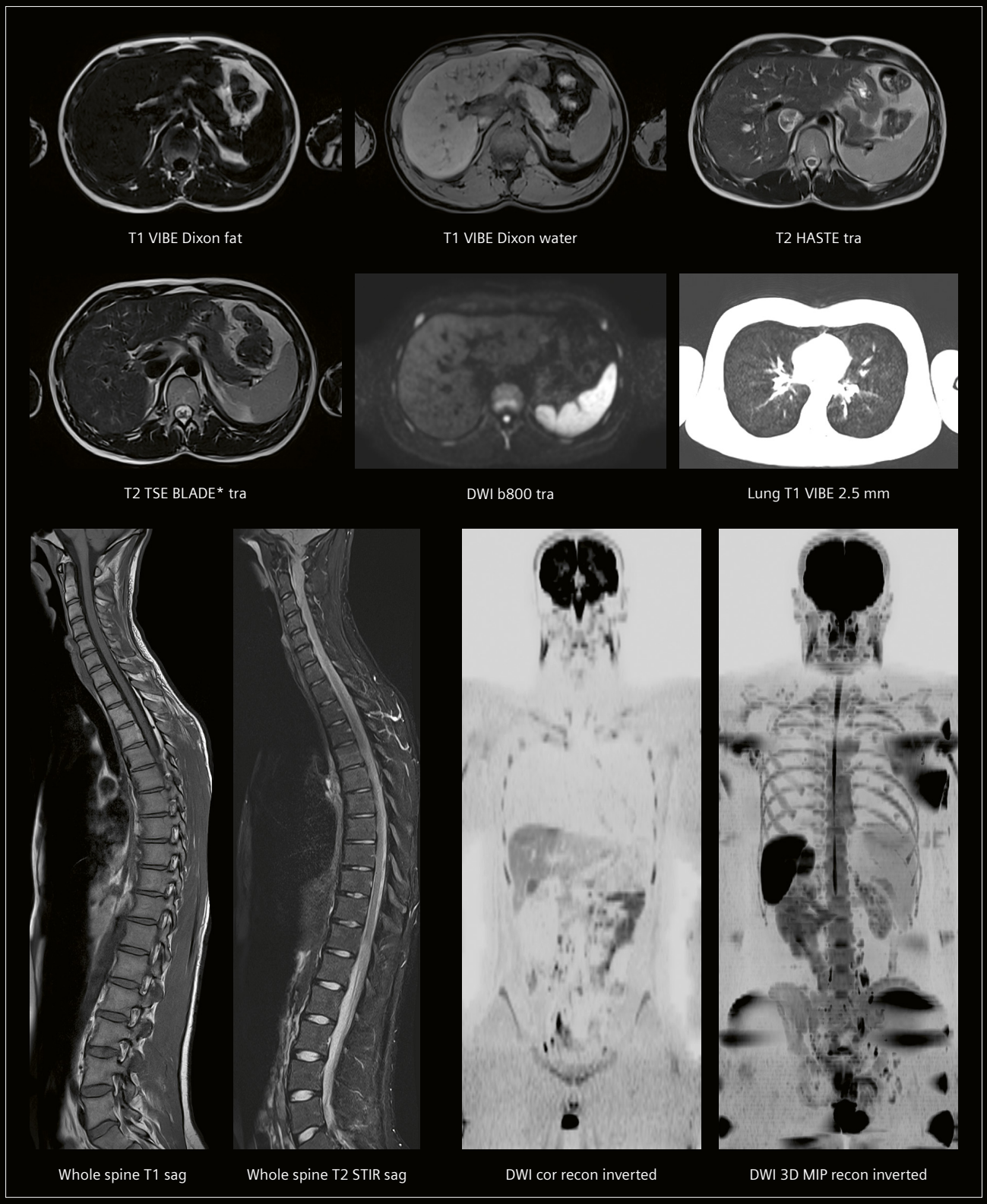
5. Workflow and scheduling

Our goal was to show that an entire scan, with patient preparation, could be done in under 60 minutes, to allow care providers to schedule their patients accordingly. As we conducted the scan, we timed ourselves to log realistic times that included patient preparation and moving the coil if needed. The table below shows that a 60-minute slot is sufficient to comfortably conduct a whole-body scan on MAGNETOM Free.Max. Of course, setting up and cleaning up might be even faster, depending on the technologist.

Workflow step	Time (min)	Start time	End time
Patient set-up	4	10:00 AM	10:04 AM
Scan (1st part)	36	10:04 AM	10:40 AM
Add table movements & breath commands	3	10:40 AM	10:43 AM
Moving coil	1	10:43 AM	10:44 AM
Additional scan time 2nd part	4	10:44 AM	10:48 AM
Add table movements & breath commands	1	10:48 AM	10:49 AM
Finish & clean-up	5	10:49 AM	10:54 AM

Table 2: Timing of a whole-body scan on the 0.55T MAGNETOM Free.Max.

6. Volunteer images



Study ID: 7aaaa1286

4 Images from a whole-body scan of a volunteer.

** Deep Resolve BLADE will be available with software version XB30. Work in progress. The application is currently under development and is not for sale in the U.S. and in other countries. Its future availability cannot be ensured.*

7. Conclusion

We hope that this guide will serve as a starting point for further exploration into performing whole-body imaging on MAGNETOM Free.Max. The 0.55T system can be a great alternative for patients of up to 185 cm total body length. We showed that patients up to this size can be scanned using the Head/Neck Coil, the Contour L coil, and the built-in Spine Coil within a 60-minutes examination time slot. Although whole-body DWI performance remains a challenge due to the trade-off between robust fat suppression and SNR, as well as the known limitations of spectral fat saturation at the periphery of the FOV, whole-body imaging at 0.55T can already provide meaningful clinical value. Beyond general whole-body assessment, it may be particularly attractive for orthopedic applications, lifestyle and longevity programs, and body composition analysis, where the strengths of the platform can be leveraged effectively.

Reference

1 Summers P, Saia G, Colombo A, Pricolo P, Zugni F, Alessi S, et al. Whole-body magnetic resonance imaging: technique, guidelines and key applications. Ecancermedicalscience [Internet]. 2021;15: 1164. Available from: http://dx.doi.org/10.3332/ecancer.2021.1164



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To download the protocol **(.exar1 and PDF)** for software version XB10 please visit

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