

7 Tesla magnetic resonance imaging

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Better [visualization](#) of [brain tumor](#) details and higher tumor detail diagnostic [confidence](#) can be obtained with [7 Tesla magnetic resonance imaging](#) ¹⁾.

The Magnetom Terra 7 Tesla (7T) magnetic resonance imaging ([MRI](#)) scanner is an advanced ultra-high-field scanner developed by [Siemens](#) Healthineers. It is one of the first 7T MRI scanners cleared for clinical imaging in the US and Europe.

The device is designed to produce cross-sectional images of the brain and knee of patients weighing 66lbs (30kg) or more. It is suitable for musculoskeletal and neurological applications.

The scanner obtained Conformité Européenne (CE) and 510(k) certifications for clinical use in Europe in August 2017, while US Food and Drug Administration (FDA) approval was granted for clinical imaging in October 2017.

[Mayo Clinic Rochester](#), is one of the first medical institutes in [North America](#) to use the Magnetom Terra for clinical practice.

The machine is also installed at Brigham and Women's Hospital (BWH) in Massachusetts, US, as well as at the Mark and Mary Stevens Neuroimaging and Informatics Institute (INI) of the Keck School of Medicine.

Magnetom Terra 7 Tesla scanner technical details The Magnetom Terra 7T scanner system is 2.97m-long and has a gradient strength of 80mT/m. It weighs less than 25t and occupies an area of 65m². The machine can be easily integrated into clinical environments.

The actively shielded highly homogeneous superconducting 7T magnet of the scanner has a length of 2.7m and a bore size of 0.6m. It is 50% lighter than other 7T magnets and is transported cold in an aircraft.

The scanner features an open system architecture design and has two coils to produce precise cross-sectional images of head and knee. It delivers eight-channel parallel transmission (pTX) to capture images of challenging body regions.

The machine comes with 80/200 gradient system, which delivers high power to perform diffusion MRI and functional MRI (fMRI). It provides enhanced imaging capabilities with up to 64 receive channels.

The ultrafine 0.2mm in-plane anatomical resolution of the machine improves the visibility of small lesions in previously undiagnosed patients. Further, the software platform of the scanner facilitates easy sharing of study protocols with magnetic resonance systems in clinical routine.

Magnetom Terra 7T scanner applications The advanced Magnetom Terra 7 Tesla scanner is intended for both musculoskeletal and neurological applications. It also supports basic clinical research activities.

The machine assists physicians to analyse and improve the visibility of very small pathologies by creating anatomical imaging of cells in musculoskeletal conditions. In neurological applications, the scanner can be used to examine and measure sub-cortical brain activity using functional magnetic resonance imaging technique.

Results from the device will help users make decisions on treatment choices and determine the effectiveness of the treatment. The scanner can also be used as an MRI microscope to explore metabolic changes by measuring the anatomy, function and metabolism of the body tissue.

The flexible design of Magnetom Terra allows researchers to configure the device for future clinical applications.

Magnetom Terra 7T scanner benefits The scanner offers twice the signal-to-noise (SNR) ratio compared to the traditional 3T MRI scanner in optimised 7T neuro, as well as musculoskeletal clinical applications. It can quickly produce 0.14cm³ of high-resolution images for metabolic brain mapping and provide better lesion conspicuity.

The device also offers sub-millimetre BOLD fMRI precision to visualise sub-cortical activations. The scanner can be used in both research mode and 510(k)-cleared clinical modes to support both clinical routine and translational research aimed at developing ground-breaking technologies.

The dual mode functionality enables it to switch between the clinical tasks and innovative research methods within seven minutes, while retaining research and clinical images on different databases ²⁾.

Thirty-nine [temporal lobe epilepsy](#) (TLE) patients were recruited with 3 and 7 T MRI scans and a semi-quantitative assessment of the hippocampal internal architecture (HIA) was performed. Differences in HIA scores between 3 and 7 T MRI were evaluated. HIA and hippocampal volume asymmetry were also calculated and compared. The utility of HIA and hippocampal volume asymmetry in [epilepsy](#) lateralization, and the predictive value between these two indicators were compared. The relationship between HIA and postoperative outcomes was investigated in 25 patients with [amygdalohippocampectomy](#).

HIA scores of epileptogenic hippocampi were lower than those of non-epileptogenic hippocampi at 3 and 7 T MRI. Higher HIA scores were observed at 7 T MRI. The HIA asymmetry and hippocampal volume asymmetry were both strong predictors for epilepsy lateralization and did not show difference in predictive value. No statistical differences in HIA asymmetry were observed between seizure-free patients (ILAE 1) compared to patients with seizures (ILAE 2-5).

Visualization of hippocampal internal architecture (HIA) may be improved at 7 T MRI. HIA asymmetry is a significant predictor of laterality of seizure onset in TLE patients and has similar predictive value as hippocampal volume asymmetry, however, HIA asymmetry at 7 T does not have extra value in determining epilepsy lateralization and neither does predict surgical outcomes³⁾.

Unclassified

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