

MAGNETOM Combi Suite Radiation Therapy. Combining MRI Intelligence and Therapeutic Expertise

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MRI's excellent soft-tissue differentiation supports target structure delineation, helps to identify structures and organs at risk, and therefore contributes to accurate treatment planning and delivery.

The MAGNETOM Combi Suite Radiation Therapy, which is available for 1.5T MAGNETOM Aera and 3T MAGNETOM Skyra, is a perfect tool for the radiation therapy (RT) treatment planning workflow.

Today's standard for radiation therapy planning

In 2009, nearly one million patients in the U.S. received radiation therapy.

Approximately 88% of these patients received external beam treatments from a linear accelerator [1], which demands careful treatment planning, precise patient set-up, and reproducible patient positioning. Patients are immobilized during pre-treatment imaging and throughout the treatment with positioning devices such as thermoplastic masks or vacuum cushions, ideally in exactly the same way throughout.

In 2009, 98% of all image-based RT treatment plans in the U.S. were based on computed tomography (CT) images [2]. In nearly all cases where MR images were used within the

context of treatment planning, these were used in conjunction with CT images. CT data – acquired for example with a Siemens SOMATOM Definition AS Open system – serves as the primary data for localizing target structures and organs at risk, for calculating dose, and for simulating the treatment.

MRI intelligence for radiation therapy planning

MRI offers excellent soft-tissue contrast without radiation dose, making it ideal for oncology imaging and – especially – radiation therapy planning, where CT data can be enhanced by valuable multi-contrast as well as

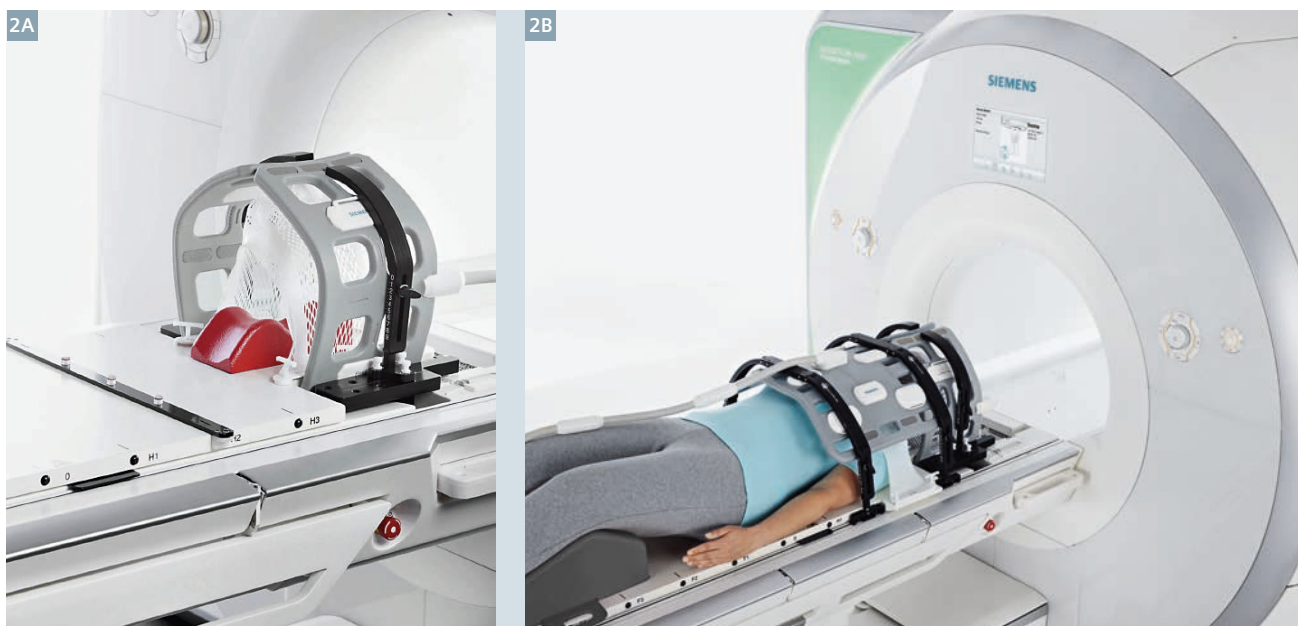
1A



1B



1 Siemens' recommended MR systems supporting RT imaging. (1A) 1.5T MAGNETOM Aera and (1B) 3T MAGNETOM Skyra with the MAGNETOM Combi Suite Radiation Therapy.



2 MAGNETOM Combi Suite Radiation Therapy options. **(2A)** Flat couch top with indexing, allowing RT-like patient set-up. The Flex 4 coils enable imaging even in the case of thermoplastic mask fixation. The coil holders help to mount the coils. **(2B)** Set-up with the Body 18 coil mounted close to the patient without contact.

multi-parametric MR data for additional confidence in treatment planning. Fast isotropic 3D sequences such as SPACE or VIBE along with 3D distortion correction enable better anatomical correlation. Advanced applications and imaging sequences, such as REVEAL and MR spectroscopy, offer additional pathology characterization.

Tumors of the brain, in the head & neck region or tumors of the prostate or rectum are good examples of cases where MRI can provide useful additional information for treatment planning, offering high-quality image-guided treatments to patients. Other examples are cervical tumors and gynecological tumors in general. MR images provide great accuracy in defining target structures and organs to be spared during treatment.

Accounting for the needs of radiation therapy in MRI

MAGNETOM Aera and MAGNETOM Skyra, both featuring a 70 cm open bore design, are today's top-of-the-line choices in 1.5T and 3T MRI systems. The bore size supports very different patient set-ups, as is the case for radiation therapy planning imaging. Inte-

grated Tim 4G coil technology offers up to 204 coil elements, delivering more signal than ever. With its high-density coils, Tim 4G also enables up to 128 channels and can be flexibly integrated into a variety of different applications to support even large anatomical coverage. The Tim Dockable Table supports the MRI workflow at both radiology-installed scanners and dedicated radiation oncology MR systems, by allowing the patient to be prepared outside the scanner room. This enables scanning within standard radiological timeslots and increases workflow flexibility. Finally, the MAGNETOM Combi Suite Radiation Therapy allows for reproducible radiation therapy-like positioning during MR scanning, easing the enhancement of CT data with MRI data during the treatment planning process.

MAGNETOM Combi Suite Radiation Therapy

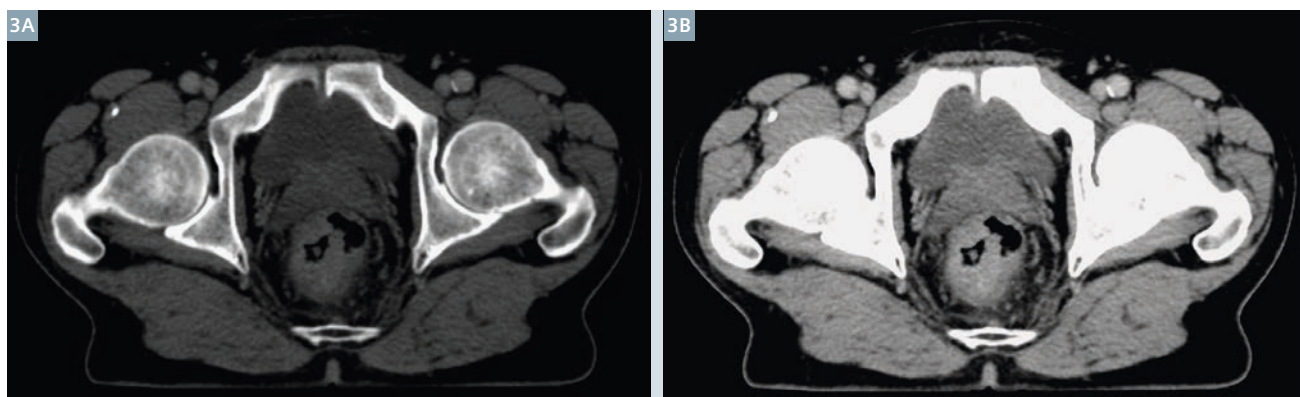
MAGNETOM Combi Suite Radiation Therapy comprises Siemens' comprehensive offering of MRI-related solutions to support high accuracy radiation therapy treatment planning. Table 1 lists the various components of the suite.

Manufacturers of radiation therapy positioning devices, including CIVCO, offer a variety of MR-compatible patient positioning devices (fitting the CIVCO RT Positioning Package).

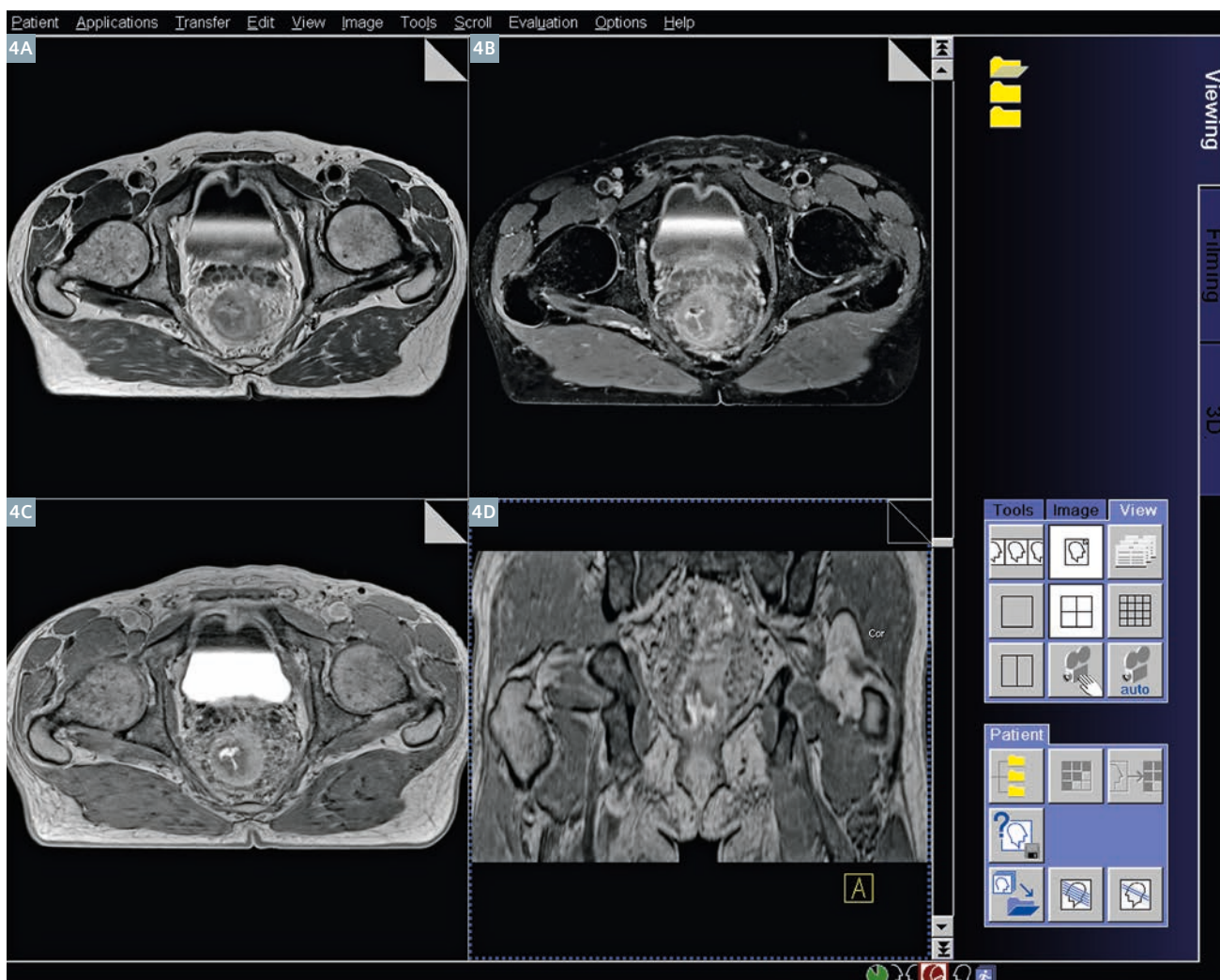
Table 2 gives examples for Tim 4G coil arrangements for RT imaging (sorted by body regions) and identifies the mounts from the CIVCO RT Positioning Package that could be used.

Feedback from the clinical community

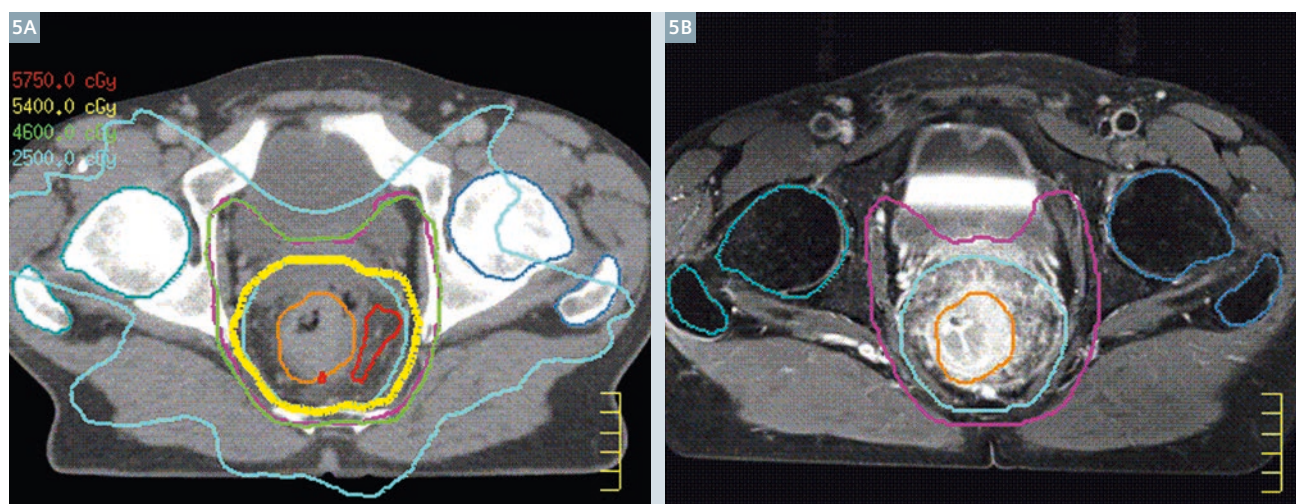
One of the first MAGNETOM Aera systems equipped with MAGNETOM Combi Suite Radiation Therapy options is installed in the Radiology department of the Sozialstiftung Bamberg in Bamberg, Germany. This scanner is a shared system, with reserved timeslots for radiation therapy treatment planning imaging. Dr. Thomas Koch, head of Medical Physics in the radiation oncology department at Bamberg, is impressed by the radiation therapy positioning package: "It works very well. It has made image fusion in our treatment planning system much easier and faster."



3 CT planning data of a patient with rectum carcinoma. (3A) Bone window, (3B) soft-tissue window).
 Courtesy of Sozialstiftung Bamberg, Bamberg, Germany.



4 Additional MR planning data for the same patient as in Fig. 3. (4A) T1-weighted contrast-enhanced TSE, (4B) T1w ce TSE fs, (4C) T1w 3D VIBE fs, (4D) coronal MPR of the 3D VIBE.
 Courtesy of Sozialstiftung Bamberg, Bamberg, Germany.



5 Image-based RT treatment planning for the same patient as in figures 3 and 4. **(5A)** CT with contoured organs and isodose lines, **(5B)** MR with contoured organs.
Courtesy of Sozialstiftung Bamberg, Bamberg, Germany.

Table 1:
Components of MAGNETOM Combi Suite Radiation Therapy

Components	Vendor	Remarks
Tim 4G coils	Siemens	required
Tim Dockable Table	Siemens	recommended
RT Positioning Package (MR-compatible couch top with indexing and coil mounts)	CIVCO	required; allows direct mounting of CIVCO Type S masks
External laser systems	LAP	recommended for virtual simulation

Note: MAGNETOM Combi Suite Radiation Therapy and its various components are available only for MAGNETOM Aera and MAGNETOM Skyra.

Table 2: Tim 4G coil arrangements for radiation therapy imaging

Region	Tim 4G coils	Mounting	Alternative / Option
Cranial	2-Flex 4 (Small/Large) with interfaces	Head coil mounts	1-Flex 4 (Small/Large) + Body 18
Head & Neck	2-Flex 4 (Small/Large) with interfacesw + Body 18 + Spine 32	Head coil mounts + Body coil mounts	1-Flex 4 (Small/Large) + Body 18 + Spine 32 coil
Abdominal	Body 18 + Spine 32 coil	Body coil mounts	a second Body 18 can be used for obese patients

Note: The brackets indicate alternatives.

Acknowledgement

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References

- 1 ASTRO www.rtanswers.org, 06/2013.
- 2 IMV 2010 Radiation Therapy Market Summary Report.

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