Introduction to MR/RT – a New Era of Adaptive Radiotherapy

Modern radiation therapy (RT) seeks to optimize targeting of the radiation so that the prescribed dose is administered to the tumor tissue while minimizing or even eliminating exposure of healthy tissue. In standard radiation therapy, advanced imaging technologies, such as diagnostic-quality magnetic resonance imaging (MRI), computed tomography (CT) scans, ultrasound or x-rays, are used before treatment to allow physicians to visualize the location of cancerous tissue and design the treatment accordingly.

Many tumors are located in organs that move during treatment (e.g., lungs move as we breathe), change location between treatment sessions or are located near critical organs or tissues. Imaging at the time of treatment – (Image Guided Radiation Therapy, or IGRT) utilizing cone beam computed tomography (CBCT), ultrasound or x-rays – can improve the accuracy and precision of treatment. One key shortcoming of these imaging modalities, however, is limited soft tissue contrast, making it difficult to precisely determine the boundaries between the tumor and surrounding healthy tissue as the radiation dose is delivered. In contrast, high field diagnostic-quality MRI is generating great interest as an option that provides unparalleled soft tissue contrast and real-time visualization to enable truly personalized radiation therapy.

Transforming Radiation Therapy to Improve Patient Outcomes
Elekta Unity, the first ever high-field MR-linac, is introducing diagnostic-quality MR images to radiation therapy. Never before have clinicians had the ability to see crystal clear, high-field MR images while the radiation dose is being delivered. The live images help to keep the radiation directly on target, even if the tumor is moving and changing shape, size or location, during the treatment. This solves a longstanding, unmet need by allowing clinicians to clearly see the tumor during treatment rather than relying on images acquired before the treatment.

Diagnostic-quality soft tissue imaging provides more information on anatomy and pathology and will enable more effective clinical decision-making. Precise visual differentiation of tumor from nearby healthy tissue allows clinicians to confidently see and track the exact location of a tumor in real time.

Elekta Unity successfully integrates a next-generation linear accelerator technology with a high-field (1.5T) diagnostic-standard MRI system in one device. It is powered through intelligent software that offer adaptation to plans while the patient is on the table, creating a personalized plan every time you treat depending on the tumor at that moment in time.
Elekta Unity is truly groundbreaking because it combines the best of two worlds, enabling a new paradigm in cancer care – magnetic resonance radiation therapy (MR/RT). MR/RT offers the potential to truly personalize therapy for each patient every time they are treated through:

- Precise tumor targeting through visualizing the target and surrounding organs-at-risk
- Scan-plan-treat approach based on up-to-date information on the patient’s internal anatomy
- Improved margin and fraction regimens

Images captured in 2018 on Elekta’s high-field MR-linac as part of imaging studies.

Supported by a Growing Body of Safety and Efficacy Data
The safety and efficacy of the Elekta MR-linac system in a clinical setting have been demonstrated and quantified. The results, published in Physics in Medicine & Biology, further validate an extensive clinical research plan as developed by the Elekta MR-linac Consortium.

A World-Class Development Team
In October 2012, Elekta established a global consortium of partner institutions to leverage collective intelligence and insights to merge precision radiation delivery with MR imaging and to validate its application for maximum clinical benefit. The development of Unity demonstrates Elekta’s ability to collaborate with industry and academic partners across the disciplines of radiation oncology, radiology and medical physics. The Elekta MR-linac Consortium reflects Elekta’s commitment to collaborating with those on the front lines of cancer care and addressing real unmet clinical need through innovation and technology advances. The Elekta MR-linac Consortium now provides a forum for other members to join with the goal of fast-tracking high-quality adoption of this technology.

Philips Healthcare, a leader in healthcare imaging technology, is Elekta’s MRI technology partner for the development of the MR-linac and is a member of the international Elekta MR-linac Consortium.

For a list of current consortium members, visit: www.elekta.com

Definitions
MR/RT (magnetic resonance radiation therapy): An exciting new approach to radiation therapy in which MRI images are captured while radiation dose is being delivered.
MR-linac: technology that integrates an advanced linear accelerator with a magnetic resonance imaging system (MRI). Combined, this system will allow for simultaneous radiation therapy delivery and MR images.
Elekta Unity: Elekta’s high-field MR-linac, the only magnetic resonance radiation therapy (MR/RT) system that integrates a diagnostic quality (1.5 Tesla) MRI scanner with an advanced linear accelerator. Powered by intelligent software, Unity provides soft tissue imaging during radiation therapy to adapt treatment delivery in real-time for precise cancer treatments.

Elekta Unity has a CE mark but is not available for commercial distribution of sale in the U.S.