Integration of 3.0T MRI into a Radiation Oncology Department: Initial Experience

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Purpose: To review the advantages and issues associated with integrating a dedicated 3.0T Magnetic Resonance (MR) Simulator imaging system into a radiation oncology department

Methods and Materials: In 2005, a GE 3.0T Signa Excite Twin Speed HD MRI scanner was installed for dedicated use as an MR Simulator in multi-modality treatment planning in the Department of Radiation Oncology. Initially, the unit's primary function was to provide treatment planning images for the more than 300 Gamma Knife ^{TM} (GK) radiosurgery patients treated in our department each year. Subsequently, MR imaging expanded to include treatment planning images in combination with CT and PET/CT studies for external beam (EBRT) patients. For treatment planning of the EBRT patients, fusions of MR studies with CT (or PET/CT) simulation images are performed, followed by multi-modality contouring on a GE Sim MD platform. Figure 1 shows a multi-modality image with target contours defined from MR, CT, and PET.

Results: The dedicated MR Simulator suite is adjacent to R/F conventional and PET/CT simulators, and centrally located for GK and EBRT patients. Staffing is provided by three MR certified technologists, two who are also RTT certified. Over 1600 3.0T MR imaging procedures for radiation treatment simulation have been performed since inception. The primary anatomic site for MR-based simulations is brain, followed by prostate and head/neck.

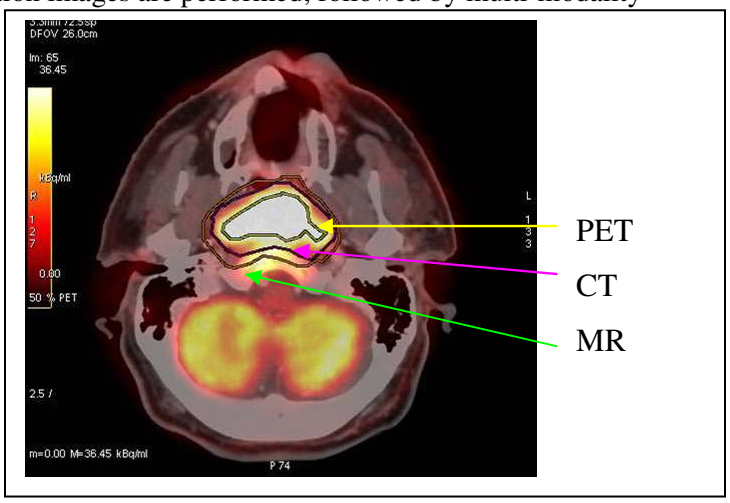

Figure 1: MR/CT/PET images superimposed with multi-modality target contours

Discussion: We have found that the improved soft tissue contrast seen in 3.0T MR images provides additional information for target definition in multi-modality radiation treatment planning in a variety of treatment sites. Figure 1 shows that defining targets by PET or CT alone can lead to underestimating the extent of the tumor. Additionally, the flexibility of MR pulse sequence selection allows treatment planning sequences to be tailored to fit specific imaging needs. This customization is commonly used in prostate patients with implanted fiducial markers, yielding artifact-free images. These gold markers cause large imaging artifacts in CT images. Our GK program has found that the use of the higher field imaging often reveals more lesions than seen at 1.5T (see ISMRM 2009 abstract #3848). Having a dedicated MR in the radiation oncology department provides better coordination of patient scheduling for imaging studies, particularly for those studies followed by same-day treatment.

Safety is a primary concern with this modality. Training of radiation oncology staff in the safety concerns of a high magnetic field environment has included reviews of projectile hazards, energy deposition concerns at high RF frequencies, and special considerations for patient screening prior to simulation.

Conclusions: Integrating a 3.0T MR scanner our radiation oncology department has provided numerous benefits for treatment planning and has required planning, safety training, and collaborations with diagnostic radiology colleagues.