

AbstractID: 12093 Title: Real-time MR-guided radiotherapy: integration of a low-field MR system

There has been increased interest in developing real-time MR-guided radiotherapy systems because of the potential of 3D imaging in real time with the improved soft-tissue contrast provided by MR. An overview of the issues related to the integration of a radiotherapy source (e.g. linac) with a low field magnetic system are discussed. The effects of the MR magnetic fields on radiation treatment plans for the various generic designs, and on the performance of the linac are presented. The effects of radio frequency fields from the linac upon the MR image acquisition process is introduced. Advantages of low fields are discussed: minimization of the magnetic field-induced distortions on plans; use conventional RTP instead of Monte Carlo for high fields; avoidance of hot/cold radiation spots at air-tissue interfaces seen with high fields; reduced susceptibility artifacts; reduced geometric distortions; reduced magnetic shielding issues; exploitation of the increased T1 contrasts at low fields for fast imaging. The main disadvantage at low fields is decreased SNR. Some proposed designs are given.

In particular, the first reported successful system providing any MR imaging during radiotherapy irradiation is discussed. This head prototype involves a 6 MV linac mounted onto an opening of a biplanar 0.2 T MR system. The linac-MR gantry would rotate together to the prescribed angle of irradiation delivery. The only observable difference between the MR images obtained with linac-radiation ON to linac OFF is the small changes in SNR. Other possible enhancements (replacing low field with high field MR if required, different types of magnets, etc) to the generic design are also given.

The lecture will offer an overview of the advantages and disadvantages of low field MR for real-time MR-guided radiotherapy (with the introduction of a working prototype).

Learning Objectives:

1. Understand the technical issues in integrating an MR system with a radiotherapy source, especially with a linac
2. Understand the issues related to distortions of the characteristics of dose deposition because of the MR magnetic field
2. Understand the imaging advantages of low field MR, as well as, its disadvantage
3. Understand the technical advantages in the integration of low field system with a linac
4. Understand the advantages/disadvantages of the different generic designs proposed to date