AbstractID: 13621 Title: Electron Beam Dose Modification Using Transverse MRI-Linac B fields; A Shielding-Delivery Investigation

Purpose: To examine magnetic field shielding possibilities in order to use the transverse magnetic field generated in MRI-Linac system with electron beams.

Method and Materials:
Using a magnetic field with electron beams in order to increase the dose in the target organ while sparing the surrounding tissue, was suggested in the past. A transverse B field applied in depth is causing the electrons to spiral and deliver their energy in a smaller volume, generating a pseudo Bragg peak. The MRI-Linac systems introduce up to 1.5 T transverse fields with respect to the beam direction. In order to facilitate this system for electron beam dose modification, an applicator that can shield the B field between the gantry and the patient is needed. This work estimates the shielding requirements for suggested applicator by using Comsol Multyphysic® to simulate the spatial magnetic fields. Those field map components are then exported to Fluka, a particle physics transport package, to transport the electron beam. Static and dynamic shielding concepts can be used. The static shielding is made in several lairs from varying materials (mu-metal and Carbon steel), while the dynamic uses coils to compensate the field lines. Those high permeability materials have relative low saturation value, and hence their permeability reduces when introduced to high fields, according to their hysteresis curve.
Results:
Neglecting several practical issues, this initial research shows up to two fold depth dose increase with respect to the surface dose, for a 25.0 MeV beam. Nevertheless high magnetic field densities were observed from the static applicator simulation that requires further feasibility investigation.
Conclusion:
Clinical potential is shown using the transverse B filed with electron beam if proper shielding is achieved. Further investigation is needed to overcome shielding and practical drawbacks in order to facilitate this delivery.

Conflict of Interest (only if applicable):