AbstractID: 10871 Title: The application of MRI pulse sequences for in-vivo verification of the proton beam radiotherapy

Purpose: The purpose of this study is to assess the clinical feasibility and effectiveness of magnetic resonance imaging (MRI) for quality assurance and dosimetry in proton beam therapy. The hypothesis is that as MRI relies on the relaxation times of protons within chemical compounds present in the tumor that are affected by proton beam therapy. Therefore, the biochemical response of the tumor site to proton therapy should be visible on the MRI machine after 1 or more days post-treatment.

Materials & Methods: A 1.5 Tesla MRI machine was used in the present study. Several gel and animal tissue phantoms were made to assess the feasibility of the MRI to quantitatively and qualitatively capture the additional therapeutic protons. The protons have a finite range in the gel/tissue, where the majority of the protons accumulate at the end of the range. The gel phantoms were composed of either gelatin (high content of water) or mayonnaise (high content of fatty compounds). The tissue phantom was composed of bovine tissue with muscle and fat. The proton beams used had a range of 16cm in water (160 MeV kinetic energy) and modulation of 6cm. A total dose of 50 cGray was delivered, which took a total of 5 minutes. Each phantom was imaged with dedicated T1, T2 and T2* weighted MR sequences post-proton irradiation.

Results: A T1 (3D VIBE) image (TE=2.45ms, TR=5.27ms) of the gelatin and bovine tissue produced a bright oval region representing the end-of-range to within 3mm of the proton treatment. While a T2* image (TE=48ms and TR=2200ms) for the mayonnaise phantom indicated a large bright area in the phantom representing the broad proton beam irradiating the phantom.

Conclusions: Preliminary results obtained with gelatin, mayonnaise and bovine tissue indicates that MRI is an excellent tool for quality assurance proton range.