

#### Purpose:

To perform a 3D dosimetric verification of a RapidArc™ treatment using Ferrous Xylenol-orange (FX) gels and optical CT.

#### Methods:

Two FX gels from the same batch were prepared using 0.3 mM ferrous-ammonium-sulphate, 0.05 mM xylenol-orange, 65 mM sulfuric acid and 6% by mass porcine gelatin dissolved in distilled water. Upon preparation, the FX gel solution was poured into two separate 0.5 mm thick PFA Teflon-walled cylinders (9.6 cm diameter, 10 cm height). One FX gel was used for RapidArc™ verification. The RapidArc™ treatment plan created with Eclipse v.8.9 software (Varian Medical Systems), consisted of 6 MV x-ray beams delivered with a single 360° gantry rotation by Varian Clinac 21IX, and a target dose of 237 cGy. A second FX gel was irradiated with a 12 MeV electron beam to independently calibrate the dose response. Both FX gels were read out using a commercial optical cone-beam CT scanner at a central wavelength frequency of 590 nm (Vista, Modus Medical Devices). Optical CT reconstructions at 0.5 mm<sup>3</sup> voxels were averaged to provide 1 mm<sup>3</sup> voxels for comparison with the planned data.

#### Results:

In the target volume of comparable slices, planned and measured dose distributions (in units of cGy) are in agreement within 2-3%. In the low dose volume region, the planned dose data is generally less compared to the measured gel data by about 5%. Contrast is slightly reduced in the cone-beam CT gel images which may be due to residual stray light. The data reveals that larger volumes of gel (>2 L) will be needed for the verification of large target and low dose volumes.

#### Conclusions:

FX gel dosimetry with optical CT readout provides accurate volumetric dose verification and quality assurance that will lead to the safe clinical implementation of complex radiotherapy applications such as RapidArc™.