AbstractID: 3031 Title: The Dose Response of Radiochromic Gel Dosimeters: Dose Fractionation Effects

Purpose: To investigate the magnitude of dose fractionation effects on the dose response of radiochromic Ferrous – Xylenol orange – Gelatin (FXG) and gelatin-free FX dosimeters.

Method and Materials: The FXG gels contained distilled water, 50mM sulfuric acid, 0.3mM ferrous-ammonium-sulfate, 0.05mM xylenol orange (XO) from suppliers Sigma(X0127) and Aldrich(22785-4), and 4% by mass of gelatin. On preparation, the liquid gel was poured into 1cm polymethymethacrylate cuvettes, sealed with Parafilm and refrigerated to 4°C. Samples were irradiated using a ^{60}Co unit to 0-5Gy. Thirty minutes after irradiation, optical transmissions through the samples were measured (referenced to 1cm water-filled cuvettes) at 589nm using a spectrophotometer (Hitachi-Perkin-Elmer-139). Samples were re-irradiated to the same doses, followed by optical transmission measurements. The procedure was repeated with gelatin-free FX aqueous solutions containing XO supplied by Sigma, Sigma-Aldrich(398187-5G) and Aldrich, respectively. Optical transmission measurements were made through 10cm pathlength cuvettes to detect smaller differences.

Results: For the FXG gel made with Aldrich XO, a linear dose response was observed in the first fraction irradiation but only above a threshold dose of 0.5Gy. Use of reagent grade Sigma XO lowered the dose sensitivity and threshold dose value to 0.2Gy. For both FXG gels, the threshold dose was removed by pre-irradiation with the first radiation fraction or by storing the gels for two weeks in the dark at 4ºC. FX solutions exhibited a similar behaviour as FXG gels thus suggesting that gelatin *per se* is not responsible for the threshold dose effect.

Conclusions: FXG gels exhibit dose fractionation effects which can potentially lead to inaccurate dosimetry for segmented radiotherapy. Manufacturing FXG dosimeters with reagent grade XO lowers the magnitude of the threshold dose. It appears that accelerated oxidation by a uniform pre-irradiation or by auto-oxidation (through storage of gels for a pre-determined time) is needed to eliminate the threshold dose effect.