AbstractID: 6435 Title: Designing a multiple spin-echo pulse sequence optimized for polymer gel dosimetry

Purpose: To formulate a systematic method to establish an optimized MRI pulse sequence using an experimental MRI scanner as an example for polymer gel dosimetry (PGD).

Methods and Materials: 3D dosimetry for clinical applications needs 2x2x2mm^3 spatial resolution with dose uncertainty lower than 3%. Fundamentals of MRI physics lead to optimized imaging parameters for R2 measurements. We chose a multiple spin-echo technique of CMPG with variable crusher pulses. The 2D imaging technique was supplemented with interleaved slice acquisition for higher efficiency. The optimized parameters were implemented in a 1.5T MR system (Magnex Scientific, Oxfordshire, UK) using the Apollo pulse programming/data acquisition system (Tecmag Inc., Houston, TX). Measurements were carried out for a phantom containing varying R2 values.

Results and Discussion: The signal-to-noise ratio (SNR) of baseline signals of our scanner was low; thereby, acquisitions had to be repeated for 25 times to raise SNR to a value greater than 50. The spin echo time was determined to be 22 ms based on the available gradient field strength. Since TR should be longer than 3 times of the longest T1, TR was set to 3 sec. The number of spin echoes (NSE) has to be sufficiently large since the uncertainty of the estimated R2 value decreases with increasing NSE. The number is limited because the signal noise departs from Gaussian as the signal decays. For SNR=50, NSE should be between 15 and 20 for R2 ranging from 2 to 10 s^{-1}. For these imaging parameters the total scan takes 21.3 hours to obtain 48 2-mm slices. We showed that increasing SNR broadens the measurable range of the R2 value and reduces NSE.

Conclusion: A key requirement of high resolution and high precision MRI for PGD is to achieve SNR larger than 50.