AbstractID: 13446 Title: Combined Effect of Intrinsic Energy Dependence and Intrinsic Linearity on TLD-100 Response to Moderately Filtered 50 kVp x-ray Spectra Relative to 60Co

Purpose: To determine the combined effect of intrinsic linearity and intrinsic energy dependence on the relative response of LiF:Mg,Ti thermoluminescent dosimeters (TLD-100) to moderately filtered 50 kVp x-ray spectra versus ^{60}Co at low and high doses.

Method and Materials: Two sets of TLD-100 chips were used to determine the relative response of TLD-100 to an x-ray beam versus ^{60}Co at two doses. One set of TLDs was irradiated to doses of 0.1 Gy and 10 Gy in an x-ray beam matched to the NIST M50 beam, while the other set was irradiated with ^{60}Co to the same dose levels. The intrinsic linearity was found by taking the ratio of the average corrected TL per unit dose at 0.1 Gy and 10 Gy for each beam quality. In addition, the response of TLD-100 to the M50 beam versus ^{60}Co was found by taking the ratio of the average corrected TL for each beam quality at a particular dose.

Results: The intrinsic linearity correction for TLD-100 at a dose of 10 Gy was 0.729±0.012 for ^{60}Co and 0.819±0.024 for the M50 x-ray beam, which includes the overresponse of the photomultiplier tube. The response of TLD-100 irradiated with the M50 x-ray beam relative to ^{60}Co is 1.122±0.027 at 0.1 Gy and 0.999±0.021 at 10 Gy.

Conclusion: TLD-100 exhibits greater supralinearity at 10 Gy when exposed to ^{60}Co versus the low-energy x-rays. This indicates that intrinsic linearity is dependent on both dose and beam quality. In addition, there is a discrepancy of more than 10% in the response of TLD-100 to M50 versus ^{60}Co from 0.1 Gy to 10 Gy, due to the combination of intrinsic energy dependence and intrinsic linearity. This work concludes that both of these effects must be properly accounted for in dose measurements using TLD-100, especially for high doses.