

AbstractID: 3649 Title: Characterization of Two Optically Stimulated Luminescence (OSL) Dosimeter Systems for Monitoring Entrance Skin Dose during Interventional Procedures

Purpose: There is a great concern of patient skin injury and a demand for an effective technique for direct measurement of patient dose in real-time. We have characterized two dosimeter systems for possible future development of a clinically feasible dosimetry system. Success of this investigation may lead to significant reduction of patient radiation dose and skin injury.

Method and Materials: High-sensitivity, fiber-optic dosimetry systems based on OSL from $\text{Al}_2\text{O}_3:\text{C}$ and $\text{KBr}:\text{Eu}$ single crystals (detectors) were developed at Oklahoma State University. The physical characteristics of the detector systems were investigated using clinical fluoroscopic machines. The detector's dependence on x-ray energy, exposure rate, and the angle of x-ray incidence were evaluated. The data from the dosimetry systems are normalized to ion chamber readings under the same conditions. The detectors were attached to an anthropomorphic chest phantom for physicians to evaluate the visibility of the detectors in the fluoroscopic image. A mathematical model was developed to simulate data sampling of the $\text{KBr}:\text{Eu}$ system when used with pulsed fluoroscopic equipment.

Results: Both types of detectors were nearly invisible under various kVp conditions for typical fluoroscopic procedures. Across the energy range of 60 to 120 kVp, energy dependence was less than 23% for $\text{Al}_2\text{O}_3:\text{C}$ system and less than 8% for the $\text{KBr}:\text{Eu}$ system. Dose rate dependence was less than 2.1% for the $\text{KBr}:\text{Eu}$ system, but the $\text{Al}_2\text{O}_3:\text{C}$ system responded too slowly. Angular dependence was less than 6% for the $\text{Al}_2\text{O}_3:\text{C}$ system and 3.5% for the $\text{KBr}:\text{Eu}$ system. The mathematical model shows that the $\text{KBr}:\text{Eu}$ system should function consistently under various pulsed fluoroscopic operations.

Conclusion: The OSL detectors are of small size, yet sensitive to low exposure, and exhibit practically invisible in fluoroscopic images. Response to variation of fluoroscopic x-ray parameters is acceptable. Both systems show promise for a clinically feasible skin dose dosimetry system.