AbstractID: 14147 Title: Evaluation of a Small-field Prototype Imager Based on a Fiber Optic Scintillation Glass Array (FOSGA): An Emerging Technology for Low Dose Megavoltage Cone-beam CT

Purpose: To evaluate a small-field prototype megavoltage x-ray imager based on a fiber optic scintillation glass array (FOSGA) being developed for low dose megavoltage cone-beam CT. **Method and Materials:** FOSGA is an emerging technology for superior megavoltage imaging based on high quantum efficiency scintillation glass fibers inserted into a tungsten-polymer septal grid and coupled to a-Si flat-panels. Recent theoretical studies showed that it can provide an order-of-magnitude improvement in image quality compared to current phosphor screen flat-panels based on modulation transfer function (MTF) and detective quantum efficiency (DQE) models. A prototype FOSGA detector (8 cm x 8 cm, 9 mm thickness) was constructed using 0.9 mm diameter scintillation glass fibers (1.1 mm pitch, 0.1 mm septa). Detector components were obtained and assembled using patented technology for grid fabrication (tomoltihographic molding), fiber drawing, and mechanized fiber insertion. Preliminary imaging was performed with 6 MV x-rays to evaluate detector performance and image quality via measurements of pixel sensitivity and uniformity, MTF, and DQE. **Results:** The structural accuracy of the detector assembly was validated using optical scans and uniformity measurements (< 50 μm fabrication accuracy, 100% fiber insertion). The prototype FOSGA imager provided good image quality (theoretical DQE limit ~ 0.07 at 0 cy/mm for this geometry), indicating significant improvement over current megavoltage imagers (DQE < 0.02). **Conclusion:** The successful construction and implementation of our prototype detector demonstrated the feasibility of accurately fabricating structured scintillator arrays. The image quality measurements will be used as a benchmark for a future large-field imaging system using thicker scintillator arrays with finer sampling (DQE ~ 0.25 at 0 cy/mm expected). The superior imaging properties of FOSGA supported by viable mechanisms for cost effective fabrication make it a strong candidate for low dose megavoltage cone-beam CT with soft-tissue contrast visualization.

Conflict of Interest (only if applicable):