

Purpose: To describe and test a novel and potentially fast, 3D relative dosimetry method based on the observation of scintillation light from an irradiated liquid scintillator (LS) volume serving simultaneously as a phantom material and as a dose detector medium.

Method and Materials: The method, named Three Dimensional Scintillation Dosimetry (3DSD), uses visible light images of the liquid scintillator volume at multiple angles and applies a tomographic algorithm to a series of these images to reconstruct the scintillation light emission density in each voxel of the volume. The method is applied to a Ru-106 eye plaque immersed in a LS volume and the reconstructed relative 3D dose map is compared along selected profiles and planes with radiochromic film (RCF) and diode measurements.

Results: The comparison indicates that the 3DSD method agrees with the relative RCF dose distributions for a small (3 mm high by ~12 mm diameter) part of the volume within 25% for most points. Larger, up to 45 % deviations are observed for fraction of the points due to elongation of the RCF transverse isodose contours, not seen by 3DSD. For a comparison, the spread of the RCF measurements ranges from 10 to 15% within this volume. The method is not accurate close to the edge of the plaque, close to the edges of the scintillator volume and further than ~9 mm from the plaque surface.

Conclusions: 3DSD shows potential for quick 3D relative dosimetry in a small volume with accuracy and resolution comparable to existent 2D techniques. More accurate determination of the point spread function of the system, of the light scatter within the cell, of the dose-rate and energy related quenching effects and enhancement of the algorithm for partially blocked projections are expected to extend accuracy to larger volumes and closer to the applicator edges.