Despite recent advances in radiochromic film and gel dosimetry techniques, radiation therapy still lacks an efficient, accurate and convenient dose measurement method capable of measuring the dose simultaneously over a plane or volume (3D). We investigate the possibility of creating a new 3D dose measurement method for brachytherapy by detecting the collimated scintillation light emitted by an irradiated volume at multiple angles and reconstructing the light emission density in the volume with tomographic analysis. The liquid scintillator (LS) which fills the volume plays simultaneously the role of a water equivalent phantom material and dose sensitive media. Through parametric study of the LS attenuation and absorption coefficients, Monte Carlo dose calculations, scintillation efficiency measurements, and point spread function measurements we developed new LS materials. The calculated dose in LS is within 5% of dose to water for distances up to 3 cm from 30 keV point photon source and up to 5 cm for 50 keV and higher energy photons. The new LS solutions are loaded with a Si containing compound, retain more than 85% of the scintillation efficiency of the unloaded solutions, and exhibit high localization of the scintillation process. The new LS solutions are superior with respect to efficiency and water equivalence to plastic scintillator materials used in dosimetry and may be used apart from the proposed 3D method.

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