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Depth Dose measurement by Using Al_2O_3 OSL Dosimeters in High Energy Photons in the Presence of Air Cavity and Density Inhomogeneities

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ABSTRACT

Air cavities and tissue density inhomogeneity significantly affects the distribution of radiation doses, potentially resulting in adverse consequences such as cancer recurrence. This research aims to assess the accuracy of Al_2O_3 optically stimulated luminescence (OSL) dosimeters in measuring doses within varying thicknesses of air cavities (3, 5, and 8 cm) and tissue inhomogeneities of low and high density simulated by the lung and bone phantoms. An expanded polystyrene (EPS) was employed in homogeneous solid water® phantoms to simulate the air cavity. The percentage depth-dose (PDD) curves at 6 MV photon were obtained in both presence of air cavity and density inhomogeneities and compared to that in the EBT3 radiochromic film dosimeters and treatment planning system (TPS). The results indicated that the presence of an air cavity and tissue inhomogeneities affected the depth dose measured in OSL dosimeters, EBT3 films and TPS. OSLD and TPS showed good agreement at the center of the cavity, which is within ±5% but could not estimate scattered radiation to the distal and proximal surfaces of the air cavity. The obtained p-values showed no significant differences of dose measured in OSL dosimeters compared to those in EBT3 films and TPS. The Kruskal Wallis test and Mann-Whitney showed no significant difference between OSL dosimeters, EBT3 film and TPS in the measurement of depth doses in the presence of density inhomogeneities. The overall results indicated the suitability of OSL dosimeters as indirect dosimeters for the measurements of depth dose in the presence of air cavity and tissue density inhomogeneities.

Keywords: OSL dosimeters, high energy photons, air cavity, density inhomogeneity
Area of research: Radiotherapy