

AbstractID: 6894 Title: Orthovoltage Dosimetry: Percent Depth Dose Multiplicity from Two Energies

Purpose: To produce a multiplicity of depth dose curves on a two-kVp orthovoltage system by appropriate combination of the 75 kVp and 225 kVp x-ray beams.

Method and Materials: Using tabulated percent depth dose (PDD) curves at 75 and 225 kVp for five rectangular applicators (4x6, 6x8, 8x10, 10x15, and 15x20 cm²) for our Philips RT-250 unit, we calculated the mixed-beam PDDs for each applicator using $w_{75} \cdot \text{PDD}_{75} + w_{225} \cdot \text{PDD}_{225}$, where w denotes the beam component weight, the subscript indicates the component kVp, and $w_{75} + w_{225} = 1$. By specifying a dose D_0 at the surface and an isodose level at a particular depth, we calculated the required beam weights; incorporating the tissue dose rates then allows us to calculate the beam-on times for the 75 and 225 kVp beams, respectively.

All single- and mixed-energy PDDs were verified in 20x20 cm² blocks of solid water (Gammex RMI, Middleton, WI) using a field standard electrometer and ion chamber set. The ion chamber fit snugly at the centre of a 2.0 cm thick block. The depth doses were measured at solid water depths of 1.0 to 15.0 cm keeping the source-to-surface distance constant at 50.0 cm, and using 10.0 cm of backscatter material. The PDD values were calculated by scaling the measurements relative to the tabulated or theoretical values at a depth of 1.0 cm.

Results: The ion chamber measurements at 75 and 225 kVp were within 2 percentage points of the tabulated values for all rectangular applicators. Similarly, the mixed-energy PDD curves for $f_{75} = \{0.25, 0.5, 1.0\}$ were also within 2 percentage points of the theoretical expectations.

Conclusion: A firm theoretical formalism to create PDDs combining the 75 kVp and 225 kVp beams was formulated and verified experimentally using ion chamber measurements. Our mixed-energy methodology allows one to synthesize a multiplicity of PDDs between any two orthovoltage energies.