

Radiation parameters of high dose rate iridium-192 sources

Matthew B. Podgorsak

A lack of physical data for high dose rate (HDR) Ir-192 sources has necessitated the use of basic radiation parameters measured with low dose rate (LDR) Ir-192 seeds and ribbons in HDR dosimetry calculations. A rigorous examination of the radiation parameters of several HDR Ir-192 sources has shown that this extension of physical data from LDR to HDR Ir-192 may be inaccurate. Uncertainty in any of the basic radiation parameters used in dosimetry calculations compromises the accuracy of the calculated dose distribution and the subsequent dose delivery. Dose errors of up to 0.3%, 6%, and 2% can result from the use of currently accepted values for the half-life, exposure rate constant, and dose buildup effect, respectively. Since an accuracy of 5% in the delivered dose is essential to prevent severe complications or tumor regrowth, the use of basic physical constants with uncertainties approaching 6% is unacceptable. A systematic evaluation of the pertinent radiation parameters contributes to a reduction in the overall uncertainty in HDR Ir-192 dose delivery. Moreover, the results of the studies described in this thesis contribute significantly to the establishment of standardized numerical values to be used in HDR Ir-192 dosimetry calculations.