Response to Dr. Janicki’s Letter to the Editor [Med. Phys. 29, 260 (2002)]

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To the Editor,

Our recent paper “Self-absorption correction for P-32, Au-198, and Re-188 stents: Dose point kernel calculations versus Monte Carlo” compared Monte Carlo and dose point kernel (DPK) calculations for the dosimetric characterization of radioactive stents.¹ Both methods agreed with gafchromic film dose falloff measurements within 5% over 0.4–3.5 mm from the stent surface. To test if the simple scaling method could be used, we calculated the scaling factors between water and steel for the three radioisotopes being studied. The Monte Carlo-based results and the scaling factor calculations did not agree. Further investigation indicated that the adjustment of the relative attenuation factor \( \eta \) did not improve the fit of the scaling method to our simulations and measurements. This led us to conclude that “the scaling method cannot be applied to high-Z materials such as steel.” Dr. Janicki disagrees and feels that we incorrectly implemented the scaling method.

In his first contention, Dr. Janicki mentions a seminal paper by Cross in 1968.² In this paper it is concluded that a linear expression is able to give values of relative attenuation (= scaling factors) for 13<Z<80. However, a more recent paper by Dr. Cross et al. explains in detail why the scaling method must be used carefully for high Z-materials (see pp. 1391–1395 of their article).³ Specifically, it is important that the medium be homogeneous and of uniform density. Furthermore, the scaling method is based on the assumption that the spectra remain the same in both media. Cross et al. calculated electron spectra at the exit of a high-Z layer and compared them with spectra at the exit of a scaled water layer. The exit electron spectrum of silver was much harder than those of water windows of various densities and thicknesses. The spectrum of steel, our stent material, will behave similarly and the assumption of similar beta spectra is thus violated. This accounts for our observed smaller rate of decrease of dose with distance and for the overestimation of the steel effect by the scaling method. As we have shown in Fig. 21 of our paper, using a lower \( \eta \) value lowers the steel effect and produces better agreement with our DPK method. The higher \( \eta \) is, the higher the overestimation of the steel effect will be.

With respect to his second contention, we believe that Dr. Janicki misunderstood the third sentence of our results section (p. 1894).¹ It reads as follows: “Using our scaling factors and calculating the depth dose behind 100 \( \mu \)m of steel to homogeneous water, we obtain the dose distributions shown in Fig. 19.” Changing “calculating” to “converting” might clarify the method we used. The sentences that follow discuss the results in homogeneous water and describe what Figs. 19 and 20 show, namely, depth dose curves in homogeneous water, not depth dose curves behind 100 \( \mu \)m of steel. The dose \( K^w \) was calculated from \( K^m \) (not the other way around), and decreasing \( \eta \) thus leads to decreasing doses. We calculated \( K^m \) in 100 \( \mu \)m of steel using Monte Carlo methods, then applied the scaling method to calculate \( K^w \) in homogeneous media and compared the results to Monte Carlo calculations in homogeneous media. The equation is given in the methods section (the last formula before the results section) and shows that \( K^w (=D^w \) in our paper) was calculated as a function of \( K^m (=D^m \) ).


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