

Catheter-based radiation delivery systems employing both β -particle and γ -ray emitters are currently being investigated for their efficacy in addressing restenosis following PTCA (Percutaneous transluminal coronary angioplasty). The dosimetric consequences of source centering within the arterial lumen and presence of residual plaque are potentially important issues for the uniform delivery of dose to the arterial tissue. In this study, we have examined the effect of source centering on the resulting dose to the arterial wall from clinical intravascular brachytherapy sources containing ^{32}P and $^{90}\text{Sr}/^{90}\text{Y}$. Monte Carlo simulations using the MCNP code were performed for these catheter-based sources with offsets of 0.5 mm and 1 mm from the center of the arterial lumen in homogenous water medium as well as in the presence of residual plaque. The results indicate a variation ranging from +70% to -40% for ^{32}P source and +50% to -30% for $^{90}\text{Sr}/^{90}\text{Y}$ at a radial distance of 2 mm from the center of the coronary artery, relative to the dose from a centered source, for a 0.5-mm offset. A concentric residual plaque layer was also modeled so as to assess the combined influence of offset and residual plaque on the dosimetry. Finally the effect of cardiac motion on catheter position and the resulting change in dosimetry were also examined by considering two separate cases of catheter displacement. The catheter was assumed to deviate from the central position due to contraction and relaxation of the heart. The results demonstrate that dose can vary between -28% to +91% with cardiac motion.