The clinical application of encapsulated radioactive sources in brachytherapy plays an important role in the treatment of malignancy. ^{125}I and ^{103}Pd sources have been widely used in the permanent implant of prostate cancer. An important consideration for the choice of brachytherapy sources is their relative biological effectiveness (RBE). Previous calculations of this quantity have used the dose-averaged lineal energy, y_D, as a measure of biological effectiveness. In this approach, however, the selection of a relevant site size remains an open question. Here we avoid this problem by using the generalized theory of dual radiation action to calculate the initial slope, α, of the dose-effect curves using the proximity function, t(x), and the biological response function, $\gamma(x)$. Proximity function t(x) is the probability distribution function of distances between pairs of sublesions; and $\gamma(x)$ is the probability that two sublesions at a distance x apart results in a lesion. The integral of $\gamma(x)t(x)$ over the separation x, ξ, can be employed to estimate the RBE of a given isotope by:

$$RBE_{isotope}= \xi_{isotope}/\xi_{Co} \quad (1)$$

where

$$\xi=\int \gamma(x)t(x)\, dx \quad (2)$$

Functions t(x) have been calculated for each source using Monte Carlo transport codes. The function $\gamma(x)$ has been taken from a published analysis. The RBE values thus obtained are: 1.5 for ^{125}I and 1.6 for ^{103}Pd. The question of whether an "effective" site size exists where y_D approximates best the variation of α with radiation quality is also addressed.