Comparison of Convolution Method with Monte Carlo Simulation by EGS4

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Abstract

Nowadays, we use radiotherapy planning system (RTPs) for three-dimensional dose distribution in patient. It is important to grasp the dose distribution because we must check whether radiation beam correctly irradiates a target or not.

Generally, there are two types in dose calculation algorithms. One is based on measured data, the other is based on calculated data. Former type is Batho method, delta volume method and equivalent TAR method and so on. Latter type is convolution, superposition and Monte Carlo method.

Recently, convolution and superposition method came to be used. There are Terma and Kernel to calculate dose distribution by these methods. Terma is defined as total energy released primary photon interaction per unit mass. Kernel is defined as the three-dimensional spatial distribution of energy at any points. Deposited energy can be calculated by following convolution integral;

$$D(x,y,z) = \iiint T(x',y',z') \cdot K(x-x',y-y',z-z') \times dx'dy'dz' \quad (1)$$

Where $D(x,y,z)$ is energy deposited at the point (x,y,z), $T(x',y',z')$ is Terma at the point (x',y',z'), and $K(x-x',y-y',z-z')$ is Kernel at the point (x,y,z) far from the point (x',y',z').

However, Terma and Kernel are usually calculated by Monte Carlo simulation because those can't be measured.

In this study, we tried to obtain absorbed dose from Eq. (1) using Terma and Kernel calculated by EGS4. Then, the absorbed dose was compared with that calculated without Terma and kernel.