

# Development a mathematical algorithm to calculate the absorbed dose in bone marrow during low-energy X-ray

Zaker Salehi<sup>1</sup>, Zahra pakkhah<sup>1\*</sup>

<sup>1</sup> Department of Radiation Sciences, School of Paramedical Sciences, Yasuj University of Medical Sciences, Iran  
zpakkhah@gmail.com

## **Abstract:**

**Background:** Bone marrow is an important element of bone tissue that is involved in blood formation. Due to the high sensitivity of this tissue and importance of its function and also considering the hazards of X-ray radiation, it is necessary to identify the factors affecting the bone marrow and prevent the occurrence of destructive effects. Calculating the absorbed dose in bone marrow will be useful to estimate the damage of radiography low-energy radiation.

**Aim of the study:** This study aimed to calculate and evaluate the absorbed dose of X-ray in bone marrow of femur during radiographic radiation of low-energy X-ray using mathematical modeling.

**Materials and methods:** A simplified model was designed according to the anatomy of bone and the location of bone marrows. In a very simple early model, bone and bone marrow were estimated with cubes and spheres. Parameters such as source to skin surface distance, bone to skin surface distance, bone to hypothetical bone marrow sphere distance, bone marrow radius density, density of environmental components and hypothetical cube dimensions were considered for mathematical modeling. Then, using the equations of absorbed dose in air and mediums and also considering the ratio of the mass attenuation coefficient of air, skin, bone and bone marrow, the final equation was obtained to calculate the amount of absorbed dose in bone marrow. The final equation was modified using the Bloch equation. The results obtained from the mathematical model were compared with AAPM as standard data.

**Results:** The results showed almost 50% discrepancy for the kVp between 40 and 60. However, in the range of 100 to 130 kVp, the disparity between the results and standard data values showed was less than 30%, which improved with increasing energy.

**Conclusion:** In this study, an attempt was made to calculate the amount of X-ray absorbed dose in the bone marrow during radiological tests using mathematical modeling. Although due to the simplifications of this model, the disparity between the results and experimental calculations was significant, but this study showed that mathematical algorithms are an effective non-invasive method for evaluation of radiation dose calculations.

**Keywords:** *mathematical algorithm, bone Marrow, Absorbed dose*

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