AbstractID: 8360 Title: Modeling Small Animal Micro Irradiator Orthovoltage Sources

Purpose: To model and compute spectral output, intensity, dose fall off, dose rate, and penumbra that can be achieved using industrial orthovoltage x-rays sources used in small animal micro irradiators.
Method and Materials: Using data from commercial sources as input parameters we investigated the performance of orthovoltage sources that can be used in small animal micro irradiators. We developed a pencil beam propagation code which was combined with a mouse digital phantom (MOBY-John Hopkins Univ.) to simulate a complete small animal delivery system (source + animal model). We computed the source spectral output, beam filters, beam penumbra, soft tissue to bone dose ratio, dose fall off, and total dose delivered to the animal model. Sources covering the range of 150 to 450kVp with submillimeter focal spot were simulated.

Results: We determined that a source of nominal maximum potential output of 320kVp and focal spot of 0.4x0.4 mm^2 outperformed other available sources. We designed an optimum Thoraeus-like filter to obtain a bremsstrahlung spectrum energy greater than 2 mm of Cu to increase skin spare and reduce bone dose. An average beam penumbra of 0.25mm and a dose rate of 40Gy/min were possible using this filtered beam. Higher energy sources would increase cost and shielding thickness. Lower energies sources showed limited intensities when they were aggressively filtered.

Conclusion: We developed a numerical model to evaluate the radiation dose delivered by orthovoltage sources typically used in small animal irradiators. We concluded that when radiation quality, skin dose, bone to tissue dose ratio and animal throughput were considered, commercial orthovoltage sources of nominal energy of 320 keV were the best fit for conformal small animal micro irradiators. To obtain high conformality a submillimeter focal spot of 0.5x0.5 mm^2 or less must be used.

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