

Purpose: This work describes planned enhancements to a synchrotron medical radiological beamline, which will improve its efficacy for therapeutic and diagnostic radiological research using monochromatic x-rays. The primary focus of the present study was the beamline's energy and dose calibrations prior to sample irradiation. This work is crucial for an ongoing study of cell survival of IUdR-laden cells undergoing photoactivated Auger electron therapy using monochromatic x-rays.

Methods: Calibrations of the monochromatic x-ray beam are essential for checking the beam energy as well as understanding the variability of the beam quality and dose output. Energy measurements have been performed using Bragg diffraction of a collimated beam from a crystalline silicon powder sample (Si640c). The resulting Debye-Scherrer diffraction rings were recorded using a digital x-ray detector. This detector has replaced the use of radiographic film utilized for earlier measurements. Dose measurements of the beam have been performed in a PMMA phantom, using a cylindrical air-equivalent chamber to measure the dose to water for depths of 0.6 - 10.1 cm.

Results: Current results suggest that the beam energy can be measured to within < 0.1 keV. Exposure times of 2 seconds were used to record the Debye-Scherrer rings, and this has greatly improved upon the 30 - 60 minute exposure times required using radiographic film. The dose rate has been calibrated as a function of the decaying synchrotron ring current, and changes in the beam quality following synchrotron re-injection have been demonstrated.

Conclusions: The use of a digital x-ray detector has improved the efficiency of the energy measurements. The dose calibration measurements provide a reliable test of the variability of the beam quality and dose output.

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