AbstractID: 10785 Title: A CMOS-based digital imager integrated with an orthovoltage x-ray therapy unit for guidance of precise small animal irradiation

Purpose: Orthovoltage x-ray units are commonly used in experimental irradiation of small animal models. However, the irradiation of targets that are deep-seated within the animal is rather problematic without an image-guidance system. This study was aimed at evaluating the use of a CMOS-based portal-imaging system to provide image-guidance for small animal irradiation using an orthovoltage unit.

Method and Materials: The imaging system consists of a CMOS-based x-ray sensor and a frame grabber connected to a PC. A fast frame rate (20 frame/sec, 50 ms/frame exposure, 96 μm pixel size) was used to minimize image saturation due to the relatively high output of a typical therapeutic x-ray unit (Phillips RT-250). We first evaluated the imaging system with a contrast and resolution phantom. A pilot animal study with this system was then carried out for experimental thoracic irradiation of mice to induce pulmonary fibrosis. We used 75-kVp beam for imaging, and 250-kVp beam for the treatment, while keeping the same irradiation geometry setup. Based on image findings, radiation shields to protect the critical organs were custom-made.

Results: The 8-mm diameter contrast discs in the testing phantom, with a minimum contrast of 0.9%, are all visible in the images. The spatial resolution based on bar-pattern findings is at least 4.0 lp/mm. Mouse anatomical structures are clearly visible in the images. The portal images provided sufficient information for target localization and shield placement in the mice lung irradiation experiments.

Conclusion: The CMOS-based imaging system provides high quality images. It is convenient to use in comparison to the use of x-ray films. We expect more accurate small animal irradiation results under the portal-imaging guidance. Development of future applications of the imager may include multi-directional imaging guidance and 3-dimentional cone-beam CT guidance for animal irradiation.

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