Purpose: Synchrotron generated Microbeam Radiation Therapy (MRT) has been shown to cause significant damage to radioresistant brain tumors while sparing surrounding normal tissues in rats. The potential translation of this experimental type of therapy to clinical use is hindered by the fact that the mechanism behind MRT is still not fully understood and by the lack of widely available MRT devices. We have developed a prototype compact MRT system based on carbon nanotube (CNT) field emission x-ray technology in the hopes of enabling more cancer biologists to explore the radiobiology behind MRT. Our purpose in this study is to begin the integration of a micro-CT scanner with the MRT system for image guided MRT delivery.

Methods: We tested the feasibility of using the micro-CT scanner in conjunction with the MRT system by designing a specialized phantom to be scanned, targeted, and irradiated by two pre-existing independent systems. After scanning, the phantom was visualized by our treatment planning software 'Micro-PLUNC', where the desired beam pattern was inserted into the reconstructed images of the phantom. Afterwards, positioning parameters were calculated to allow for the beams to be delivered at the planned locations within the phantom. Finally, the phantom was irradiated with internal Gafchromic films to verify the delivered dose pattern.

Results: A pre-determined microbeam pattern was successfully delivered to within +/- 150 um accuracy. Films placed on the phantom holder and within the phantom itself confirmed the desired dose pattern. Based on this study, construction of the Micro-CT guided MRT dual system was begun.

Conclusions: The feasibility of using our existing Micro-CT technology as image guidance for MRT was displayed. When integration is fully completed, the new system will allow for precise dose delivery in small animals and will prevent wasting dose in areas outside the treatment volume.

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