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Microbeam Radiation Therapy controls in vivo tumors more effectively than conventional radiation treatment

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Introduction
Microbeam Radiotherapy (MRT) and Minibeam Radiotheraoy (MBRT) have proven to not only increase normal tissue tolerance but also the ability to combat tumors more effectively. The latter aspect is the focus of our research, where we are interested in the tumor control probability of MRT and MBRT compared to conventional uniform doses.

Methods
A549 cells were injected subcutaneously into the right flank of immunocompromised CD-1 Foxn1nu mice. Once the tumors had reached a volume of >= 60mm³ they were irradiated with either MRT or uniform doses. All irradiations were performed using a self-developed setup within the small animal irradiator XenX platform. For microbeams the radiation dose was determined using the concept of the equivalent uniform dose (EUD) based on the linear quadratic model (LQM. The dosimetry for both radiation modalities was carried out using Gafchromic EBT3 films and a daily quality assurance protocol was established utilizing the PTW microdiamond detector.

Results
Fitting the preliminary data using logistic regression shows a significant shift in the TCD50 value, where 50% of the tumors are controlled. For MRT the TCD50 value was found to be (19.6±1) Gy, whereas the value for conventional treatment was (28.8±4.6) Gy. Furthermore, the slope of tumor control probability increase is steeper for MRT than for uniform dose.

Conclusion and outlook
This study was the first demonstrating the effective tumor control probability of MRT in a xenograft mouse model performed at a small animal irradiator. The TCD50 value for MRT was found to be substantially lower compared to conventional radiation therapy from our preliminary results, indicating an increase in the therapeutic window for lung cancer treatment.
Further, experiments including groups irradiated with different Minibeam doses are already being carried out and will provide the tumor control probability of MBRT.

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